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Producing Large Herringbone Gears by the End-milling Process at the Woodard Machine Co.'s Plant in Wooster, Ohio

By FRED R. DANIELS

THE service required of transmission gearing in steel rolling mill machinery demands that the gears be so designed and machined that they will withstand the heavy loads and severe stresses encountered, and at the same time have a smooth action in which the meshing teeth will have a continuity of engagement. This type of smooth-action transmission has been approximated by what is known as "stepped" gearing, in which two gears are placed side by side on a shaft, with the teeth of one member opposite the spaces in the other.

It was soon recognized that the best type of transmission was the double helical or herringbone gear drive, but the difficulty that has usually been experienced in the machining of this type of gear has been one of the greatest hindrances to its more general use. When the herringbone gear is made in two parts, each being a helical gear of opposite hand to the other, the teeth may be cut by any convenient means and the halves securely fastened together after cutting. Modern developments in helical gear cutting, however, have made it possible to cut what is known as the Wuest type of herringbone gears by hobbing, running the cutter past the center where the teeth of opposite helical angles meet. One-piece herringbone gears may be cut in this manner without encountering the difficulties that formerly restricted the use of herringbone gear transmissions. In the Wuest type of gear, the teeth on opposite sides of the center line are staggered an amount equal to one-half the circular pitch.

The present article describes the method of cutting a one-piece herringbone gear by end-milling and without staggering the teeth of opposite halves of the gear. A special form of end-mill is used, and the teeth on one half of the gear are completely cut before the position of the gear is reversed to cut the teeth on the opposite half. The equipment employed is illustrated in Figs. 2, 3, and 4.

Objections to the End-milling Process

A number of objections have been raised to the practice of cutting teeth by the end-milling process, one of which is

Fig. 1. Semi-shrouded Rolling Mill Herringbone Pinions machined by end-milling

that the flutes of the cutter become clogged with chips, resulting in the tool becoming overheated. Another objection frequently brought forth is that the tool is so comparatively small that the cutting edges are subjected to excessive wear, the result being an incorrectly formed tooth. These objections, it will be seen, can be overcome. The end-milling process is the only one by which integral shrouded or semi-shrouded herringbone gears can be machined satisfactorily. It may be that this fact accounts for the amount of research which the Woodard Machine Co., Wooster, Ohio, has put forth in developing a method for end-milling these heavy gears that would produce entirely satisfactory results and that would withstand the arguments that have been advanced against the use of the end-milling process for machining gear teeth.

The obvious purpose of shrouds and half-shrouds is to furnish added strength, and on straight-toothed gears to eliminate end play of gear and pinion. For shrouded herringbone gears, the end-milling process is the only one practicable. Although the helix angle generally used for herringbone gears is 23 degrees, gears having greater helix angles than this, up to 45 degrees, are conveniently cut by the end-milling process, and an angle of about 30 degrees has proved very satisfactory.

Cutting Teeth in a Steel Mill Driving Gear

The practice in the shop of the Woodard Machine Co., in machining rolling mill machinery transmission gears, is to plane gears having a circular pitch of more than 5 inches and to end-mill those of less circular pitch. This article will cite two examples of finishing rolling mill transmission gears, one employing the end-milling process, and the other using the planing method. It is claimed that the objections commonly raised to the use of an end-mill for cutting gear teeth have been overcome by designing the tool so that it has a special form. Fig. 2 shows one view of the machine used in end-milling a 15-foot driving gear for one section of a 12-inch continuous strip mill. In service, this gear transmits a normal load of about 600 horsepower through a pinion, the ratio of the gear to the pinion being 8 to 1. The gear has 160 teeth, 20-inch face, a helical angle of 30 degrees, and a circular pitch of 3.534 inches. The teeth are not cast, but are cut from a solid blank in two operations. The gear is a steel casting with a carbon content of 0.35 to 0.45 per cent.

The planer style of table and the worm-gearing for revolving the gear are driven by a 25-horsepower reversing motor, the transmission of which is shown in the foreground. The table is driven by a rack meshing with a worm on the drive shaft, the end of which is shown at *A*. This shaft is set at an angle with the direction of travel of the planer table. It is driven through spiral and bevel gearing by a secondary drive shaft. This secondary drive shaft may be driven directly by the motor, when the planing process is used, or through the reduction transmission and selective speed gear-boxes when a slow feed is required for the milling process. This secondary drive shaft also drives, through gearing and helical change-gears, splined shaft *S*, Fig. 4, which actuates the worm by means of which the spindle and faceplate are rotated. The speed may be varied for machining gears of different diameters by selecting suitable change-gears for driving worm-shaft *S*. The worm drives the faceplate by means of a sector arm *D*, Fig. 3, attached to the lower side of collar *C*.

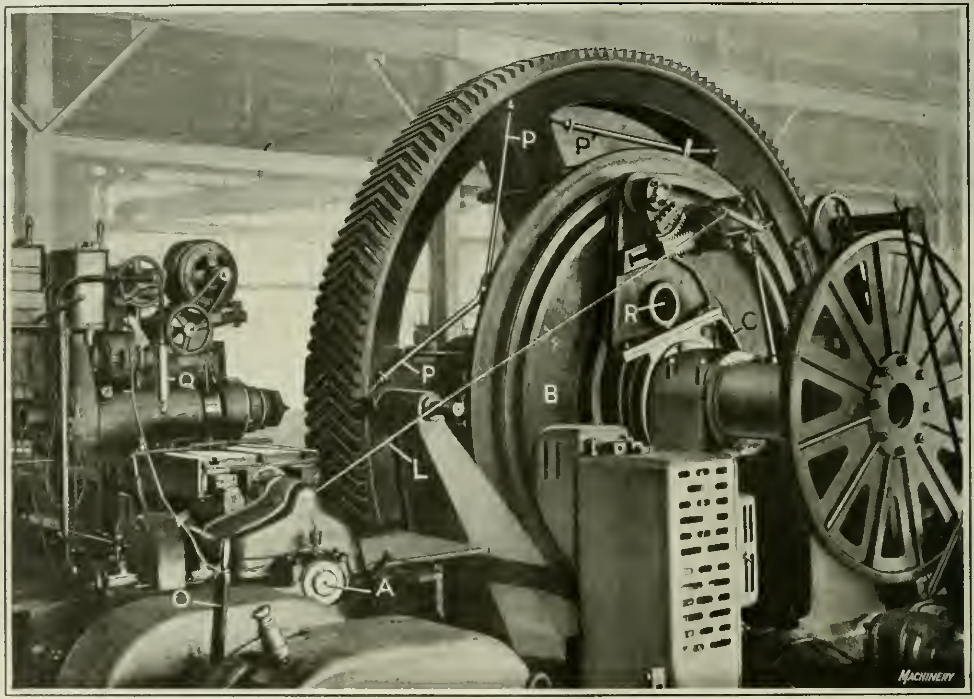


Fig. 2. Set-up of Machine used in end-milling the Teeth in Large Herringbone Driving Gears

Air-operated Clamping Device

The locking arrangement by means of which the faceplate is released during the indexing of the gear is also shown in Fig. 3. This is a view from the rear of the machine, and gives a good idea of how the indexing and clamping of the work are accomplished. On the upper slab portion of the collar *C* is bolted an extension arm *E*, which carries an air cylinder *G*, the piston of which is extended in the form of a double-sided rack *F*, which rides in a suitable slide.

At the extreme end of this extension arm there is an arm *H* which carries a segment. The segment arm *H* is fitted with a bronze nut which, acting on the thread of bolt *I*, draws the square head of the bolt which rests in the circular T-slot *J* in faceplate *B*, up against flanges in the faceplate slot, thus securely locking the faceplate to the oscillating worm. This is accomplished by air cylinder *G* acting on segment arm *H* through rack *F*.

After the faceplate has thus been locked to the drive shaft, the worm and sector arm *D* may be engaged so as to rotate the gear past the cutter the amount demanded by the angularity of the teeth, which in this case is tan 30 degrees (helix angle) × 10 inches (one-half face width), or approximately 5¾ inches. After machining each tooth, the faceplate is released by opening the air valve, and the indexing device is engaged. The lever that operates the referring to both Figs. 2 and 4. The latter illustration is a view from the opposite side of the gear and shows the type of end-mill used to better advantage. It will be noticed that a portable motor-driven grinding wheel *A* is located in a convenient position relative to the cutter-spindle, so that the end-mill may be dressed as it becomes dull. When grinding the cutter, the contour of the cutting edge is not touched by the wheel, the front clearance angle only being ground. Burrs produced by grinding the cutter may be smoothed off by lightly stoning the outer cutting edge, but not to such an extent that the contour of the cutter will be affected.

Reference to Figs. 2 and 4 will enable the method of attaching the work to the faceplate to be seen, as well as the use of auxiliary pipe-jack supports *P*, which withstand the turning moment in both directions and thus aid in assuring

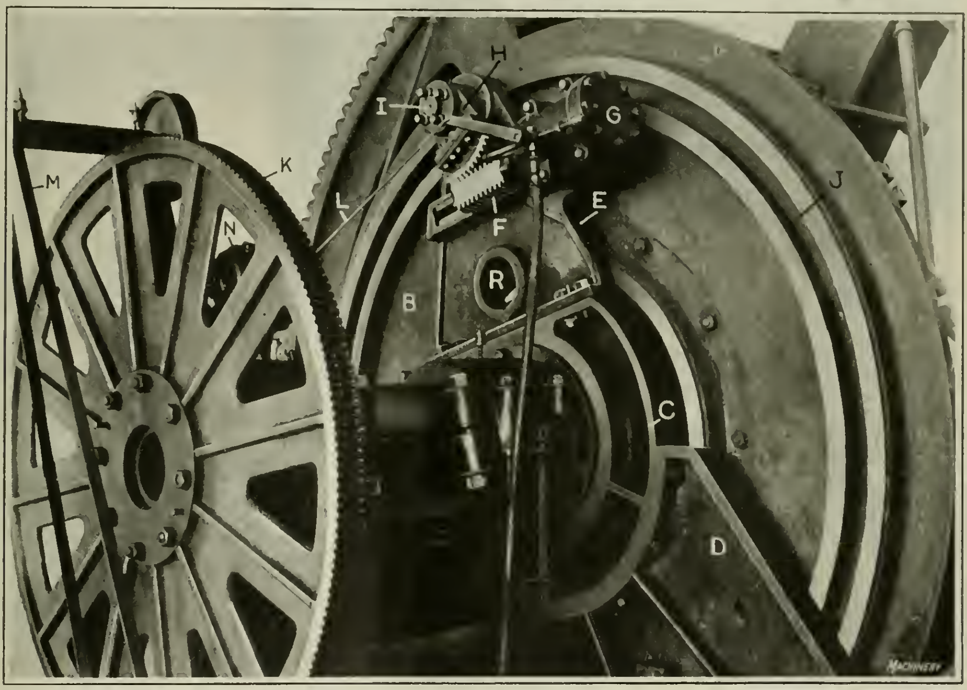


Fig. 3. Air-operated Device for clamping the Faceplate to the Driving Shaft of the Machine, and Indexing Mechanism

air valve of the cylinder is connected by rod *L* to the operator's station, as may also be clearly seen in Fig. 2.

Indexing Mechanism

The indexing mechanism consists of a worm and a worm-wheel *K*, Fig. 3, and a slip pulley drive. The worm is carried on the lower end of an arm located adjacent to the inner side of gear *K*. The worm-shaft carries the slip pulley which is driven through a belt *M* from the pulley shown just above the worm-wheel, and the motor *N*, which also is attached to the previously mentioned arm and which oscillates with it during the operation of the indexing mechanism. The switch for the indexing motor is located at the operator's station, as are also all other controls for the feeds and speeds of the machine.

The pendent switch *Q*, Fig. 2, which controls the main motor, is furnished with a cable so that the power may be quickly reversed or switched off without requiring the operator to leave his station. The milling head is equipped with hand controls for the regulation of the cutter, and motors for rotating and feeding in the end-mill, as may be seen by a positive drive for the gear. A support for the hub of the gear is provided by the swinging arm *D*, Fig. 4, which is clamped over the end of the gear hub by a turnbuckle screw, as shown. This arm carries a roll at *C*, so that the gear is not only free to revolve, but is also provided with a suitable outboard bearing.

Two cuts are required for machining these gears. In this particular instance, the cutter revolves at 210 revolutions per minute during the roughing cut and at 160 revolutions per minute while finishing the teeth. Although the speed of the cutter is decreased for finishing, the feed is the same in both operations, the rate being approximately 1½ inches per minute.

Sequence of Operations

The sequence of operations in machining a tooth on one side of the gear is as follows: The feed of the planer table is first engaged by means of the pendent switch *Q*, Fig. 2, which also results in revolving the faceplate and gear at the proper speed, as determined by the selection of the change-gears for the segment worm-shaft. In the present

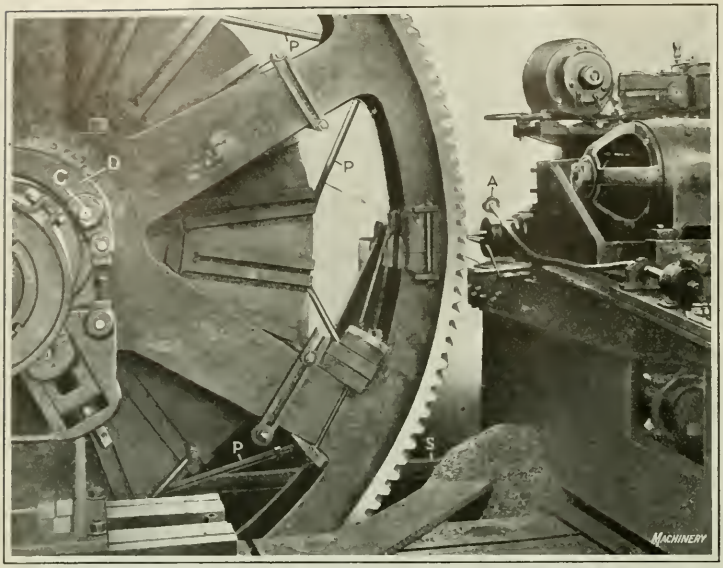


Fig. 4. Opposite Side of Gear illustrated in Fig. 2, showing the End-mill and the Method of attaching the Gear to the Faceplate

case, the gear ratio would be such as to rotate the gear a peripheral distance of approximately 5¾ inches while the table is feeding horizontally about 11½ inches. After the cutter has advanced to the center of the gear face, and the cut is completed, the driving motor is reversed, so that the end-mill travels back in the space just cut at a greatly increased speed, and the faceplate locking device oscillates backward in anticipation of the indexing movement. The motor that drives the cutter is then switched off, after which rod *L*, which controls the air cylinder valve, is operated to release the faceplate from the driving shaft of the machine. The indexing motor may then be switched on by means of the switch convenient to the operator's station. As soon as the faceplate has been indexed back a distance equal to the circular pitch, the air-operated segment-and-rack clutch is again engaged, the driving motor switch *Q* for traversing the planer table and rotating the faceplate, thrown in, the end-mill driving motor switched on, and the cut started.

After all the teeth on one side of the gear have been cut, the end-mill is moved to the opposite side and the operation continued. In Fig. 2, all the teeth on one side have been finished, and on the other side they have all been rough-cut except two. In the finishing operations, any inaccuracies in roughing are rectified, the tool used being of substantially the same design as that used in roughing.

For gears of smaller diameter the outer ring of the faceplate, which is attached with bolts, may be removed so that it will not be in the way, and the same segment gear *H*, bolt *I*, etc., (Fig. 3) are mounted in hole *R* and the opposite side of the rack is utilized.

Reference was made in the early part of this article to the particular advantage of the end-milling process where shrouded gears and pinions are to be cut. Although the gear shown in the illustrations referred to is not of the shrouded type, it is evident that cutting the teeth with semi-shrouds or full shrouds would not introduce any radical change in the machining procedure.

Planing Blooming Mill Pinions

The gear planer shown in Fig. 5 is the same type machine as shown in Fig. 2, except that the milling head has been replaced by a planer head, mounted on the same table. Here the work is a cast-steel gear, with a carbon content of 0.30 to 0.35 per cent, containing fifteen teeth of the stub involute form. The circular pitch is 7.33 inches, the helical angle, 25 degrees 25 minutes 21 seconds, the pitch diameter, 35 inches, and the width of face, 34 inches. It will be noticed that for this particular gear, a faceplate is not employed, a substantial collar *A* being used instead, in which one turned bearing end of the pinion enters and is secured by set-screws. The arrangement for indexing the pinion is the same as that previously described, except that the locking device is not used and a worm-wheel segment *B*, of shorter radius, takes the place of the large segment *D*, Fig. 3. The other end of the pinion is supported in a roller bearing having a swinging arm, roller, and turnbuckle arrangement which is similar to that employed in supporting the larger gear, as shown in the illustration Fig. 4.

Referring to the planer table, it will be seen that the tool-holder block *C* may be set at the proper angle to agree with the helix angle of the pinion to be cut, being rocked to the desired angle by means of segment gear *D* and hand-wheel *E*. The spring-operated clapper-box *F* is carried on the block *C*, which may thus be swiveled in the cradle fixture *G* in which it is carried, by means of gear *D*, as already stated. The arrangement is quite clearly shown, and the advantage of swiveling the tool *H* is that it does not become necessary to regrind the tool to machine teeth of opposite helical angles (except to maintain a good cutting edge) but only to change the angular position of the tool. At the time that this work was photographed, no cuts had been taken except the preliminary lining up cuts, which show faintly in the illustration at the tops of the teeth.

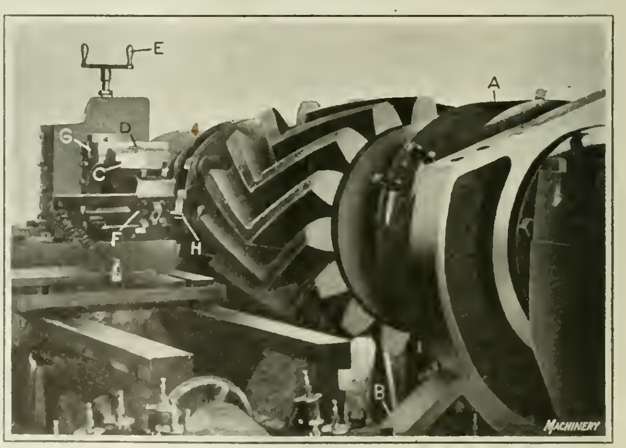


Fig. 5. Cast Pinions of Large Pitch planed on a Machine of Similar Design to that shown in Fig. 2

Lapping and Running-in Machine

By A. B. BASSOFF

Of the various methods employed in fitting automobile engine bearings, it is probably safe to assume that the "running-in" and lapping processes offer the greatest opportunity for improvement along lines tending to increase production and accuracy. Lapping and running-in are two distinct methods, and the incorrect application of the term "lapping" to what is strictly a running-in operation often results in misunderstanding. A lapping operation consists of grinding to size the surface to be finished, by the use of a lap charged with an abrasive; while a running-in operation consists of assembling two parts that are to run together, then applying a mixture of oil and an abrasive, and running the parts thus assembled until they are ground down to size or until the required smoothness of finish is obtained by the action of the abrasive particles in the oil. Both of these methods are employed to obtain the fine bearing surfaces required to eliminate vibration and noise and to insure the proper functioning of engine parts that operate at high speeds.

In running-in bearings, one of the assembled members may be rotated by power while the other is held stationary, but experience has shown that in most cases the best results are obtained by rotating one of the parts by hand. The reason for this is that the workman can change the direction of rotation and also give the work a slight reciprocating movement. The oscillating and reciprocating movements are nearly always employed when performing a lapping operation by hand, and this doubtless accounts for the incorrect application of the term "lapping" to what is actually a running-in operation. When the work is oscillated by hand, the workman can tell by the "feel" if the surfaces are not being finished uniformly, and he can control the oscillating and reciprocating movement to grind down the high portions.

While bearings fitted in this way are in most cases superior to those finished by other means, the method is not all that could be desired. In fact, it is considered a slow expensive process, and it requires the services of skilled workmen. It is also evident that the personal factor makes it impossible to obtain absolutely uniform results.

Function of Lapping Machine

In order to expedite the various lapping and running-in operations, and to provide a means whereby uniform results could be obtained, the writer designed the machine here described. The results obtained with this machine are superior to those obtained by hand lapping, even when the machine is operated by an unskilled workman. The installation of the machine not only made it possible to eliminate one department, but also released twelve skilled workmen from the tedious work of lapping, so that they could be employed on other work. The principal function of the machine is that of imparting to the work an oscillating and a reciprocating motion such as would be employed by a skilled workman.

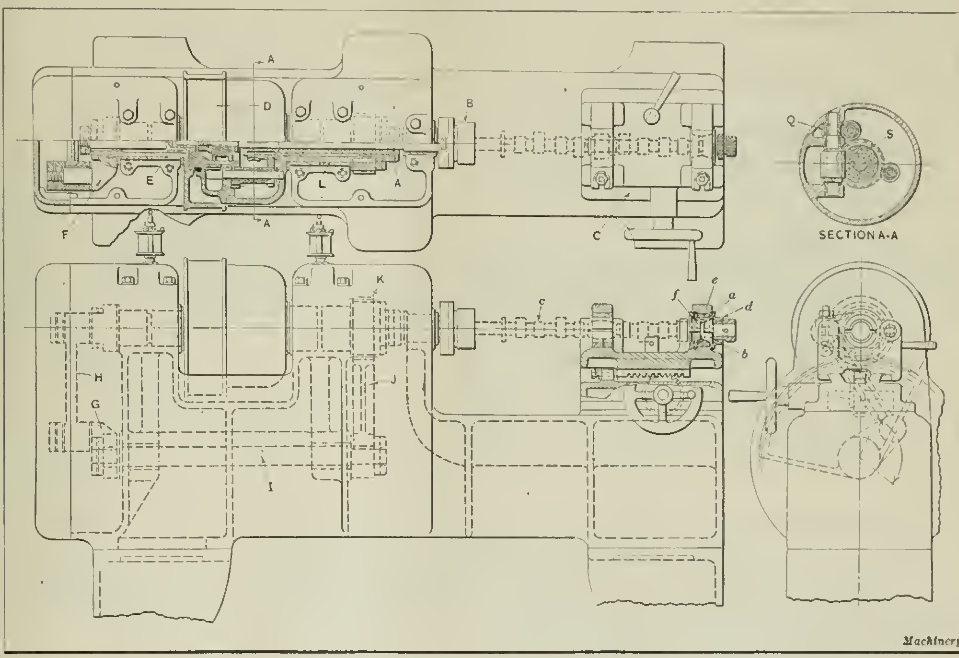


Fig. 1. Lapping Machine which imparts Oscillating and Reciprocating Movements to Work

Referring to Fig. 1, it will be noted that the oscillating movement is imparted to the work through shaft *A*. This shaft is equipped with a chuck *B*, which is designed to permit rapid insertion and removal of the work. One end of the work is supported in tailstock *C*, which is provided with hinged caps that can be swung back to receive the work, or tightened in place over the work-holding bushings by means of eye-bolts as shown. The diameter of the holes in the cap bearings is sufficiently large to accommodate bushings adapted for supporting the largest work to be lapped.

In some instances, one of the cap bearings may be used to hold a lap or a bearing which is to be run-in with its mating shaft. However, for most lapping operations a special lap-holding stand such as shown in Fig. 3 is employed. It will be noted in Fig. 1 that the tailstock is fitted to the machine by a dovetail slide provided with a rack and pinion adjustment operated by a handwheel. In operating the machine, the workman first throws back the tailstock bearing caps and locates the work in place, after which it is gripped by chuck *B*. The lapping or grinding compound consisting of a mixture of oil and abrasive particles is then applied to the surfaces to be lapped and the machine started. The lapping motion imparted to the work consists of a rotary movement first in one direction and then in the other, with a slight overlapping or advance at each oscillation, and a sliding or reciprocating movement parallel with the axis of the work. The rotary motion with the overlapping stroke brings different points of the work and the lap into contact, thus keeping the work round, while the reciprocating motion prevents it from becoming ringed or grooved.

Design of Oscillating Mechanism

The head of the machine has two housings between which is located the flanged pulley *D*, which is driven from a countershaft in the usual manner. This pulley is machined from a steel forging, and has a stem *E* to which is keyed the crank-arm *F*. The entire unit revolves between the two housings of the machine head, all end thrust being taken care of by the thrust collars shown. Crank-arm *F* is connected with crank-arm *G* by a connecting-rod *H*. Crank-arm *G* is keyed to shaft *I* as shown. At the other end of shaft *I* is keyed a sector gear *J* which meshes with gear *K* on the oscillating sleeve *L*.

Oscillating sleeve *L*, which is machined from a steel casting, carries the large end gears *M* and *N* (Fig. 2) which are cut from one piece, as well as the other cluster gear *O*. Gear *M* meshes with gear *P*, which is doweled and screwed to pulley *D*. The spiral gear *N* drives spiral gear *Q*, which is shown in the section *A-A* keyed to the shaft on which worm *R* is held. Worm *R*, in turn, drives worm-wheel *S* to which are keyed sleeve *T* and gear *U*. Cluster gear *O* receives its motion from gear *U*, which is keyed to sleeve *T*. Cluster gear *O*, in turn, drives sleeve *V* which carries the roller *W* located in the groove in cam *X*.

The upper crank *F*, Fig. 1, has a smaller radius of throw than the lower crank *G*, the result being that when the pulley makes a full revolution the lower crank oscillates but does not revolve. The ratio of the gears is such that for each revolution of the pulley the oscillating sleeve makes one revolution in each direction. The worm-gearing, consisting of worm *R* and worm-wheel *S*, Fig. 2, is self-locking, and therefore carries the work-driving spindle *A* (which is keyed to sleeve *T*) around an equal number of revolutions plus the amount that the worm-wheel sleeve is advanced by the epicyclic gear train. This advance constitutes the overlap which has been found necessary, and equals one-quarter revolution for each revolution of the pulley, so that when the pulley makes four revolutions, the work oscillates an amount equivalent to five revolutions in each direction.

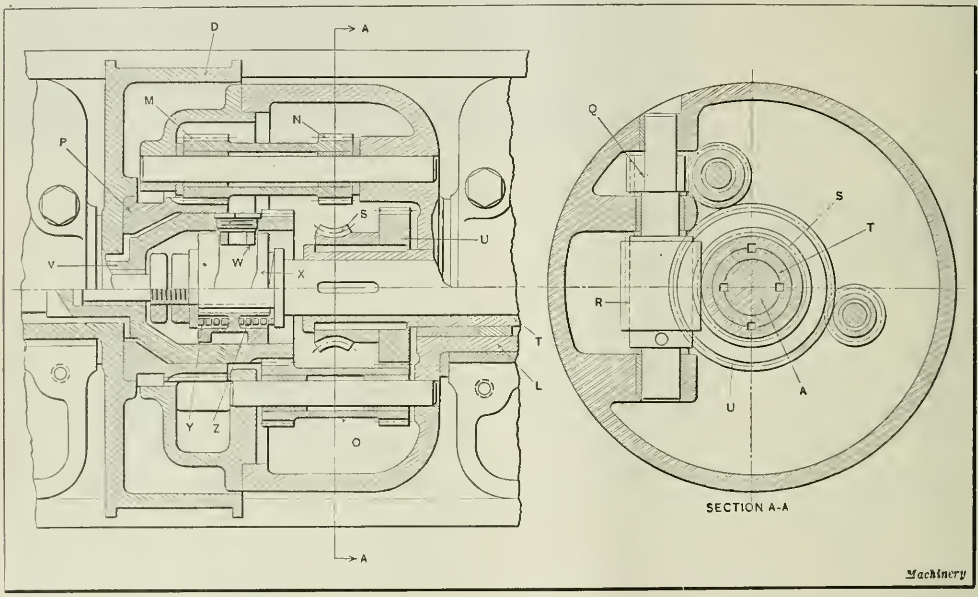


Fig. 2. Oscillating and Reciprocating Mechanism of Lapping Machine

Design of Reciprocating Mechanism

The sliding movement is obtained through the drum cam *X* in the following manner: It will be seen that sleeve *V*, which carries roller *W*, cannot slide endwise, whereas the drum cam *X* is keyed to the work-spindle in such a way that it is free to slide on the latter member. As the drum cam revolves the springs *Y* and *Z* are alternately compressed and released, thus producing pressure on the spindle *A*, which acts first in one direction and then in the other. The spindle is also free to slide in sleeve *T*; consequently, as soon as the pressure becomes greater in one direction than in the other, the spindle will slide in its supporting bearing in the direction in which the greatest pressure is exerted. It was found that more satisfactory results were obtained when the sliding movement was transmitted through cushioning springs instead of by positive means. This construction also permitted an even pressure to be exerted on the lapping compound in the case of the running-in operation on the conical bearings of the work.

The gear ratio is such that the drum cam *X* makes a complete revolution once in every twenty revolutions of the pulley as this ratio has been found to give the best results. It should be mentioned that the bearings on the main shaft and the oscillating shaft are not split. This construction was decided upon, as it permits the removal of the entire operating mechanism from the machine as a unit. It will also be seen that there are only two oil reservoirs on the machine, lubrication being effected by a system of leads and ducts, which prevents the possible burning out of bearings and damage to other parts of the mechanism.

Method of Holding Work

Since the work must float back and forth with the spindle, it is necessary that it be rigidly attached to the spindle. It is also necessary that the chuck or whatever means is employed to hold the work to the spindle should be quick-acting. Chucks of different kinds are employed to hold various types of work, the one shown in Fig. 1 being typical of those commonly employed. Referring to Fig. 4, which shows the construction of this chuck, it will be seen that the chuck is composed of a body which is held on the spindle and driven by a tongue. In this body are located three fingers *A*, which swing on pins *B*. These fingers are forced outward by springs *C*. The outer ends of the fingers bear against a sleeve *D*, which slides on the outside surface of body *E*. Sleeve *D* is normally forced outward in the position shown, by spring *F*. The sleeve is prevented from dropping off the body by set-screw *G*, which fits into a slot in part *E*. In loading the work, the operator simply slides sleeve *D* back, thus allowing the fingers to open outward against the recess or counterbored section of the sleeve. This permits the work to be readily inserted or removed. Releasing the sleeve closes the fingers and holds the work securely to the end of the spindle. Two large pins, one of which is shown at *H*, extend into holes in the end of flange *I* on the work, thus providing a positive drive. It will be noted that there are few working parts in the chuck, and that although it is easy to dismount it for the replacement of worn parts, the wearing surfaces are so well protected from dust that they should have a long life.

Types of Work Lapped

While this machine has not been employed or fitted up for internal lapping, it will be evident that it is adapted for this kind of work as well as for external work, provided suitable equipment is employed. Although the machine is employed for finishing a great variety of bearings, some of the more common operations for which it is used are lapping or running-in camshaft bearings, lapping timing gear shafts, crankshafts, and piston wrist-pins. These illustrations are representative of the automobile industry, but the nature of the machine is such that it is suitable for lapping almost any kind of round work. The running-in operation on the cone bearing of the camshaft, which is shown in heavy dot-and-dash lines in Fig. 1, is performed in order to obtain the required fit between the conical surfaces of bearing *a*, held in the tailstock of the machine, and the conical bearing collar *b*, held on the camshaft *c* by means of nut *d*. A mixture of oil and emery is applied to the bearing surfaces as a grinding compound. It should be understood that cone *b* is a separate piece, and is keyed to the camshaft when the latter is assembled in the motor. When in the lapping machine, a spacing collar *e* is placed between cone *b* and the fixed cone *f*, so that there is a small space between cone *b* and bearing *a*; then when the tailstock is properly adjusted the reciprocating motion imparted by cam *X*, Fig. 2, will bring the surfaces to be ground into contact, rotate the shaft first in one direction and then in the other, and release the parts from contact at regular intervals. For grinding the cone bearing *f*, it is only necessary to advance the tailstock toward the head of the machine the proper amount by means of the handwheel, and then repeat the running-in operation previously described.

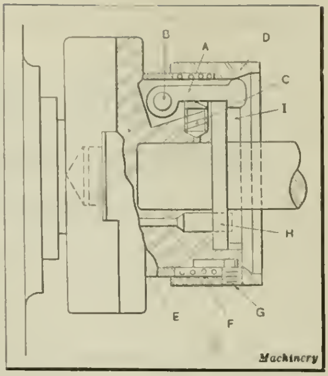


Fig. 4. Special Chuck for holding Flanged Shaft

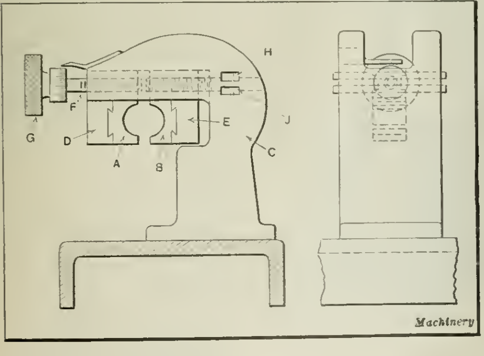


Fig. 3. Stand for holding Laps

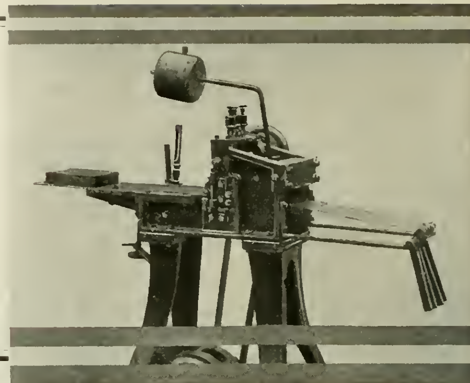
In lapping straight bearings, a stand such as shown in Fig. 3 is employed to hold cast-iron laps *A* and *B*. The stand *C* consists of a tool-steel forging having a T-slot in which blocks *D* and *E* may be adjusted by means of screw *F*, which is provided with right- and left-hand threads. A knurled nut *G* having graduations reading to 0.0002 inch is attached to the end of screw *F*. The jaws *D* and *E* are lapped all over, as is also the slot in which they are fitted. Taper blocks *H* and *J* are employed to take up wear and to make any transverse adjustment of the screw that may be necessary to center or locate the laps properly.

* * *

In a recent address by Mr. Hoover relating to world trade, it was pointed out that the reparation payments exacted from Germany must have a profound effect upon the economy of the whole world. Germany is to pay to the Allies $500,000,000, plus 26 per cent export duty, or, say, a minimum of about $750,000,000 a year. As she is left without much gold, foreign property, or foreign business earnings of consequence, these payments must be made mostly by the sale of manufactured goods outside her borders. But beyond the reparation payments, she must also sell sufficient goods abroad to buy her imports of food and raw materials. Any calculation based on the pre-war trade of Germany implies an enormous increase of her pre-war exports. In view of the export duty and other payments, she must produce these goods for about one-half our production cost in order to take our markets. Such an increase in exports must be in manufactured goods, and until the world consumption grows, these must be marketed in displacement of the goods of other industrial nations. We shall certainly feel the effects of this flow of goods that must be produced if she is to make reparation payments. On the other hand, Germany must take more raw materials from us for this purpose. However, the crowding in the market of German exports will affect her immediate neighbors more than us, for 80 per cent of her market must lie in Europe itself.

Punching Storage-Battery Insulating Sheets

By CHARLES O. HERB



THE necessity of developing a single-purpose machine for performing some operation for which no machine on the market is adapted frequently confronts a manufacturer. The present article deals with a machine designed, patented, and built by the Commercial Truck Co., Philadelphia, Pa., for punching rows of narrow slits in the hard rubber sheets used for insulating purposes in the electric storage batteries employed in driving the motor truck manufactured by this concern. This machine has proved satisfactory in every respect, and is here described because it is believed that some of the mechanical principles incorporated in its design may be of interest and value.

Use of the Hard Rubber Sheets

In the storage batteries mentioned, wooden plates are placed between the negative and the positive metallic plates, and sheets of hard rubber are placed between each wooden plate and a negative or a positive plate, as the case may be. An idea of the manner in which the rubber sheets are punched may be obtained by reference to Fig. 2, which shows the full width of a sheet but only a portion of the length. The sheets are actually about 8½ inches long, 5¾ inches wide, and range from 0.015 to 0.025 inch in thickness. It will be observed that there are 22 rows of slits, the slits being 0.009 inch wide, 3/16 inch long and spaced thirty-two to an inch. There is approximately 0.022 inch of rubber between each slit in a row, and the unpunched rubber remaining between each row is about 1/16 inch wide.

The function of the slits in the rubber sheet is to permit the electrolyte to filter through to the various plates, but it is essential that the holes be of such a size and shape that the chemical salts from which the electrolytic solution is obtained are not carried through the rubber sheets with the solution. Prior to the use of slits of the type shown, circular holes were used in the rubber sheets, but these were unsatisfactory because, in order to obtain the same amount of filtering area, it was necessary for each hole to have approximately the same area as one of the present slits, and circular holes of such a size permitted the electrolytic salts to seep through. In designing the machine for punching the slits, it was evident that if the operation was to be performed on an economical basis, it would be necessary for the tools to be operated at a high speed. A view of the machine as finally constructed is shown in Fig. 1.

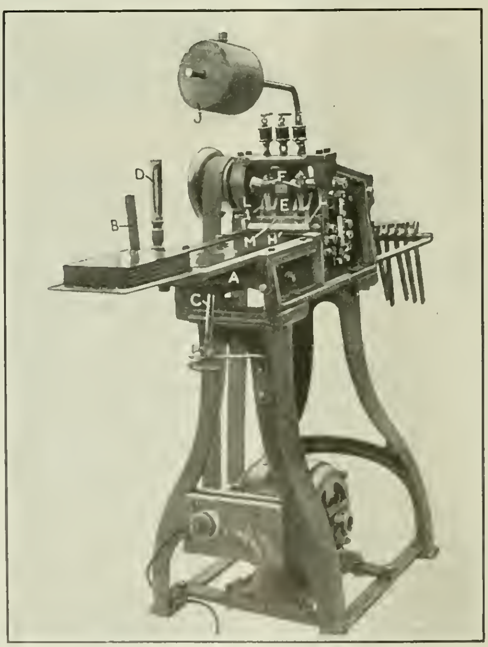


Fig. 1 Punching Machine developed for cutting Rows of Slits in Storage Battery Insulating Sheets

Construction of Punching Machine

The machine has a vertical ram, which reciprocates at a rapid rate. Attached to the lower end of the ram is a block containing twenty-two blades that pass through a stripper plate and into corresponding slits in a die beneath, during which movement a series of slits is produced in a rubber sheet. One of the problems encountered with the machine was that the sheets would crack and break when the punch blades came in contact with them, due to the brittleness of hard rubber. This difficulty was overcome by including a water chamber in the construction of the machine, the water in which is heated to a temperature of about 150 degrees F. The sheets are passed over the upper surface of this chamber prior to being fed through the machine, with the result that the rubber becomes sufficiently pliable to permit the successful performance of the punching operation. It will be evident that it is necessary to advance the rubber sheets a certain amount during each ram stroke and to keep them stationary while being punched. This intermittent movement is obtained by the provision of a mechanism to be described later.

The water chamber for preheating the rubber sheets is indicated at *A*, Fig. 1. It is filled by means of pipe *B* which is closed with a cap after sufficient water has flowed into the chamber. Provision is made for draining the chamber when the occasion demands. The chamber

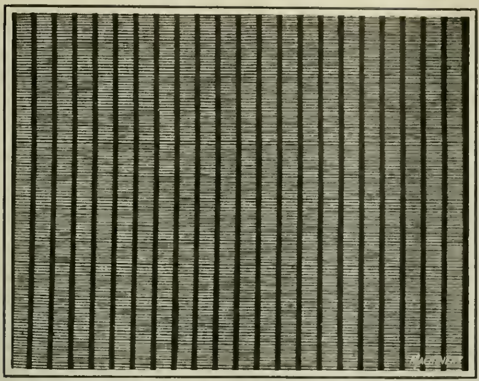


Fig. 2. Hard Rubber Sheet slit by Punching Machine shown in Fig. 1

is heated by means of gas-burner C which is connected to a gas supply line. The temperature of the water in the chamber can be ascertained at any time by reference to thermometer D. The illustration shows a pile of sheets lying on the sheet-metal bracket extending in front of the water chamber and two sheets lying on the water chamber. Ram E to which the punch-holder is attached is reciprocated up and down by means of two cranks F mounted on a horizontal crankshaft having a throw of 0.10 inch. This crankshaft is made of chrome-nickel steel, heat-treated, and it carries near the left-hand end a pulley connected by a belt to the pulley of the driving motor bolted on the bar supports at the bottom of the machine.

This motor is of 1/2 horsepower, and is connected to a lamp socket; it operates at the rate of 1750 revolutions per minute. As the ratio between the motor and machine pulleys is 6 to 7, the crankshaft rotates at the rate of 1500 revolutions per minute, the ram reciprocating the same number of times. A flywheel mounted on the left-hand end of the crankshaft beyond the pulley insures uniform operation of the ram. The crankshaft is mounted in a large Hess-Bright ball bearing where it extends through the left-hand frame, while other bearings support the crankshaft at the right-hand end and at the center.

Ram Support

A unique feature of the machine is that the ram does not operate in slides, as in common types of punch presses, but instead is supported by the outer ends of four parallel springs. Three of these springs may be seen in Fig. 3 at G. The photograph reproduced in this illustration was taken with one side of the machine frame removed, to permit the method of attaching the ram to be easily seen. The back ends of the springs are secured to the tying member of the machine frame at the rear. By this arrangement a rigid construction is obtained. It is evident that with this design the punch blades actually traverse in an arc rather than in a directly perpendicular path. However, the radius of the arc in which the blades operate is so great, and the distance that they enter the die openings so small, that the horizontal movement of the blades in the die is negligible and no difficulty arises from this source.

Intermittent Feed Mechanism

Attention has been called to the fact that it is necessary to move the rubber sheets a certain amount during each stroke and to hold the sheets stationary while being punched, so that the slits will be properly spaced. This movement of the sheets is obtained by four rollers, two of which are placed in front of the die and two at the rear, the four rollers being rotated intermittently. Three of these rollers are shown in Fig. 3 at H. The intermittent movements are obtained through the mechanism on the right-hand side of the machine which may be seen in Fig. 1. On the right-hand end of the crankshaft is a collar having a projecting pin that successively engages each of the six teeth of a Geneva gear mounted on a parallel shaft directly below the crankshaft. The duration of each engagement is sufficient to cause the Geneva gear to be rotated through an arc of 30 degrees, and during the remainder of a revolution of the crankshaft the Geneva gear remains stationary.

Helical teeth cut on the outer end of the shaft on which the Geneva gear is mounted mesh with a helical gear on the upper end of a vertical shaft. This vertical shaft also carries a helical gear at the lower end, which meshes with teeth machined on a horizontal shaft. On each end of the horizontal shaft, in turn, is mounted a helical gear, and these gears drive a gear on each of the lower rollers H, Fig. 3. The upper roller in each case is driven by another gear meshing with the one on the corresponding lower roller. Thus, ten helical gears, a Geneva gear and a special collar are contained in the intermittent gearing. The reduction obtained by this gearing is such as to give the rollers and sheets the required movement. One advantage secured through the employment of helical gears in this mechanism is that, although the fine rubber punchings may in some way be carried to the gearing, the sliding action of the teeth of the various gears in those of their mates is such as to cause the punchings to be easily worked out, and so they do not cause clogging. A cover is provided for this gearing, but this was removed at the time the photograph was taken.

Maintaining Friction between Feeding Rollers

A certain amount of friction must be maintained between the two rollers in each set to insure that the rubber sheets will be moved with the rollers. This friction is secured by means of counterweight J, Fig. 1, which is attached to a bent rod inserted in a suitable holder on shaft K, Fig. 3. Long projecting fingers also mounted on this shaft extend forward and rest upon wooden strips L, Fig. 1, which are hollowed out to suit the upper rollers on which they lie. By swiveling the counterweight rod from the position shown, the weight is brought to the rear of the machine and the fingers previously mentioned are raised. This removes all pressure from strips L so that they and the upper rollers may be quickly taken out to permit an inspection of the punch and die.

As the finished rubber sheets pass through the rear rollers, they are conveyed on ribbon belts, as shown in the heading illustration, to the back of the machine. The conveying

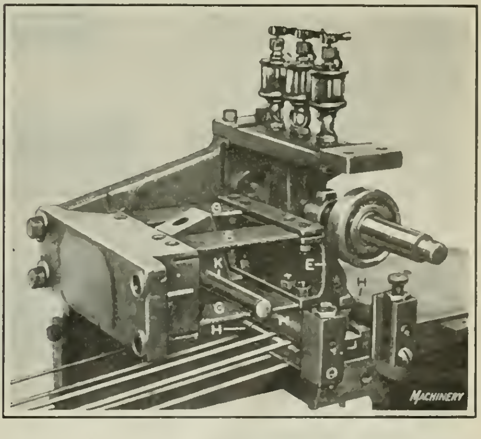


Fig. 3. Method of supporting the Ram on the Free Ends of Four Flat Springs

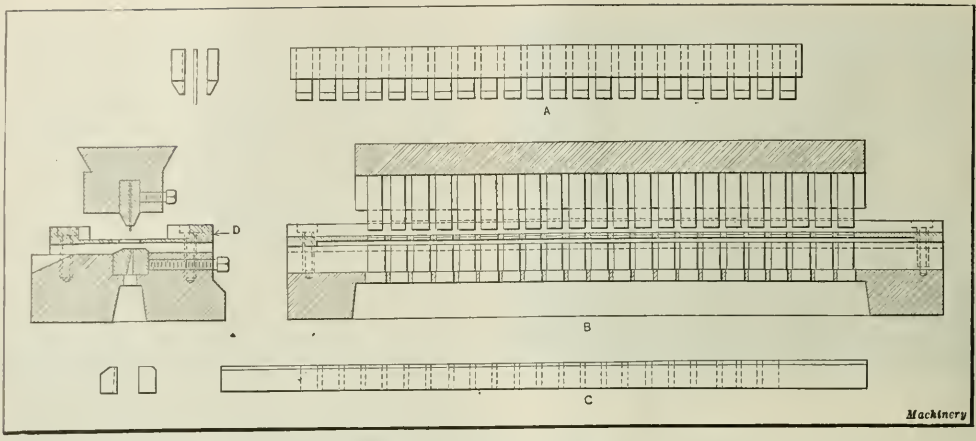


Fig. 4. (A) Punching Blades and their Strips; (B) Arrangement of Punch and Die Parts on Machine; (C) Die Strips

ribbons are driven by means of the lower of the rear set of rollers, which are grooved for that purpose. At the end of the machine, the ribbons pass over small pulleys mounted on weighted brackets which hold the ribbons taut. It will be noticed that lubricant is furnished to the various bearings by means of sight-feed oilers.

Punch, Stripper Plate, and Die

The construction of the punch, stripper plate, and die used on the machine is illustrated in Figs. 4 and 5. In Fig. 4 at *B* these parts are shown in the manner in which they are assembled on the machine. The punching blades are held in place by two steel strips that have fingers extending almost to the lower end of the blades as shown at *A*. The surface of one of the strips in contact with the blades is flush the entire length, while the contact side of the other strip has recesses milled to suit the width and thickness of each blade. The strips and blades are held together in the punch-holder by twenty-two set-screws as shown at *B*, and at *A*, Fig. 5. By clamping the blades individually in this way, each one may be adjusted independently of the others.

The punch-holder is secured to the ram of the machine by means of the dovetail tongue at the top, the rear side of the dovetail, that is, the side on which the set-screw heads are placed, being supported by a corresponding slot in the ram. The front dovetail surface is supported by the gib *M*, Fig. 1, one side of which is machined to suit. By this arrangement the punch-holder is securely held to the ram in a way that permits its ready removal. The stripper plate *D*, Fig. 4, is attached to the upper surface of the die-block and is so machined that not only the punch blades extend through its openings, but also the supporting fingers of the strips which hold the blades.

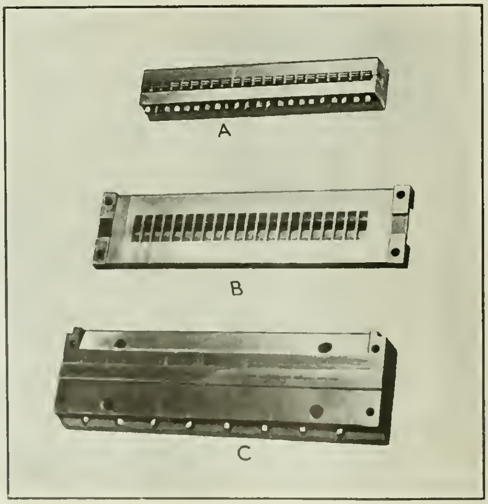


Fig. 5. (A) Assembled Punch-holder; (B) Under Side of Stripper Plate; (C) Die Strips assembled in Die-block

The openings of the stripper plate are hollowed out on the under side as shown at *B*, Fig. 5, so that the rubber sheets will not be stripped along the sides of the slits, but rather at the ends. By employing this principle, the narrow sections of rubber left between the slits in a row do not become torn, as would otherwise be probable. The die consists simply of two long strips as shown at *C*, Fig. 4, which are held in the die-block by means of set-screws as illustrated at *B*, and at *C*, Fig. 5. One of the strips is flat on the side which comes in contact with the punch blades, while the corresponding surface of the other is milled out to suit the blades. The punchings are forced through the die and fall into a receptacle beneath.

The punch-holder and die strips are made of a water-hardened non-shrinkable tool steel. An average of 2500 rubber sheets is punched before it becomes necessary to regrind the punching blades, which means that about 700,000 holes are punched by each blade. The long life of the blades is attributed to the rigid manner in which the machine ram is operated, and to the construction of the punch, die, and stripper plate.

* * *

MEETING OF AMERICAN ENGINEERING COUNCIL

The next meeting of the Executive Board of the Engineering Council of the Federated American Engineering Societies will be held at the Cosmos Club in Washington, D. C., September 30. The most important business coming before this meeting will be the election of a president to succeed Herbert Hoover, who resigned when he became Secretary of Commerce. Special attention will also be given to the extension of the employment service, and the question of licensing and registering engineers. Plans are also being made for a general engineering meeting, to be held in conjunction with the annual meeting of the American Engineering Council some time in the latter part of January. At this meeting such topics will be taken up as the elimination of waste, licensing of engineers, a governmental department of public works, and other subjects of importance.

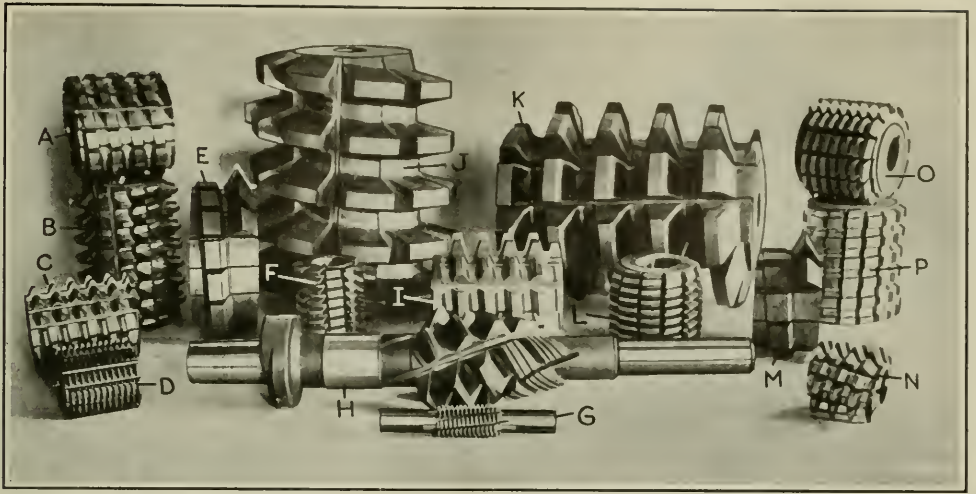


Fig. 1. Collection of Different Types of Hobs

Inspection of Involute Spur and Helical Gear Hobs

Testing the Accuracy of Hob and Tooth Parts—Hobbing Test—First of Two Articles

By CARL G. OLSON, Chief Engineer, Illinois Tool Works, Chicago, Ill.

EVERY user of hobs is interested in methods which will help him, when a new supply of hobs is received, to determine quickly if these tools are made with the accuracy required for his work. The purpose of this article is to point out and explain practical ways of conducting the inspection, whereby definite conclusions may be quickly reached. Broadly speaking, the inspection of hobs consists of determining whether or not orders have been correctly interpreted, and whether the hobs are made in accordance with the specifications given in these orders. The correctness of the type and size are first checked. Then the tooth parts are carefully gaged and examined before making the final test of cutting sample gears.

Type of Hobs

The term "type of hobs" refers to whether they are made for spur and helical gears or for other hobbed work, whether they are single or multiple threaded, straight or helically

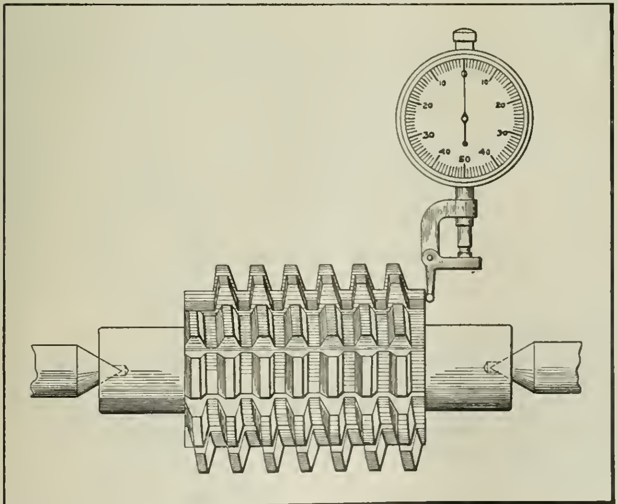


Fig. 2. Testing Accuracy of Hob at End of Arbor

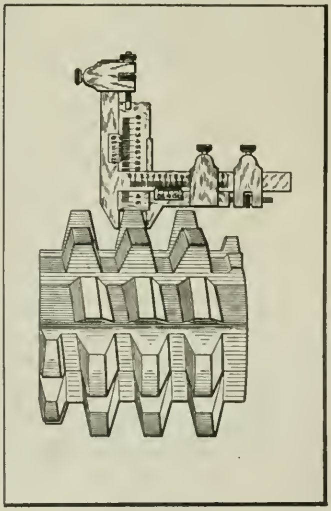


Fig. 3. Calipering Dimensions of Hob Teeth

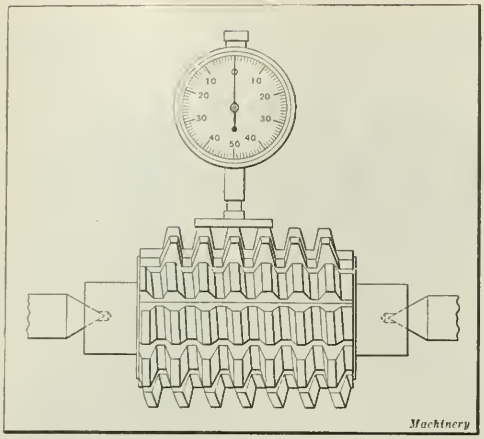


Fig. 4. Testing Eccentricity of Hob Teeth with Indicator, after sharpening

fluted, whether they have an arbor hole or shank, and whether they are intended for the roughing or finishing of gears. Several types of gear hobs are shown in Fig. 1, the letters referring to various types as follows: *A*, spline shaft hob; *B*, right-hand spur gear hob with hooked teeth; *C*, silent gear sprocket hob; *D*, standard straight-gash spur gear hob; *E*, Gould & Eberhardt type stepped-tooth worm hob; *F*, spur gear hob with helical flutes; *G*, shank type of hob; *H*, worm-gear hob used on machine equipped with tangential feed mechanism; *I*, spur gear hob; *J*, left-hand hob for helical gears; *K*, right-hand hob for helical gears; *L*, spur and helical gear hob with tapered end; *M*, Gould & Eberhardt type stepped-tooth worm hob; *N*, double-thread worm-gear hob; *O*, special spur gear hob; and *P*, spline hob.

Size of Hobs

The diameter and length of hobs of standard pitches, used on the various makes of hobbing machines, are given in the hob manufacturers' catalogues. These measurements do not usually require precision, but the cutters should be true cylinders at the points of the teeth, and the ends should be perfectly parallel and at right angles to the axis of the hobs. The accuracy of these conditions may be inspected by the methods shown in Figs. 2 and 4. The face and ends of the hob are checked with an indicator, while the hob is held on an accurate arbor, and is turned on true centers.

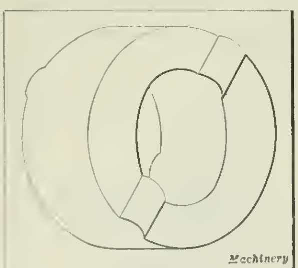


Fig. 5. Form of Equalizing Collar

Tooth Parts

The dimensions of the teeth in hobs are the same as the corresponding dimensions in racks and gears. The thickness of the teeth at the pitch line is equal to one-half the circular pitch; and the width of the space between the teeth, measured on the pitch line, is also equal to one-half the circular pitch. Therefore, the spacing of the teeth, measured between corresponding points, is equal to the circular pitch. The gear tooth caliper, shown in Fig. 3, is a convenient tool for checking the dimensions of hob teeth. In diagrams *A* and *B*, Fig. 6, is given the interpretation of the notation of the tooth parts, and also dimensions for 1 diametral pitch. Complete tables of tooth parts may be found in MACHINERY'S HANDBOOK.

Hobbing Test Gears—The Final Proof

After a hob has passed a general inspection, the final proof of its quality is determined by the perfection of the gears it will cut. To produce a good gear with any hob, it is necessary that the hobbing machine be kept in proper condition and that the setting up be carefully done. In preparing a machine for making a test, it is very important for the spindle bearings and the slides of the machine to be carefully adjusted, and for the gears governing the ratio of the spindles to mesh properly. The gears must not be too tight, as this will cause vibration in the machine. All minor adjustments and precautions necessary to care for a machine properly should be observed. The hob and gears are mounted on their respective arbors in the machine, after these parts have been carefully tested to ascertain that they are true. The shoulders on the arbors, as well as the ends of the collars and the nuts, must be perfectly true. A frequent test of these points of precision should be made, as illustrated in Figs. 8, 10, and 11.

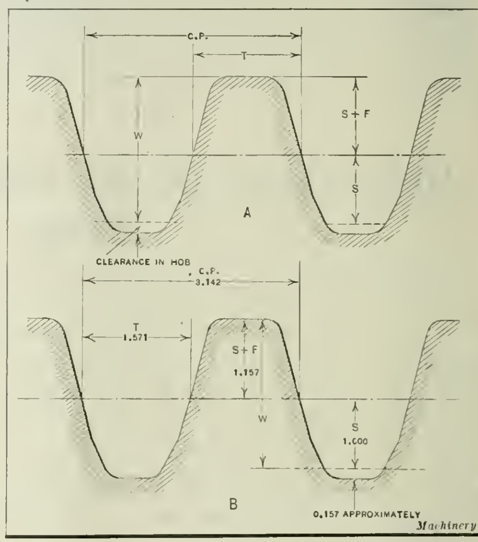


Fig. 6. Notation of Tooth Parts and Dimensions for 1 Diametral Pitch

The collars next to the hob on the arbor should be ground perfectly true inside and outside, and should fit the arbor exactly. When this is carefully done, the indicator may be used directly on these collars, on each side of the hob, as shown in Fig. 12, to determine whether or not the arbor has sprung in tightening the nut. The gear blanks, Fig. 9, should also be tested with an indicator after tightening the nut of the work-arbor. If it should be found, after these precautions have been taken, that the parts do not run perfectly true, the cause may be looked for in the accumulation of minute errors in the different parts; and when this occurs, the trouble is difficult to detect.

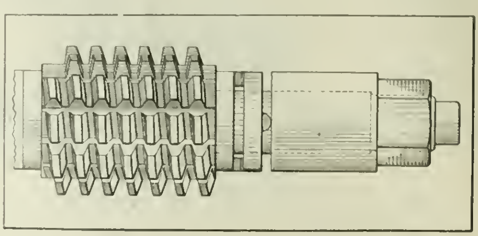


Fig. 7. Application of Equalizing Collar of the Type shown in Fig. 5

Equalizing collars are sometimes used to overcome these difficulties, one of which is illustrated in Fig. 5 and shown assembled on the arbor in Fig. 7. These equalizing collars are made with ridges on each side, the ridges on one side being located at right angles to those on the other side of the collar, as shown in the illustration.

In cutting test gears, it is best to take a roughing cut and a finishing cut, with only a slight amount of stock left for finishing. The proper depth is obtained by measuring the root diameter, after taking the roughing cut, subtracting from this the finished root diameter, and then feeding the hob in an amount equal to one-half the difference so obtained. This measuring is done with a vernier caliper or a micrometer. If the gears have an odd number of teeth the measurements may be taken from the root of one side to the outside of the opposite side; and by making the necessary allowance for the depth of the cut, the diameter may be found. The gears are ordinarily inspected by the use of master gears, but when no master gears are kept for this purpose, two gears must be cut for making the tests. The following article in this series, which will appear in October MACHINERY, will describe the methods and equipment used in making the involute test, the jump test, and the roll test on involute gears.

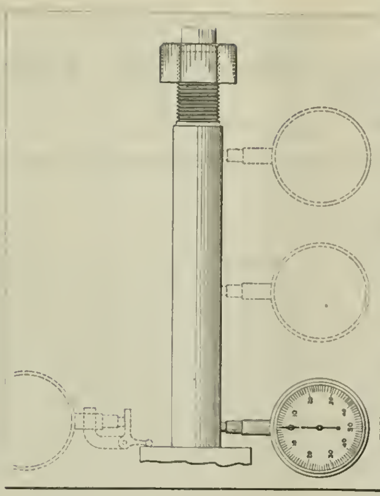


Fig. 8. Testing Accuracy of Work-arbor

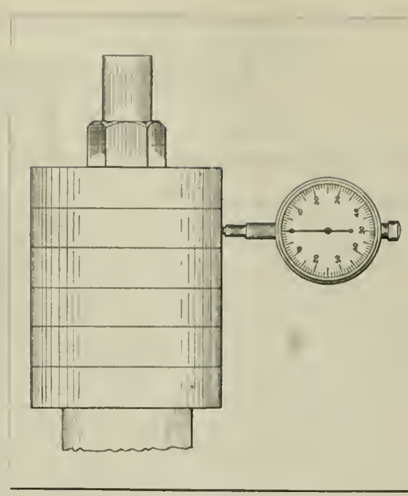


Fig. 9. Testing Accuracy of Gear Blanks after tightening Nut

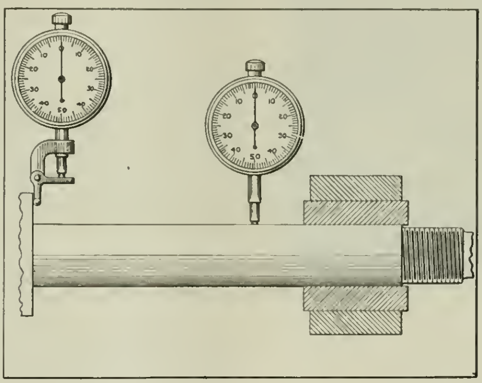


Fig. 10. Testing Accuracy of the Hob Arbor

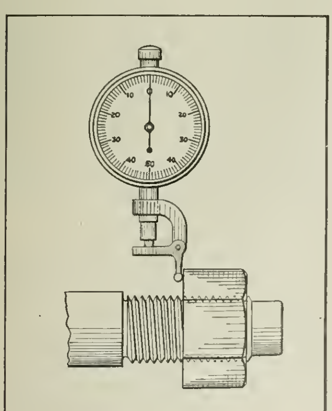


Fig. 11. Testing Accuracy of Arbor Nut

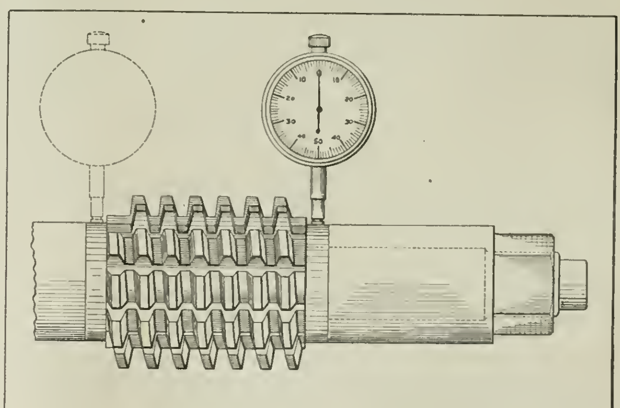


Fig. 12. Testing Accuracy of the Hob Arbor after tightening the Nut

ENGINEERING EDUCATION IN UNITED STATES

Statistics compiled from the reports of eighty-one engineering colleges located in thirty-six states show that at present there are over 12,000 students enlisted in mechanical and an equal number in engineering courses, 8600 in civil engineering, 6500 in chemical engineering, 2400 in mining engineering, and 6500 in miscellaneous special engineering fields, making a total of over 48,000 students registered in engineering schools. Fourteen of these colleges have more than 1000 students, the highest figure being that of the Massachusetts Institute of Technology, with 2747 students. The next in order are the University of Michigan with 2212; Purdue University with 1845; Cornell University with 1825; and the University of Illinois with 1818.

Demonstrating Machine Tools

By HOWARD W. DUNBAR, Sales Manager, Grinding Machine Division, Norton Co., Worcester, Mass.

THE old adage "He who serves best profits most" is probably reflected more in the machine tool industry than is generally admitted. One of the essentials in the sales program of every successful machine tool builder is to render service to his customer, not in the sense of doing the things for him that are a legitimate part of his own, everyday routine work, but by giving the customer help in the truest sense of the word, when help is needed; and this can best be done by aiding the users of machine tools in getting out of them the most there is in them. It is better policy by far to show a customer how he can do more work with the equipment he has than to encourage him or influence him to buy more machines; because sales based on such encouragement or influence do not build up good-will for the concern, and this, after all, is one of the greatest assets that any machine tool manufacturer can have.

There are three distinct points that should be taken into account by a demonstrator in carrying out demonstration work in a customer's shop: (1) He must thoroughly instruct the user of the machine tool in obtaining the best results from the machine by its proper operation and care—this is to render real service. (2) As a result of this service he should try to impress on the customer the value, efficiency, and suitability of the machine tools that he is demonstrating, and to firmly impress the name of his concern upon those with whom he comes in contact, as one that stands for quality and integrity in machine tool building. (3) He should collect data and facts relating to the service given by the machine and its productive capacity. Such data later will prove of great value in increasing the service that the machine tool builder can render to this and other customers.

Service visits should not be limited to responses for calls for help. When a machine tool manufacturer has once established friendly relations with a customer by the demonstration of a machine, he can maintain cordial relations by calling for the purpose of inquiring concerning the operation of the equipment. This kind of attention has a double value. The machine tool builder learns of proposed plans for expansion that may mean additional business, and the customer learns that the service the machine tool builder renders is not of a temporary nature, but really permanent.

Instructing the Users of Machine Tools

With the sale of most machine tools in these days there is practically a tacit understanding that a demonstrator will be sent to the customer's plant to see that the machine is properly installed, instruction given to operators in its proper functioning, and a demonstration made to prove the ability of the machine to produce according to stipulated representations or guarantees. The majority of machine tools today are sold on the basis of their ability to produce certain quantities of work in a given time and of predetermined quality. On all new types of machines, wherever a definite guarantee is made, it is important to assist the customer in this way, both in order that he may obtain from the machine the very best results, and in order to safeguard the interests of the machine tool manufacturer.

Some customers show a tendency to take advantage of this willingness of the machine tool builder to render service. The fact that this service is available sometimes makes it too easy for the customer to call for assistance when it is really not required. When, for example, a concern is a large user of a certain type of machine tool, it is quite unnecessary for the manufacturer to go to the expense and trouble of sending a demonstrator with any additional machines that he may be furnishing to his customer, and there is no object in making an offer of a demonstration in such a case.

Sometimes the customer asks and actually requires services beyond those that may legitimately be given to him without cost. In that case an arrangement should be made whereby a demonstrator is sent to perform the specific work outlined, but the demonstrator's time and expenses should be charged for at a nominal rate. For example, suppose a concern should order several sets of spindle boxes for machines that had already been in operation for a number of years, and should request the machine tool builder to send a man a distance of several hundred miles to install and fit the boxes. In cases of this kind service rendered to a customer should be charged for, and the customer should not expect to be given such service for nothing.

Establishing a Reputation

If a machine tool manufacturer is always ready to furnish a customer with the proper kind of service, if he is always ready to lend a helping hand, and if through capable demonstrators he is able to prove the ability of his machines to produce accurately in quantity and continuously, it is inevitable that this kind of service will reflect credit upon his concern and ultimately lead to more business. Every machine tool manufacturer should endeavor to gain a high reputation for the kind of service that he gives. This can only be done by rendering a service that does not savor of patronizing, but the kind that helps a customer out of a tight hole when he needs help the most. Experience has proved that there is no easier way of securing orders than by following this policy. No hard work or extravagant promises are necessary to obtain a new order. It comes naturally and surely, if proper service and demonstration have been given in connection with former sales.

Service visits should not be limited to responses for calls for help. When a machine tool manufacturer has once established friendly relations with a customer by the demonstration of a machine, he can maintain cordial relations by calling for the purpose of inquiring concerning the operation of the equipment. This kind of attention has a double value. The machine tool builder learns of proposed plans for expansion that may mean additional business, and the customer learns that the service the machine tool builder is prepared to render is really permanent.

The Collection of Data and Facts for Future Use

In order to assist in the development of the business, and to enable the highest type of service to be rendered constantly, it is necessary that data be collected and returned to the home office of the machine tool builder, where it should be recorded for future reference. This data should cover results in regard to production; questions relating to the best kind of tools to be used; and anything that may be of value in the future in selecting the proper equipment for a similar job, either in the same plant or elsewhere. By collecting and recording such data the demonstrator himself acquires a valuable fund of knowledge, which assists him in his work; and the home office becomes a clearing house for information relating to performances that will be of the greatest value in developing new business.

It is evident that a demonstrator will also make it a point to study the performance of competitive machines, noting what they are doing, and particularly observing wherein they may excel his own, so that by making proper suggestions, steps may be taken to overcome any failings or shortcomings that may exist in the equipment being built by his own firm.

In order to facilitate the work of recording such data as may be collected in connection with the demonstration of machines in a customer's plant, forms should be provided so that the demonstrator can merely fill in information relating to speeds and feeds, depth of cut, production per hour, etc. These blanks should be filled in as completely as possible; but if certain data are not known, it could simply be noted on the blank by filling in the word "unknown," or, if the exact data were not available, but the demonstrator should judge the condition to be that met with in average shop work, he could fill in the word "normal." In all cases where data of this kind are given, a statement should be made as to whether the work is done by the demonstrator or the customer's own operator.

At the completion of each demonstration, the demonstrator should also submit a report to the home office, setting forth, in a brief statement, the work done and the production obtained. A special form ought to be provided for this purpose, and the report should be signed by the customer's superintendent or foreman, so as to indicate that the machine has been demonstrated to his satisfaction.

The Attitude of the Service Man

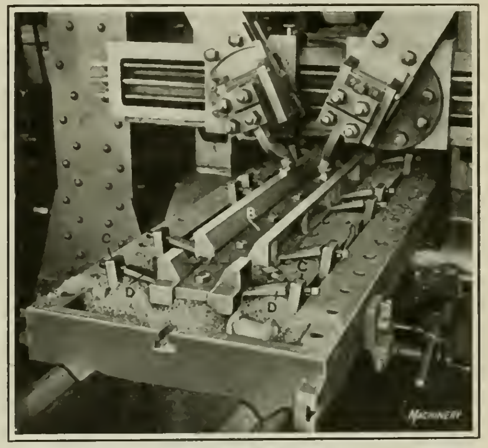
The attitude of the service man has much to do with the creation of a favorable impression of the service being rendered. Very often a customer calls for help when he is unable to correct a fault, simply because he is not looking in the right place for the cause. The service man or demonstrator should in all cases examine all the facts, and should accept no statements without having convinced himself of their accuracy. Erroneous statements are often made through lack of knowledge of the construction of the machine or by mistaken or erroneous assumptions. In investigating all details for himself, the demonstrator, of course, must use tact, but the acceptance without question of the user's statement of the cause of some unsatisfactory performance is likely to lead to delay in finding the remedy and to confirm the impression of faulty construction or design. As an example it may be mentioned that when unsatisfactory results are obtained in the use of a certain cam grinding equipment, it is natural to place the blame on the grinding of the master cams. As a matter of fact, the real cause of the difficulty is nearly always the alignment of the centers, speed of revolution, grade of wheel, or similar simple errors—something that is entirely in the hands of the customer's own operator.

Tendency to Overdo Demonstration Work

It may not be out of place to emphasize again the point that a great deal of needless expenditure of time and money results from offering the services of a demonstrator when the customer does not need his help. Some machine tool builders have on their quotation sheets a statement to the effect that when the machine is set up or ready for use a demonstrator will be sent to instruct the customer's operator without charge. While it should be understood that such service is available, it is hardly necessary to have this accompany every quotation. The services of a demonstrator will be furnished without charge in case the customer needs it, but many needless trips will be saved by not making this offer except when it is clear that there is a good reason for sending a demonstrator.

PLANING SLIDE GIBS FOR WOOD MOLDING MACHINES

The accompanying illustration shows a Niles-Bement-Pond planer equipped for finishing the slide gibs on a wood molding machine. This planer is used in the Pratt & Whitney Co.'s plant. The chief point of interest in connection with this operation is the provision made for setting up the work and locating the tool-heads so as to plane the slide gibs at the required angles. At the front end of the planer table, there is a templet *A* which has two inclined faces that match the contour of the surfaces that have to be planed on the work. In setting the tool-heads, it is the practice to locate the points of the cutting tools on these two inclined templet faces and to adjust the angles of the heads so that the tools may be fed along and kept constantly in contact with the templets. In addition to their use for setting the tools, these templets constitute a means of checking the accuracy of the finished surfaces of the work, the reading of an indicator in contact with the templet being compared with that of an indicator in contact with the finished face of the work. In this manner the planer operator can easily ascertain whether the job has been finished to the required form.



Application of Tool-setting Form in planing Irregular shaped Pieces

There is nothing of special interest in regard to the setting up of these castings for planing. It will be noticed that extending back from templet *A* there is a bar *B*, the sides of which are carefully finished to make them parallel, and as the inside vertical faces of the work have already been planed, they can be located against these parallel sides of the central portion of the fixture. Only the front end of the planer table is shown, but it will be apparent that the work is comparatively short and that a string of pieces is set up at each side of the parallel bar *B*. The ends of the first pair of castings at each side of this bar will be seen just back of the points of the cutting tools.

The method of clamping the work is quite simple. It will be seen that stops *C*, carrying clamping bolts in their upper ends, are placed in the table T-slots; and that fingers or so-called "butters" *D* are inclined downward, so that the pressure of the clamping bolts on these fingers serves the double purpose of pushing the work against parallel bar *B* and of holding it down on the table. On this job the depth of cut is ¼ inch, with a feed of 3/16 inch per table stroke, and a cutting speed of 35 feet per minute.

* * *

The French Government is encouraging the use of tractors for agricultural work, and granting loans for the purchasing of tractors and tractor material.

PRESS EQUIPMENT FOR FASTENING AND CLOSING PERFORATED CAN CAP

By S. A. McDONALD

The equipment employed on a horn press for securing a cap on the neck of a talcum powder can, and at the same time closing the sprinkling holes so that the powder will not sift out is shown in Figs. 1 and 2. The top of the neck fits loosely in the hexagonal-shaped cap, so that the latter may be moved around sufficiently to bring the perforations out of line. The horn press used for the fastening and closing operation is equipped with a hexagonal turret operated by a Geneva wheel which receives its motion from the brake end of the crankshaft.

The holder *A*, Fig. 1, has a hole through the shank, and a spiral threaded stem *B* is babbitted in place in this hole. On the end of the stem is a pad *C*, having a recess at *R* which fits loosely over the hexagonal-shaped cap. A ring *D* is secured to the punch, which acts as a guide for the pad *C* and the leather-faced pressure pad *E*. It also contains the trip-lever *F*, which engages the catch-screw *H* to hold pad *C* up until the end of the up stroke is nearly reached.

Six work-supporting horns like the one shown in the lower view, Fig. 1, are secured to the hexagonal turret, each of which has a tapered mandrel *J*, on which the expanding

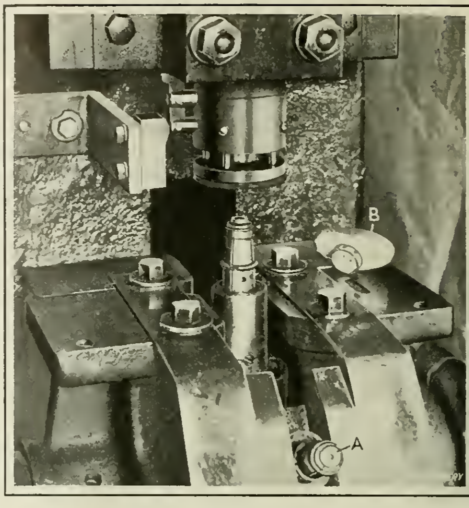


Fig. 2. Press equipped with Device shown in Fig. 1

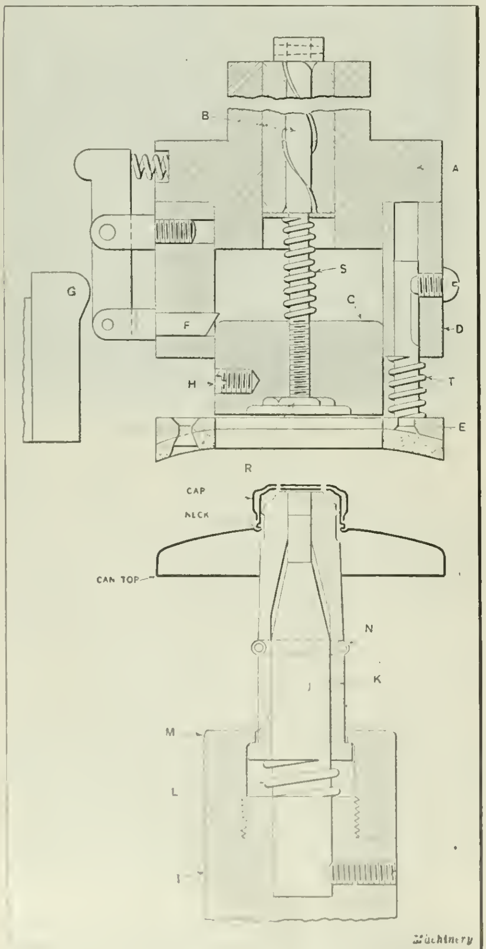


Fig. 1 Device for fastening and closing Perforated Can Cap

beading sleeve *K* slides. The spring *L* holds the sleeve in the upper position, and the nut *M* limits its upward travel. The small spring *N* serves to collapse the expanding sleeve. The trip-bracket *G* is attached to the body of the press by another bracket, as shown in Fig. 2. The operation of the device is as follows: When one of the turret tools or horns comes to the lower position shown at *A*, Fig. 2, the operator places an assembled can top, neck, and loose cap on the end of the expanding beading sleeve *K* of the horn in the position indicated in Fig. 1. At the next stroke of the press this horn comes under the punch, and when the punch descends the top and cap are located in their respective pads.

On the further descent of the punch the two pads stop, but the holder continues to descend, compressing the springs *S* and *T*, so that the pad *E* grips the can top while the pad *C* revolves, thus twisting the cap and closing the holes. When the pad *C* comes in contact with holder *A*, the spring *L* is compressed by sleeve *K*, and as the latter member slides down on the tapered mandrel *J*, it is expanded so that the bead sinks into the neck. This enlarges the neck so that the cap cannot be pulled off, but is free to revolve as far as the hexagon forms in the top will permit.

On the return stroke of the press, the pad *C* is retained or held up in the punch by means of the trip-catch *F* until its lever strikes the trip on the bracket *G*. Meanwhile, the pad *E* holds the can top down on the sleeve *K* so that the cap is free from the pad *C* and will not be turned to open the holes in the perforated cap. As the holder continues upward the trip releases the pad *C* and it spirals down to its lower position. The pad *E*, having traveled as far as its retaining pins will allow, moves upward, leaving the assembled work on the top of the now collapsed sleeve *K*. At the next stroke of the press, the assembled parts are carried in back of the press, where they tip off into a chute. One of the assembled parts is shown on the knee of the press at *B* in Fig. 2. As the operation is a continuous one an operator can assemble about 25,000 parts per day of eight hours.

* * *

Machinery manufacturers in Indianapolis are planning to take a large part in the Indianapolis Industrial Exposition, which will be held October 10 to 15, at the Indiana State Fair Grounds under the auspices of the Indianapolis Chamber of Commerce. Space has already been taken by more than 400 of the 781 different lines of manufacturing located in Indianapolis.

The British Machine Tool Industry

From MACHINERY'S Special Correspondent

London, August 16

BEYOND an improvement in the tone of inquiry, it cannot be said that the condition of the machine tool industry has altered since my last month's letter. There have been instances of orders booked for heavy machine tools, and some of the makers of these, particularly in the Manchester district, have been able to work full time. Judging from the latest of the inquiries received, there is a probability of a greatly increased trade with Japan, and not only there but in other prospective foreign markets much is being done to stimulate trade by improvement in British catalogues and other aids to sales. The absurdity of sending descriptive matter in a language that cannot be read by the potential purchaser is now recognized. Nothing is helping the overseas trade more than the cooperative trading policy, whereby firms act together as one concern in everything except the actual manufacture of products, and here they each agree to keep to that class or type of machine tools with which they have had the most experience.

Demand for Machine Tools in Domestic Market

There is a phase of the automobile industry that is bound to react favorably on the machine tool and small tool trades. Some of the makers who have previously confined their efforts to the production of the more luxurious cars are now interesting themselves in light cars that appeal to a much wider class of users; taking into account the many other concerns that cater for this trade there is no doubt that keen competition will call forth the most rigorous investigation and recasting of production methods. In the Birmingham district, there is some demand for machine tools for the brass trades, while in most districts it is clear that the small tool trade is quickly recovering. The Sheffield steel works are gradually returning to full activity.

It is reported that an order for 45 large locomotives. 2500 cars, and 12,000 tons of rails has been placed by New Zealand with British firms. A further order is also expected from the New Zealand Government for equipment for hydroelectric works, seven million pounds having been appropriated for that development. Some important Indian railway contracts have also been placed with British firms, and the low price at which the orders were taken points to an intention on the part of British manufacturers seriously to meet foreign competition. Part of the contract mentioned is for 135,000 tons of steel rails, and was taken at a price of about £10-2-6d (about $36.45 present exchange) per ton. This price is 15 per cent below Belgian quotations, but 3½ per cent above German quotations.

Imports and Exports of Machine Tools

Exports of machine tools in June show a small but welcome increase; the exports are valued at over £260,000 (about $936,000. present exchange) a figure that dwarfs the £40,000 ($144,000) value of imports. The fall in the value per ton of imported machines that was so strikingly pronounced in April and May was continued in June, the value per ton of both imports and exports being now about £150 ($540). This sudden fall in the import ton value from about £275 in only three months is very remarkable, and has occurred in a period during which the tonnage imported has remained fairly constant at a little over 200 tons per month.

During June no fewer than 246 lathes of a total value of nearly £100,000 ($360,000) were exported from Great Britain, while the most important items figuring in imports were 150 drilling machines of a total value of under £3500 ($12,600) and 78 presses, punches, and shearing machines totaling £17,600 ($63,360) in value.

New Developments in Small Tools and Special Machinery Field

The activity in the small tool trade is reflected in the large orders for twist drills being received by Tidswells Ltd., Ancoats, Birmingham. The methods used by this firm differ from those of other manufacturers in that the flutes are formed, and the backing off done after hardening. More uniform hardness is claimed and the number rejected is reduced, as naturally the plain round bar hardens with less distortion than a finished twist drill.

There are several plants requiring special machinery under construction for the quantity production of specific articles. One such plant is for the manufacture of door hinges; the equipment consists chiefly of special milling and drilling machines, and an output of 300 complete hinges per hour is arranged for. Another such plant is for the manufacture of sewing machines. These are designed to be made to sell at under 30s ($5.40) retail.

Prices of Materials

The uncertainty of material prices is having a detrimental effect on business generally. Users are buying only enough to just tide them over immediate needs. The iron and steel trade in consequence remains lifeless. Production of pig iron is negligible, smelters preferring to wait until they know what fuel prices are likely to be. Home supplies of pig iron are practically sold out, and weeks must elapse before furnaces can be got into regular production again. Meanwhile, many of our foundries are becoming familiar with foreign iron, where previously the practice has always been regulated by the employment of certain makes or mixtures of pig iron obtained at home. Modifications in their casting arrangements have been effected, so as to adapt them to imported material, and during the last three months Belgian iron, in particular, has made such rapid headway that it has established a position for itself from which it will be difficult to dislodge it.

The increase of about 5s (90 cents) per ton for coal is particularly unfortunate when the whole question of material prices hinges on this dominating factor. Everyone is agreed that nothing but substantial reductions in fuel charges can effect a lasting trade improvement and enable manufacturers to meet competition. Generally speaking, iron and steel prices have varied little during the last month, and the same is true of other metals.

* * *

REGIONAL MEETING OF THE A. S. M. E.

On October 3 to 4 a regional meeting of the American Society of Mechanical Engineers will be held in Cleveland, Ohio, with headquarters at the Hotel Winton, in the rooms of the Cleveland Engineering Society. Several papers will be read, and among others one by E. J. Lees, president Lees-Bradner Co., Cleveland, Ohio, on grinding and measuring involute gear teeth. The local sections and engineering clubs of the following cities have been invited to participate in this meeting: Akron, Buffalo, Chicago, Cincinnati, Cleveland, Columbus, Detroit, Erie, Rochester, Toledo, Indianapolis, Ontario, Pittsburg, and the Engineering Society of Dayton.

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THE "NEARLY HUMAN" MACHINE

Automatic machines of various types constitute one of the wonders of this wonderful mechanical era. Some automatic machines are spoken of as being nearly human. If any deserve this attribute, surely the machines used in making watches do. Some of these machines are illustrated and described in the series, "Automatic Machines in a Watch Factory" now appearing in MACHINERY. The sudden stopping and reversing of rotation, the indexing of the work-holding turrets, the timing and reversing of compound slides, and the various other mechanical movements, each governed by pneumatic control in turn actuated by auxiliary cams and levers, give to these machines such range and accuracy that they seem indeed to be more human than mechanical.

More and more mechanical devices automatically perform all the purely mechanical operations involved in production; but it is in the tireless, restless, and progressive human brain that these highly ingenious machines must first be conceived and fashioned. The thinking must be done for them—every step worked out.

Nor does the invention of these wonderfully productive machines injure even the workers directly replaced. On the contrary they are released from tedious, monotonous manual routine to render more interesting and useful service in channels requiring greater skill and ability where the automatic machine is still a stranger. The worker himself is advanced by invention which thus alters the character of his service, and enjoys the fruits of invention and progress to an extent undreamed of by the wealthiest and most powerful of a century ago. What would Napoleon have given for the twenty thousand Fords, owned by working men, which operate in and out of the single city of Detroit on a fair Saturday afternoon!

* * *

THE EXECUTIVE'S UNDERSTUDY

Carnegie is quoted as having said that he considered himself a good executive because he could leave his job at any time without being missed. He had selected such men and built up such an organization that if he were temporarily absent, everything would proceed along the lines laid down. It is all too well known that this could not be said of a great many manufacturing organizations. Very often production is under the supervision of a factory manager or superintendent who personally attends to a great many details without consulting to any extent with assistants or department foremen. So long as the man entrusted with this work is on the job everything goes well; but too much dependence is placed upon his being constantly on the job; and if he takes to his bed with a long illness, goes on a vacation, or leaves for another job—any of which is likely to happen—confusion generally reigns for a while until someone else, after many mistakes, is trained for the responsibility.

Every organization should have an understudy working with every man who is holding a position of responsibility. The understudy should do the actual detail work, so as to learn all about policies and details, and be able, temporarily at least, to fill the position of his superior. This is the only way in which to give an understudy the training that he must have to permanently fill the position, should a change become necessary. Progressive and prosperous businesses often suffer greatly through losing the services of some executive who had no capable understudy.

In a small shop a single understudy would be sufficient. In a large shop it would be better to have a number of men trained under the direction of the chief executive. One large manufacturing plant has created an advisory board of assistant superintendents, half a dozen in number, to work under and in consultation with the general superintendent. The duties and responsibilities of each of these assistant superintendents are defined so that the foundry, pattern, and drafting departments come under one man; the die, tool, jig and fixture work under another; the assembling, shipping, bench, and repair work under another; all the production machine work under another, etc. By this method the general superintendent is relieved of a great deal of minor detail and can devote himself to the bigger production problems; while on the other hand, the men working directly under him become trained in handling executive problems. Should the factory manager take sick, die, or leave, there would be a group of trained men from whom the most capable could be selected to fill his place.

We have been so busy producing during recent years that we have almost forgotten how to train men for executive positions, but there is ample evidence that our manufacturers are awakening to the great necessity for regular and systematic attention to this very important organization problem.

* * *

TRADE SCHOOL EQUIPMENT

Generally speaking, machine tool manufacturers show very little interest in the equipment of trade schools. This field has been left largely to a few manufacturers specializing in machinery for trade schools, but it would be to the interest of the entire machine tool industry if trade schools were equipped with a greater variety of standard machine tools. Young men who receive their education in these schools pass out into active shop work, and many of them become executives later. They always remember the names of the makers and the characteristics of the machines used during their training period. For this reason alone it is decidedly to the interest of machine tool manufacturers generally to have their machines used in trade schools.

In selling surplus machine tools at 15 per cent of the purchase price to trade and engineering schools, the Government greatly aided many to obtain an up-to-date and varied equipment, and hundreds of machine tools that otherwise never would have found their way into such schools were thereby placed to the great advantage of engineering education. One town in the Middle West alone acquired $200,000 worth of these machines for its trade school at the comparatively small cost of $30,000. Some of these machines were new, and some very slightly used. But in cases where additional auxiliary equipment was required, the trade school authorities complain that they received little encouragement or help from the manufacturers, and that the makers were reluctant to give them the aid of their service departments. Ordinarily, buyers of second-hand machinery are not entitled to free service, but in the trade school where the future executive makes his acquaintance with the tools of the machine building industry, it is of lasting value for the manufacturer to have his machines operate satisfactorily.

The Present Situation and the Outlook

Summarizing the Views of MACHINERY'S Correspondents

THE many interesting letters in the symposium by practical business men published in July and August MACHINERY give a clear idea of the trend of thought in the machine building industry. The note of confidence, the definite constructive suggestions, the forward-looking attitude, the clear recognition and concise statement of the salient facts—all are equally significant. It is well worth while to glance again at the views so definitely stated; to note the quite unanimous opinion that improving business is just around the corner. Here are some quotations:

"I have been in the machine tool business for thirty years; I have seen its ups and downs periodically, but I have never lost faith in it."

"No one will believe that the human race is going to stand still very long."

"A good, healthy, reliable business that takes care of the normal requirements of our people is what we want and is what we are going to have in the near future."

"Do not overlook the thousands of new devices invented every year to replace hand labor, such as office appliances, household conveniences, sporting goods, toys, etc., all of which require machine tools in great quantities."

"We should not forget that in the long run everything points to the continually increasing use of machinery to replace manual labor in the factory, on the farm, and in the household. This calls for an increasing amount of machine tools, and the machine tool industry is always certain of its place in the economic structure."

"The most pressing needs of the industry are: the effecting of economies in our organizations, the still further perfection of design, and unfailing confidence in its ultimate future following the readjustment, when the resumed demand for things mechanical will inevitably be felt. This is no time for discouragement as to the future."

The following definite statements as to the return of more active business in the machine tool industry came from men of long experience:

"I am convinced that we have turned the corner and that before many months we shall have the definite evidence of another era of prosperity."

"The last three months of this year will probably be fairly good months in the machinery line. Beginning in January, 1922, I am looking forward to good, normal, healthy business which will probably last for several years."

"I believe there will be a gradual revival of business in the fall, and in a year from now the purchasing power of Europe may be enough improved to make the machine tool business in the United States about normal."

The keynote of many letters was the importance of using the present slack time to lay definite plans for the future—for improving the product so as to be ready for business when it resumes its full volume. Emphasis was laid on this, especially by men whose success in the machine tool field entitles them to more than ordinary attention:

"The present pause in the industry presents an excellent opportunity to make plans for the future. This is the time to bring equipment and methods up to date. The manufacturer who does this most effectually will have least cause for worry in the days of hard competition impending."

Definite opinions clearly expressed, straightforward advice, and practical suggestions—that is what the leaders in the machine tool industry gave to each other and to the industries in general in the symposium published in July and August MACHINERY. Manufacturing and selling problems must be solved, and the broad and candid exchange of ideas is now the most valuable form of cooperation in industry. This brief summary gives some of the salient points emphasized by responsible men now guiding their ships through the uncertain sea of business depression. The chief note is one of confidence and assurance.

"We all need a period of quietness in which we can check over our designs and our methods of manufacture. The machine tool builder who is not looking into the possibilities of specializing on some class of tools which will reduce the cost of production is losing a great opportunity."

"Increased production is obtained principally by or through efficient machine tools. Big opportunities are not far off for the machine tool builder who has a line of machines for intensive production, for when the tide turns it will be on greatly reduced cost."

"The manufacturer who makes a product of superior quality, and is prepared to give service, is going to reap a reward with the revival of business that is sure to come."

The reduction of production costs is the dominant thought in industry and will be in the years to come. It is also the dominant thought among the men who control in the machine tool industry. To quote from their letters:

"We believe that the words of Charles M. Schwab: 'Now is the time for the business-man to concentrate attention on the cost-sheet and not on the profit statement' should be given serious thought by every executive."

"The outstanding feature of the present machinery trade situation is the vital necessity for radical cost reduction."

"Cost cutting machinery and methods must be installed in both large and small shops of all industries in order that low production costs all along the line will permit of normal sales prices."

"A large number of concerns which manufacture in quantities are waking up to the fact that special machines and special tools will give them a much larger output per man-hour—sufficient to warrant the purchase of new and improved equipment."

"We are now entering upon a period of competitive production, in which the fittest to survive will be those who produce either better quality for a given price, or, by more efficient tooling, a satisfactory product at a lower price—or both."

The necessity for adequate publicity was touched upon by some of those who contributed to the symposium. Effective publicity is one of the sure factors of success, and has counted heavily with many of the leading manufacturers in the machine-building field:

"The very last asset a business man can dispense with, in these times of restoration, is his advertising program."

"The time to treat publicity matter as a side issue is past; and with a clear conception of the obstacles to be overcome, the results will more than justify the expenditure."

"Advertise and let the people know what you have, and do it now when they all have time to read your message. Don't do it with a splurge and then quit; you may quit just at the time when the man who wants your product has made up his mind to buy."

The quotations given are typical of the ideas expressed in most of the letters received. If space permitted, the number of extracts well worth repeating could easily be doubled. Every section of the country where tools and machine shop equipment are made was represented in this symposium. The selections sum up the conclusions for MACHINERY'S readers, and it will be interesting and doubtless stimulating to watch developments in the light of these authoritative opinions as to the Situation and the Outlook.

Instructions for Designing Fixtures

By H. P. LOSELY, Industrial Engineer, James E. Morrison Co., Detroit, Mich.

MANY tool-drafting departments make a practice of supplying checkers with instruction sheets enumerating all points on the finished design requiring checking. This is a good idea, but, why not give the instructions to the designer in the first place so that he may discover mistakes and omissions long before the drawings reach the checker? The instructions here presented have been compiled for the purpose of educating young designers of fixtures and reminding more experienced men of certain fundamentals which should be observed. These have been condensed into the seventeen major points shown in the accompanying list. The various points mentioned in the list will be dealt with more fully in the following, the same numerical order being maintained:

1. Examine the operation sheet to determine the condition of the piece prior to the operation for which the fixture is intended, and then draw the piece according to this actual condition. If the piece is unsymmetrical, take care to show it drawn to the correct "hand" and to scale; then check carefully before proceeding further with the design, as any errors in the scale of the drawing of the work, may cause the rejection of the whole design.

2. Pay attention to the condition of the surfaces or points from which the piece is located, and design the fixture to suit the tolerances allowed. If locating from a rough surface, design so that an adjustment can be made to suit the casting or forging. When locating from holes, note whether they are drilled or reamed and make the locating plugs to suit. If locating from rough- or finish-machined surfaces, note the limits allowed and consider the effect on the position of the piece.

3. Design the fixture so that the work can be readily inserted and removed, and leave ample clearance between the piece and any walls or other parts of the fixture. If the fixture is to be used much, do not hesitate at some extra expense in making the loading and unloading easier.

4. Make the clamping and supporting arrangements strong and stiff enough so that the pressure of the tool cannot move or distort the piece, and design the fixture so that it will withstand rough use.

5. See that the chips can get away from the cutting point without choking, and make the locating surfaces so that they can be readily cleaned before putting in the work. If cutting compound is to be used, it may be necessary to provide a retaining wall, and, if this is done, arrange so that the level of the wall will be at the right height, making an outlet at some point where the flow of compound will not be objectionable, or providing a pipe line to carry it back to the pump. In this case pay particular attention to avoiding pockets which will make it difficult to clean the fixture. If a retaining wall is not required and a heavy stream of compound is used, make an inclined surface or channel so that the stream will automatically wash the chips away.

6. All screws used in operating the fixture should have the same size of head so that one wrench will suffice for tightening the piece. If possible, avoid plain heads altogether and use wing-nuts, hand-knobs or plain heads with a heavy pin through them so that the screw can be tightened by a hammer-blow.

7. Make the operation of the fixture as simple as possible. Provide springs to bring clamps and levers back against the screws operating them; provide stops against which to run tools or open lids; use cams in preference to screws whenever practicable; and otherwise make the fixture so that the time consumed in changing the work is reduced to a minimum. On quantity production this is important, as the output of the machine may be greatly influenced thereby.

8. Avoid a complicated construction. While rapid operation is desired, frills are to be shunned, and any construction likely to get out of order or cause operating trouble, will never be acceptable to the shop. In any case, keep the cost of the fixture in proportion to the operation that is to be performed.

9. Look up the data of the machine on which the fixture is to be used and make the fixture to suit. See that operating clearance is provided, and that no interference with feed handles or the machine column exists. Check up the position of the tools and their range of action to see that the range of the machine feed is sufficient.

10. Make the base large enough for the fixture to be stable and free from any tendency to rock. Make the body, walls, and ribs heavy enough to insure rigidity, but do not make them excessively heavy, especially if the fixture is one which must be moved around.

11. If the fixture must be fastened to the table, provide ample facilities and such locating elements as keys in a milling fixture to fit the table slots, pads against which to set feeler gages, a machined circular surface to indicate the position of the faceplate fixture, etc.

12. Where a complicated casting would otherwise result, make separate brackets which can be screwed and doweled on the body. Remember, however, that the simplest bolting-

IMPORTANT POINTS IN FIXTURE DESIGN

1. Draw part to scale corresponding to latest blueprint and operation sheet.
2. Consider the condition of locating surfaces and the tolerances allowed.
3. Provide for the easy insertion and removal of work.
4. See that the piece will not be distorted by clamps or tool pressure.
5. Provide for the disposal of chips.
6. Do not require more than one wrench to operate the fixture.
7. Make a rapid-operating fixture.
8. Avoid a complicated construction.
9. Make the fixture to suit the machine.
10. Make a stable and rigid fixture.
11. Design to facilitate the set-up on the machine.
12. Make castings as simple as possible.
13. Use machine steel whenever it is economical.
14. Make sure that the tools can operate in the required position.
15. Picture mentally the whole operating process to see if all accessories are provided.
16. Use standard parts, castings, and stock material.
17. Consider the safety of the operator.

on job takes at least two hours' work in the tool-room to square up faces, drill, tap, and ream the required holes, and fit the screws and dowels, so that it does not pay to bolt on a separate piece to avoid one simple core. Wherever cores and loose pieces on the pattern can be avoided, choose the simple casting rather than the good-looking one.

13. Do not use a special casting for a piece which may readily be made from machine steel. On the other hand, if the making of a piece from machine steel entails a great amount of roughing out, it is better to make a pattern for producing a casting than to tie up a machine in the tool-room for a few hours.

14. Show the outlines of arbors, drill chucks, or any other small tools in the assembly drawing to make sure that there is no interference and that the distance from the table to the cutting point is within the range of the machine.

15. Consider the actual operation of the tools and fixture, and see that all accessories have been supplied. For instance, if support arms are required on a milling job, they should be shown in the assembly drawing, together with arbor collars and cutters. Furthermore, the list of tools to go with the set-up should be checked.

16. Use standard parts and castings whenever practicable, and when using machine or cold-rolled steel, consult the stock lists and design so as to utilize stock material with a minimum of machining. The designer should familiarize himself with the material carried in stock and listed in the drafting-room catalogue.

17. Have some consideration for the man operating the fixture. That the fixture should be designed so as not to endanger the operator goes without saying, although some designers neglect this point once in a while. On faceplate fixtures for a lathe or grinder particularly, do not omit a circular guard for covering any moving projections and provide against latches, etc., flying open. Supply ample clearance on all hand-knobs and levers so that the operator need not be particular in grasping them lest he scrape his knuckles.

* * *

TAXATION OF U. S. CITIZENS DOING BUSINESS ABROAD

The National Foreign Trade Council, India House, Hanover Square, New York City, has published a pamphlet entitled "The Unwisdom of Taxing the American Trader in Foreign Countries," containing an argument in favor of exempting Americans living and doing business abroad from taxes payable to the United States on income derived within the foreign country.

Citizens of the United States living and doing business in a foreign country are placed at a tremendous competitive disadvantage, because they are forced to pay to the United States a tax on income derived from their work and business in the foreign country. No country except the United States taxes its citizens living abroad on income derived from foreign sources.

It is true that the United States allows its citizens to credit against these taxes the total of all income and excess profits taxes paid to foreign countries upon income derived from sources therein, but this still places the American doing business abroad at a competitive disadvantage. On a business income of $500,000, the difference against the American trader, that is, the excess of taxes paid by him, may vary from $242,000 to $375,000. As an example, it is mentioned that there is a French concern in Manila handling American automobiles and tractors. In 1919 this company earned a net profit of $600,000 on which it paid a tax to the Philippine Government of $77,735, but paid no tax to the French Government. An American concern doing the same business in Manila would have to pay a total of $375,190 in taxes, or nearly $300,000—one-half of their net profit—in excess of what the French concern had to pay.

CONDITIONS IN THE GERMAN METAL INDUSTRY

Factories making the following lines of goods are reported to be well occupied: Locomotives, railway cars, shipbuilding, internal combustion engines, paper-making machinery, and woodworking machinery. All other industries are either working on stock or with reduced time. The iron and steel industry is in a critical position, and can sell only part of its production, in spite of the fact that it is short of raw materials, using in some cases cheap Spanish ores. By losing Lorraine and separating the Saar district from Germany, as well as separating Luxemburg from the customs union, Germany has lost 75 per cent of its ore supplies, 40 per cent of its blast furnaces, and 30 per cent of its steel and rolling mills. Prices have been cut 50 per cent without reducing wages, but it is stated that further reductions can be made only if the workers themselves voluntarily give up the legal eight-hour day. Up to the present time the workers have refused. On the first of April 887,000 men were reported out of work. A report issued by the Allgemeine Elektrizitäts Gesellschaft, covering plants employing 2000 officials and office people and 11,000 workmen, indicates that since 1913 wages, as expressed in marks, have been increased so that they are eight times what they were then.

News of the German Machine Tool Industry

Sondermann & Stier of Chemnitz have made an agreement with the machine tool works of Karl Wetzel of Gera and the Union Works of Chemnitz, according to which Sondermann & Stier will devote themselves entirely to boring and turning mills, and drop the manufacture of horizontal boring and milling machines, which latter line will be made a specialty of by the Union Works for machines up to a 3-inch diameter spindle, and by Karl Wetzel for machines with a spindle diameter of more than 3 inches. The three firms will also exchange all technical knowledge and experience with each other, have consolidated selling organizations, and will occupy a leading position in their branch of the machine tool industry.

Fritz Werner of Berlin-Marienfelde, employing at present 1000 men, is working exclusively on stock. The plant, however, is large enough to give employment to double the number or more. The foundries of these works have a daily capacity for 30 tons, all of which is not machine tool castings. The Fritz Werner Works are now manufacturing a large vertical milling machine. The Ludwig Loewe Co. reported for last year a net profit of 4,860,000 marks, and paid a dividend of 21 per cent. This company is now working exclusively on stock.

Very interesting tests are being carried out by the Berliner Präzisionswerke with the use of liquid air in relieving the internal stresses of tools, gages, and measuring instruments. It is said that the firm has obtained good results by chilling the material from which the tools are made to 80 degrees C. below zero.

Some interesting news comes from Austria. A prominent German leader in the iron and steel field has acquired an important interest in one of the large Austrian iron and steel works, which before the war produced 600,000 tons of pig iron and 500,000 tons of steel annually. Coke will be supplied from Germany, and it is expected that this transaction will mean a turning point in the whole Austrian iron and steel industry.

It may be of interest to note the varied lines of business to which the large number of German airplane manufacturers have turned. Taking ten of the leading of these manufacturers we find that they have entered such fields as the making of motor boats, electric railways, elevators, traveling cranes, locomotive and car repairs, bedsteads, milk separators, bicycle rims, driving motors for bicycles, motorcycles, agricultural machinery, domestic electrical apparatus, and furniture.

AMERICAN GEAR MANUFACTURERS' INSPECTION STANDARDS

At the annual meeting of the American Gear Manufacturers' Association, the following inspection standards were adopted as recommended practice:

Cylindrical Holes

Cylindrical holes up to 3 inches in diameter should be inspected with "Go" and "Not Go" plug gages, the diameter of the "Go" end being the same as the smaller limit specified on the customer's drawing, and that of the "Not Go" end, the same as the larger limit given. For holes between 3 and 12 inches in diameter, the gage should consist of two bars placed approximately at right angles to each other and held together by a handle, pressed through a hole in the middle of each bar. One bar should be made to the "Go" dimension and the other to the "Not Go" dimension. The length of the handle and the question as to whether the bars should be placed close together or at opposite ends of the handle will depend upon the nature of the work and principally upon the length of the hole. Holes larger than 12 inches in diameter should be inspected by means of measuring rods, inside micrometers set to vernier calipers, or a standard measuring machine. Gages should not be used after their wear has exceeded the limits on a customer's drawing.

Tapered Holes

Tapered holes should be inspected by means of taper plug gages, the quality of fit being determined by lightly coating the gage with red lead or Prussian blue. A full bearing should be shown. The proper depth of reaming or grinding of the hole should be indicated by means of a stepped shoulder located at either end of the plug, as the case may require, the height of the step and the relationship to the taper, agreeing with the limits specified on the customer's drawing.

Keyways in Holes

Single and multiple keyways in straight and tapered holes should be inspected for width by using "Go" and "Not Go" flat limit gages. For alignment and depth, a plug gage should be employed, the body diameter of which is the small limit of the hole and which has a key or keys, as the case may be, long enough to reach the entire length of the keyway. The width and height of the key gage should agree with the low limit specified. If the maximum depth is important, a similar gage should be used as a "Not Go" gage. This gage should have a key height equal to the maximum dimension given on the customer's drawing.

All keyways for Woodruff keys should be inspected by using a hardened gage similar in shape to the Woodruff key used, but slightly thinner than standard. A keyseated ring gage should be slipped over the key when the latter has been placed in the keyway. Two keyseats may be put in the ring gage to agree with the depth limits on the customer's drawing. For width of keyway, a "Go" and "Not Go" flat limit gage should be used, the dimensions of both ends of which should agree with the limits specified.

Shafts

Splined shafts should be checked for width of spline and root and outside diameters by "Go" and "Not Go" snap gages made to the dimensions given on the customer's drawing or with micrometers set to the same dimensions. For accuracy of spacing, a ring gage should be employed, which should have one portion of the hole ground to the minimum diameter of the keyways of the mating member, an annular portion at one end with a diameter of hole equal to the maximum diameter of the shaft body, and should be milled and ground away so as to obtain projections the cross-sectional dimensions of which will be the same as the minimum space allowed between the keys.

Inspection Standards for Shifter Grooves

Shifter grooves should be inspected for diameter by using a "Go" and "Not Go" snap gage, slightly thinner than the width of the groove and made to the dimensions specified on the customer's drawing. Shifter grooves may also be inspected by means of a micrometer. If a fillet is required at the bottom of the groove, a similar allowance plus a small amount for clearance, should be provided in the snap gage. A "Go" and "Not Go" flat limit gage, made to the limits specified on the customer's drawing, should be used for testing the groove width.

Small Sizes of Spur, Spiral, and Internal Gears

Small sizes of spur, spiral, and internal gears should be inspected on hand fixtures for pitch diameter, eccentricity, and irregularity of teeth. The fixture should be rigid in construction and have one stationary and one freely sliding head, the latter being so arranged that its movements will actuate a dial indicator. It is preferable to use a hardened and ground master gear of proved accuracy. The studs on which the work and master gear are mounted should be at right angles with the surface on which the sliding head moves and parallel with each other within 0.002 inch in a length of 12 inches. The diameter of the work stud should not be smaller than the low limit of the plug gage used in testing the hole in the work, while the stud for the master gear should be about twenty-five hundred-thousandths inch less in diameter than its hole. This fixture may also be used for determining the quality of tooth bearing.

For the determination of noise, a power-driven fixture should be resorted to, the requirements of which should be the same as for the hand fixture, except that it should be possible for one spindle to be rotated in either direction and the other spindle should be provided with a brake. No indicator should be furnished, and the movable head should be controlled by an adjustable screw having a micrometer collar. A clamping screw should be provided for locking the movable head. Master gears of 6 diametral pitch and finer should be true within an eccentricity tolerance of 0.001 inch. In disputes concerning eccentricity when master gears of proved accuracy are not available, a hardened gear with teeth cut away so as to have but one tooth in engagement at a time may be used by rolling it through the arc of contact and then ratcheting to the next tooth to be inspected.

Bevel Gears

Bevel gears should be inspected on hand or power-driven fixtures for quality, and on reversible power-driven fixtures equipped with brakes for noise. These fixtures should also be rigid in construction, and the belt pull should be downward rather than upward so as to seat the movable head, rather than to pull it away from the bearing surfaces. The spindles should lie in the same plane and be at right angles to each other within an error of 0.002 inch in 12 inches. With straight-tooth bevel gears, conical pointers may be used to ascertain whether the teeth are radial or not. The foregoing applies to such gears as are used in automotive constructions and not to the larger mill gearing.

Questions of tooth bearing should not be determined in the final assembly in case of dispute, but by inspection on proper test fixtures. The holes in collets or bushings for holding stem gears should be equal to the maximum shaft limit plus the smallest allowance which will permit the stem to be entered. A satisfactory way of testing the backlash of gears is by the use of standard feelers. The backlash of an individual gear may be determined by substituting a master gear of standard thickness of tooth and pitch diameter in place of the mating gear.

Other standards and recommended practices adopted at the annual meeting of the American Gear Manufacturers' Association will be published in coming numbers of MACHINERY. The association is doing a very valuable work along standardization lines.

LONG AND SHORT ADDENDUM BEVEL GEAR TEETH

Tables giving the proportions of 14½-degree teeth for long and short addendum bevel and spiral-bevel gears of ratios between 3 to 1 and 8 to 1, were presented at the recent annual meeting of the American Gear Manufacturers' Association by the bevel and spiral-bevel committee of the organization, and were adopted as recommended practice. These tables are given herewith, together with a description of the manner in which the values were arrived at. Long and short addendum bevel gear teeth are treated in the same manner as similar spur gear teeth, with the exception

TABLE 1. MAXIMUM THEORETICAL ADDENDUM OF BEVEL GEAR TEETH WHEN THE PINION BACK CONE RADIUS EQUALS 1 INCH

Dimensions in Inches

Ratio of Gear to Pinion	Pressure Angles			
	Plain Bevel		Spiral Bevel	
	14½ Deg.	20 Deg.	14½ Deg.	20 Deg.
1 to 1	0.0899	0.1623	0.1159	0.2043
2 to 1	0.0699	0.1295	0.0909	0.1655
3 to 1	0.0659	0.1226	0.0859	0.1571
4 to 1	0.0645	0.1201	0.0841	0.1541
5 to 1	0.0638	0.1190	0.0832	0.1527
6 to 1	0.0635	0.1184	0.0828	0.1519
7 to 1	0.0632	0.1180	0.0825	0.1514
8 to 1	0.0631	0.1177	0.0823	0.1511

Machinery

that the back cone radii are used instead of the pitch circle radii. The pitch circles of a gear and pinion are shown in view *A* in the accompanying illustration, together with the base circle of the pinion as determined by the pressure angle *a*.

Contact of involute teeth cannot take place below the base circle, since the involute curve has its inception at the base circle. Thus, any projection of the addendum portion of a

TABLE 2. PROPORTIONS OF PLAIN BEVEL GEAR TEETH WITH PRESSURE ANGLES OF 14½ DEGREES FOR GEAR RATIOS BETWEEN 3 TO 1 AND 8 TO 1

(Values are for Gears of 1 Diametral Pitch)

No. of Teeth in Pinion	Addendum		Full Depth	Circular Thickness	
	Gear	Pinion		Gear	Pinion
14	0.560	1.440	2.157	1.186	1.955
15	0.600	1.400	2.157	1.221	1.920
16	0.640	1.360	2.157	1.256	1.885
17	0.680	1.320	2.157	1.291	1.850
18	0.720	1.280	2.157	1.326	1.815
19	0.760	1.240	2.157	1.361	1.780
20	0.800	1.200	2.157	1.396	1.745
21	0.840	1.160	2.157	1.431	1.710
22	0.880	1.120	2.157	1.466	1.675
23	0.920	1.080	2.157	1.501	1.640
24	0.960	1.040	2.157	1.536	1.605
25	1.000	1.000	2.157	1.571	1.570

Machinery

Dimensions in Inches

TABLE 3. PROPORTIONS OF SPIRAL-BEVEL GEARS WITH PRESSURE ANGLES OF 14½ DEGREES FOR GEAR RATIOS BETWEEN 3 TO 1 AND 8 TO 1

(Values are for Gears of 1 Diametral Pitch)

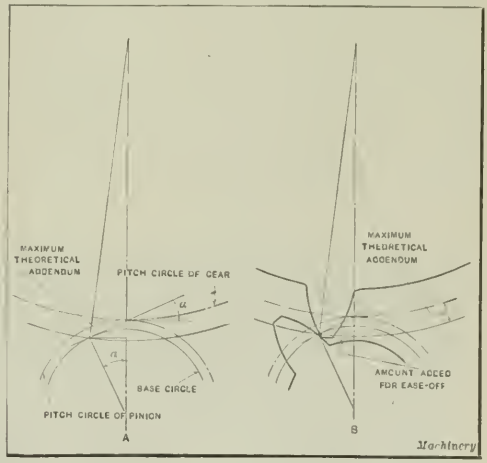
No. of Teeth in Pinion	Addendum		Dedendum		Full Depth	Circular Thickness	
	Gear	Pinion	Gear	Pinion		Gear	Pinion
10	0.500	1.200	1.420	0.720	1.920	1.2000	1.9416
11	0.550	1.150	1.370	0.770	1.920	1.2500	1.8916
12	0.600	1.100	1.320	0.820	1.920	1.3000	1.8416
13	0.650	1.050	1.270	0.870	1.920	1.3500	1.7916
14	0.700	1.000	1.220	0.920	1.920	1.4000	1.7416
15	0.750	0.950	1.170	0.970	1.920	1.4500	1.6916
16	0.800	0.900	1.120	1.020	1.920	1.5000	1.6416
17 or over	0.850	0.850	1.070	1.070	1.920	1.5500	1.5946

Machinery

Dimensions in Inches

gear beyond the base circle of the pinion at the beginning and end of the theoretical arc of action is useless so far as tooth action is concerned. The first problem is to find the gear addendum which at the beginning of the arc of approach extends to the base circle of the pinion. This is known as the "maximum theoretical addendum." Values for this addendum to suit various ratios and for 14½- and 20-degree pressure angles are given in Table 1; these values were obtained by calculating the opposite side of the smaller of the two triangles of which *a* is the acute angle. The values given are for gears of 1 diametral pitch, and for any other diametral pitch they must be divided by it. Examination of the table will show that the values between ratios 3 to 1 and 8 to 1 do not change greatly, and for the sake of simplicity in preparing the tooth proportion tables, it will be assumed that there is no difference.

Table 2 gives the dimensions for 14½-degree plain bevel gear teeth. The addendum in each case has been obtained



Diagrams used in determining the Proportions of the Gear Tooth

by adding a certain percentage to the maximum theoretical addendum to provide an "ease-off." The view at *B* in the illustration shows graphically that unless this percentage is added, the tooth load on the gear at the beginning of the approach will lie along the very top of the tooth, which is a condition to be avoided. The circular thickness, that is, the thickness of the tooth measured along the pitch circle, was in each case obtained from a lay-out giving consideration not only to the strength of the tooth, but also to the width of the top. The tooth widths are sufficient to prevent a complete carburization, and consequent brittleness, in casehardening.

The values given in Table 2 are also for gears of 1 diametral pitch, and must be divided by the diametral pitch of the gears being proportioned. No table has been compiled for gears of 20-degree pressure angles, as the standard proportions, where the addendum is one-half the working depth, have proved satisfactory when the number of teeth in the pinion is not less than twelve. For ratios below 3 to 1, the percentages of change are so great, as shown in Table 1, that a lengthy table would be required to cover properly the proportions of gears of these ratios.

Table 3 gives the tooth proportions of 14½-degree spiral-bevel gears of ratios between 3 to 1 and 8 to 1, this table being also for gears of 1 diametral pitch. The values were obtained in the same manner as for plain bevel gears, with two modifications—the working depth of spiral-bevel teeth is 85 per cent that of plain bevel teeth, which are of standard depth, and the bottom clearance is 0.07 times the circular pitch instead of the usual standard of 0.05 times the circular pitch.

* * *

GREATER EFFICIENCY NEEDED IN RAILROAD OPERATION

If there is to be an early revival of industrial activity, the transportation system of the country must be placed in a position to obtain the same efficiency in operation as any manufacturer running his own plant. Only by so doing will it be possible for the railroads to reduce fares and rates; and such a reduction is necessary if we are again to have real industrial prosperity. In view of this situation the National Founders Association, in common with many other groups of manufacturers in the United States, recommends and urges that the agreements made during Federal control by the Railroad Administration be completely abolished. The Labor Board has ordered the cancellation of these restrictive rules, but has ordered the railroads to make new agreements with various union crafts. Leaders of these organizations are demanding that the new agreements be practically identical with the ones made during government control. Refusal of the railroads to perpetuate all these rules—which it is estimated cost the transportation interests of the country more than $300,000,000 annually—means that the Labor Board will be called upon to decide the question, so that there is danger, unless a firm stand is taken, that conditions such as prevailed during government control will be made perpetual.

It is further urged that jurisdiction over questions of wages, classifications, and working conditions be restricted to the individual railroad administration. Rules and regulations made by the Government during Federal control, continued in effect by the Labor Board, have standardized wages and rules on all railroads without regard to living conditions in particular communities or the rates of pay of employes of other industries doing similar work in these communities. Workers should be paid according to the service they perform, as they were before the Government took over the railroads.

It is also demanded that Congress immediately repeal the Adamson Law, passed under duress and unquestionably one of the most hampering pieces of legislation affecting a legitimate industry ever enacted at Washington. The Adamson Act was not really a law governing hours of labor, but was essentially a wage measure, sought by the union leaders as a way to increase the pay of certain classes of railroad employes. To repeal it would enable the railroads of the United States to save enormous sums annually without impairing their service or doing an injustice to any employe.

* * *

The total export trade of the United States to India increased 147 per cent in value from 1918 to 1920. The value of the metal-working machinery exported in 1918 was $1,251,662 and $1,374,068 in 1920.

INDUSTRIAL CONDITIONS IN FRANCE

By MACHINERY'S Special Correspondent

Paris, August 11

There has been but little change in the industrial conditions during the last month. A slight improvement is noticeable in the automobile field, which is somewhat more active as a result of the reduction in the price of gasoline in France. The Renault plant is now producing 800 cars a month. A year ago 1200 cars a month were built, but the present output is considered satisfactory, as the firm is devoting part of its facilities to other branches of metal manufacture.

In the shipbuilding industry conditions are not as good as they were a year ago. One of the yards in the Loire-Inférieure district, established about a year and a half ago, has been closed down. The steel mills are still reducing the prices of materials. It was thought some time ago that the minimum had been reached, but that was not the case. A reduction of 20 per cent in the price of iron and steel is expected in Belgium in the near future. The German and Luxemburg metal manufacturers have made a further reduction in the price of steel bars.

As an indication of the price reductions, it may be mentioned that pig iron which was quoted last year at 650 francs (present exchange, $50.70) a ton, is at present marketed at 200 francs ($15.60) a ton, and a further reduction in price is expected. One of the steel companies is said to have sold pig iron as low as 150 francs ($11.70) a ton. In spite of these great reductions, there is but a small market, and furnaces are continually being closed down in the various iron and steel districts.

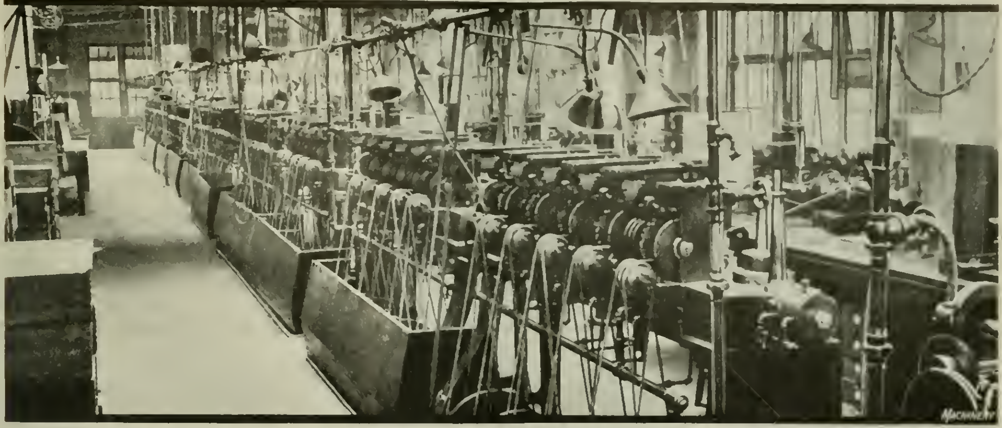
New Tariff Regulations

Early in July new tariff regulations were officially published. A general revision of the tariff rates will be made during the first three months of 1922, and the present rates quoted below are therefore only temporary. The rates published in the article entitled, "New French Tariff on Machine Tools" in June MACHINERY should be multiplied by the following coefficients: machine tools, 3.3; precision instruments, measuring instruments, and drawing instruments, 3; threading tools, turning, boring, and planing tools, and milling cutters, 3; vises, 4; drill chucks and drills, 4; wire-drawing dies, 4; files, 3.2; saws, 5; abrasives in pulverized form, 2.8; abrasive wheels, paper, and cloth, 2.7.

By employing coefficients that can be easily stated in this manner, an actual change in the figures designating the amount of the tariff in francs is avoided, the coefficient only being changed.

Labor Conditions

Although there has been no disturbances among the workers, the reductions in wage that have recently taken place in all the industries have not been accepted without protest. It is possible that the reductions have not been considered carefully enough in comparison with the actual reduction in the cost of living, and it is likely that with a return to normal industrial conditions some adjustments will have to be made again. The labor cost at the present moment is the principal production cost, amounting to a great deal more than the cost of materials. Hence, while six months ago the labor cost was one-sixth of the selling price, at present in many cases of manufactured metal goods, on account of decreases in prices, the labor cost has increased to one-third of the selling price. The Societe Alsacienne de Constructions Mecaniques at Grafenstaden, an important machine tool manufacturing concern, has closed its doors, as the men refused to accept a reduction of 20 per cent in wages; as a result, 2000 men are idle. In general, the principal metal-working concerns have reduced wages about ten per cent, in addition to the ten per cent reduction effected about three months ago.



Automatic Machines in a Watch Factory

Machines, Devices, and Methods Employed in the Plant of the Waltham Watch Co., Waltham, Mass.—Second of a Series of Articles

IN the first article in this series, published in August MACHINERY, automatic surfacing and drilling machines used in the manufacture of plates for watches were described, as well as a duplex type taper-turning and taper-boring machine. In the present article, additional types of automatic machines are illustrated and described.

Automatic Plate Recessing Machine

A seven-spindle automatic machine employed for producing the recesses in which the various watch wheels are set in pillar plates, barrel bridges, etc., is shown in Fig. 8. The work on which this machine is shown engaged is that of recessing barrel bridges. The shape of one of these parts may be seen at the end of the feed magazine *A*, and also at *B* in the assembly view of a watch, Fig. 1 of the first installment of this article. The eight carrier arms *B*, Fig. 8, are swung from left to right to position the work in the chucks, by an air-operated shaft which extends lengthwise beneath the machine, and which has rack teeth cut in it at intervals. The arms are oscillated by their gear connection to this rack shaft, the general construction being similar to that mentioned in August MACHINERY in the description of the plate roughing machine. Circular tools are used, which are mounted in tool-blocks supported on compound slides. The two slides *C* and *D* operate at right angles to each other, being actuated by levers *E* and *F*. Cams *G* control the lateral feed of the lower slide and the longitudinal or radial feed of the upper slide.

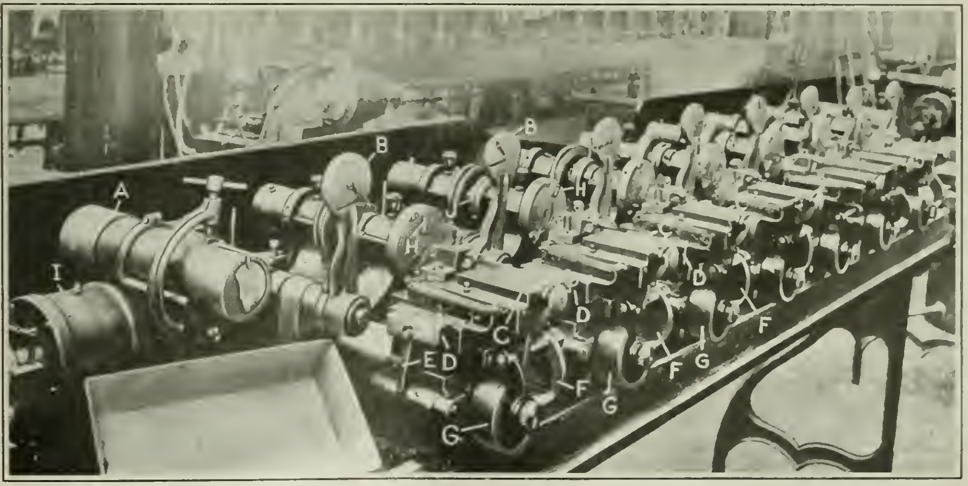


Fig. 8. Automatic Multiple-spindle Watch-plate Recessing Machine

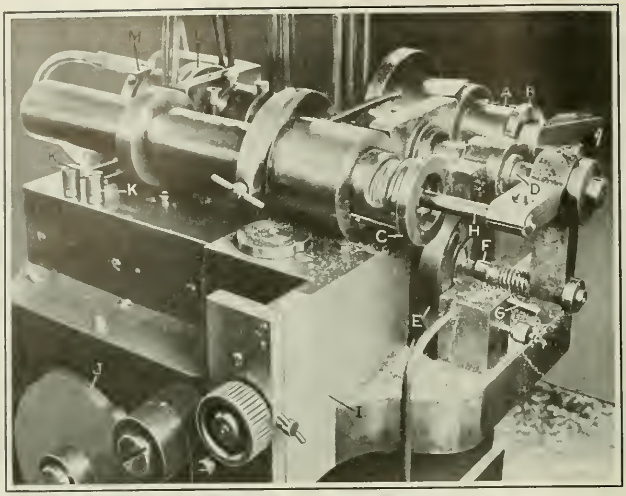


Fig. 9. Automatic Machine with Magazine Feed for turning the Rims of Watch Plates

When pillar plates are to be recessed, they are located in the chucks by dowel-pins, which engage the dial foot holes in the work. Incidentally, these three holes are used as a locating means in all operations performed on the pillar plates, if possible. The chuck is provided with spring jaws *H* for holding the barrel bridges, and obviously it is necessary to stop each spindle while being loaded from the carrier arms, in exactly the same position, so that the work will be located properly in the jaws. The abrupt stopping of rotation and the positioning of the spindles in the same angular relation to the work are accomplished by the operation of the air countershaft in conjunction with a one-tooth ratchet wheel and pawl. This ratchet wheel is located in front of the pulley and can be barely seen at *J*. As soon as the air which controls the direction of rotation is released and air is admitted to the opposite side of the countershaft pulley, the spindle is quickly stopped and reversed until the pawl which engages the ratchet tooth is dropped into place. The pawls are positively operated by the action of a cam.

The work passes from spindle to spindle for performing the various recessing operations, until it is finally delivered to the magazine at the opposite end of the machine. The work in the feed magazine is forced against spring jaws by air pressure, and these jaws are released by being forced radially outward when correspondingly located jaws on the carrier arms are brought into contact with them. The air then deposits the work into the carrier arm. After they have been swung into position in front of the spindles, the carrier arms are fed backward slightly, causing the hinged jaws *H* of the chucks to fulcrum and close over the periphery of the work and firmly clamp it in position.

The operations performed on a pillar plate are turning the recesses for the hour wheel and cannon pinion with tools mounted in the first tool-block; machining the intersect-wheel cap recess and its clearance with one tool at the second station; cutting the minute wheel seat at the third station; producing the recess for the third wheel at the fourth station; turning the recess for the minute pinion at the fifth station; machining the clearance for the minute pinion recess at the sixth station; and cutting the dial recess at the seventh station. The air cylinder through which the shaft that operates the carrier arms extends is shown at *I*, and the shaft carries a suitable stop arrangement at the end for placing the arms in a neutral position, this being the vertical position in which the carrier arms are shown in the illustration. The carrier arms occupy this neutral position after they have received the work from the station at the left of each arm, and remain in readiness to swing to the right, this movement occurring immediately after an operation has been completed and the work is ready to be passed to the next station.

Plate Rim Turning Machine

The machine shown in Fig. 9 turns the recess in the pillar plate in which the dial is located. Magazine *A* at the rear of the machine feeds the work into holder *B* by air pressure from within, and after being located in the holder it is held securely by three spring jaws. This holder and holder *C* are carried by a double carrier arm which rotates on shaft *D* to bring the work into position in front of the centrifugal three-jaw chuck *E*, from which position it is forced into the chuck by the spring plunger *F*. The tool *G* is then fed in to the proper depth, and the slide on which the tool-block is mounted is fed in radially to complete the recess or cup-section for the dial. The work is next picked up by holder *C*, which has previously swung into position, and transferred to the magazine where the finished work is deposited. The plates are forced from holder *C* by pin *H*, which is moved axially with shaft *D*. Both the pin and the spring plunger are carried by a two-arm casting attached to this shaft. As soon as the shaft is reciprocated outward, the carrier arm is again in readiness to oscillate 90 degrees and briug another piece in holder *B* into alignment with the centrifugal chuck.

The 90-degree movement of the carrier arm is obtained by a four-notch ratchet wheel, these notches being successively engaged by a spring-operated pawl which is disengaged by an air-operated piston-rod. The ratchet wheel is attached to shaft *D*, which is belt-driven, so that as the pawl is disengaged and a 90-degree turn of the shaft occurs,

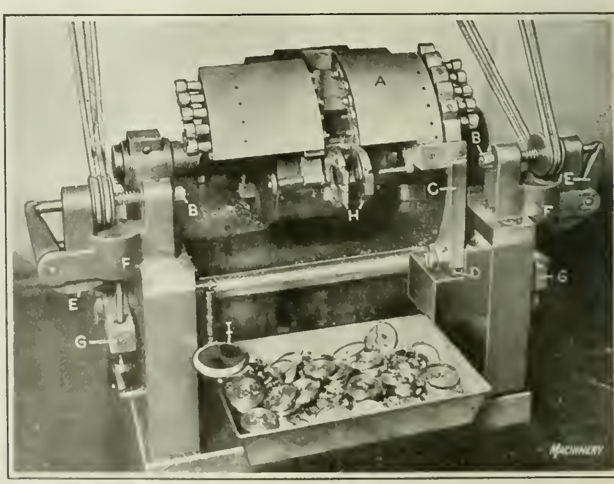


Fig. 10. Multiple Opposed-spindle Reboring or Uprighting Machine

the pawl will spring back into engagement and hold the shaft while the cut is being taken on the work. During this period the belt which drives the shaft and ratchet slips on pulleys *L*.

The cross-feed for the tool-slide *I* is actuated by cam *J* at the front of the machine, which controls the movement of a lever arm that transmits the motion to the slide. This lever has a ball-end which fits in a socket in the slide, allowing universal connection with the lever, which is required in producing the feed movement. The slide is returned to its normal position by the application of air. Shaft *D*, which slides but does not revolve, is guided at its rear end by a slotted finger *M* attached to it extending down with the slot riding over a square key. The knob shown at the front of the cross-slide is used to adjust the crosswise position of the slide when setting up the machine.

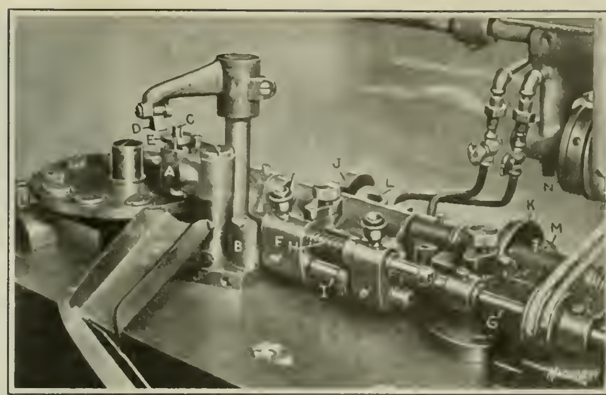


Fig. 11. Air-controlled Boring and Milling Machine for machining Clutch Clearance in Barrel Bridges

In some of the machines to be described, air tubes are provided of the type shown at *K*, for the direct application of compressed air to operative parts. In certain designs of machines it is often necessary to drill air channels through solid castings and direct the flow of air, in the manner most convenient, to the desired point. This method of utilizing compressed air in the operation of machines is novel and peculiar to those found in the Waltham Watch Co.'s factory, and it is this feature especially, rather than the cam-operated valve lever construction, to which attention is directed.

Uprighting Machine

The bench machine illustrated in Fig. 10 contains five pairs of opposed work-spindles which operate on opposite sides of the movement plates to bore the previously drilled holes in which the train wheel bearings are staked. This method insures that the holes will be absolutely normal with respect to each face of the plate. The spindles are carried in a swinging arm *A*, which is operated by a rack and pinion at the rear of the machine. This rack operates vertically by air pressure, swinging the spindle arm downward to bring the spindles successively into alignment with the driver at *B* at each end of the machine. The spindles are locked in the several operating positions by pawl *C* engaging with notches on the spindle arm. The pawl is operated by pin *D*, which is forced against the heel of the pawl by air pressure.

The driver spindles *B* are belted to an air-operated countershaft and are advanced axially to bring the clutch on each driver into successive engagement with the spindles, by means of a fulcrum lever *E* at each end of the machine. These two levers force the drivers forward when their lower ends are acted upon by air. The air cylinders are shown at *F*, and the application of air results in swinging the opposite ends of levers *G* into engagement with a feed-cam carried on the camshaft and located outside the frame at each end of the machine. The feed-cams, after each operation, permit the release of the driver clutch, this action being synchronized with the indexing movement of the spindle arm as it is swung downward by the rack-and-pinion construction previously mentioned.

The watch movement plates (which consist of the pillar plate with the various top plates assembled) are placed in a recess in one of the holders *H*, after which the two holders are brought together by air pressure and held in a vertical plane relative to the axis of the tools. After the various machining operations are completed, the work is ejected by a spring plunger shown to the left of one holder. This machine is semi-automatic, it being necessary after loading each piece by hand to depress the pedal *I* which engages a friction clutch connected with the driving gear on the camshaft of the machine. A quantity of these plates showing the number of holes that they contain may be seen in the foreground of the illustration.

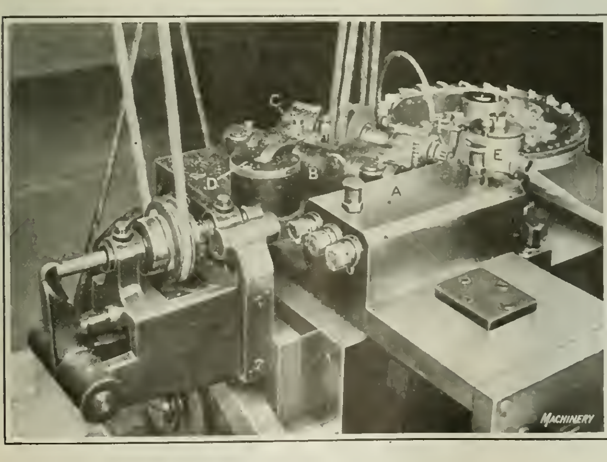


Fig. 12. Machine for centering, drilling, and tapping the Hole for the Hair-spring Stud in a Balance Cock

Dome Turning Machine

The operation performed on the machine illustrated in Fig. 13 consists of turning the diameter of the balance cock dome with an angular under-cut and boring a hole through the center, at a single setting. This insures concentricity between the hole and the turned circumference of the dome. The regulator arm is attached to this dome in the construction of a watch. This operation is performed after the plates have been assembled to the pillar plate, as shown at *A*. The assembled unit is located on the chuck *B* by spring jaws of the regular type, the location being such that a spacer bar *C* may be advanced to act as a support under the balance cock. This is a necessary provision because the unsupported end of the balance cock would not present a rigid enough surface to permit the operations to be performed with the required degree of accuracy. The air cylinder which operates this spacer bar is located at *D*.

The special feature of this machine is the means provided for readjusting the vertical height of the turning tool for each piece of work. An air-operated rack swings the spindle arm *E* to the right until spindle *F* is in alignment with the driver *G*. Spindle *F* is a locating spindle only, and is used for establishing the vertical height of the turning tool *H*. This setting is accomplished by feeding the driver *G* against the end of spindle *F*, which results in pushing the locating spindle down against the work and causing the yoke *I* to be raised or lowered slightly, in which new position the yoke spindle is locked in its bearing by an air-operated clamping device that binds a split collar *K* to the yoke shaft.

The feed mechanism is connected by a universal joint to the rear end of the fulcrum lever *J*, and as soon as the yoke shaft has been locked, the spindle arm is located in a new vertical position, from which the depth of cut employed in turning the dome is re-established. As soon as this height has been predetermined, the driver is raised and the spindle arm swung to bring the second or turning spindle into the operative position. At the completion of the turning operation, the spindle arm is again swung and the third or boring spindle is employed to machine the hole concentric with the turned dome.

The mechanism for actuating the feed is contained within the box casting which forms the base of the machine. It consists of an air plunger which actuates a bellcrank lever, bringing one end of the lever against the feed-cam; this air-actuated movement then permits the feed-cam to operate lever *J* and advance the cutting tools. This arrangement is known as a "permitted feed" movement. The tools are periodically set to the proper height in the carrier arm by a master gage of the disk type. This machine produces at the rate of 400 balance cocks per hour.

Balance Cock Drilling and Milling Machine

The automatic special-purpose machine shown in Fig. 12 centers, drills, and taps the hole for the hair-spring stud in balance cocks, and also mills a portion of the lug in which

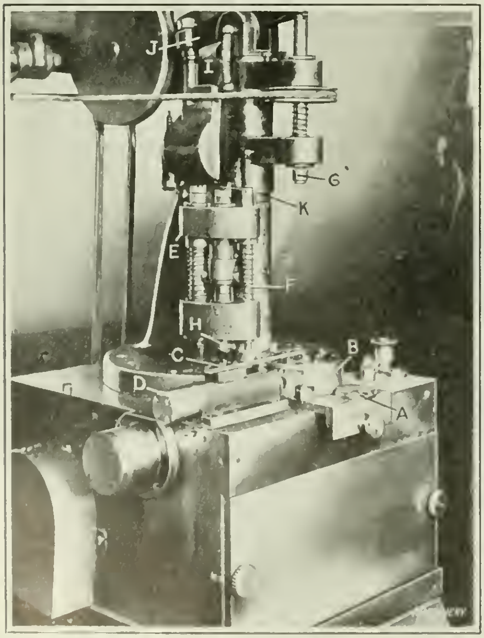


Fig. 13. Machine used for turning and boring the Dome on Balance Cocks

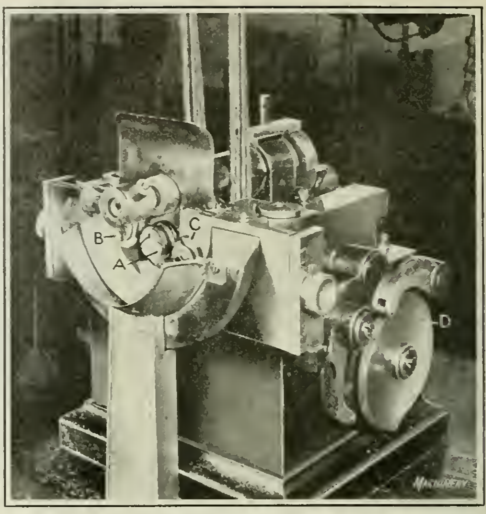


Fig. 14. Turning Plates to fit the Watch Case after assembling

this hole is machined. The balance cocks are located by pins on a turret which is revolved intermittently by a mechanism controlled by the work-carrier head *E*. This mechanism is contained within the machine frame and operates as soon as the spindles have finished working. The carrier spindle, as it revolves when another piece of work is to be picked up, trips a finger on the turret post within the machine, and this finger or lug carries a pawl which turns the turret by engaging a ratchet wheel also mounted on the turret stud. The work is picked up and swung into position and held thus during the several operations. The opening and closing of the jaw which is on the under side of the carrier head, is accomplished by a small pin extending vertically through the head, which is operated to contact with the end of the jaw by an air plunger actuated by a cam within the machine. When the work is being picked up, this plunger is depressed. A similar carrier head is illustrated at *A*, Fig. 11.

The three spindles of the machine are clutch-driven, and provided with a "permitted feed," the general construction being similar to that already described in connection with other machines in this series of articles. The feed-cam in this particular instance, however, has been designed to furnish a relief motion for the drill, but in other respects the mechanism is not radically different from the others. The tools, which project from the further end of the spindle-block *A*, are provided with three stop-pins for limiting the depth of cut, and when the slide moves crosswise to bring each spindle in alignment with the driver, an arm on the frame of the machine is swung over to act as a locating abutment for these stops.

The rear end of the cross-slide carries the swinging bracket *B* in which the milling spindle *C* has its bearing. This spindle is belt-driven and has a "permitted" radial feed movement which functions as follows: As soon as the three spindles have completed their work and the slide has advanced the milling cutter *F* into position for taking its cut, the projecting end of a lever attached to the camshaft of the machine is forced up by cam action and raises a stop-pin until it bears on the under side of bracket *B*, and acts as a steadier for the cutter during its downward feeding movement. The air cylinder *D* then causes the bracket to swing downward, thus feeding the cutter through the work.

A device for automatically stopping the machine if breakage of the drill or tap occurs is included in this machine equipment, and is located at the further end of the machine. There is a contactor, or piece of flat steel, against which the tools bear one at a time as the slide is fed forward to the next operative position. As long as contact exists between the tool which has just finished operating and the contactor, a steel magnet at the opposite end of the machine will act on the free end of a flat finger which is regularly reciprocated under it by cam action. As long as the tools continue to contact, the magnet will draw this lever up and over the trip which operates the air valve for shutting off the air to the countershaft. If the tools fail to contact, however, there will be no magnetism in the steel piece and the reciprocating finger will be permitted to trip the air valve and immediately stop the machine. The cam that reciprocates this flat finger is attached to the end of the regular camshaft of the machine.

Boring and Milling Machine for Clutch Clearance on Barrel Bridges

A machine for milling the winding pinion clearance and for boring the clutch clearance on barrel bridges is illustrated in Fig. 11. The work is loaded and located by pins on the turret of the machine. The work-carrier head *A* is swung from the position in which it is shown, to the right, until it is in a position to locate the work on block *B*. This movement is accomplished through the medium of an air cylinder on the left-hand end of the machine having a plunger on which teeth are cut to engage a segment gear and operate the take-up and retainer pawls. The work is picked up and held by the jaws in the carrier head, and is deposited on block *B* and held in this position until the machining of the work has been finished. The carrier head, with the work, then swings backward to the left, and when it reaches its foremost position a step on the vertical stud *C* is depressed by the swinging triangular trip *D*, past which the stud cannot travel without being depressed. Depressing this stud causes the collar *E* to force down the pivoted jaws by means of which the work is held on the under side of the head, opening them and allowing the work to drop into a chute.

The spindle arm *F* carries two spindles, one for each operation, and these are driven by a clutch on the driver *G*. A "permitted" cam-feed motion is incorporated in this machine, the construction of which has previously been described. This spindle arm may be held stationary as required in the boring operation, or may be fed both independently of the driver when indexing the tools and with the driver when performing the milling operation. This is the special feature of this machine to which attention is directed.

The boring spindle is shown at *H*, and after the hole has been bored, arm *F* is swung upward by a combined cam and compressed-air movement, and the driver clutch brought into engagement with the milling spindle *I*. In this position finger *J* has swung downward into contact with the end of the air-cylinder piston; also finger *K* at this part of the movement is in contact with the piston of another air cylinder. The pistons in these two air cylinders *L* and *M* are operated in unison during the milling operation, and permit both the milling spindle and the driver to feed upward a distance of about 3/8 inch, which is the required amount for producing the clutch clearance on the work.

The spindle arm is returned to the position shown in the illustration by means of a spring, after which the work is picked up and deposited in a chute as previously described. The machine is driven from a worm and worm-wheel, by means of a camshaft which extends through the machine and carries the cams for operating the various air valves and the feed-cam for the spindles. The air countershaft is shown at *N*.

Plate Diameter Turning Machine

After the barrel bridge, pillar plate, and balance cock have been assembled to the pillar plate as shown at *A*, Fig. 14, the diameters of the assembled unit are turned on the bench machine shown in this illustration. Circular tools *B* and *C*, mounted on each side of the work-holding chuck, are employed, the slide on which these tools are mounted being reciprocated to bring the tools alternately into operation. There are four diameters turned with the two tools shown, and the feed movement is "permitted" by the use of compressed air, and is actuated by the cam *D* shown at the right-hand end of the machine. Provision is also made, by the application of springs and compressed air, for moving the work-holding chuck transversely so that the same tools may be used to turn two other diameters.

The third installment of this series of articles will be published in October MACHINERY, and will contain a description of an automatic watch pinion making machine, a wheel opening or reboring machine, and automatic machines for cutting teeth in steel wheels and for numbering watch plates, concluding with a description of the process and machine used for finishing the convex heads of watch screws.

* * *

METAL FATIGUE UNDER REPEATED STRESSES

The development of the internal combustion engine, the steam turbine, the automobile, and the airplane has made the study of the fatigue of metals of increasing importance. Much information relating to this subject was given in a paper by H. F. Moore and J. B. Kommers, recently read before the American Iron and Steel Institute. The failure of machine parts under repeated stress has come to be commonly spoken of as due to "fatigue" of the metal. The cause of such failure was at one time thought to be the "crystallization" of the metal. In the paper referred to, it is shown that the phenomenon is one of a breaking up of crystals rather than of their formation.

RESULTS OF STRESS TESTS

Part of Structure or Machine	Approx. No. of Repetitions of Stress in the Life of the Structure or Machine
Railroad bridge, chord members.....	2,000,000
Elevated railroad structure, floor beams	40,000,000
Railroad rail, locomotive wheel loads..	500,000
Railroad rail, car-wheel loads........	15,000,000
Airplane engine crankshaft..........	18,000,000
Car axles	50,000,000
Automobile engine crankshaft........	120,000,000
Lineshafting in shops................	360,000,000
Steam engine, piston-rods, connecting-rods and crankshafts..............	1,000,000,000
Steam turbine shafts, bending stresses	15,000,000,000
Steam turbine blades................	250,000,000,000

Machinery

The accompanying table, which gives some idea of the number of repetitions of stress in the normal life of various structural and machine members, was prepared from the data supplied in the paper referred to.

* * *

According to a recent Commerce Report, there was a total of sixty-seven foreign steamship lines maintaining regular routes from Hamburg, Germany, to the principal countries of the world, at the beginning of 1921. Among this number were represented several flags which seldom, if ever, had been seen in that port before the war. The nationalities represented, together with the number of lines of each, were as follows: English, 22; Dutch, 11; Norwegian, 6; French, 5; Belgian, 4; Italian, 3; Swedish, 3; American, 2; Danish, 2; and Japanese, 2. The remaining seven lines were of various nationalities.

Group of Brown & Sharpe Employes, consisting of Twelve Nationalities, being assisted in filling out Citizenship Papers

Industrial Americanization

Policy of the Brown & Sharpe Mfg. Co. in Assisting Alien Employes to Become American Citizens

By LUTHER D. BURLINGAME, Industrial Superintendent, Brown & Sharpe Mfg. Co., Providence, R. I.

WHILE Americanization work among the children through the public schools must be looked to as the most important means of assimilating the many peoples of as many ideals who come to our shores, it is believed that the adults in our industries must not be neglected, either in the matter of language, customs, or in the ideals of American institutions and government, if we are to reap the benefits and avoid the dangers resulting from promiscuous immigration. Various methods have been tried to reach and influence adults coming from foreign countries, but with only partial success, and in many cases with admitted failure. Even though free opportunities for instruction and guidance are offered and the way is made easy, it is the exception rather than the rule for such adults to take advantage of the opportunities that are offered, and it requires watchfulness and sometimes drastic action to keep their children in school until they reach the minimum age limit.

To stimulate an interest in school attendance on the part of adult aliens, various methods have been tried, among which are the offering of prizes, paying wages during the time of instruction, or imposing penalties in the way of discharge or lack of opportunity for advancement for those who would not accept the help offered. Even such inducements or penalties have often proved futile. There is a general feeling among those who have dealt with this question that Americans made under compulsion, or by the holding out of what may be classed as bribes, are at best poor Americans, and that while figures may thus be made to show much progress in Americanization the results are but skin deep and of little real value.

In one of his last public addresses Theodore Roosevelt urged strongly that only such immigrants should be allowed to enter this country as would agree to learn the English language and acquaint themselves with American ideals, that ample provision be made at public expense to give them the needed instruction, and that, if after a reasonable time they had not complied with the conditions, they be sent back to the country from which they came.

In the industries lies the greatest opportunity for doing effective Americanization work. Here the foreign-born come in contact with American workmen, and are given an opportunity to absorb American ideals. From their associates and those under whom they work they derive their ideas of what this country stands for, and whether they become loyal or otherwise depends largely upon their industrial environment. If the managements of industrial plants encourage steps toward Americanization in a manner that will promote a feeling that the service is given as a privilege and opportunity, rather than as compulsion, much can be done of a helpful nature along these lines.

Responsibility of the Industries for Americanization Work

It is in the industries where there is the greatest opportunity to deal helpfully with adult foreigners in Americanization work. Here they come in contact with American workmen and the use of the English language, and are thus given an opportunity to absorb American ideals. From their associates and foremen they derive their ideas of what this country stands for, and whether they become loyal or otherwise depends largely upon their industrial environment. If the managements of industrial plants encourage steps toward Americanization, and cooperate with the workmen in taking out citizenship papers, and in becoming proficient in English, etc., and if this is done so that the men will feel that the service is given as a privilege and opportunity rather than as compulsion, much can be done of a helpful nature.

To carry out such a program, it should be understood throughout the works that the officials of the company are behind the movement—that they consider it important and are undertaking it seriously. In the language of commercial men, they must "sell" the idea to the foremen, who, in turn, must be so instructed and enthused as to "sell" it to the men. The preliminary canvass of a plant to learn the facts regarding citizenship is likely to bring out some matters of surprise as to who are and who are not American citizens. Foremen and others in responsible positions, in some cases, are not citizens themselves. There will also be found a surprising lack of knowledge on the part of foremen as to the status of their men relative to nationality and citizenship.

Americanization Methods in a Machine Tool Works

In the winter of 1916-1917, the officials of the Brown & Sharpe Mfg. Co. were impressed with the importance of Americanization work, not only from the standpoint of developing an interest among alien employes in becoming citizens and of training them in the English language and American ideals, but also in order to know who might be trusted as being loyal and who might need watching when America entered the war, which then seemed inevitable. The campaign was inaugurated by giving a dinner to the foremen at the local Y. M. C. A. building. The foremen were invited by formal letters signed by the secretary of the company, so that in every way it was impressed upon them that the matter was important and that their cooperation was expected. The officials of the company sat at the head table with national representatives of Americanization work, and the situation was forcibly presented, both from the standpoint of the national movement and from the point of view of the company. The industrial secretary of the Y. M. C. A. was requisitioned to give active help in cooperation with shop officials in carrying on the campaign.

TABLE 1. PROPORTION OF NATIONALITIES APPLYING FOR CITIZENSHIP IN THE B. & S. PLANT FROM 1916 TO APRIL, 1921

Nationality	Number Becoming Citizens	Number Securing First Papers	Total
English	272	178	450
Scotch	72	82	154
Irish	111	165	276
Canadian	95	90	185
British West Indian	3	2	5
Total English-speaking races	553	517	1070
Swedish	117	97	214
Italian	99	240	339
Armenian	11	84	95
Polish	10	72	82
Russian	26	98	124
Turkish	3	4	7
French	5	3	8
Norwegian	5	5	10
Portuguese	4	13	17
Dutch	3	4	7
Austrian	4	13	17
Bulgarian	0	2	2
Lithuanian	5	6	11
German	7	5	12
Danish West Indian	3	0	3
Danish	2	0	2
Swiss	2	6	8
Bohemian	2	2	4
Total non-English-speaking races	308	654	962
Grand Total	861	1171	2032

Machinery

TABLE 2. RECORD OF B. & S. EMPLOYES IN THE EVENING CLASSES

	Classes in English			
	First Term	Second Term	Average	Prizes
No. Enrolled	112	67	90	$461.38
No. Completing	69	39	54	$227.46

	Classes in Citizenship		
	First Term	Second Term	Average
No. Enrolled	24	10	17
No. Completing	13	2	8

Machinery

Following this meeting, a census of the factory was taken, through the foremen and clerks of departments, and an index made. Each card contained the name of an alien and stated whether or not he had been in the country and state a sufficient length of time to make application for first naturalization papers. If he had previously made an application a record was made of the date on which this had been done. A record was also made of those who had made application for second papers and were waiting for appearance in court, dates and other needed information being noted.

A notice was then sent to each man eligible for citizenship or for advancement in his steps toward citizenship, calling his attention to the fact, asking whether he desired to become an American citizen, and offering him help if desired. The majority replied "Yes," and for all such an appointment was made to meet a representative of the company during working hours, and be given assistance in making out his papers. The accompanying illustration shows a group of men of twelve different nationalities being helped in this work. About fifteen minutes time was required for each employe, and a special job number was issued to which this time was charged. The applicant was then directed to go to the Federal authorities, pay one dollar, and complete his application. Upon receipt of word from the Federal authorities that a man had done so, his card was filed in a "tickler" index dated two years later, showing the time at which he should make application for second papers. All cases pending, including those waiting for second papers, were filed in a similar manner and as the period was reached when they should take the next step, they were notified and the offer of help repeated.

Results Secured by the Method

Those declining citizenship were further interviewed by their foremen, and some induced to change their minds, but no pressure was brought to bear at the time if a man refused. The reason most often given by a workman for not becoming an American citizen was his intention of returning to his native country. There were also many who felt that while their native country was in the war, and America was not, it would indicate cowardice to renounce their allegiance to their mother country. Many of these took out their first papers as soon as the United States entered the war. One man refused to apply unless the company would pay the dollar fee.

In the first comprehensive campaign, the 1312 aliens then employed in a total force of about 6000 were all interviewed relative to citizenship, and all but 201 took steps toward citizenship for which they were eligible at the time. Many already had first papers and, the two-year waiting period having been passed, were eligible to become citizens at once.

Others having first papers were waiting for the expiration of the time limit so that they could apply for second papers. Over five hundred applied for first papers.

Classes in English and Citizenship

Following the first general canvass, language classes were started which were held during the noon hour, those in English being of two grades, the first for those who had little knowledge of the English language or were illiterate in any language, and the second for those who were more advanced. These were carried on under the Roberts system. Lessons were also prepared under such headings as "Getting a Job in the Foundry," "At Work in the Foundry," "At Work in the Paint Shop," etc., these being in the form of simple dialogues printed in English and in each language represented by a sufficient number of workmen. Evening classes in citizenship were being conducted in the city in which the plant is located and many employes took advantage of these. Literature was distributed to men preparing for citizenship, including the Constitution of the United States and leaflets telling of the requirements of citizenship, of our form of Government, and of some of the important historical events which should make a man proud to be a citizen of this country.

Statistics of Americanization Work

During the last four years about 2600 employes have been approached regarding citizenship. Of these, 2032 have made application and the company has a record of 861 having become full citizens. No doubt hundreds of others who made application through the cooperation of the company have completed their citizenship, but having left its employ there is no record available. Table 1 shows the number of men who applied for citizenship and the proportion of nationalities. It will be seen that more than half of those who applied were recruited from the English-speaking races, while a still greater proportion of those who have become full citizens are of those races. Of those still employed there are now 184 waiting for the time limit to complete their citizenship, and a recent report from the foremen shows 66 recent employes not as yet citizens who have not been reached but who will be in the near future. Adding to these a few of the old list who declined to become citizens because of being illiterate or too old to feel it worth while, gives a total of only 263 of the entire force not as yet full citizens, and most of these will become such within the next few months.

In the recent reduction of the force due to the depression of business, the policy was to lay off alien employes rather than American citizens, other things being equal, and in rehiring, this thought of giving preference to American citizens, whether native or by adoption, will be kept fully in mind, the employment department being especially watchful not to give preference to men who showed a disposition to be "slackers" and evade their evident duty when their native country or the land of their adoption was at war.

Aid of Public Schools in Americanization

During the winter of 1919-1920 a special effort was made in Providence to stimulate an interest among adult aliens in the study of English and in preparing for citizenship. Evening classes with competent teachers were provided in eight of the public schools, and classes in citizenship were also held at the public library. The industries of the city were asked to assist in arousing interest and securing attendance. The earlier efforts of the Brown & Sharpe Mfg. Co. to encourage attendance at noon-time classes had been but partially successful, it having been necessary to bring pressure to bear through foremen, and in various other ways to secure continued attendance. Therefore, in cooperating with the public schools, it was thought best to offer an inducement to a man to attend the English classes, even though it was believed that a desire to better himself by learning to speak and write English and by becoming an American citizen should be a sufficient inducement without holding out any further reward.

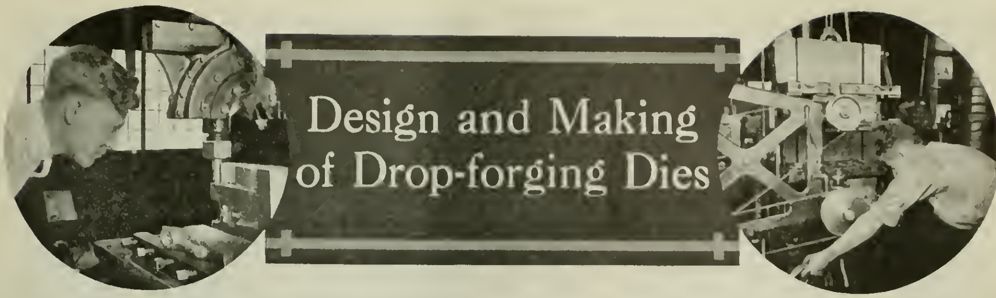
At that time a large proportion of the employes were members of thrift clubs and purchased thrift and war savings stamps in large quantities weekly. For this reason it was decided that the inducement offered should be prizes of thrift and war savings stamps. A thrift stamp was given for each session attended, provided a favorable report was received from the teacher as to faithfulness in attendance and in doing the required work at the school. This small inducement appealed to the men so strongly that the attendance jumped at once to a point much higher than had before been reached, and was so large as to cost the company during that winter nearly $700 in prizes. The gathering of these "coming Americans" to receive the prizes was an inspiring occasion. The meeting was addressed by the superintendent of schools and by officials of the company. To look into the faces of these men and see their interest, intelligence, and responsiveness, gave a feeling that they were assets to the nation, and that it is not always necessary to wait for the second generation in order to secure desirable citizens.

Of course, when the novelty of school attendance had worn off, excuses for absence and for dropping out gradually increased. Some of these are interesting, such as "going to see my girl," "sickness at home," and "too hard to learn." The record for the winter's attendance in English classes, distributed among eight of the city schools, is shown in Table 2. The attendance, it will be seen, fell off during the second term, but it is interesting to note that in each term about the same percentage (60 per cent of those starting) completed the course. In the citizenship classes no prizes were offered, and as a result, the enrollment was much less and the dropping off more noticeable. These statistics are also given in Table 2. It is no more than fair to state, however, that in the citizenship classes the small number in attendance at some of the schools led to abandoning the classes, so that those who would have willingly continued were forced to drop out. In both the English and citizenship classes some of the falling off was due to an increased amount of night work at the plant.

Summary

The loyalty of the force during the war, as shown by the large number of alien employes (133) who went into the service, largely in the United States Army and Navy, and the response of those remaining at the works to calls for financial help and other imperative demands of the war, can be traced, in part at least, to the influence of the previous Americanization work. Because of the situation created by the war, the activities here described to assist "coming Americans" would be fully warranted as an aid to America in the war, and its aftermath, yet this is but a small proportion of the benefits resulting—benefits belonging to times of peace—and a policy of undertaking such work can be recommended to all employers of alien labor.

Judging from past experience and the showing in other industrial plants, it is believed that an active citizenship campaign is needed to bring results, because but a small percentage of aliens will become citizens on their own initiative. Even those who go so far as to take out first papers often fail to take further steps—in fact, many were found whose first papers had become outlawed because of exceeding the seven years' period allowed, thus requiring these men to take out their first papers again and go through an added waiting period. While the war served as a special reason for carrying on an active campaign, the making of citizens permanently interested in and feeling that they are a part of our body politic is what will give lasting results. Such results can be obtained only by interest and enthusiasm on the part of the employer, coupled with systematic, sustained, detail work.



Design and Making of Drop-forging Dies

Methods Employed in Modern Drop-forging Plants—Second of Two Articles

IN the first article dealing with the design and making of drop-forging dies, published in August MACHINERY, all the factors entering into the design of drop-forging dies were discussed, including die materials; the proper grade of die steel, and the considerations entering into its selection; the importance of adequate draft, shrinkage, and machining allowances; the laying out of the die impressions; and the design and purpose of the fuller and the edger. In this article the actual making of the dies is discussed.

Sinking the Die Impression

Having selected the steel for the dies, according to the size and requirements of their service, and determined upon the location of the impression and the location and design of the fuller and edger, the next step is to follow out the machining operations in making these impressions. Two practices are followed in sinking the die impression, which may be broadly classified as all-mechanical and part-mechanical methods. In both of these methods, the machined surfaces must be finished by the usual hand work, although in the all-mechanical method the amount of hand work is greatly reduced. In general, the machines and methods used are those which can be most conveniently employed.

In Fig. 6 is shown a No. 6 Becker milling machine and the roughing mill employed in hogging out the fuller impression in a locomotive switch crank die. This die illustrates a case where, on account of the depth of edger *A*, the matching surface must be on the left-hand and the edger on the right-hand side, just opposite to the usual design. It has been stated that no matter how the die impression is produced, a certain amount of hand work, such as typing and riffling, is required and that the development of modern automatic machines has reduced the amount of hand work materially. For convenience in differentiating between the practices followed in sinking a drop-forging die impression, that method in which automatic machines of special design are employed has been termed "all-mechanical," although this expression is not literally correct, as considerable hand work is sometimes necessary on intricate designs, even when automatic machines are used.

Die-sinking Machines

One of these die-sinking machines is made by the Jackson Machine Tool Co., of Jackson, Mich., and is essentially a vertical milling machine provided with an additional head for cutting semi-cylindrical impressions, such as those by means of which a camshaft is drop-forged. The second head is commonly called a cherrying head, and carries a cherrying tool which is semicircular in shape and which has an oscillatory movement imparted to it through the mechanism of the head. On the completion of the cutting stroke of this oscillation of the tool, the tool is lifted from the cut and again lowered into the impression at the termination of the return stroke. Since the table of the machine is fed under the cherrying tool, it will be readily seen that a semi-cylindrical groove of varying length and radius can be readily machined. By employing tools of narrow width, it is possible to machine comparatively deep circular impressions to such a degree of accuracy that little, if any, typing is required. It is not probable, however, that the use of types for the more intricate cavities will ever be supplanted by this method.

An entirely different type of automatic die-sinking machine is manufactured by the Keller Mechanical Engraving Co., Brooklyn, N. Y. The principle employed in the design of machines of this company's manufacture is that incorporated in profiling machines. Instead of following an outline, however, a master pattern or model is employed which may be cast from an ordinary wood pattern or from a plaster-of-paris mold, or it may be built up from laminations corresponding to various sections of the forging and then machined. One of these machines is known as a duplicating type, and in this design the die produced is of the same size and shape as the pattern used. The work is

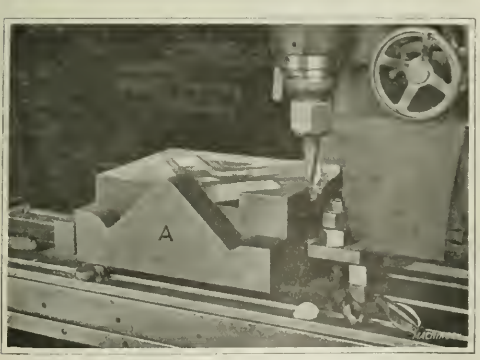


Fig. 6. Machining Impression in Locomotive Switch Crank Die

Fig. 7. Forging and Trimming Dies for Automobile Steering Arm

located directly in the machine without the necessity of laying out the impression, with the face of the die in a vertical plane. A rotating cutter carried on the lower part of a swinging frame is employed to remove the metal. The upper part of the swinging frame carries a tracer, which passes over the contour of the master model as the table on which the pattern is mounted traverses back and forth and feeds upward, thus guiding the outline machined by the revolving cutter. Means are provided for keeping the tracer point in contact with the contour of the master, and where particularly intricate dies are to be reproduced the chaser point is also revolved to facilitate following the rise and fall in the impression. The frame on which the revolving cutter and the tracer are carried is mounted on centers in such a way that it will swing freely outward and at the same time keep the tools in contact with the impression by the application of a suitably located counterweight.

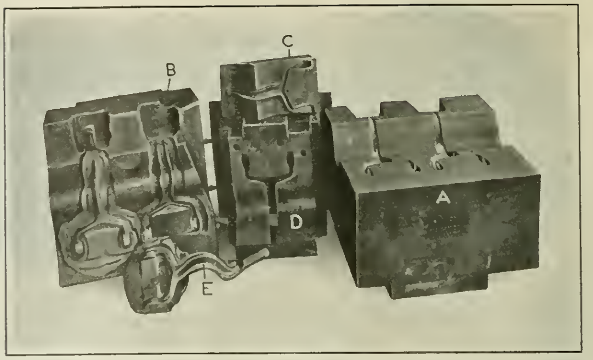


Fig. 9. Drop-forging Dies for Motor Truck Towing Hook

The reducing machine for die-sinking, which is also manufactured by the Keller Mechanical Engraving Co., employs the same method of establishing the contour of the impression, namely, a master model. With this machine, however, a different construction is employed owing to the fact that a larger pattern is used. It is stated that die impressions of an intricate nature can be more accurately reproduced when the master is larger than the die impression. Obviously this facilitates the manufacture of the master, and enables the delicately proportioned parts of the impression to be more accurately reproduced.

In this machine, two vertically revolving faceplates are employed, on one of which is attached the master, and on the other the die-block in which the impression is to be sunk. The tracer point (which may revolve or not as required) and the revolving cutting tool are adjustably mounted on a pivoted bar. This bar is so hung that it may swing freely in either a horizontal or vertical plane as the tracer passes over the master pattern. The relative distances of the two faceplates and the centers of the tracer and the tool from the end of the swinging rod on which these tools are carried establishes the amount of reduction. It will be obvious that in case the positions of the work and the master are reversed, an enlargement rather than a reduction will result, but for the manufacture of drop-forging dies such a setting of the machine would hardly be of advantage. In both of the machines which operate on the master model principle, the feed of the cutter and tracer is from the center of the pattern to the periphery, and suitable feed and speed changes are provided to correspond with the size of the work being machined. Machines of these types employ round-nosed cutters, ordinary end-mills, and in some cases cutters of special though simple design. Three cuts are often required, the end-mill being used to rough out most of the metal, and the intermediate and finishing cuts being taken with special milling cutters. The cherrying machine and the automatic profiling or duplicating machine are shown in the heading illustration.

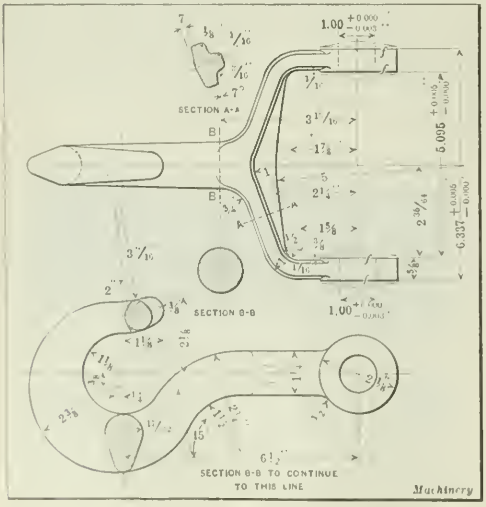


Fig. 8. Towing Hook, drop-forged in Dies shown in Fig. 9

Two-impression Dies

A second or finishing die is often required, as in the case illustrated in Fig. 7, because of an offset or bend in the forging. The automobile steering arm which is produced in the dies illustrated has a sharp offset, necessitating much more work in sinking the impression than would otherwise be required. Dies of this kind are known as locked dies, and in designing them there must be sufficient flat striking surface to absorb some of the shock produced by the hammer blows. This is a case where the all-mechanical method of die-sinking will result in a great saving of time and money. When the impression is to be laid out, it is apparent that a templet cannot be used owing to the offset. In such cases use may be made of a lead casting made from half of the first-impression die; this is bent to the proper offset, laid upon the face of the blocks which have previously been machined to the contour of the parting line of the forging, and circumscribed with a scratch awl.

Nearly every design of forging may be considered as a special case. It would therefore be impossible to attempt to cover all points in design except those that are most commonly encountered. Often the piece is of such shape and size that the first and finishing impressions can be made in one block, so that the forging will not require a second heating to complete it. In drop-forging eye-hooks in which the eye passes through the forging at right angles to the bend in the hook, this method can be employed. By producing a large lump of metal in the first-impression die, when the eye is subsequently to be forged, and then transferring it quickly from one impression to the other and turning it at right angles, the end through which the eye passes can be drop-forged while the part is still hot.

Another example where a two-impression die is employed to drop-forge a hook is shown in Fig. 9. These dies are used in the production of the motor truck towing hook shown in Fig. 8. The upper die is shown at *A* with the impressions partly completed, the lower member at *B*, and the trimming punch and die at *C* and *D*, respectively. The forging produced in the finishing die is shown lying in the impression, and the forging produced in the breakdown die at *E*. It will be noticed that a large amount of flash is produced in making the drop-forging, which must be trimmed off before

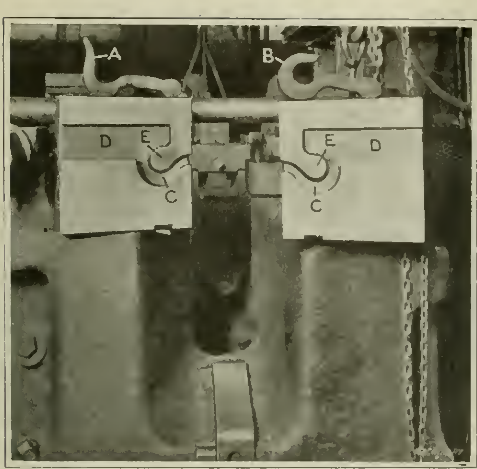


Fig. 10. Upsetter and Dies for bending Towing Hook

the end of the hook can be bent. This bending is a job for the upsetter or forging machine, and Fig. 10 shows the hook with the flash removed; the illustration shows the hook at *A* and *B*, before and after bending, respectively, resting on the upsetter dies by means of which the bend is produced. This is a view looking into the end of the machine. The end to be bent is held in the impressions *C*, with the tapered end in a vertical position, so that the bender which slides in channels *D*, may force the end of the hook around the center *E*. These dies are of comparatively simple design, and the method of making will not be gone into, as they cannot really be classified as drop-forging dies, although closely identified with the production of drop-forgings.

The method of making dies for drop-forging bronze, copper, and aluminum is not different from that already described. In finishing the impressions, however, much more care must be taken to produce a surface which will be free from all imperfections and tool marks. If this is not done, the forgings will be unsatisfactory and will cause difficulty in handling in the dies. Carbon steel die-blocks will be found suitable for this class of forgings.

Trimming Punches and Dies

In most cases the lead casting is employed in laying out the hot trimming dies, but for the cold trimming dies a forging is usually obtained and used as a guide in finishing the die opening. Two hot trimming dies are shown in Fig. 7, one for trimming the first-operation forging and one for the finishing operation. The die openings are cut in a plate which is attached to a bolster plate, designed so that as the punch descends, the hot forging may be pushed through and withdrawn from an opening under the die plate. In the case of trimming dies for cold work, the design is practically the same as that used for hot trimming dies, except that in hot-trimming the sprue is usually removed in a subsequent operation, while in cold work the entire scrap is removed at once. It will be evident that the openings at the front of the trimmers shown in Fig. 7 are for the passage of the sprues.

The steel for hot trimmers may be considerably lower in carbon than for cold trimmers. For cold-trimming, shear must be provided on the cutting edge of the die. For long, comparatively large work, and especially if the forging is of circular or of irregular section, this shear may be similar to a scallop. In such a case the shear should be located between the ends of the die opening. The punch should be formed on the face to conform with the shape of the forging, so that it will bear firmly on the ends and prevent the forging from being displaced when the press descends and forces it through the die. The punch and trimming die shown in Fig. 9 are good examples of tools of this kind. These are used for hot-trimming, the punch *C* carrying the form of the forging on its face, and being shaped to agree with the hook.

Shear for Trimming Dies

For flat work the cold trimmer should have shear provided from end to end of the die opening, but not enough to cause the forging to tip up at one end. The degree of inclination, or shear, commonly provided for cold trimmers is frequently expressed as a fraction of the thickness of the flash being trimmed; for example, one-half shear means that the inclination of the die face is equal to one-half the thickness of the metal to be trimmed. The shear may also be expressed as inclination of the face of the die in inches per foot, which is the more common method when referring to trimming dies. It does not matter whether the die has a straight shear or whether it has several cutting edges as in a scalloped shear, as regards the pressure required to trim the forging. The pressure, in pounds, required to force a forging through a trimming die provided with shear, when this amount is expressed as a fraction of the flash thickness, may be determined by the following formula:

$$W = \frac{ldf}{c}\left(t - \frac{dt}{2}\right)$$

When the shear is expressed in inches per foot of inclination, the following formula applies:

$$W = \frac{6dt^2f(2 - d)}{S}$$

in which W = pressure in pounds required to force forging through die opening;
l = length of cut (or distance around the die opening) in inches;
d = a constant varying from ¼ to ½—usually taken as 1/3 for cold steels;
f = ultimate strength of material, in pounds per square inch;
t = thickness of flash, in inches;
c = shear expressed as a fraction of the thickness of flash; and
S = shear expressed in inches per foot.

Shear expressed in terms of thickness of the material being cut is more commonly spoken of when referring to the shearing of plate stock.

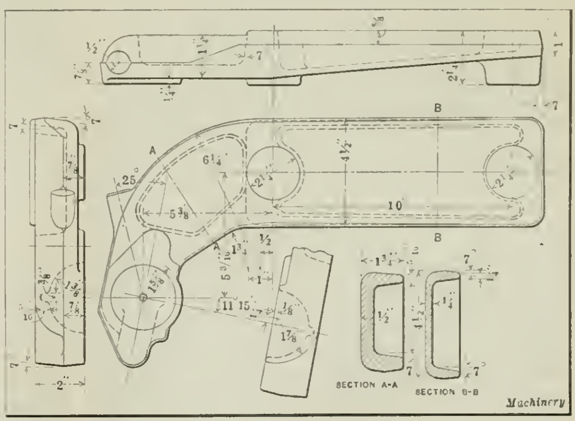


Fig. 11. Radius-rod Bracket for Motor Truck

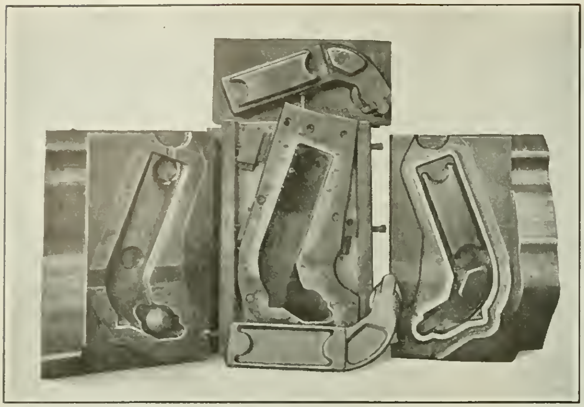


Fig. 12. Drop-forging Dies for Radius-rod Bracket shown in Fig. 11

Under favorable conditions from 10,000 to 12,000 drop-forgings may be cold-trimmed without regrinding the die, and this output is not dependent on the size of the work. Combination trimming punches and dies are sometimes used, if the quantity of work and its requirements should warrant the expense of such equipment. Liberal clearance should be provided for the die openings, in the under side of the die plate, to facilitate forcing the forging through the die opening.

The radius-rod bracket, Fig. 11, is forged from low-carbon steel in the dies shown in Fig. 12. The upper and lower dies are shown at the right and left, respectively, and the trimming die in the center with the punch resting on it. This hot trimmer removes the sprue as well as the flash, which may be done if the forging does not need to be restruck after trimming. This illustration shows how the die is located in the bolster plate and the adjusting screws by means of which it is aligned with the punch. The holes for the machine screws which fasten the die in place are enough larger than the heads of the screws to allow for adjustment. The face of the punch is shaped to seat evenly in the impressions of the forging. The forging is shown beneath the trimming die.

Much of the information contained in this article was obtained through the courtesy of the Union Switch & Signal Co., Swissvale, Pa., and J. H. Williams & Co., Brooklyn, N. Y. The next article in this series will appear in October MACHINERY, and will deal in detail with modern methods of heat-treating drop-forging dies.

* * *

LOW WAGES IN GERMANY

According to a recent item published in Commerce Reports, an investigation covering a total of 2,300,000 workers in the German metal-working industries shows that, figured in marks, 63 per cent of the workers get eight times the wages they received in 1914, 36 per cent from five to eight times, and the remainder less than five times the wages in 1914. When we compare this with the fact that, still using the mark as a basis of comparison, the cost of living in Germany has increased fifteen times since 1914, it will be readily seen that the actual wages of workers in the German metal-working industries are only from one-third to one-half the amount received in 1914. This is one of the reasons why German industry is able to under-sell other nations in the world's markets. Taking even the highest paid group of workers mentioned in this report, and comparing wages on a dollar basis, we find that they are less than one-half of what they were in 1914, and for the lowest paid workers in the same field they are not much more than one-fourth.

SENSITIVE MEASURING APPARATUS

By J. B. MORAN

The Bureau of Standards is now experimenting with an electrical measuring device which is sensitive to one two-hundred millionths of an inch. While this approaches closely its limit of measurement, it may be adjusted to make much more practical measurements. It represents the greatest advance in mechanical measurement that has ever been made. Credit for the origination of this method is due Professor Whidington of London, England.

Before describing the details of this new development, an example of its unusual sensitivity will be given. Referring to Fig. 1 two ½-inch steel rods *A* and *B* are solidly mounted on a steel base *C*. Attached to one of the rods is a small lever *D*, which may be adjusted vertically. A sliding pan *E* is arranged on this lever. It has been found possible to measure the outward bending of this rod when the infinitesimal weight of one milligram is placed in the weighing pan and the latter is adjusted 5 inches from the rod. At this point of adjustment it is computed that the rod bends outward at its uppermost end one two-hundred millionths of an inch.

The detection of this slight movement has been made possible through the use of the little vacuum tube used in radio work. A non-technical explanation of the functioning of the electrical circuits used should interest mechanical men even though they have no knowledge of radio work. In radio circuits, what are known as high frequency currents are dealt with. These are alternating currents that oscillate to and fro thousands or even millions of times per second. Fundamentally, they are the same as the alternating currents of low cycle used in electric lighting work. The radio currents, however, oscillate at a much higher rate.

Let us imagine that we have an oscillating radio current with a period of 100,000 cycles per second; that is, the current alternates 100,000 times per second. This rapid oscillatory current is generated by the little audion bulb or vacuum tube previously mentioned. Before going further it should be mentioned that such high frequency circuits are very sensitive to changes in capacity and inductance. By capacity, we mean electrostatic capacity which is represented by the condensers in the circuit. By inductance, we might say, roughly, the amount of wire in the circuit.

At the side of the circuit oscillating at a frequency of 100,000 cycles per second, let us set up another circuit exactly the same as the first one except that it oscillates with a frequency of 101,000 cycles. It must be understood that the human ear will not respond to frequencies beyond 10,000. For this reason the currents in both these circuits will be inaudible. When these circuits are placed in proximity to

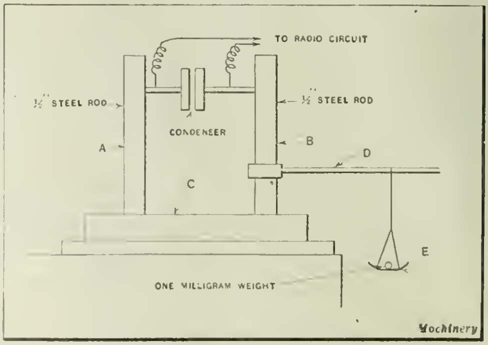


Fig. 1. Equipment used to show Sensitiveness of Measuring Apparatus

each other, however, the oscillating current in one will be superimposed on the other through the property of inductance. This brings about a very interesting result. There is set up in the second circuit what is called a "beat note," and this beat note will have a frequency that will amount to the difference between the frequency of the two oscillating circuits. In this case, the beat note will have an audible frequency of 1000 per second, which is the difference between the 100,000 cycle current in the first circuit and the 101,000 cycle current in the second circuit.

The slight change in the capacity of one of these circuits will change the frequency of the oscillatory current and therefore alter the beat note, which is the difference between the two frequencies. So sensitive are these circuits to changes in capacity that the slightest change imaginable will produce an audible effect in the telephone receivers of the second circuit. The actual measuring instrument used in this electrical device consists of two metal plates which represent the two contacting plates of an electrical condenser. Every change in the distance between these plates will change the capacity of one of the oscillating circuits and thereby produce a difference in the beat note.

Theoretically, a movement of one five-hundred millionths inch is measurable with the device, although one two-hundred millionths inch is the smallest measurement that has yet been made. The actual measurement is made by calculating or measuring the frequency of the beat note. The frequency of the beat note can be measured directly on a frequency meter and the reading of this instrument can be translated to linear measurement. With the proper constants and data available, the measurement of the movement of the plates of the condenser is possible. Of course, one two-hundred millionths inch is a measurement beyond the realm of practice, and this figure is mentioned only to impress the reader with the unusually high sensitivity of the apparatus. The natural expansion and contraction of all substances due to changes in temperature fluctuate so widely that such measurement would not be practical. For instance, with this device the expansion of a piece of steel due to the heat from a human body can be measured.

This measuring instrument is so sensitive that it will measure the deflection of a table top due to the weight of a fifty-cent piece. Fortunately the sensitivity of this electric circuit is adjustable within wide limits, and it may be brought down to a point where it will make practical measurements with absolute accuracy that are beyond the measurements attainable with any known means. If the difference in frequencies in the two oscillating circuits is made greater, the sensitivity of the device is altered accordingly, and comparatively large measurements may be made.

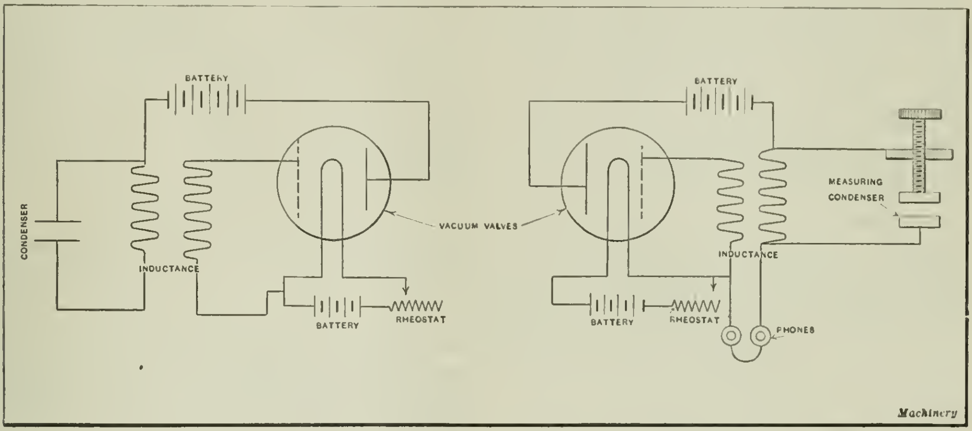


Fig. 2. Wiring Diagram of Electrical Measuring Apparatus

WROUGHT TUNGSTEN

In a review of the results of research work done to produce tungsten lamp filaments of great strength, prepared by Dr. Irving Langmuir of the General Electric Co., and published by the Engineering Foundation, 29 W. 39th St., New York City, many interesting facts relating to this remarkable metal are brought out. Until 1904, tungsten had been known for a century and a quarter only in its unrefined state. Its value as a hardening alloy for steel had been recognized and appreciated; but it was not until 1905 that the metal, mixed with paste and squirted through dies, had given the incandescent lamp its most efficient filament, although the brittleness of this filament caused great embarrassment to electric lamp makers and users alike.

For many years Dr. W. D. Coolidge, of the Research Laboratory of the General Electric Co., had sought a process for making tungsten ductile. The feat was regarded as almost impossible by metallurgists. To make any ordinary metal soft, it is heated to a temperature above its annealing point and then cooled to room temperature. This process, however, left tungsten as brittle as ever. It was eventually found that the only way to make the metal ductile was to mash the grains out into fibrosity and thus make it ductile while cold. This was accomplished by first heating the tungsten to a temperature below its annealing point and then mechanically working it with infinite care at a variety of degrees of heat, each less than the one preceding it, until it was at room temperature. A similar treatment would, if applied to ordinary metals, destroy their ductility.

A process was worked out which, if followed without the slightest deviation, stretched the grains out and the metal was made ductile; but if the working varied from this process, failure resulted. The tungsten would break at a stroke, when cold. Thus, after years of patient labor a triumph of far-reaching consequence in the field of research was attained. The filament produced had a startling tensile strength—about 600,000 pounds per square inch for wire 0.001 inch in diameter. It was so pliable that it could be wound into any form safely.

The tungsten filament has doubled the efficiency of incandescent lamps and provides a white light of far purer quality than any lamp heretofore known. It has provided new targets for X-ray tubes, phonograph needles fifty times as efficient as any that preceded them, better ignition contacts for automobiles, and many other new articles and improvements of old ones. Trained facilities for scientific study and experiment, a spirit of indomitable perseverance, and the facilities afforded by a completely equipped laboratory made this achievement possible.

Common Causes of Errors in Machine Design

Instructions and Standards—Convenient Form for Data—Attitude Toward Errors
Concluding Installment of a Series of Articles

By R. H. McMINN

THE present installment of this series of articles, which began in the January number of MACHINERY, concludes the discussion of the underlying causes of errors in machine design. In the eight articles presented, all the common causes of errors have been classified, and methods have been suggested for preventing the occurrence of each kind of error. The points dealt with in the present article include lack of concentration, reasoning from slight knowledge, systematic methods of applying knowledge, and attitude of employer and employe toward errors.

Systematic Methods of Applying Knowledge and Experience

The lack of a systematic method of applying one's full knowledge and experience is productive of many errors. A designer may have had wide experience, but he must use an orderly system to bring his knowledge to bear in producing the most accurate results in any particular design. Constant reference to a suggestive list of important factors which he has learned may partially determine design is safer than relying on memory to always consider these factors.

A draftsman should therefore tabulate for his systematic use the considerations which enter into the design of machines in general, and as he becomes acquainted with the design of any particular machine, he should tabulate any considerations applying especially to its design. This should be done right after he completes the design or checking of any machine and is most familiar with it. If after completing the making or checking of a drawing, he discovers an error by chance he should try to determine why it was not found by his regular routine system for preventing errors, and should try to incorporate in his system a method for discovery of that kind of mistake in the future without failure. In addition to using a definite system as a guide, he must always bear in mind that unless a machine or a single part to be designed is carried by the mind through all the surroundings with which the machine or part must come in contact, from raw material to operation, conditions affecting design may be overlooked.

Utilizing Experience of Entire Organization

The responsibility in eliminating errors in an engineering department does not rest entirely upon the individual. It should be the aim to have every bit of experience possessed by an organization go into all the methods of manufacture and into all the products, and this cannot be done without a thorough system. One phase of such a system should be in trying to prevent drafting-room errors. This cannot be done solely by constant admonitions to employes to be careful. The system should not be based upon an opinion concerning the accuracy that men of average ability ought to be able to maintain, but upon the discovery that all men are inclined to make errors. Many mistakes can be avoided by recognition of the mind's frailties and the erection of every possible safeguard against error. It should therefore not only be the endeavor to make drawings which are fool-proof for the shop and a machine which is fool-proof for the customer, but to adopt a drafting-room system which, as far as can be governed by methods and general practice, is fool-proof for draftsmen.

Instructions and Company's Standards

Important instructions given by the head of an engineering department to subordinates should be in writing. This not only gives less chance for forgetting or misinterpreting, but incites a tendency to more care in giving instructions as well as avoiding argument as to what they were. Giving full reasons for certain instructions not only may make them more readily understood, but may serve as a guide to a subordinate for future practice. It is often impossible for one receiving instructions to carry them out with the same degree of intelligence that might be used by the one who gave them, unless he knows the result to be accomplished.

A set of instructions consisting of company standard parts and practices, given to men at the beginning of their employment, greatly increases their initial efficiency and accuracy in drawing. Unless there also are written instructions pertaining to determining factors in the design of each type of machine manufactured by a concern, it is impossible for the whole experience of that company to go into each modification of the machine for particular cases, except when the smallest details come under the direct supervision of one man. This man must not only know all necessary facts relating to the design, manufacture, shipping, and erecting of the machine, but he must have a memory so faultless that he will see that no necessary consideration is overlooked in any machine being built. It is evident, in order to insure that he overlooks nothing, that he, at least, requires written data even though it be not for general distribution in the engineering department. If such information be made inaccessible to most of the draftsmen so it cannot so easily get into the hands of competitors, there is a question as to whether this will not prevent most of the men from attaining their maximum usefulness to a concern and thereby offset any possible benefits of secrecy. In as far as possible, it is well to have all useful information relating to one kind of machine grouped together where it will be examined by following a regular routine. If such a collection of data does not contain all the necessary information relating to a particular machine, it should refer to what the missing data is and where it can be found.

Advantage of Having Data in Convenient Form

Draftsmen will not always go to the lengths necessary to eliminate all doubts regarding a certain point. They realize that they are not expected to spend too much time on any one phase of work. Consequently the head of an engineering department should bear in mind that the easier it is to obtain information, the more likelihood there is of its being used. Therefore, data concerning stock material, kinds of machines in the shop, with maximum size of work that can be handled, limitations in foundry work, and maximum sizes and weights of parts that can be taken into all plant buildings and on all elevators and floors should be easily available. When a change is made in a plant standard or in the design of any standard machine all draftsmen affected should be informed. Likewise all other departments, such as estimating, sales, manufacturing, or any others interested should be notified. All old blueprints or other data affected should be corrected or withdrawn from the departments holding them. A single change may require an alteration in such a large number and so many different kinds of records that it is well to have a standard reference sheet listing all the records which may be affected, so that none will be overlooked.

Standard drawings and bills of material must be kept up to date or prominently marked out of date. In order that draftsmen may know definitely the reliability of any drawing which they may wish to use for reference, a list, kept constantly corrected, should give the serial numbers of drawings which can safely be referred to in designing any new machine. A report should be filed in the engineering department regarding the results of operation of each new type of machine built, as well as any special difficulties experienced during manufacture, assembly, shipment, or erection, to show how far a design may be taken as a precedent for future similar machines.

Adoption of Standard Practice

The engineering department should try to eliminate errors by perfecting the routine. Settled standards are a part of a concern's assets. Unsettled features are liabilities. As many things as possible should be settled once and forever —that is, things which could apparently be done in a number of ways with equal success. In order to dimension all parts in the best manner from the standpoint of clarity, and ease of laying out and measuring, every shop should adopt standard methods of giving dimensions on drawings of all representative parts with which it deals, such as gears, shafts, plates, bearings, etc., with instructions that the standard methods shall be followed as closely as practicable. Uniformity of practice should be followed to as great an extent as possible even in small things. Uniformity in the use of words, names, and abbreviations saves time and promotes accuracy. Small, apparently insignificant errors, such as mis-spelled words, should be weeded out to prevent their perpetuation. Changing the pattern number of a part already used promotes error. Changing a symbol number of a part having a certain size should be avoided: thus a certain size crane hook that has been known as No. 25 should not be changed to No. 26, as this invites confusion. Forms for use in the drafting-room should not have spaces too small. This necessitates the crowding of letters, making difficult reading, and promotes error.

Stress of business should not be allowed to interfere with an established routine any more than is absolutely necessary. When drawings are sent to the shop for the work to be started before all related drawings are completed, or when a drawing is sent out without checking, the probabilities are that something will require changing. Interruption of men by change to a new job before completion of another should be avoided if possible, as this disturbs continuity of thought. The amount of work required of men should be considered in its relation to accuracy, as an unreasonable demand will induce a tendency to take chances regarding doubtful points. Absolute harmony in the engineering department and throughout an organization should be sought, as an inharmonious atmosphere is disturbing to the closest attention to one's work.

Attitude of Employe Toward his Errors

When a drafting-room error is not detected until after a machine or part is manufactured, the men who made and checked the drawing are inclined to look for every possible circumstance that may help to exonerate them. But inwardly, at least, they should accept the full weight of responsibility. Each man should try to discover the fundamental law which was violated, so he may observe the law in future related cases, correct the mental habit which made the error possible, or improve his routine system to avoid similar errors.

Attitude of Employer Toward an Error

When an error involving a financial loss occurs, it is not wise for an employer to censure an employe severely who has a good past record of performance, on the assumption that the mistake was due to carelessness. A man may exert care to the limit of his mental capacity and experience, and yet may fail to detect an error in his work. In order to think properly along engineering lines men require equanimity. Severe censure, for a certain error probably lessens the liability of a man's failing to detect that particular kind of error in the near future, but opens the way for a multiplicity of errors along other lines, because of the mental disturbance that has been created in his mind. Unduly emphasizing the occurrence of an error not only destroys the enthusiasm of the individual who made it but that of his associates as well, and lowers the productiveness of all. The loss due to an error should be charged to an account called "Experience." In each case the employer should try to discover if the drafting-room system or data could be improved, and thereby lessen the liability for the recurrence of errors of that class.

* * *

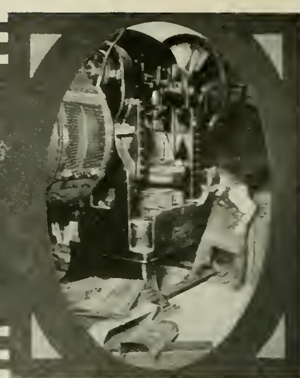
BUSINESS SECURED THROUGH GOVERNMENT DEPARTMENT AID

In a letter sent out by the Bureau of Foreign and Domestic Commerce, attention is called to the fact that the foreign representatives of the Department of State and the Department of Commerce who are engaged in trade-promotion work hear of the results of that work in only a few of the cases handled. Possibly only a small proportion yields results that can be measured in dollars and cents; and it may also be that some of the firms concerned do not wish to divulge the amount of orders received through the information given by consuls, commercial attachés, or trade commissioners. In order to encourage the men in the field to continue to increase their efforts, the Bureau of Foreign and Domestic Commerce asks any firm that benefits in any way from the services of the government representatives abroad to acknowledge this assistance either by writing to the Bureau of Foreign and Domestic Commerce, Washington, D. C., or to the official through whose effort some business may have been obtained. Any information contained in such acknowledgments will be considered strictly confidential.

* * *

According to a recent Commerce Report, a contract has been signed between the Bolivian Government and an American company for the financing and construction of a railway from La Quiaca on the Argentine border, to Atocha, Bolivia, a distance of 126 miles. This is the final connecting link needed to give La Paz, Bolivia, an all-rail route to Buenos Aires, Argentina.

Safety Devices for Power Presses



Guards and Safety Measures Provided for the Power Press Equipment in the Cleveland Metal Products Co.'s Plant, Cleveland, Ohio—Second of Two Articles

IN the first installment of this article, published in August MACHINERY, various types of gate guards were shown. In the present installment, additional types of guards, including the sweeping type gate guard, sliding guards, stationary guards, and guards for shears, will be illustrated and described.

Gate Guards of the Sweeping Type

A positive acting sweeping guard, attached to a Bliss No. 3½ toggle press, is illustrated in Fig. 9,,and its method of attaching to the machine, in Fig. 8. The machine is air-operated. The guard is operated by a stud which engages a cam-slot at the upper end, raising and lowering the guard as actuated by the toggle of the press. In Fig. 9 the guard is shown in its closed position, from which it will be apparent that when the ram of the press ascends the gate will swing to the left and expose the dies to view. This type of guard is of simple construction, and has proved very satisfactory in use. Referring to Fig. 8, there is a leather bumper attached to the guard at *A*, and if the operator's hand is in a precarious position prior to the closing of the dies, the guard will sweep the hand out of the danger zone. The construction of this device is so simple that further description is unnecessary.

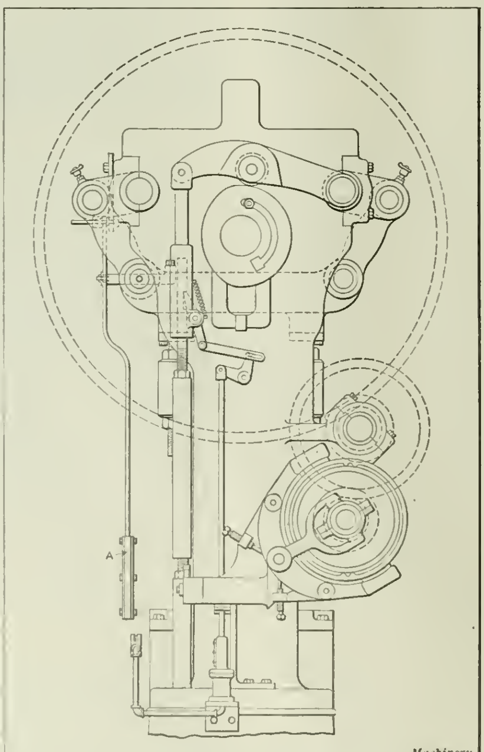


Fig. 8. Method of attaching Gate Guard of Sweeping Type to Toggle Press

Stationary Guards for Blanking and Piercing Work

The guard shown attached to the inclinable press in Fig. 10 consists of a framework and reinforced glass. This type is especially suitable for blanking or piercing operations; it permits the work to be observed without obstruction, and at the same time makes it impossible for the operator's hands to extend into the danger zone. The side arms by means of which this guard is attached to the machine are adjustable so that the guard may also be used on machines having a greater stroke.

Another type of glass stationary guard is illustrated in Fig. 12. It will be noted that this guard may be adjusted vertically as required, and that it gives a very clear view of the punch and die. This particular die is provided with an automatic stop so that the stock may be easily fed to the machine by the operator. Fig. 13 shows another type of stationary guard suitable for blanking operations. This guard is attached to the die in such a manner as to just enable the stock to enter, and the space is sufficiently small to exclude the operator's fingers. A guard of this type may be slightly modified in design so that it will entirely enclose the die. This guard is attached to the machine in a different manner from that shown in Fig. 12, but its construction is so simple that it may be applied in a variety of ways to suit the machine and the work.

Sliding Guard

A guard that is operated by a somewhat different arrangement from that used in other movable guards described in this article is illustrated in Fig. 14. This is a Bliss No. 76½ single-geared press. The guard operates on a track from which it hangs, and is advanced into its closed position, as shown in the illustration, before the ram of the press descends. With the gate open, the operator presses the foot-treadle down, which causes rods *F* and *E* to close the gate by means of lever *G* and to pull roller *D* from engagement with clutch drum *J*. Before roller *D* has been pulled down sufficiently to remove

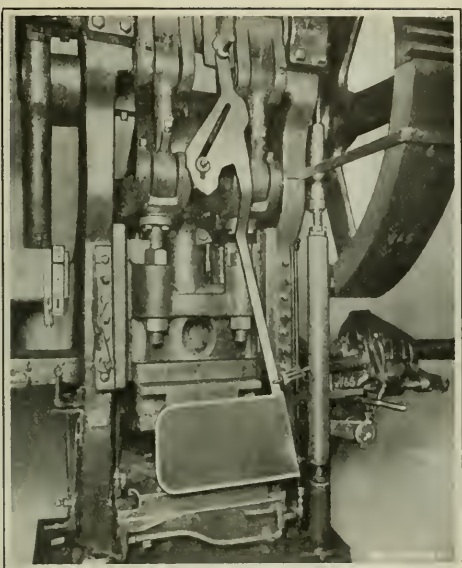


Fig. 9. Application of Sweeping Type of Gate Guard to Toggle Press

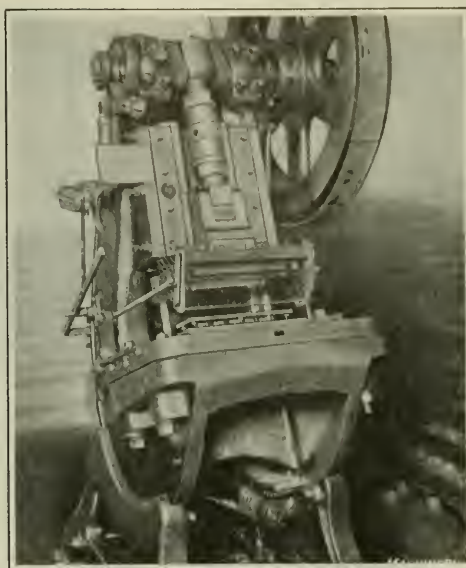


Fig. 10. Inclinable Press with Stationary Reinforced Glass Guard

it from contact with dog *H*, the lever *B* swings forward and locks itself under weight *C*. This constitutes a lock for the gate, the locking movement occurring just before roller *D* is pulled entirely away from contact with dog *H*. The clutch will not engage until roller *D* has been completely disengaged from dog *H*, at which time the press will trip. The gate is held in the closed position

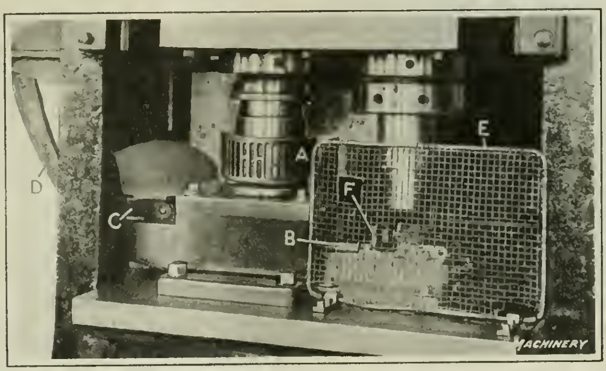


Fig. 11. Guard for a Double-action Press employed for Blanking, Drawing and Redrawing Operations

until the ram is about to be raised, at which time cam *A* operates lever *B*, permitting the weight to drop; this brings roller *D* into contact with the clutch drum *J*, and the clutch is disengaged as soon as dog *H* contacts with the roller. In the meantime, the raising of roller *D* has lifted the foot-treadle and returned the gate to the open position. It will be readily seen that the arrangement of

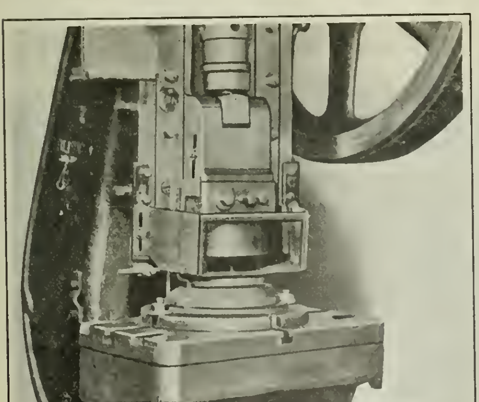


Fig. 12. Stationary Glass Front Guard which may be adjusted for Various Heights

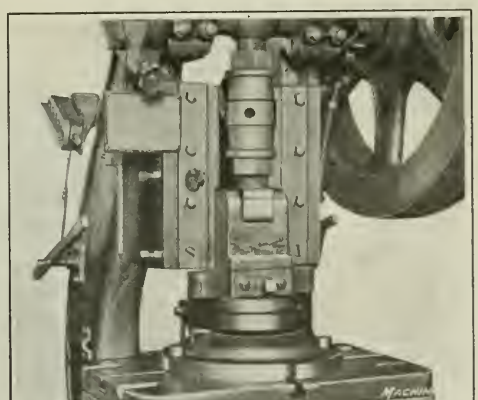


Fig. 13. A Type of Guard Suitable for Blanking and Piercing Operations

the levers that control the sliding of the gate is such as to make it improbable that the operator would slide the guard manually to expose the dies, for in so doing he would need to exert enough pull to lift the foot-treadle which is practically impossible to do, on account of the connection to the clutch mechanism.

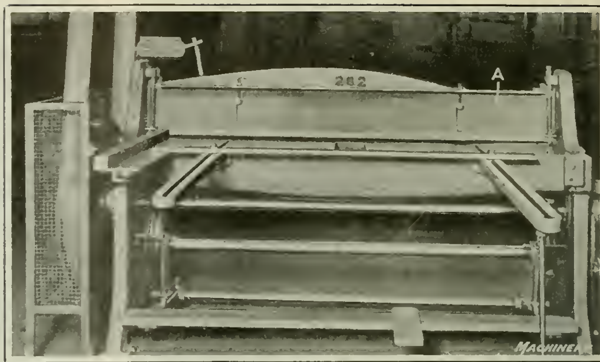


Fig. 15. Front View of a Square Shear with Guard attached to Arch Bracket

Stationary Guards for Double-draw Press

A Bliss No. 353 double-draw press, properly guarded, is illustrated in Fig. 11. The blanking and first drawing operation is performed by the punch and die shown at the left-hand side of the machine. The punch is protected by a stationary sheet iron guard *A*, which practically encloses the entire distance between the punch and the die, leaving only a 3/8-inch opening for feeding the stock under the guard. The partially drawn blank is pushed down into an opening in the die-block, where it is picked up by a pusher *F* on the end of reciprocating ram *B*, which may barely be seen through the hinged guard *E*. This pusher *F* is connected to link *C*, so that it may be

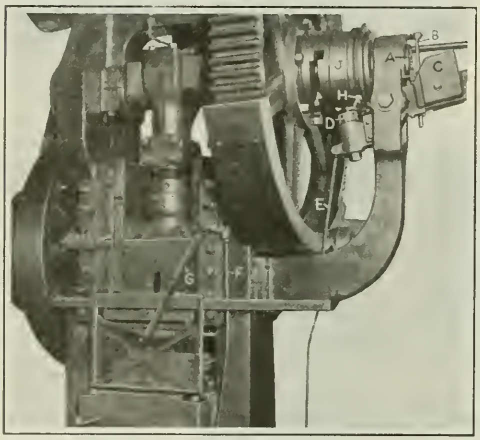


Fig. 14. Sliding Gate Guard, actuated from the Press Clutch

operated by lever *D* with each throw of the crank. It is rarely necessary to swing the guard *E* down, because the drawn shells do not need to be handled, for they are pushed through the die and deposited in a receptacle at the rear of the press. This guard may be readily swung forward however, as it is provided with spring hinges which hold it in an upright position against the frame of the machine. A combination of two guards such as this is very effective, and may be applied to blanking and redrawing dies of numerous types.

Guard for Shear

In the operation of the square shear shown in Figs. 15 and 16, provision has been made for guarding the shear blade so that the work may be cut rapidly without the possibility of the operator's fingers being injured. Only a 3/4-inch opening is allowed for stock between the bed of the machine and the guard when the arch bracket is raised. This prevents the operator's fingers from getting under the shear blade. Fig. 15 shows a front view of this machine, to the arch bracket of which a guard *A* made of channel iron, with elongated slots in it, is hung by means of bolts passing through the slots. This construction is very simple. As the shear descends the lower flange of the channel iron rests on the work and precludes all possibility of the fingers coming into contact with the blade. This arrangement does not curtail the output, but rather is an aid in increasing the speed at which the shear may be operated. At the rear of the machine, Fig. 16, a chute *B* may be seen attached to the head of the shear so that the stock may be fed rapidly under the blade and against a stop at the front without danger to the operator.

All power presses, shears, etc., in this press department are equipped with individual or group motor drive, to suit the machine lay-out, which is another feature adding to the general safety of the machine operators.

* * *

At the annual meeting of the German Machine Builders' Association (not the German Machine Tool Builders' Association, which is another organization), it was stated in the annual report that 700,000 men are now employed in the machine building industry in Germany, and that the association has 944 individual firm members with 40 additional branch works, representing over 550,000 employes. Since October, 1920, the monthly average has been 20,000 export orders distributed between the members of the association. The industry exported, in 1920, machinery valued at 6,000,000,000 marks (about $75,000,000 present exchange). There has been a decrease in the export business during the present year, and poor business conditions have been met with all around. The main subjects of discussion at the convention related to methods for holding Germany's export markets in machinery, and for producing more economically.

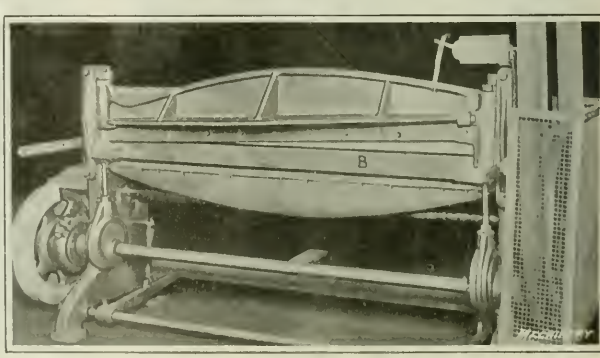
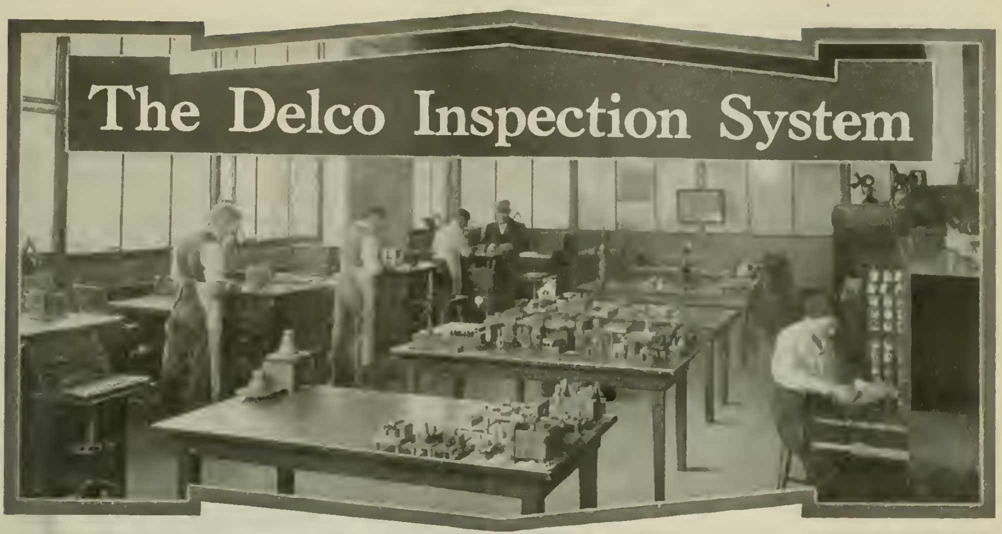


Fig. 16. Rear View of Shear illustrated in Fig. 15, showing Chute provided to facilitate feeding the Stock

The Delco Inspection System



Typical Examples of Gaging Fixtures Used by the Dayton Engineering Laboratories Co. in the Manufacture and Inspection of the Company's Product—Second of Two Articles

By ERIK OBERG

IN the first article on typical examples of gaging fixtures, published in August MACHINERY, concentricity gages, gages for motor generator frames and distributors, and recess gages were dealt with. In the present article a number of additional fixtures and gages will be described, including a spring testing fixture, a gage for testing installation conditions of motor generators, amplifying gages, device for testing the spacing of ignition cams, plate gages for the automatic screw machine department, gear-testing devices, limit gages for rollers, etc.

Spring Testing Fixture

The spring testing fixture illustrated in Figs. 14 and 15 is used for testing the automatic advance spring on the distributor of a Delco ignition system. It tests the loads at two given compressions of the spring. For example, the spring is compressed to a height of 1 inch, at which it should register a certain load. It is then compressed to, say, 3/4 inch, at which it should register another definite load. The base of the device is a weighing scale, and the loads are registered on the dial of this scale. Referring to Fig. 15, *C* is a rack by means of which pressure is applied to the spring by rotating the handwheel. At the upper end of the rack there is a pointer *F*, which indicates on a graduated scale on rod *A* as the spring is compressed. The lower end of the rod rests on the platform of the scale so that it is free to move up and down with it.

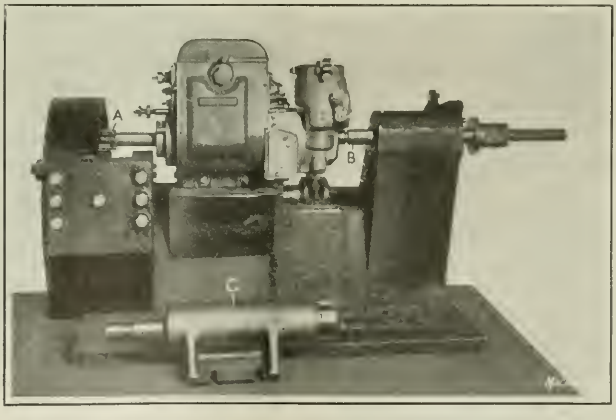


Fig. 13. Running-in Gage for testing Installation Conditions of a Motor Generator

In making use of the device, pointer *E* is first set to the correct graduated scale reading for the compression required. Rack *C* with pointer *F* is then moved down by means of the handwheel until the spring has been compressed beneath face *D* to the proper length. Then the weighing scale is read for the applied load. Rack *C* is then moved downward to compress the spring further, until pointer *F* coincides with pointer *G*, which has been set to the correct scale measurement, and the reading on the weighing scale indicator is again noted. It will be evident that pointers *G* and *E* can be independently adjusted to agree with any desired compressed lengths.

Testing Tension Springs

The auxiliary testing unit shown resting on the platform of the scale in Fig. 14 is used for testing tension springs by the aid of the device just described. The fixture, which is more clearly shown at *B* in Fig. 15, is set on the platform of the weighing scale so that surface *D* bears upon surface *H* of the auxiliary device. The spring to be tested is fastened to two projecting studs *I* and *K*, *I* being attached to part *H*, and *K* to the base of the auxiliary device. Stud *I* is then actuated by rack *C*, and the pull on the spring is transmitted through stud *K* to the platform of the weighing scale. It is evident that the application of the device is otherwise the same as that described for testing compression springs.

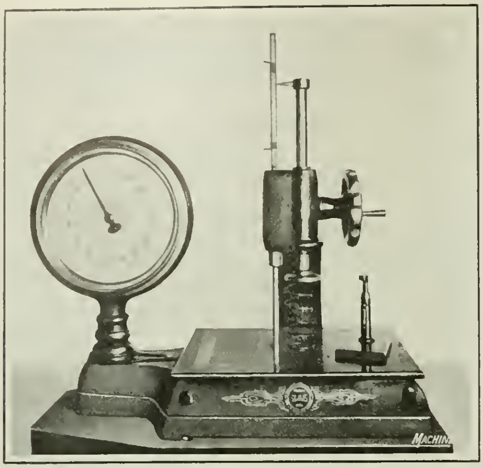


Fig. 14. Spring Testing Fixture

Gage for Testing Installation Conditions of a Motor Generator

The gaging fixture shown in Fig. 13 is employed for checking the relation of the center line of the armature of a motor generator to the center line of the crankshaft, and for detecting backlash between the armature pinion *A* and the

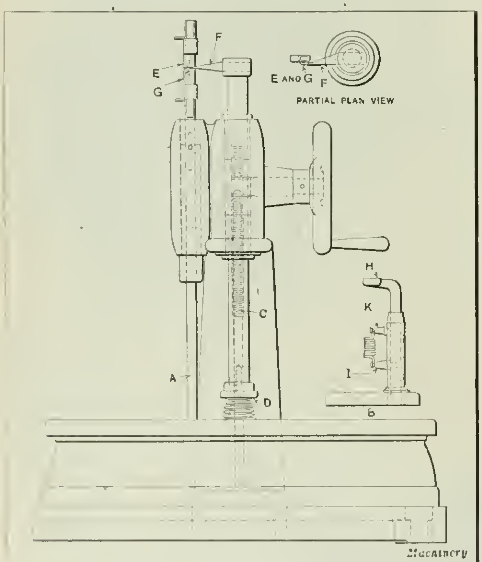


Fig. 15. Assembled View of the Spring Testing Fixture and Auxiliary Gaging Device for Coil Tension Springs

starting clutch gear. Also, when the motor generator is located properly in the gaging device, it is checked for gear noise, by running the motor generator as a motor from a storage battery. For testing the gaging conditions of the fixture, the master gage *C* is used, being mounted on the fixture with its shaft in the same relative position as that occupied by the armature pinion shaft. After the device has been located in this manner, it is replaced by the motor generator to be inspected. This fixture enables the actual installation conditions to be checked. The aligning gage *B* checks the center line of the coupling in the generator clutch with the center line of the pump shaft coupling.

Amplifying Gages

Figs. 16, 17, and 18 are views of three "American" amplifying gages—made by the American Gauge Co., Dayton, Ohio; these are used for the gaging and inspecting of different classes of work in the Delco plant, including practically all cylindrical work inspected in the grinding department. Fig. 16 illustrates the method of gaging cylindrical surfaces. An anvil is provided on which the work rests while it is rolled under the gaging point. A set-block gage is employed for first setting the dial of the amplifying gage to zero. This means of inspection provides a simple method of determining whether the work is within the required limits.

Fig. 17 shows the same type of gage applied to work held on centers for gaging the concentricity of the work in relation to the centers, and Fig. 18 is a similar type of gage employed for testing lobes of cams. One cam lobe after the other is passed under the gaging point, and the limits of accuracy are thereby quickly inspected.

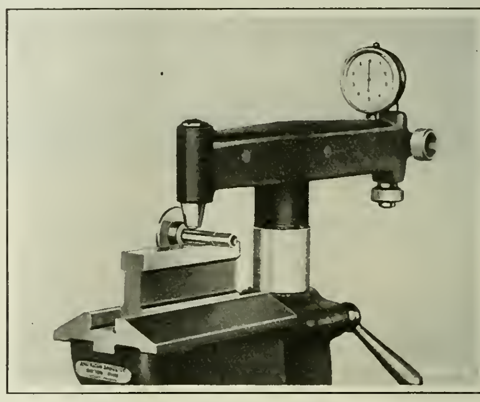


Fig. 16. Amplifying Gage for Small Cylindrical Work

Testing Spacing of Ignition Cams

Figs. 19 and 22 show an interesting device for testing the spacing of lobes or "breaking points" of cams for ignition distributors. The cam is secured on a central stud which

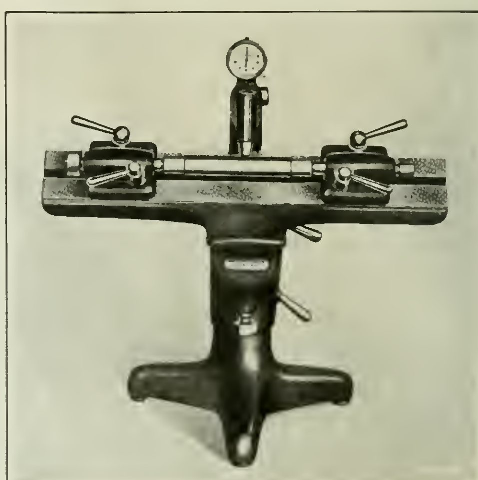


Fig. 17. Amplifying Gage used for inspecting Work held between Centers

is firmly fastened to the fixture. The dial *A*, which may be freely revolved, is mounted on a sleeve having a good running fit on the central stud. The dial is graduated around its outer edge in degrees. The fixture is provided with breaker arm *B* so that when the graduated dial is revolved, each lobe of the cam will cause the breaker arm to break contact and open an electric circuit, thereby extinguishing an indicating light. The cam is so set that the indicator points at zero with the breaker arm at the high point on one of the lobes and with the light out. As the dial is revolved about the cam, which is held tightly on the central stud by friction, if the lobes of the cam are accurately spaced, this is indicated by the fact that the light will go out at 45-, 60-, or 90-degree spaces, according to whether there are four, six, or eight lobes on the cam.

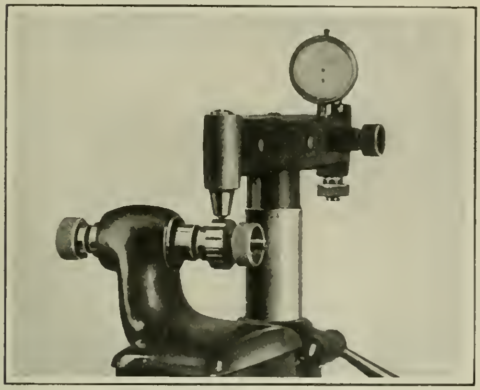


Fig. 18. Testing Lobes of Small Cams on Amplifying Gage

Plate Gages for Automatic Screw Machine Department

The examples shown in all the previous illustrations have been of inspection gages for the final inspection of assembled mechanisms and parts. A number of gages are used in the manufacturing departments both as working gages and as inspection gages that have a great deal of interest. One of these gages, shown in Figs. 20 and 21, is a plate gage for testing a shell after it has been finished in the automatics.

Fig. 19. Fixture for testing the Spacing of Lobes on Ignition Distributor Timing Cams

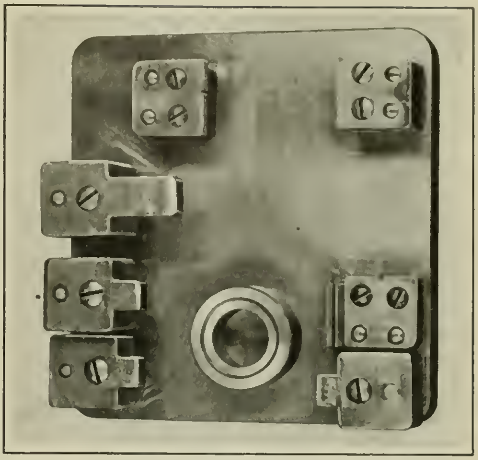


Fig. 20. Plate Gage for Inspecting a Clutch Shell

The fixture consists of a plate with a number of gage-blocks screwed to it, which constitute limit gages for different dimensions on the work. The center hole *G* of ring *A*,

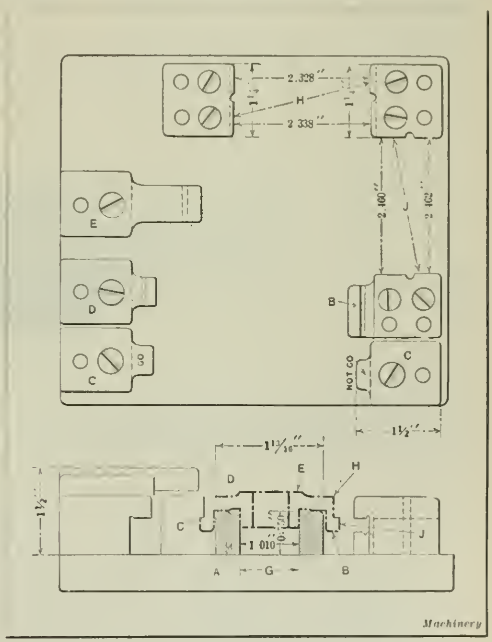


Fig. 21. Details of the Gage shown in Fig. 20

Fig. 21, is the "Go" size for the hub of the piece. The part, shown in dot-and-dash outline, is mounted on the gage-ring *A*, and is then slid under or between the various gages, as indicated by the corresponding letters in the elevation and plan view. The shoulder *C* in the elevation, for example, is gaged by the "Go" and "Not Go" gages *C* in the plan view; the shoulder *D* in the elevation by the limit gage *D* in the plan view; the face *E* by the limit gage *E*; the diameter *H* by the limit gage *H*; the diameter *J* by the limit gage *J*; and the surface *B* by the limit gage *B*. After the parts to be gaged have thus been moved around the gage plate and gaged on the various dimensions, plug gages are used to gage the center hole, thus completing the cycle of inspection operations. No further checking is necessary until other operations are performed on the piece. This group arrangement of inspection operations eliminates considerable inspection labor, and thus saves time.

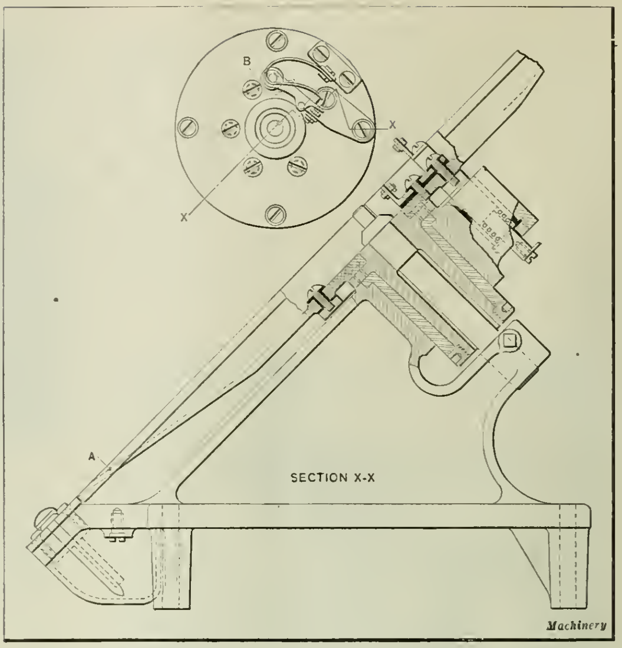


Fig. 22. Sectional View of Lobe Spacing Inspection Gage shown in Fig. 19

Gear Testing Devices and Clutch Roller Gage

Fig. 24 shows two simple gear testing fixtures intended simply for determining the free running qualities of gears. The fixture at the left is for spur gears, and the one at the right for spirals. The tooth thickness of the gear to be tested has previously been inspected, and the test for running qualities merely shows that the gears will assemble in the mechanism for which they are intended, without binding; that is, the center distance between the two studs on which the gear to be tested and the master gear are mounted during the test are placed at the minimum limit of the center distance in the frame into which the gears are finally assembled. The master gear used in the test, with which the gear to be tested runs, is made to the maximum limit of tooth thickness and outside diameter. In testing a gear in this way, there is absolute assurance of the free running of the tested gear.

The spiral gear testing fixture at the right tests the running qualities of spiral gears on the same principle as the spur gear fixture operates. The master gears both for the spur and spiral gear testing fixture are made soft, and are duplicates of the gears with which the gears being tested are to run, except that they are made to the maximum limits as already mentioned. To make sure that they represent in every way the actual working gears, they are cut on gear-cutting machines the same as the mating gears that will be assembled in the mechanism. These testing fixtures are used both for gears and for pinions, by simply changing the position of the masters.

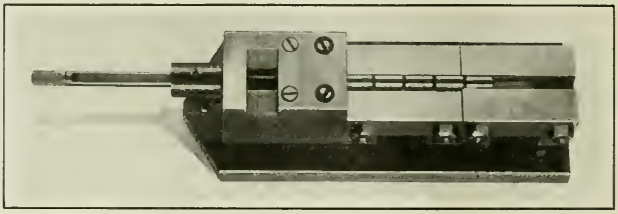


Fig. 23. Gage built up of Plates, which checks the Length and Diameter of Clutch Rolls

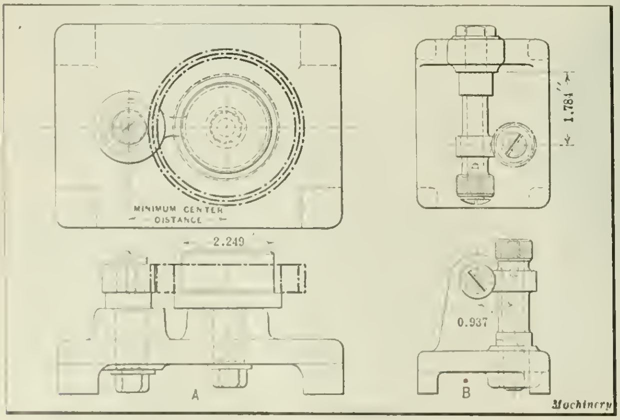


Fig. 24. Gear Testing Devices

A gage for checking lengths and diameters of rollers for clutches is shown in Fig. 23 and in the upper part of Fig. 25. This gage could be equally well applied to the testing of rollers for roller bearings or various other purposes. The roller is put into the gage in the receptacle shown at the left end in Fig. 23, and is then pushed through a hole and into a groove formed by gaging plates assembled on the baseplate. Block *A*, Fig. 25, permits the gaging of two different lengths of rollers, the block being removed or left in place, according to the size to be gaged.

The object of the gage is to prevent the passing of rollers that are too long, in which case they are unable to enter the gage at the receiving end. If the rollers are somewhat shorter than the opening in the gage, no harm is done; hence the gage checks only the maximum limit in regard to length. The roller, having dropped into the receptacle at the end, is pushed along by the plunger shown. If it is too small in diameter, it will drop through the opening at *C*, Fig. 25, which is set to the minimum limit. If it does not drop through here, it will pass along between the plates until it reaches section *D*, where it will drop through if it is within the maximum diameter limits. If it is too large in diameter, it will not drop through here, but will then be passed over the gage and ejected at the end. When worn, the gage parts at *C* and *D* can be readily removed, relapped, and replaced.

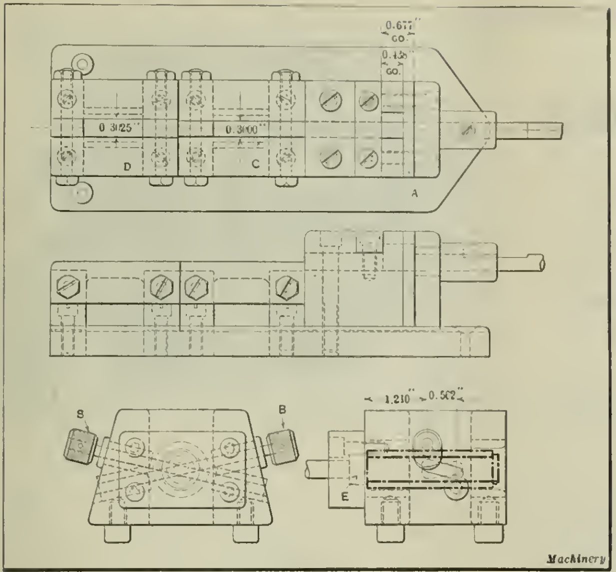


Fig. 25. (Above) Detail View of the Roll Gage shown in Fig. 23. (Below) Gage used for testing the Spiral Slots in a Sleeve

Testing Spiral Grooves in a Sleeve

An unusual type of testing fixture is shown in Fig. 26 and in the lower part of Fig. 25. These gages are used for gaging the location of two spiral grooves in a sleeve, the sleeve being shown in the upper part of Fig. 26. In this sleeve there is one spiral groove on each side that must have a definite relation to the groove on the other side. The relation of these grooves to the center hole of the shaft as well as to the outside diameter and ends of the shaft is also checked by this gage. To test this part it is passed through a hole in the gage, as more clearly shown in Fig. 25, where the sleeve is indicated by dot-and-dash outline, and pushed against a stop *E* at one end, which also acts as an ejector after the gaging. With the part in place, the two plungers *B* are pushed in. These must be able to pass clear through the spiral slots in the piece. The fixture shown in Fig. 26 is used for gaging spiral grooves and for additional gaging of the work. With this fixture the testing of the milled grooves at the other end of the piece is accomplished by means of plungers *C*. Plunger *D* is a "Go" and "Not Go" gage, which tests the length of the part.

* * *

THE RIGHT ATTITUDE TOWARD THE JOB

By WILLIAM C. BETZ

During the present business depression any man having a job should realize that it is to his advantage to do all in his power to produce work economically, because costs must be cut in order to bring back business. He must understand that wages will have to come down with other things. A man is injuring his own chances by nursing a grouch, lying down on his job, or criticizing the management because of the necessity of reducing hours of work, or wages, or both.

A great many workmen today apparently believe that manufacturers are holding up orders with a view to bringing down wages. To believe such statements is the height of folly, for surely no manufacturer would tie up his equipment while paying taxes, insurance, interest, and many other expenses which must be paid whether the plant is in operation or not. Any thinking man will find it impossible to believe that the firm should go on losing dollars in that way in order to gain cents.

The firm with which the writer is connected is doing everything in its power to obtain business to keep its steady and capable employes busy, and any man who has the least idea about business should be able to understand that no firm would refuse an order in these times. It is a case of the survival of the fittest, both as regards firms and individuals, in the machinery business for years to come, and the man that goes to work with a determination to produce better and cheaper than he has ever done before is the man who is going to be kept on the payroll as long as the firm can keep that payroll going.

It may be of interest to state a comparison of prices of goods manufactured in this country and in Europe. A firm in Milwaukee is making a certain device which it cannot sell, according to its own statement, for less than $120, and yet the best possible equipment is being used in its manufacture. A German firm, after paying transportation and tariff on an identical machine, sells it in the United States for $22.50. This should bring home to the American workman the necessity for cutting costs to the core.

It has often come to my notice that the men who are the most fault-finding about working conditions and wages and who deliberately lie down on the job, are the men who feel that a great injustice has been done to them when they are laid off on account of lack of work.

* * *

The oldest iron manufacturing plant in Austria, employing furnaces using wood charcoal, has been in operation for over six hundred years, according to a Commerce Report. This plant, which is located at Vordenberg, was forced to shut down three years ago by being supplanted by the larger furnaces at Donawitz which employ coke as fuel. As a result of the present difficulty of securing coke, however, work has been resumed at the Vordenberg plant where five carloads of pig iron per day are being produced at about the same cost of production as at the Donawitz plant.

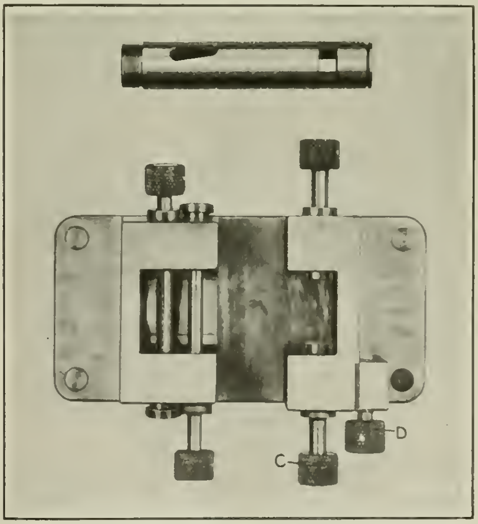
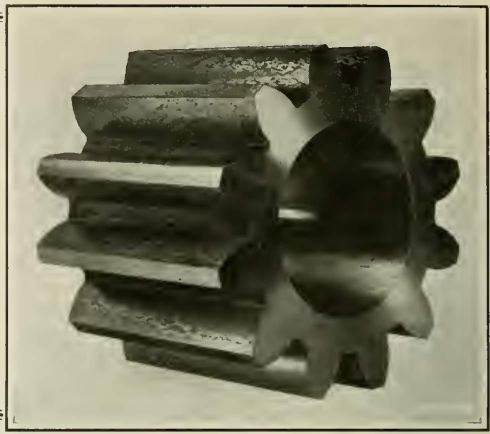


Fig. 26. Sleeve with Spiral Slots, and Gaging Fixture by Means of which it is Inspected

Principles of Maag Gearing

An Analysis of the Maag System of Gearing, Advantages that are Claimed for this Type of Gears, and Machines for their Production



THE main objective in choosing a curve for the profile of gear teeth is the fulfillment of the requirement that two toothed wheels, when meshed together, shall have the same relative angular velocities as two given disks would have if their edges touched and no slipping took place. Theoretically, a variety of forms can be given to the teeth of one gear from which complementary teeth can be determined for the other so that the required ratio is obtained. The curve obtained by rolling a circle of infinite radius on one of finite radius is known as the involute. Its advantages for tooth form are well known; not the least is the fact that the center distance between two meshed gears with involute teeth can be varied, so long as the involutes are in contact, without disturbing the constant relative angular velocity of the gears. The only requirement for maintaining this constant relation between gears is that at any moment the common normal to the contacting faces must, if produced, pass through the pitch point or point of contact between the imaginary disks.

Difficulties Encountered with 14½-degree Pressure Angle

With involute teeth, provided the center distance is maintained, these normal lines are always coincident, and the usual practice has been to so form the involute that this normal is inclined at 75½ degrees to the common center line of the gears, the pressure angle thus being 14½ degrees. The normal is tangent to two base circles concentric with the imaginary disks, the base circles being of the same proportionate diameters as the disks and of such size that the tangent touching each is at an angle of 75½ degrees with the center line of the gears. Other angles besides 75½ degrees have also been used as standards.

The strict adherence to a common normal or pressure angle of 14½ degrees brings with it endless difficulties in gears with few teeth, and all sorts of "corrections" have been suggested to overcome them. Since the base circles to which the common normal is tangent must be in a strict relation to the velocity ratio desired, it follows that, if normal proportions of addenda and dedenda are followed and one gear has very few teeth while the other has a large number, the base circle of the smaller gear will be very near to the pitch circle, while the base circle of the larger gear will be relatively further from its pitch circle. Since the involute curve cannot exist within the base circles, it follows that only a very short portion of the teeth of the small gear below the pitch circle will be of involute form. Another difficulty crops up since the crests on the tooth addenda of the larger gear sweep out more or less of the bottom of the teeth on the smaller gear, under-cutting them so that not only are the teeth weakened, but in gears with few teeth, part of the involute, short as it is, is also

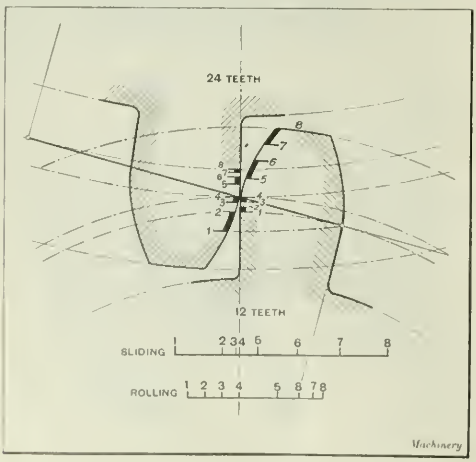


Fig. 1. Diagram showing Amount of Sliding and Rolling Contact on Gear Teeth having a Standard 14½-degree Pressure Angle

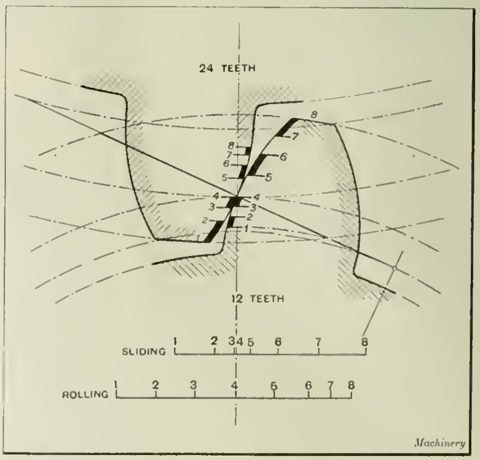


Fig. 2. Sliding and Rolling Contact on Teeth of Gears of Same Ratio as in Fig. 1, but with a Pressure Angle of 22 Degrees 55 Minutes

removed and, therefore, this important part near the pitch circle is of no purpose. For these reasons, pinions with a smaller number of teeth than twelve have not been recommended.

Effect of the Pressure Angle on the Shape of the Teeth

In Fig. 1 are shown teeth of a 12-tooth pinion and a 24-tooth gear in mesh; the common normal passes through the pitch point and is tangent to both base circles. The pressure angle is drawn at 14½ degrees. It will be noticed that in each case a large proportion of the tooth flanks is below the base circles, and therefore cannot be involute. This is especially the case with the pinion tooth. Fig. 2 shows teeth of gears having the same ratio but with the pressure angle and tooth proportions chosen to give a better shaped pair of teeth. In this case the pressure angle is 22 degrees 55 minutes. It will be noticed that a reduction in the diameter of the base circles improves the tooth shape, and it is interesting to compare the usefulness of these profiles with those in Fig. 1.

By dividing into three equal parts the profile of the pinion between the pitch and base circles (Fig. 1), and striking from the center of the pinion circular arcs from these divisions to the normal line, the position during rotation at which these several points will contact with the other tooth face may be determined. From the points located on the normal line, draw arcs about the gear center to the tooth flank of the gear. In this way the corresponding points of contact are obtained. Thus, points 1, 2, 3, and 4 on the pinion tooth contact at points 1, 2, 3, and 4, respectively, on the gear tooth. It will be seen that about one-half of the addendum of the gear tooth is useless. By dividing the addendum profile of the pinion tooth into four equal parts and proceeding as before, contact points 5, 6, 7, and 8 on the pinion tooth, and 5, 6, 7, and 8 on the gear tooth may be obtained. By proceeding similarly with the teeth shown in Fig. 2 the better utilization of the tooth faces in this illustration will at once be apparent.

Comparison of Sliding and Rolling Contact

Again, by comparing the distance between points 1 and 2, 2 and 3, etc., on each tooth, the sliding and rolling between the faces can be followed. For example, in Fig. 1 the distance between the points 1 and 2 on the pinion tooth is very short, while on the gear tooth it is comparatively long. The difference in length between these points on the two teeth is a measure of the sliding which will occur during action between these portions of the tooth profiles. The shorter distance represents the distance of the rolling contact. These measures so obtained are shown enlarged on the scale below the diagram; the same procedure has been followed in Fig. 2. The advantage of choosing a pressure angle and pitch circle position relative to the teeth, to suit the gears, is at once apparent. By maintaining a standard 14½-degree pressure angle and keeping to standard tooth proportions as in Fig. 1, about two-thirds of the tooth flank is useless, and the wear on the part that is used is increased proportionately. The sliding contact is reduced in Fig. 2 by about 11 per cent, and the rolling contact increased by about 75 per cent, while the thickness of the teeth at the root is as about 1.3 to 1 as compared with that in Fig. 1.

It has sometimes been the practice to improve pinions with a small number of teeth by keeping the pressure angle at 14½ degrees, and increasing the addendum and correspondingly decreasing the addendum of the gear, the dedenda being modified accordingly. With large gears and small pinions the results are not unsatisfactory, but such a compromise is of decreasing value as the number of teeth of the gears becomes less than about 40, since the improvement of the pinion is made at the expense of the gear teeth.

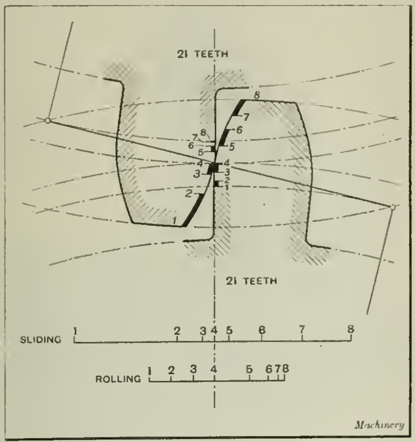


Fig. 3. Comparison of Sliding and Rolling Contact on Two Gears having 21 Teeth and 14½-degree Pressure Angle

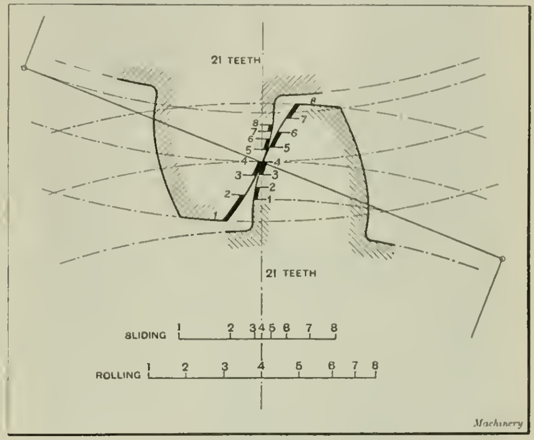


Fig. 4. Profiles of Teeth of Two Gears of the Same Ratio as those in Fig. 3, but with a Pressure Angle of 21 Degrees 44 Minutes

Another interesting gear ratio is 21 to 21; Figs. 3 and 4 show the teeth for gears of this ratio and pressure angles of 14½ degrees and 21 degrees 44 minutes, respectively. By following the same procedure as in Figs. 1 and 2, the comparison has again been made between sliding and rolling contact. The useless radial portions of the tooth flanks are again evident, and a comparison of the distances between points 1 to 2 on each is striking. The improvement following the adoption of a pressure angle and tooth proportions better suited to the gear ratio is evident as regards tooth shape, active profile, and proportion of rolling to sliding contact. As a further illustration, Fig. 5 shows the teeth for gears having a 5 to 50 ratio and a pressure angle and tooth proportions chosen to obtain the most satisfactory pair possible. While these teeth are kinematically correct, of ample strength, and have good wearing qualities, they represent an extreme case and are not to be recommended except where necessary to meet some unusual condition.

Principles of the Maag Gear System

One of the main arguments advanced in the early days of the involute gear was that a pressure angle of 14½ degrees meant a considerable increase in the force tending to separate the bearings of mating gears, and no doubt this fear was at the root of the failure to take full advantage of the properties of the involute for gear teeth. In the system

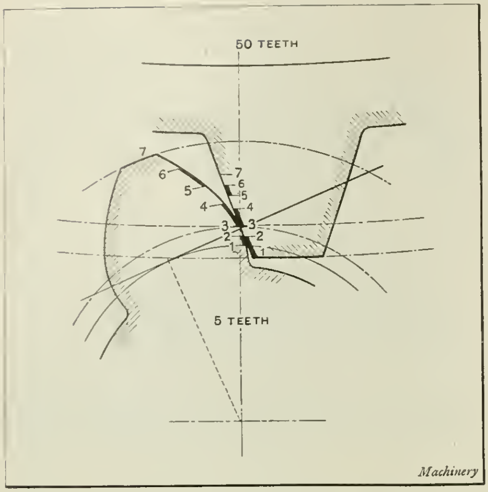


Fig. 5. Teeth of Gears of a 50 to 5 Ratio, with Pressure Angle and Proportions chosen to obtain the Most Satisfactory Combination

developed by Max Maag, Zurich, Switzerland, all standards for pitches, relations between addenda and dedenda and pressure angles are subsidiary, that is to say, each ratio is treated on its merits, and any pitches are therefore possible. Although the smallest number of teeth calls for pressure angles of 25 degrees if satisfactory teeth are to be obtained, this only means an increase of 6.6 per cent in the tooth pressure, while in less extreme cases where a pressure angle of, say, 20 degrees meets the requirements, the increase in the tooth pressure is only 2.7 per cent.

The increases in tooth pressure are, of course, inversely proportional to the cosines of the pressure angles. As far as the bearing load is concerned, it is claimed that although, for a pressure angle of 20 degrees, the pressure component in line with the two centers is increased 32 per cent, the increase being proportional to the sine of the angle, this involves no extra pressure on the bearings, since the same resultant pressure has to be sustained in any case. Any pair of components giving this resultant pressure will have the same effect, the only difference being one of direction. The increased tooth pressure amounting to 6.6 per cent for a 25-degree pressure angle is, therefore, the only increase of load on the bearings, while the advantage of really efficient gears having a small number of teeth may be considered to outweigh fully any disadvantage on this score. The independence of the center distance between gears having involute teeth overcomes the seeming complexity of a large number of arbitrary pressure angles. Neither need there be any clinging to well-defined pitches, and a designer can fix his center distances and pitches strictly as called for by any conditions that arise in the designing stage.

Using Standard 14½-degree Rack Cutters

If a pair of gears of a definite ratio is required and the best pressure angle and tooth addenda and dedenda have been decided upon, ignoring any standard proportions to get an efficient tooth, it is possible, within well-defined limits, by taking advantage of the properties of the involute, to cut these gears with a standard 14½-degree rack cutter. It is clear that one imaginary circle on the gear blank will be equal in circumference to the number of teeth cut multiplied by the pitch of the cutter. This imaginary circle will be the normal pitch circle for that particular rack, and no matter what depth the teeth are cut into the blank, this pitch circle will remain the same.

If this gear is mated with another produced by the same cutter, they will work correctly together at a pressure angle of 14½ degrees, if the center distance equals the sum of the halves of the pitch circle diameters. The pressure angle will vary, but the velocity ratio will be correct and uniform with any other center distance at which the teeth will mesh. This may have the effect of producing backlash if the teeth have been cut to the standard depth, but if the degree to which the gears are to be separated is known, the cutter can be fed to a lesser depth in one or both gears just sufficiently to prevent backlash, and the gears will have different pitch circles and a new pressure angle.

Working backward, the position relative to the teeth at which the pitch point is to occur can thus be determined, and also the outside diameters and the radii of the base circles. The position along the profile where the 14½-degree rack tooth flank will be tangent can be calculated, this point giving the radius of the normal pitch circle for cutting with the 14½-degree rack cutter. In this or any other rack system of gear cutting, it is possible, in general practice, to use only a stepped series of pitches. The teeth of the gears must be such that the involutes cut the pitch circle for a pressure angle of 14½ degrees, at points, the distances between which correspond to a circumferential pitch equal to the linear pitch of the rack cutter available.

There can be no doubt that the involute without corrections or under-cut of any kind is the right line of development for gears. Under the Maag system, in the case of pinions having small numbers of teeth, the so-called pressure angle and the fixed position of the pitch circle relative to the teeth, are abandoned. However, a 15-degree pressure angle is maintained for gears with a large number of teeth, the angle being increased and the blank diameters varied as required to obtain the most satisfactory teeth that can be obtained for gears with a smaller number of teeth.

The Maag Gear Generating Machine

A Maag gear generating machine for cutting gears up to 40 inches in diameter is illustrated in Fig. 7. A rack type tool cuts on the down stroke, being backed by a spring-tempered plate, which enables the tool to be used even when thin from repeated grindings. The faces of the rack-cutting teeth are ground concave to give a small amount of top rake to the cutting edges. The tool-holder is pivoted horizontally

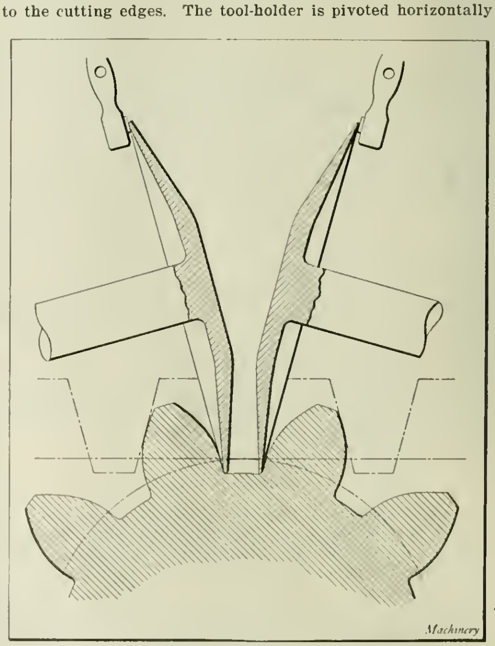


Fig. 6. Operating Principle of the Maag Gear-grinding Machine

in the ram, the tool being depressed positively at the end of each downward stroke, to provide clearance on the upward stroke. The blank remains stationary during the cutting stroke, and the indexing movement takes place during the return stroke. The cutter-head can be swiveled to cut helical gears, the setting being determined by means of a vernier scale which indicates readings to within 1 minute. The ram is driven by a slotted link giving a quick return. The stroke can be adjusted by a handwheel from the rear, and this can be done while the machine is running. The ram is counterbalanced, and the connecting-rod driving the ram is in two parts which are connected by a cast-iron sleeve that acts as a safety device, breaking if overloading occurs. The drive is controlled by a cam clutch which is connected with a brake, so that the movement of the tool can be controlled and stopped at any position.

In the generating movement given to the gear blank, the rotary motion is obtained through a worm, and the transverse motion through a feed-screw. The blank is set at the required position relative to the cutter, which always cuts at the full tooth depth, the generating cut being preceded by gashing. The setting is read on a scale and vernier. Fig. 8 shows a rear view of the machine. Several sizes of the machine are made, including those for the large gears used in turbo-reductions. In this country the Niles-Bement-Pond Co. is building a machine for cutting spur, helical, or herringbone gears up to 40 inches in diameter.

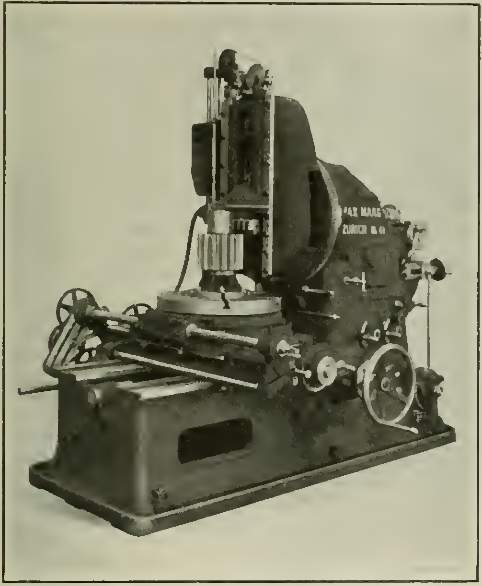


Fig. 7. Maag Gear Generating Machine provided with a Rack Cutter that cuts on the Down Stroke

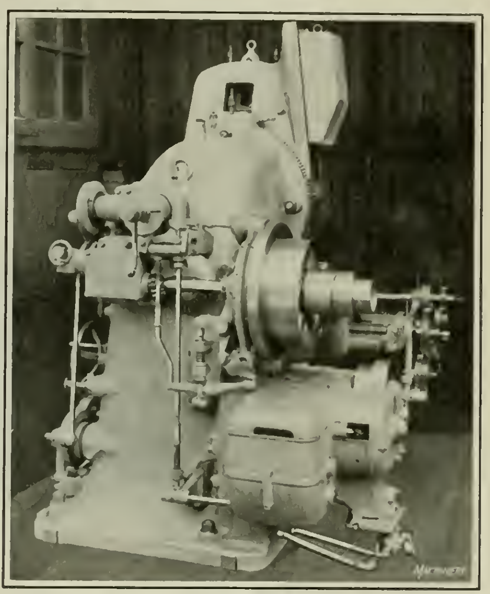


Fig. 8. Rear View of the Maag Gear Generating Machine illustrated in Fig. 7

Operating Principle of Maag Gear Grinding Machine

The distortion which occurs in hardening has a decided effect upon the efficient working of gears. It is useless to pay considerable attention to the cutting of accurate tooth profiles concentrically arranged around a center if the tooth conditions are upset in the subsequent hardening. The distortion produced in hardening Maag gears is corrected by grinding on a specially developed machine, the principle of which is shown diagrammatically in Fig. 6.

The problem in developing this machine was to secure a movement of grinding wheel faces in true planes parallel to the gear axis, the planes to include the profile of the rack tooth flank. The flat face of a grinding wheel has disadvantages, since the plane surface is quickly destroyed. This difficulty was overcome by the use of saucer-shaped wheels of which only the edges lie in the plane referred to. Generation is effected by feeding the gear tooth space under a pair of such wheels, the gear at the same time being rolled alternately in each direction an amount sufficient to generate to the full extent the involute required for the teeth profiles. The wheel edges are generally set 15 degrees from the vertical. When the teeth are small, both wheels cannot occupy the same tooth space, and so in such cases one wheel operates on the corresponding flank in the next space or the next space but one.

As the wheel wears, which is likely to take place quickly owing to the small area in contact, especially if soft wheels are used, the planes come nearer together and the teeth would become thicker as the work proceeded, if a remarkably effective compensating device were not provided. Near the upper edge of each wheel is a pivoted arm carrying a flat ground diamond. Every six seconds or so the diamonds are allowed to advance to the edges of the rotating grinding wheels. If the edge is still in the predetermined plane, the diamond touches the wheel and the lever is held up at this point. However, if the wheel has worn slightly, the diamond must advance further to touch the edge, and in so doing an electrical contact is made, and the wheels are fed outward 0.001 millimeter (four hundred-thousandths inch). It is claimed that the wheel edges are kept to the required plane within this degree of accuracy.

Construction of Maag Gear Grinding Machine

Fig. 9 shows a Maag grinding machine for gears up to 16 inches in diameter. The grinding wheel spindles are seen at *A*, each being driven by an independent motor which, through a light belt and worm-gearing, drives continuously a camshaft that rotates and permits the advance of the diamond as explained. A quick adjustment is provided for use when setting new grinding wheels. The continued adjustment of the grinding planes enables quick-cutting soft wheels to be employed. The spindles, with their ball bearings, are self-contained in sleeves that enable them to be changed easily. The spindle slide motion and compensating mechanism is a self-contained unit that can be swiveled to give the equivalent of a rack of any pressure angle. The units are carried on horizontal slides independently adjustable for setting the width of the ground tooth space, and the depth of tooth is set by the handwheel at the top of the machine, vernier scales showing the position accurately in each case. It is also possible to adjust vertically to enable different sizes of wheels to be used together. A diamond dressing attachment *C* enables both wheels to be dressed accurately as to height when the vertical scale reads zero.

The work carriage has a dead center at its inner end, and an automatic dividing head at its outer end. In addition to the movement for one passage from end to end of each tooth space under the grinding wheels, the carriage has to make several short cross traverses to supply the rolling movement to the work for generating the involute profiles. The bottom slide, with the work, is fed under the grinding wheels by a screw, the travel being adjustable according to the width of the work. The upper or rolling slide also has a variable stroke, and is driven by a slotted crank disk arranged horizontally at the far side of the machine.

The dividing spindle, which also carries the work, is mounted on the upper slide carrying the division plate, while the locking pawl that engages with the plate is carried by the aluminum circular housing *D*, which is mounted on a sleeve or outer spindle surrounding the dividing spindle. On the outer end of this sleeve are mounted four segmental blocks of equal diameter. Nine sets of these blocks are provided, corresponding to nine convenient pitch diameters. Four steel ribbons wrap around the circumferential parts of the segments, two passing to one side of the machine and two to the other, the free ends being secured at points *E*. The securing blocks are carried in a frame *F*, and can be partially rotated to adjust the ribbons by means of the heads *H*. The frame can be raised or lowered on vertical slides so as to bring the ribbons in a horizontal position for various segmental block sizes.

If the wheel being ground has an imaginary pitch diameter corresponding exactly to the segmental ribbon blocks in use, the work-slide is reciprocated during the traverses under the grinding wheels and the ribbon frame carrying blocks *E* remains fixed. A to-and-fro rolling motion along the pitch circle is thus given to the work. If the nominal pitch circle of the gear is not equivalent to that of an available set of segmental blocks, the ribbon carriage is also given a reciprocating movement that compensates exactly for the difference in pitch diameter, and this is originated by the cross-slide. The movement is transmitted by the slotted bar *J*, which rocks on a vertical axis that can be altered to vary the ratio of the two arms of the rocking bar.

The travel forward of the work during each short rolling motion is dependent on the finish required, 1/32 inch being suitable for a medium sized tooth when finish-grinding. Grinding takes place during both the in and the out travel of the main slide, and indexing occurs when the wheels are clear at either end. A pinion on which the teeth were ground on a Maag grinding machine is shown in the heading illustration. The hatched effect given to the teeth by the grinding wheels is very noticeable. When an indexing is to occur, the feed of the main slide is stopped and the position maintained by a solenoid lock. The gear-box, from which the slides are driven, is seen at the extreme outer end of the bed. The main driving motor is placed behind the gear-box, which it drives through worm-gearing. Four speeds are provided for the rolling slide, and four for the feed-slide.

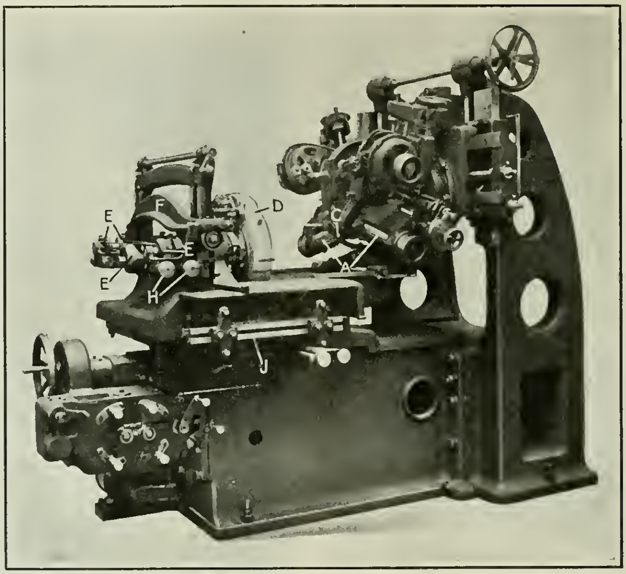


Fig. 9. Grinding Machine with Two Wheels used for grinding Profiles of Maag Gears

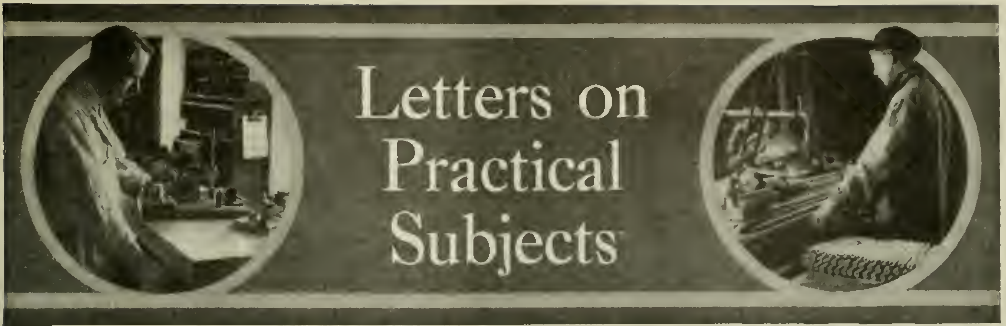
Applications of Maag Gears

Hardened and ground gears produced on Maag machines and designed without regard to standard pressure angles are in fairly extensive use. This is especially the case in Switzerland, where the state railways use them for motor drives on 2000- and 2500-horsepower electric locomotives. They are used almost exclusively on street-car motor drives in that country. In turbine reductions there are several instances in which double helical gearing has been superseded by straight-cut Maag gears, the pinions being hardened and ground. It is claimed that since the grinding operation produces a true tooth form and concentricity, the pinion acts as a master to the softer teeth on the gear, which are thus burnished and any irregularities corrected. In several turbine installations the gears run silently at the high peripheral speed of 13,400 feet per minute with no other lubrication than that supplied by leakage from bearings. The Niles-Bement-Pond Co. has the exclusive American rights to the manufacture of Maag gears. The Pond Works, Plainfield, N. J., have cut gears up to 80 inches in diameter, while the Pratt & Whitney Co., Hartford, Conn., has cut and ground gears up to 16 inches in diameter.

* * *

INDUSTRIAL CONDITIONS IN SWEDEN

The difficulties at the present time experienced by the Swedish industries were first felt in the metal and machine industries as early as 1919, but the depression did not become particularly acute until the last months of 1920. Out of the 120 blast furnaces in Sweden, only 42 were active in December, 1920, and the production of iron and steel was lower than for a great many years past. During the latter part of 1920, Germany offered severe competition, quoting prices in the Swedish markets lower than the bare cost of labor and materials in Sweden. Wages in Sweden are now three times as high as before the war, and the labor efficiency less, so that the actual labor cost per unit of production is four times as high.

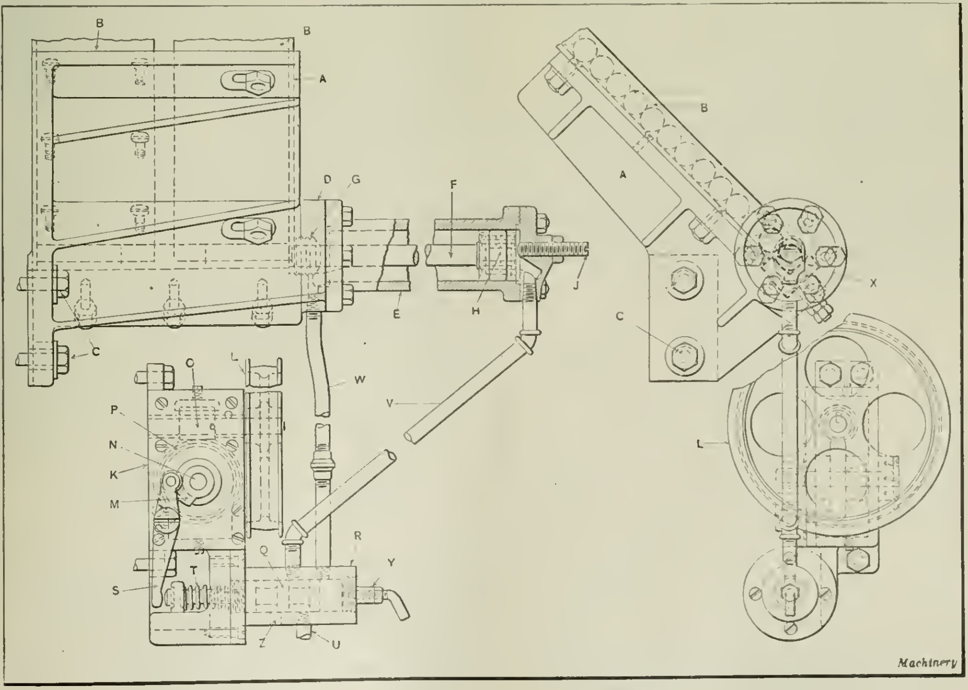


PNEUMATIC FEEDING ATTACHMENT FOR CENTERLESS GRINDER

The accompanying illustration shows a feeding attachment which has been successfully applied to a centerless grinder of the Detroit Tool Co.'s manufacture. This device is designed to handle rolls and pins of various diameters and lengths, the range of adjustment making it particularly well adapted for use in grinding parts employed in automobile construction, such as engine wrist-pins, valve rollers, etc. In designing this attachment, the writer was handicapped by lack of space around the grinder. This necessitated the use of a compact fixture, the stroke of which could be controlled without cumbersome and expensive mechanisms. Reference to the illustration will show that the feeder is operated by air, and is so designed that it can be easily controlled by an inexperienced operator. The advantages of a pneumatic device of this nature are: The ease with which the length of stroke can be adjusted; the adjustable slow feeding feature; and the rapid return movement of the feeding plunger.

It will be noted that the cast-iron slide *A* is provided with elongated bolt holes to permit the adjustment of the sheet-metal sides *B* to accommodate rollers or pins of different lengths. The slide can be made as long as desired and adapted for holding any length of work within the capacity of the feeding mechanism. The chute is bolted to the grinding block of the machine by means of bolts *C*. A flange *D*, cast integral with the chute, carries a bronze cylinder *E* fitted with a piston-rod *F*, a suitable packing-box *G*, and a properly packed piston *H*. The length of the stroke is adjusted by the headless set-screw *J*.

A small gear-box *K* is bolted to the side of the grinder. The pulley *L* of this gear-box is driven by a belt from the lineshaft or a countershaft. A cam *M* keyed to the worm-wheel shaft *N*, which is driven by worm *O* and worm-wheel *P*, actuates the plunger valve *Q* in the bronze cylinder *R* through the medium of lever *S* and spring *T*. The speed of the gear-box pulley *L* controls the number of strokes per minute of the feeding rod *F*. The point at which the air supply pipe *U* enters the cylinder *R* must be carefully located, that is, it must be correctly positioned with respect



Air-operated Feeding Attachment for Centerless Grinding Machine to the bored holes which lead through pipes W and V to and from cylinder E. In the illustration the plunger valve Q is shown in such a position that the air will travel up pipe V and enter cylinder E at its outer end. The air entering at this end of the cylinder, forces the piston H inward against the resistance of the air in the opposite end of the cylinder. The air thus forced down the vertical pipe W enters the outer end of cylinder R where it escapes through a small needle valve at Y.

A moderately fast or a very slow stroke of the feed-rod can be obtained by adjusting valve Y. When the valve is so adjusted as to permit the air to escape slowly from the inner end of cylinder E, the feed-rod F will move forward slowly, while if the valve is opened to permit the air to escape more rapidly, the feed will be faster. The return of piston H is accomplished when the valve Q, actuated by cam M, simultaneously opens exhaust port Z and the inlet port of pipe W. With the valve in the latter position, the air is quickly exhausted from one end of the cylinder through pipe V and opening Z while the air from the feed-pipe W, acting on the inner side of piston H, forces the latter quickly toward the outer end of the cylinder until it reaches the position shown in the illustration. When plunger F reaches the end of its outward stroke, a roll or pin, as the case may be, drops down by gravity into the feeding position, when it is carried forward into contact with the grinding wheel by the slow-feed stroke. The operation of the device is therefore automatic and continues as long as the feed-slide is supplied with work. The V-shaped block X is so designed that it is possible to adjust it in order to bring work of different diameters into the proper feeding position.

Rochester, N. Y. A. H. Schwab

SELF-ADJUSTING LATHE DOG

In a large factory devoted to the manufacture of textile machinery considerable difficulty was experienced in turning cast-iron drums for carding machines. These drums consist of a cast-iron cylinder of the shape shown in Fig. 1. and are about 5 feet long and 4 feet in diameter. At each end is a central hub supported by a set of six arms or spokes. When assembled in the carding machines and in operation, these drums maintain a relatively high surface speed. As no heavy loads are applied to them, it is desirable that they be of light weight construction.

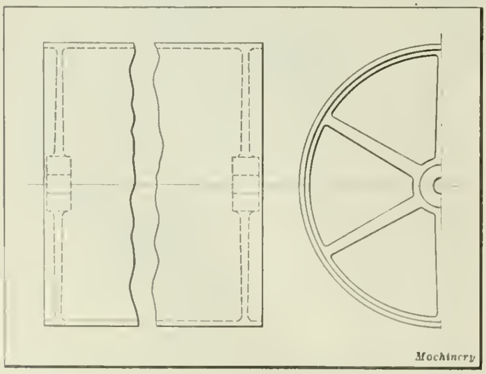


Fig. 1. Cast-iron Drum used in Textile Machine

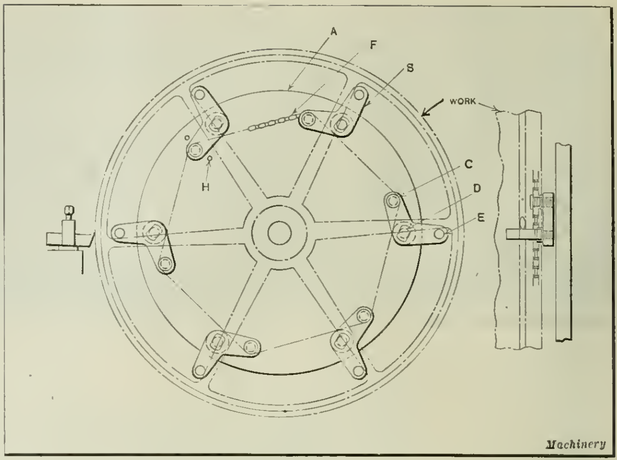


Fig. 2. System of Multiple Dogs for Lathe used in turning Drum shown in Fig. 1

While lightness is an advantage so far as the functioning of the drums in the carding machine is concerned it proved a drawback from the manufacturing point of view. When properly centered in the lathe, the outer surface is turned down to finish, and on account of the large dimensions a considerable amount of stock must be removed to give a clean surface all over. It often happens that some portions of the middle part of the rough casting will run out 3/8 inch or more, and it is a slow job to finish even the best castings.

A light cut and slow feed must be applied; otherwise the spoke in contact with the lathe dog will break off, thus ruining the drum. As it was impossible to have more than one fixed driving point, a system of self-adjusting multiple driving dogs was tried out which proved very satisfactory. The construction of this device is shown in Fig. 2. In this illustration A represents the lathe faceplate and B the main part of one of the six driving dogs. These dogs are made of cast iron of suitable dimensions and of approximately the form shown in the illustration. They swivel on a stud D fastened to the faceplate.

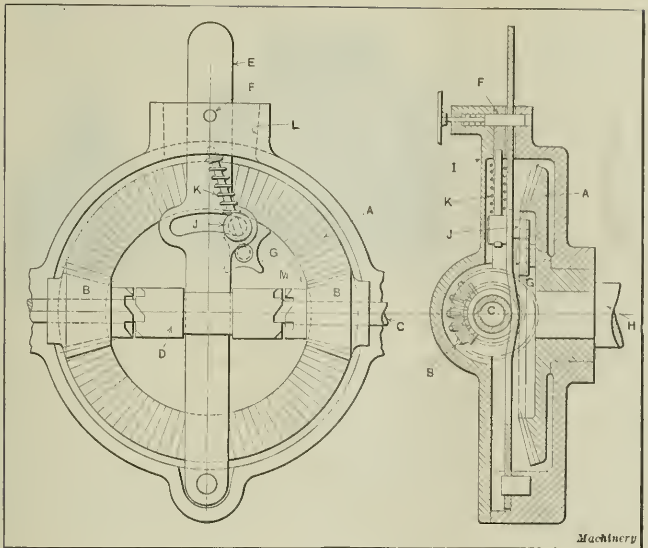
At E is shown one of the driving studs which make contact with the arms or spokes of the drum. There are also six studs C which are provided with flanges and which carry an endless block chain F. The six dogs are fastened at the proper distance and spaced 60 degrees apart. The chain is of suitable length and allows each driving pin to exert the same power on each spoke. Twelve pins H, only two of which are shown, are driven into the faceplate to prevent undue movement of the parts when idle.

With the drum in place and the lathe started, each of the six dogs will drive its respective spoke with an equal driving force. By this method of driving, a deeper cut and a higher feed are used, and the breakage is reduced to practically nothing, which results in a greater output.

New York City C. G. Youngquist

A RECIPROCATING MECHANICAL MOVEMENT

The type of mechanical device described and illustrated in this article is used for producing the reciprocating motion of a washing machine. The device is compact, and has but few parts to require attention. The working parts are contained in an enclosed case, which may be cast from any suitable material and which is provided with a cover I, attached to the case in any convenient manner. The working parts consist of a bevel gear A with which two bevel



Mechanism for producing a Reversal of Rotary Motion

pinions *B* mesh. These are a running fit on the shaft *C*. and should be provided with phosphor-bronze bushings and backed with a substantial flange or end thrust bearings. The construction shown in the illustration, however, does not show these features.

The purpose of the mechanism is to reverse the rotation of shaft *H* to which the bevel gear *A* is attached. This is accomplished by means of a sliding jaw clutch *D*, which operates on a sliding key carried on shaft *C*. The sliding member of this clutch is necked at the center, the width of the neck being such as to accommodate the width of the operating lever *E*, which bears against it from beneath. The operating lever fulcrums on an ordinary steel pin, and this movement slides the clutch *D* sufficiently to alternately engage and disengage the clutch teeth which are an integral part of each pinion *B*. These alternations of movement are accomplished by star-wheel *G*, which is made of casehardened machine steel. The star-wheel operates on a stud which screws into the body of the bevel gear. It is important that the star-wheel be securely attached to the gear, because if it becomes loose the operation of the mechanism will fail. The operating lever *E* is held in a neutral position by a spring plunger *F*, which extends through the cover of the case and is operated by a knob. There is a hardened steel stud *J* which operates in a circular slot in the operating lever and is held in contact with the end of this slot by the tension exerted by spring *K*. This spring is carried by a long pin, the opposite end of which is pivotally fastened to the gear *A*.

In order to more thoroughly understand the operation of the mechanism, the method by which the reversal of rotation is accomplished will be described. Assuming that the motor which drives the shaft *C* is in operation, the stop-pin *F* is pulled out and given a quarter turn to lock it in its raised position until the mechanism is again brought into a neutral position. The stop-pin releases the clutch-operating lever *E* which, owing to the tension exerted by spring *K*, is forced to the right until it is brought up against surface *L*. This engages the right-hand bevel pinion clutch and drives the gear in the direction indicated by the arrow. Each revolution of the bevel gear brings one point of the star-wheel *G* into contact with stud *J*, resulting in rotating the star-wheel a quarter turn with each revolution of the bevel gear. On the fifth revolution of the gear, the long arm of the star-wheel becomes wedged against surface *M* of the bevel gear, so that as the gear continues to revolve, the stud *J* will be swung over to the opposite side of the slot in which it operates, thus disengaging the right-hand clutch and engaging the clutch which operates the left-hand pinion. This results in reversing the motion of the machine during another five revolutions of the gear, at which time the transfer movement again occurs, and this sequence of mechanical movements continues until the machine is placed, manually, in a neutral position by again engaging the spring-pin *F*. It is important to remember that the number of revolutions before reversing the direction of rotation is governed entirely by the number of arms on star-wheel *G*, there being one more revolution required to reverse the shaft *H* than there are arms on the star-wheel. The length of the odd point of the star-wheel must be such as to just bind against surface *M*.

Cleveland, Ohio C. F. George

MILLING AND GRINDING HELICAL OR SPIRAL CAMS

The face or helical cam shown in the accompanying illustration at *A* is required to have a fairly accurate helix face, with a rise or pitch of ½ inch in 350 degrees. This cam is made from an iron casting about 6 inches in diameter. In milling the face, the blank was mounted on the arbor of the indexing head of a universal milling machine, as shown. A 1½-inch end-mill *B* mounted in the main spindle was used to mill the helical surface. By tilting the head the amount of rise or lead of the spiral, or helix, can be changed considerably from what it would be if the dividing head spindle were parallel with the surface of the milling machine table. If the lead obtained with the spindle of the dividing head set parallel with the surface of the milling machine table were 1 inch, the lead would be approximately 11/16 inch with the spindle of the dividing head set at an angle of 45 degrees as shown in the illustration. With the head set vertically, the lead would be zero, as the cutter would simply pass over the work.

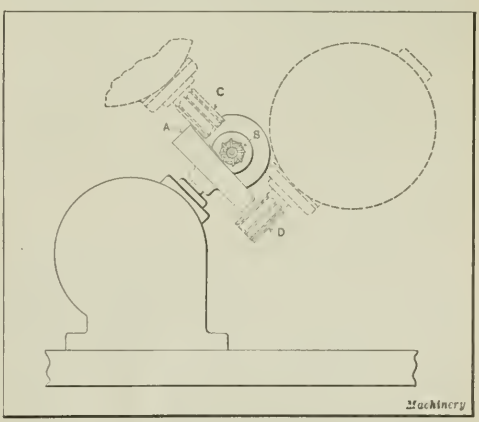


Diagram indicating Positions of Cutters for milling Helical and Spiral Cams

The helix generated by setting the head at an angle of 45 degrees was not strictly accurate, but it was sufficiently so in this case to meet the requirements. When greater accuracy is required, a vertical milling attachment can be used with the milling cutter set as indicated by the dotted lines at *C* for milling the face cam, and as at *D* for a plate or spiral cam. In setting up the milling machine for milling cams of the kind described, the machine is first geared to cut a spiral which is nearest the desired pitch or lead that can be attained with the available gearing. The dividing head is then set at the angle required to give exactly the desired result. The writer knows of no better way of setting the dividing head to the required angle than the trial method. By this method the high and low points are located, and an indicator is attached to the spindle in place of the milling cutter. The head is adjusted until the indicator registers zero at both points. The milling operation can then be performed with the assurance that the required lead or rise in the cam surface will be obtained. If it is desired to grind hardened steel cams, a portable electric grinder can, of course, be mounted on the milling machine spindle in place of the milling cutter.

Providence, R. I. JOHN T. SLOCOMB

USING A PUNCH PRESS FOR MILLING MACHINE WORK

The illustration Fig. 1 shows a tube connection used on an air-testing device. This part is made from a hard brass composition. The view at the left shows the condition of the work as it comes from the automatic machine. To finish

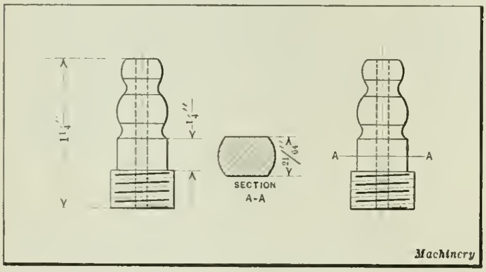


Fig. 1. Tube Connection requiring Machined Flats at Section A–A

the work, it is necessary to machine two flats on the shank as illustrated by the right-hand view and also by the section *A–A*. At first sight this looks like a milling machine job, but the only manner in which the flats could be milled with the milling machines available was to locate the work in a horizontal position using a side milling cutter, and then turn the piece 180 degrees and machine the other face; or else to place the piece in a vertical position and use an end-mill, which would also necessitate indexing the work after taking a cut on one side. Even the use of a special fixture to hold a number of the parts would not greatly facilitate production, as time would be required to place the work in the fixture and turn or index each piece in order to machine both flats.

This problem was solved by equipping a punch press for the job, the tools employed being shown in Fig. 2. The piece is placed in the die with its threaded end resting against stop-pin *A*, being located in the threads in the die which are cut to the same diameter and pitch as those on the work. The other end rests in the concave surface *B*, which has a radius equal to that of the larger spherical section of the part. The die is held rigidly in the bolster of the punch press. The punch *D* is made with two cutting edges. The space between the cutting surfaces is the width of the flattened portion of the part, or 21/64 inch.

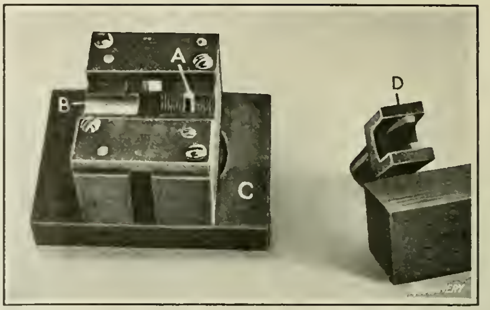


Fig. 2. Punch and Work-holding Block for machining Flats on Part shown in Fig. 1

In operation, the punch is held in the press by means of the shank, which fits the ram, and as it is forced down the two cutting edges shear away the material of the part to the correct width. The work is thus not only machined to the correct size, but owing to the knife-like cutting action of the punch it also has a smooth finish, and the production is far in advance of anything that could be expected from the use of a milling machine for this particular job.

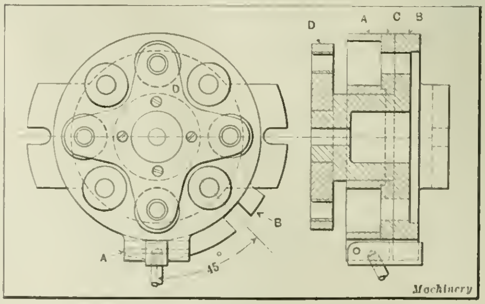
BERT TOWLER

CONTINUOUS DRILL JIG

The accompanying illustration shows the design of a continuous drill jig for use in drilling four cast-iron pinions at one time. This jig was made to be used with a four-spindle multiple drilling head, but can, of course, be employed with any multiple drilling head having spindles adjustable to the holes or bushings in plate *D*. The work-holding plate *A*, having eight equally spaced pockets, is indexed 45 degrees back and forth around the central part of jig body *B*. The latch attached to plate *A*, acting as a handle, is dropped into either slot on the projecting lug on the side of body *B*. Plate *C* is fastened to work-holding plate *A* and prevents the work from dropping through. Parts *A* and *C* can be made in one piece, if desired.

The bushing plate *D* is secured to the body of the jig in such a position that the drills are in line with one set of holes when the latch is in either slot. The pinions are prevented from turning by means of one or two teeth inserted in each pocket. It is advisable to provide feet on the jig in order to facilitate cleaning out the chips and also to give the drills sufficient room to pass through. When operating the jig, it is simply necessary to remove the four finished pinions and replace them with new ones while the four others are being drilled, then index the work-holding member *A* 45 degrees and repeat the unloading and loading of the jig.

Toronto, Canada J. J. LINTON



Continuous or Indexing Drill Jig for Use with Multiple-spindle Drilling Head

METHOD OF LOCATING TOOL WHEN CUTTING MULTIPLE THREADS

The following method of cutting multiple threads has been used successfully by the writer. First set the change-gears of the lathe to cut the required number of single threads per inch, or to give the correct lead. Then set the compound rest to the required angle (30 degrees for U. S. form threads) so that the tool can be fed to the work in the direction indicated by arrow *D* in the accompanying illustration. When one thread groove has been cut to depth, the tool is withdrawn a distance equal to dimension *A*, this distance being measured by the graduations on the dial of the compound rest feed-screw. The cross-slide is then employed to advance the tool in the direction indicated by arrow *E* until the point of the tool touches the work or has advanced a distance equal to dimension *C*.

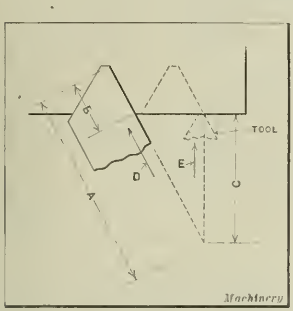


Diagram illustrating Method of setting Tool for cutting Multiple Threads

The formulas for obtaining the dimensions required in setting the tool for cutting multiple threads of U. S. form, as described, are as follows:

$A = B + \sec 60 \text{ degrees} \times P = B + 2P$

$B = \sec 30 \text{ degrees} \times 0.6495P = 1.1547 \times 0.6495P$

$C = \tan 60 \text{ degrees} \times P = 1.7321P$

$P = \dfrac{1}{\text{number of threads per inch}}$ = distance from center to center of thread.

For next thread proceed as before.

When using this method care should be taken to see that the compound rest is accurately set to the required angle and that the backlash in the feed-screw is taken up when using the graduated dial to set the tool. J. F. T.

[For information regarding the methods generally employed in cutting multiple threads see MACHINERY's book "Thread Cutting Methods." This book explains how the tool may be set when cutting multiple threads (1) by indexing or turning the piece being threaded a fractional part of a revolution; (2) by setting the compound slide parallel with the screw thread being cut, so that the slide can be used for adjusting the tool; (3) by disengaging the lock-nut from the lead-screw while the lathe spindle is stationary, moving the carriage the required distance; and (4) by engaging the lead-screw at the proper time (with the lathe in motion), as shown by graduations on the thread chasing dial or indicator.—EDITOR]

REDESIGNING JOURNAL-BOX TO FACILITATE REPAIR WORK

The handling of repair work in large manufacturing plants requires considerable ingenuity and executive ability. The designer, draftsman, or shop executive, who superintends this class of work, must be able to decide quickly what parts will be required to put any broken-down machine or equipment in operation, and he must also know how to get these parts in the quickest and cheapest way.

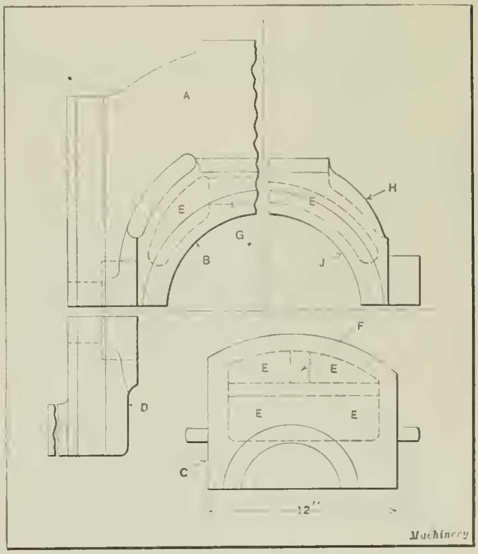
To accomplish this he will disregard all unimportant details of construction that may be incorporated in the original design, and have the repair parts made in the simplest possible manner consistent with the proper functioning of the part. The following instance serves to illustrate the importance of carefully considering the design of broken cast-iron parts when ordering new castings.

In the accompanying illustration is shown in broken sections, a water-cooled journal bearing of the saddle-trunnion type, incorporated in the design of a tilting rolling mill. The part shown at *A* is the upper trunnion slide, and the part shown at *D* is the lower trunnion slide. These slides, however, were not required to be replaced, but are merely shown to give a better idea of the relationship which the broken part bears to the complete assembly. The broken half view of the part shown at *B* indicates the shape of the upper half of the journal box as originally made. This is the part that was required to be replaced. At *C* is a side elevation of part *B*, and at *J*, a broken end elevation of the journal box as it was made to meet the requirements of a hasty repair job.

It will be noticed that the outer diameter of part *B* is oval in shape, starting with a very flat circle at the hub and ending in a circle of short radius at the "saddle." The cored water pocket *E* is made to conform to the shape of the outer surface, but where it comes next to the journal at *G* it is made flat.

This design calls for a pattern entirely shaped by hand. The middle portion of the journal box which has the greatest pressure against the neck of the roll, is solid, except for the narrow passage, and therefore derives but little benefit from the circulating water. From the illustration it is evident that the core-box for this part requires considerable labor, and that it is a somewhat difficult job for the core-maker unless he has special equipment for this class of work.

Now let the redesigned part as shown at *J* be considered. It might be mentioned here that a drawing showing every detail of the broken casting was given to the writer with instructions to have a pattern made for the part as soon as possible. After carefully studying the design, the writer



Original and Redesigned Journal-box Bearings for Rolling Mill

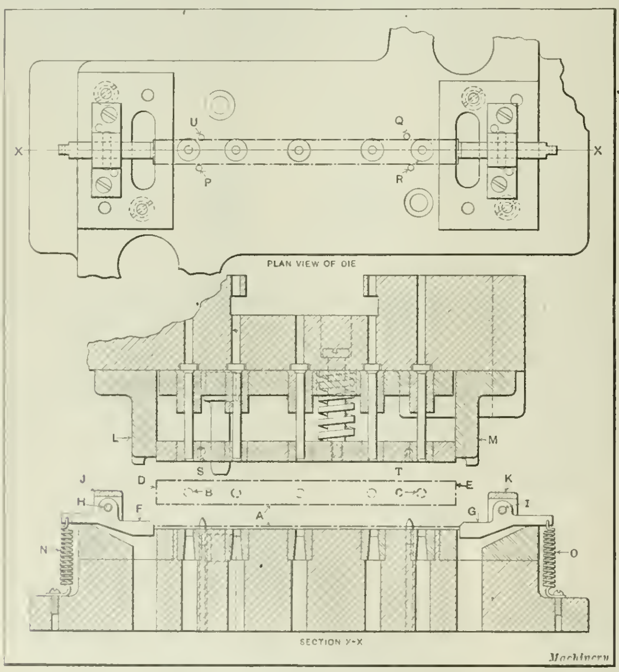
realized that considerable labor would be required to make the pattern according to the drawing. However, it was found that the design could be simplified without affecting in any way the proper functioning of the part. Referring to *J* it will be noted that the circles indicating the most important surfaces in the redesigned box are struck from a common center. It will also be noted that the design provides an unobstructed water-cooling chamber. The middle portion is reinforced with ribs of the shape indicated at *H*. By redesigning the part as shown, it was possible to employ the band saw in cutting and shaping practically all the pieces required in building up the pattern. Thus the pattern was made in half the time that would have been required had it been made according to the original design. The casting, as redesigned, with its large water-cooled chamber, was machined and substituted for the box shown at *B*. After a thorough trial it was found to be much more satisfactory than the one with which the machine was originally equipped.

Kenosha, Wis. M. E. Duggan

DISAPPEARING NESTS FOR SHAVING PUNCHES

When shaving a sheet-metal punching, the work is generally located by pilot-pins or by nest plates. As the former method is preferable, holes are occasionally punched merely to permit the use of pilot-pins in subsequent operations. When pilot-pins cannot be used, and the ends or sides to be shaved must also serve as locating surfaces, the disappearing nests described in the following may be used to advantage.

In the illustration, the work or punching *A* (a plan and side view of which are shown by heavy dot-and-dash lines) is required to have holes *B* and *C* accurately located from the ends *D* and *E* to within 0.0005 inch. Therefore, the ends were shaved and the holes pierced at the same stroke of the press. The work is located endwise by the disappearing or swinging nests *F* and *G*, which are pivoted on pins *H* and *I* to brackets *J* and *K*, respectively. Before shaving



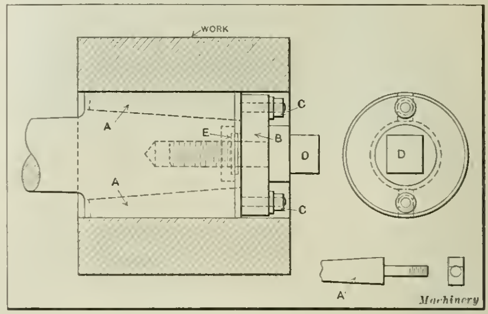
Shaving Punch equipped with Disappearing Nests

punches *L* and *M* come in contact with the ends of the work, they first hit swinging nests *F* and *G*, thus depressing the latter and bringing them out of contact with the work. On the upward or return stroke, springs *N* and *O* bring the nests back to their normal positions. The work is located sidewise by pilot-pins *U*, *P*, *Q*, and *R*. Holes *S* and *T* provide clearance for the pilot-pins that are shown at *U* and *Q*.

B. Spector

FRICTION ARBOR

The special arbor here shown has several advantages over the ordinary expansion arbors generally used to hold work of the kind indicated in the illustration. The chief advantage is that it will not work out of true after being in use



Friction Arbor for Work requiring Facing and Threading Operations

for a considerable length of time, as is frequently the case with arbors having spring collets. The operation performed on the work in this particular instance consists of facing both ends and threading the outside. It is, of course, necessary, in using an arbor of this kind, to have the hole in the work finished close to size.

After the chuck is turned and finished to a good fit in the work, two taper slots are cut to take the taper keys *A*. Two holes are drilled through collar *B* as indicated, to take the shanks of keys *A*. The holes through collar *B* are slightly larger in diameter than the key shanks to allow a slight rise or fall of the keys as they slide in the tapered slots. Nuts *C* are screwed on the end of the key shanks. Screw *D* is drilled to receive a pin *E*, and the tops of keys *A* are rounded to the same radius as the body of the arbor which fits the work. When the work is slipped in position, the tightening of screw *D* against collar *B* forces the wedges out against the work. When screw *D* is loosened for the purpose of removing the work, pin *E* comes in contact with collar *B* so that the wedges are withdrawn, thus releasing the work.

Harry Moore

Rosemount, Montreal, Canada

* * *

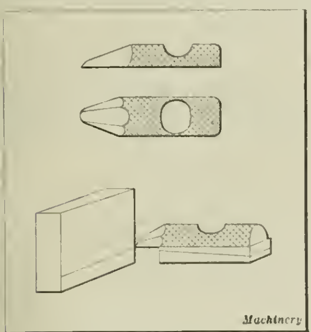
BUREAU OF INFORMATION AT WASHINGTON

On the initiative of President Harding a Bureau of Information has been established on the ground floor of the Post Office Department Building, Pennsylvania Ave. and 12th St., the purpose of which is to give as full information as possible concerning all governmental departments to those who go to Washington to transact business with any department or bureau of the Government. The Information Bureau will be able to advise the visitor as to the exact location of any particular department and the means of reaching it. Manufacturers and others having business to transact with the Government Departments in Washington are invited to make use of this facility. There is need for such an information bureau, as it is often a difficult matter to locate the department or official to be seen among the many government offices in Washington.

SHOP AND DRAFTING-ROOM KINKS

SCRIBE FOR LAY-OUT WORK

A marker or scribe for use in laying out lines a predetermined distance from the edge of angle-plates, die-blanks, etc., is shown in the accompanying illustration. This marker is made by knurling a piece of round carbon steel and then machining and filing the knurled piece to the shape shown by the two upper views in the illustration. The notch filed in the top of the knurled portion serves as a "finger-grip." After being hardened, the marker is, of course, ground flat on the bottom and to a sharp point at the end. It can be used with standard size blocks, or with adjustable parallels as indicated in the lower view.

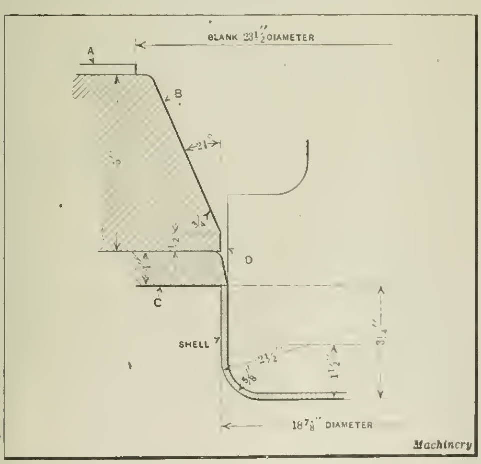


Scribe for Lay-out Work

Brooklyn, N. Y. HOWARD HOUSE

DRAWING DIE KINK

The accompanying illustration shows how a slight change in drawing die design enabled a shell to be drawn having a large radius at the bottom, which formerly had caused trouble. The die is of the push-through type, and the blank, which was 23½ inches in diameter, was located in the gage



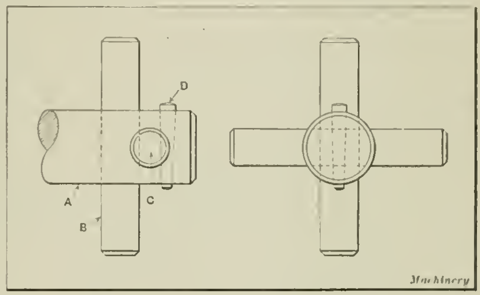
Tapered Drawing Ring for drawing a Part with a Large Radius

ring *A*. The drawing ring is shown at *B*, the stripper at *C*, and the punch at *D*. All the parts are standard construction, except the drawing ring, which is made with a 24-degree angle. By making the drawing ring with this angle, the shell was successfully drawn to the diameter and radius indicated. The stock is 5/32-inch sheet steel, and the operation was performed on a No. 78½ Bliss press.

Cleveland, Ohio D. C. OVIATT

SECURING TWO RODS AT RIGHT ANGLES

In the accompanying illustration is shown a method devised by the writer for rigidly securing two rods at right angles to each other, when the rods pass through a shaft. Shaft *A* is first drilled to take rod *B*. After rod *B* has been inserted and properly located, another hole is drilled at right angles to the first, to receive rod *C*. The distance between the centers of the two holes is made less than the diameter of the stock used for the rods, so that the drill will cut into rod *B* slightly, when drilling the second hole. Rod *C* is then inserted and properly located, after which another hole is drilled and reamed to receive taper pin *D*, as shown. When



Method of securing Two Rods at Right Angles

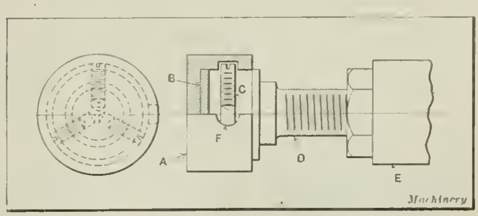
pin *D* is driven into place, it locks rod *C* securely, and rod *C*, in turn, locks rod *B*.

Baltimore, Md. HENRY R. BOWMAN

REVOLVING STOP FOR SCREW MACHINE

The revolving stop shown in the accompanying illustration was designed for use in an automatic screw machine or other machines such as turret lathes, where the stock to be machined is chucked while the spindle is revolving. The writer has found that a better quality of work will be produced when this stop is employed in place of the stationary type of stop generally used. In addition, it also reduces the time required to keep the machine adjusted, since it does not become scored or loaded with metal, as is frequently the case with the stationary type. The stop consists simply of a hardened and drawn steel cap *A*, a bronze bearing washer *B*, three evenly spaced set-screws *C*, and a shank *D* which is adjustable in holder *E*. It will be noticed that an annular groove is cut inside cap *A* into which the heads of screws *C* project. These screws are inserted through a hole *F*, drilled through cap *A*, and prevent the cap from slipping off the end of part *D*.

Akron, Ohio BERKLEY E. WIGGLESWORTH



Revolving Stop for Screw Machine

HOW AND WHY

QUESTIONS ON PRACTICAL SUBJECTS OF GENERAL INTEREST

PROBLEM INVOLVING THE USE OF TRIGONOMETRY

R. T. R.—In the accompanying illustration, $a = 1\frac{1}{4}$ inches, $h = 4$ inches, and angle $A = 12$ degrees. Please show how to find distance x and angle B.

ANSWERED BY L. D. CASTOR, ELIZABETHPORT, N. J.

In April MACHINERY, page 792, under the title "Problem Involving Algebra and Trigonometry," a solution involving considerable algebra was given to this problem. The writer

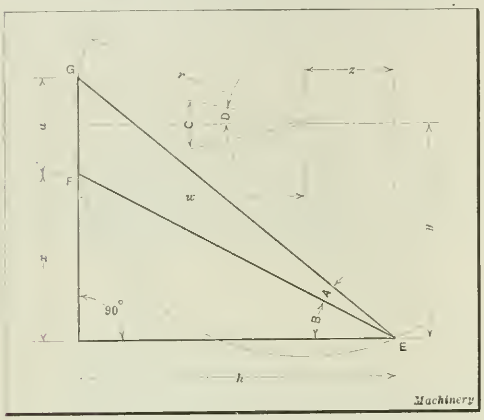


Diagram used in Trigonometric Solution

believes that the solution here presented is much simpler than the one referred to. Draw an arc through points E, F, and G, as shown, with r as a radius. According to a well-known theorem of geometry, which is given on page 250 of MACHINERY'S HANDBOOK, if an angle at the circumference of a circle, between two chords, is subtended by the same arc as the angle at the center, between two radii, then the angle at the circumference is equal to one-half the angle at the center. This being true, angle C is twice the magnitude of angle A, and angle D = angle $A = 12$ degrees. It will now be readily observed that

$$r = \frac{a}{2 \sin D} = \frac{1.25}{2 \times 0.20791} = 3.0061$$

$$w = \frac{a}{2} \cot D = 0.625 \times 4.7046 = 2.9404$$

and

$$z = h - w = 4 - 2.9404 = 1.0596$$

Now

$$y = \sqrt{r^2 - z^2} = \sqrt{7.9138505} = 2.8131$$

and

$$x = y - \frac{a}{2} = 2.8131 - 0.625 = 2.1881 \text{ inches}$$

Finally,

$$\text{Tan } B = \frac{x}{h} = \frac{2.1881}{4} = 0.54703$$

and

$$B = 28 \text{ degrees } 40 \text{ minutes } 47 \text{ seconds}$$

A similar solution was submitted by C. N. Pickworth, Manchester, England.

CALCULATING DIAMETER OF ROLL FOR ROLLER CLUTCH

W. A. Z.—In the accompanying diagram are shown the conditions encountered in the design of a roller clutch. From the dimensions given, please explain the method of finding the diameter of the roll.

ANSWERED BY W. W. JOHNSON, CLEVELAND, OHIO

A.—Referring to the diagram, the diameter of the roll can be found in the following manner: Since, by construction, $MK = KL$, angle KHM = angle $KHL = \frac{1}{2}$ (90 degrees $- x$)

Let $\frac{1}{2}$ (90 degrees $- x$) $= y$; then,

$$KL = r \tan y$$

and

$$LA = HN = b - KL; \; HN = b - r \tan y$$

$$HO = \sqrt{(HN)^2 + (NO)^2}$$

But

$$HO = R - r$$

Therefore

$$\sqrt{(b - r \tan y)^2 + (a + r)^2} = R - r$$

Squaring both sides of the preceding equation,

$$(b - r \tan y)^2 + (a + r)^2 = (R - r)^2$$

Expanding, combining, and arranging terms with reference to r, we get the quadratic equation

$$r^2 \tan^2 y + 2r\,[(R + a) - b \tan y] - (R^2 - a^2 - b^2) = 0$$

Solving this equation for r,

$$r = \frac{-[(R + a) - b \tan y]}{\tan^2 y} \pm \frac{\sqrt{(R + a)^2 - (R + a) \tan y\,[2b - (R - a) \tan y]}}{\tan^2 y}$$

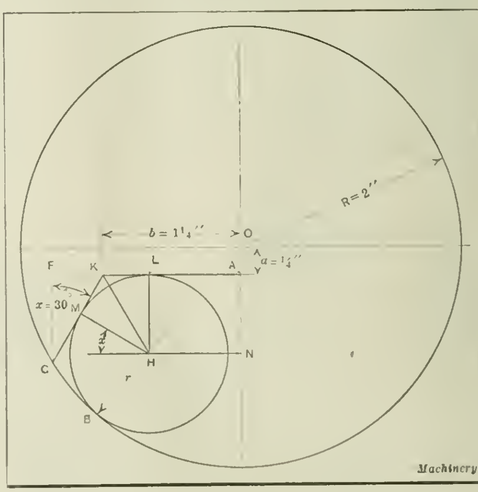


Diagram for finding Diameter of Roll for Roller Clutch

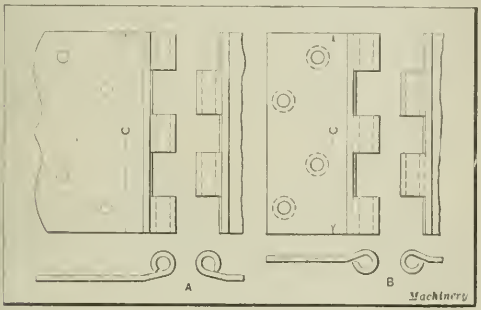
Now, $y = \frac{1}{2}$ (90 deg. $- x$) $= 30$ degrees. Tan 30 deg. $= 1/3\sqrt{3}$ and $\tan^2 30$ deg. $= 1/3$. Inserting these values of $\tan y$ and $\tan^2 y$ and those given in the diagram, in the foregoing equation, and taking the plus value of the quantity under the radical sign, we find that

$$r = \frac{\sqrt{3.12740 - 1.52831}}{0.33333}$$
$$= 3(1.76844 - 1.52831)$$
$$= 3 \times 0.24013 = 0.7204 \text{ inch}$$

The diameter of the roll, then, is equal to $2r$ or 1.4408 inches.

MANUFACTURE OF HINGE BUTTS

C. L.—Can any reader of MACHINERY give information as to the methods in use in some shop for manufacturing hinge butts of the two styles illustrated at *A* and *B*, in



Types of Hinge Butts of which Information is desired concerning Manufacturing Methods

various sizes of which *C* ranges from 1 to 4 inches? It is desirable that only tools actually used in producing such parts be described and that production figures be given.

DETERMINING ALTITUDE OF AN ACUTE-ANGLED TRIANGLE

A. A. G.—Will you please show how to find the distances x and y from the dimensions given in the illustration?

ANSWERED BY W. W. JOHNSON, CLEVELAND, OHIO

A.—Referring to the illustration, we have

$$y^2 = R^2 - x^2 \quad (1)$$

$$y^2 = r^2 - [(R + r - c) - x]^2 \quad (2)$$

From Equations (1) and (2) by comparison,

$$x = \frac{R^2 + (R + r - c)^2 - r^2}{2(R + r - c)} \quad (3)$$

Substituting this value for x in Equation (1), we get

$$y^2 = \frac{[2R(R + r - c)]^2 - [R^2 + (R + r - c)^2 - r^2]^2}{4(R + r - c)^2}$$

Then,

$$y = \frac{\sqrt{[2R(R + r - c)]^2 - [R^2 + (R + r - c)^2 - r^2]^2}}{2(R + r - c)}$$

Factoring and reducing the terms under the radical sign in this equation,

$$y = \frac{\sqrt{([(R + r - c) + R]^2 - r^2)\,(r^2 - [(R + r - c) - R]^2)}}{2(R + r - c)} \quad (4)$$

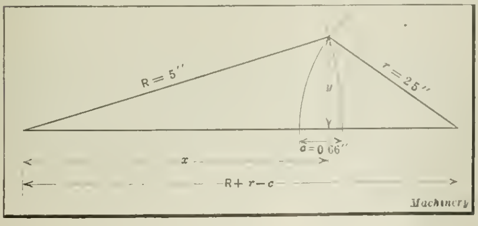


Diagram for calculating Distances x and y

Substituting numerical values for the known quantities in Equations (3) and (4), we find that

$$x = \frac{65.5356}{13.68} = 4.7906 \text{ inches}$$

and

$$y = \frac{\sqrt{133.9356 \times 2.8644}}{13.68} = 1.4318 \text{ inches}$$

TANGENCY PROBLEM

L. M. S.—Referring to the accompanying illustration will you please show how to find angle y without involving the use of higher mathematics? Let it be assumed that in this problem a equals 5.5 inches; b, 3 inches; and R, 1.625 inches.

ANSWERED BY J. F. THORNTON, CINCINNATI, OHIO

The following method of solving the problem stated requires only an elementary knowledge of trigonometry and the use of a table of trigonometrical functions. According to trigonometry,

$$\text{Tan } x = \frac{b}{(a - R)}$$

and

$$t = \sec x \times (a - R),$$

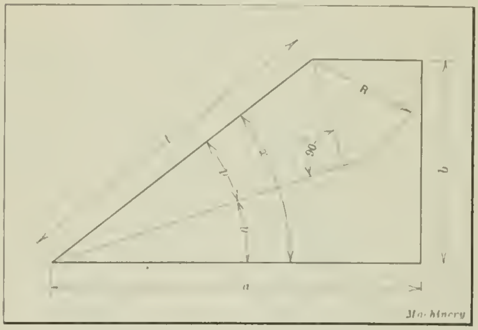
also

$$\text{Sin } p = \sin (x - y) = \frac{R}{t}$$

and

$$y = x - p$$

Substituting the known values and solving,



Conditions of Tangency Problem

$$\text{Tan } x = \frac{3}{3.875} = 0.77419 = \tan 37 \text{ degrees } 44 \text{ minutes}$$

and

$$t = 1.2644 \times 3.875 = 4.89955$$

Also

$$\text{Sin } (x - y) = \frac{1.625}{4.89955} = 0.33166 = \sin 19 \text{ deg. } 22 \text{ min.}$$

Therefore,

y = 37 deg. 44 min. — 19 deg. 22 min. = 18 deg. 22 min.

* * *

A machine tool dealer in Germany, writing on the prices of machine tools in that country, states that standard machines of first-class quality, such as lathes, milling machines, grinding machines, upright and radial drilling machines, planers, etc., cost about 10 to 11.5 marks (11 to 13 cents present exchange) per pound, net weight. First-class American machine tools in the German market, with ocean freight and import duty into Germany added, cost about 30 marks (34.5 cents) per pound. Machine tools of the cheaper class of German make cost only from 7 to 9 marks (8 to 10 cents) per pound.

Demand for Machine Tools in India

By GEORGE CECIL

THERE was a time when European employers of native labor in India did not encourage the use of imported tools; and the obstinate native mechanic also, for many years, fought shy of modern tools and methods, anything in the way of a time-saving device being objectionable to him. The longer he worked, the greater his profit, so he thought; consequently, he allowed his task to drag on. Finally, employers and mechanics alike more or less fell into line with the new order of things, and today machine tools have been adopted in the mill repair shops; indeed, many of them are particularly well equipped.

India being preeminently conservative, this result was not achieved without a severe struggle. The native argued that his father, grandfather, and great-grandfather had used tools of Indian manufacture, and nothing would, at first, induce him to desert those to which he had been accustomed from his youth. But by degrees contractors and other employers of labor came to the conclusion that "time is money." Today, though the old-fashioned users of native tools refuse to bend their knees to progress, they are, fortunately, in a minority. As to the European concerns, both large and small, they expend money freely in acquiring suitable tools, a certain pride being taken in the shops.

General Industrial Conditions

Of late, India has, for an Eastern country where progress seldom is encouraged, been unusually active industrially. Some of the railway companies, for example, have constructed their own locomotives with good results. For many years past, most companies have made their own cars, India being rich in suitable lumber. The shops are well equipped, and skilled European foremen, brought from England, are in charge. Under their fostering care the natives, who are employed by the thousand, often do very good work—they can, in fact, hardly be excelled. When, however, a supposed economy is effected by putting an incompetent and inexpensive half-caste native in charge, the quality of the output usually falls off. The semi-white man is naturally indolent; he seldom masters the use of the machinery entrusted to his care, and the men dislike working under him.

Some of the small native shops in which machine tools are used serve apparently as an outlet for mere rubbish in the way of tools and machines. Obsolete contrivances, instead of being "scrapped," are purchased for a trifle by the economical Indian mill or mine owner, and those who use them are but poorly acquainted with their operation. One finds an antiquated lathe in a repair shop, with a venerable native endeavoring to operate it. The lathe is coated with rust; so, too, is the mind of the operator.

Types of Machine Tools in Demand

A small percentage of the machine tools in local use are manufactured in India, but the number imported is by far the most important. Milling and drilling machines and woodworking machinery are in demand; light gap lathes (12-inch swing), heavier gap lathes (16-inch swing), screw machines, bolt- and nut-making machinery, shapers, and saws are needed. Woodworking machines are used in Calcutta, Bombay, Madras and elsewhere. The market, while not unlimited, is well worth the exporters' close attention. India has many capitalists, both native and European. With a little urging, they often are ready to launch out upon new enterprises.

Both Japan and Germany have made frantic efforts to capture the Indian market. The Japanese products, unfortunately, seldom are like the samples, or representations made. German manufacturers have not always kept their word, a failing which neither European nor native machinery users are inclined to tolerate. The Indian himself may not be a model of all the virtues; but he has a great admiration for the exporter whose honesty is unassailable; and it must be confessed that during many years' trading with India, Germany has scarcely earned a reputation for upright dealing.

Small Tools in Demand

The demand for small tools is considerable. The European tea and indigo planters provide themselves with tool-chests, for in many cases the exiled agriculturist is far from the haunts of the native mechanics. Missionaries are in the same position, and government officials who find themselves in isolated spots are forced to supervise, if not to undertake, domestic repairs. Well-stocked tool-boxes may be found in the large hardware establishments, but they seldom include everything that is required. A really complete box would need to be very large—a miniature shop. It should contain everything by means of which the possessor may perform temporary repairs of all kinds—both in wood and metal—and should include even a lavish supply of nails and screws. As to the nature of the tools used in India, they are the same as those required in other countries. The native, though haggling over prices, knows when he is getting value for his money.

Dealers in Machinery and Tools

In the three main cities, Calcutta, Bombay, and Madras, there are many reputable machinery and small tool dealers. They generally know their business; and they are as active as the enervating climate permits them to be. The consul at each town should be in a position to vouch for their standing and capabilities. Calcutta and Bombay support hardware establishments of repute, all of which deal largely in small tools. Both the machinery agents and the hardware men are in a position to know what is wanted, and they possess the necessary means of distribution. Their travellers constantly are on the move; they are in complete touch with requirements—both European and native. Consequently, the manufacturer who aspires to conquering the Indian field may safely leave his interests in their hands.

The large mercantile houses also are ready to undertake agencies for the sale of anything—"from a needle to an anchor." Jute firms, cotton firms, wine merchants, even tailors—all are willing to pose as agents for lathes and drilling machines, hammers and nails. These people are, of course, worse than useless as agents or representatives.

* * *

A number of automobile manufacturers in France have recently formed a combination known as L'Union Commerciale des Marques Francaises, capitalized at 1,500,000 francs. The object of this organization is to develop foreign markets by securing capable agents throughout the world for automobiles; it is stated that the organization will also handle machinery in general. The office of L'Union Commerciale des Marques Francaises is at 2 rue du Bois de Boulogne, Paris.

STRADDLE-MILLING FIXTURE FOR CONNECTING-RODS

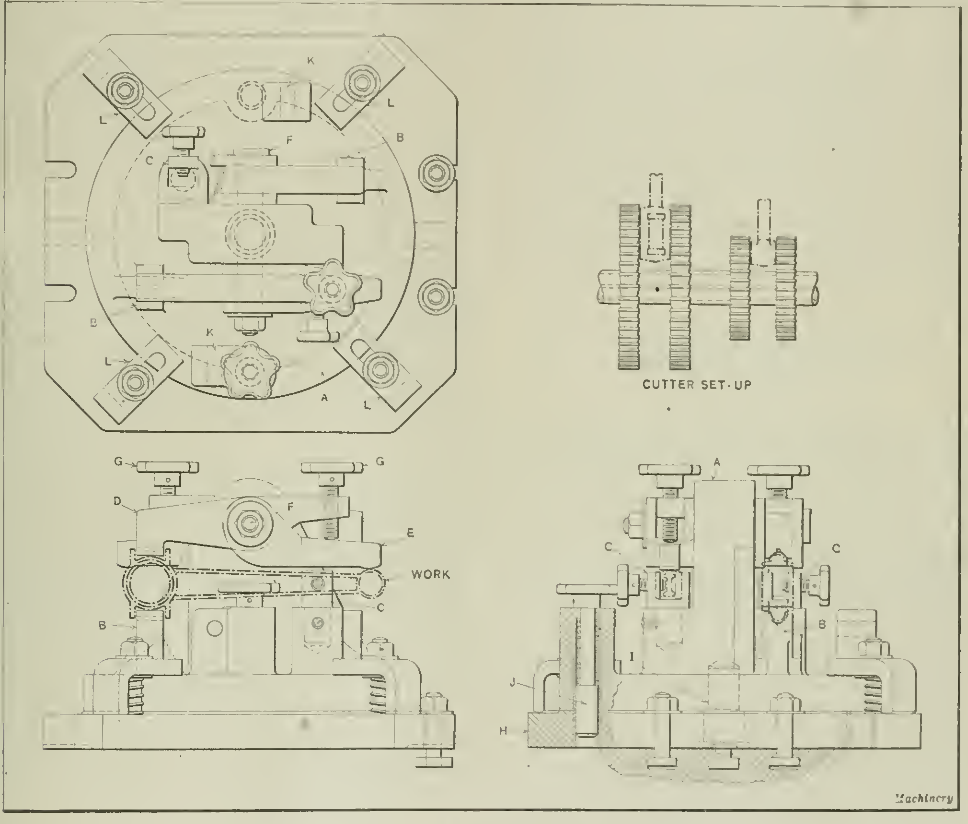
By CLARENCE M. SCHLEH

In machining the faces of crankpin and wrist-pin bearings of automobile connecting-rods it is essential that these surfaces be finished correctly in relation to each other, and also that they be held as closely as possible in alignment with the web and bolt bosses of the forging. Connecting-rods are made as light as possible, and so the bolt holes usually have only from ⅛ to 3/16 inch thickness of wall. Therefore, if the bearing faces should be milled off, say 1/16 inch, in relation to the center line of the rod, through some faulty method of setting up the work, and the holes are drilled and reamed by means of jigs, the holes would be located 1/16 inch off the center of the bolt bosses, as the rods are located in the jig for drilling and reaming, from the milled bearing surfaces. One way of accurately machining the bearing faces is by using a fixture such as shown in the accompanying illustration, which is designed for straddle-milling. Its construction and operation are simple.

The fixture is used on a Milwaukee horizontal-spindle milling machine with a double over-arm construction. The bearings on the connecting-rod for which the fixture was designed are of two different lengths. If they were of the same length it would have been a simple matter to make a fixture in which one or more rods could be secured, mill one end of the rods first, then lower the table to permit the cutters to clear the fixture, traverse the latter past the cutters, again raise the table, and finally mill the opposite end of the rods. In the present case this procedure was impossible, because the distance between the cutters on the arbor would have to be altered to suit the two bearings, and so there were but two alternative methods of machining. Either the work must have to be reset for milling the second end or else a fixture must be provided which would permit the milling of opposite ends of two rods at one time, and then could be indexed for milling the other two ends. The fixture developed was based on the second of these principles.

The two connecting-rods are mounted on the fixture as indicated by the heavy dot-and-dash lines, a large end of one rod being placed beside a small end of the other rod. The larger end of each rod is located by having the bolt boss on the lower side rest in the V-groove of a lug *B* cast integral with the rotary body *A*, while the upper bolt boss is held in a V-groove in clamp *D*. Lugs *B* are narrower than the connecting-rod bearing which they support, for a sufficient distance beneath the work to permit the cutters to finish the bearing faces without interference with the fixture. The I-section close to the small end of each rod is supported in the slot of a steel block *C*, which has a shank that is a pressed fit in a hole in the body, and is held by means of a small headless set-screw. The I-section of the rod is forced against the inside wall of the slot by means of an adjusting screw. This locating arrangement permits both bosses on the large end of each rod and the web to be brought approximately in line with the cutters.

After a connecting-rod has been located as described, it is secured in place by means of clamps *D* and *E*, the former bearing on the large end as already mentioned, and the latter on the small end. There are, of course, two sets of



Indexing Fixture used in straddle-milling the Bearing Faces of Automobile Connecting-rods clamps, all four fulcruming on pin *F*. Each set of clamps is brought to bear on the corresponding connecting-rod by adjusting a screw *G*, which is contained in a threaded hole in clamp *D* and bears on clamp *E*, thus affording a quick-acting device. Body *A* may be rotated on base *H*, being pivoted on the vertical pin *I*, and there are two bushings located 180 degrees apart to accommodate spring plunger *J*. When the plunger has been placed in either of these bushings, body *A* is clamped to base *H* by means of clamps *L*. Then the work is fed past the cutters mounted on the arbor as shown in the upper right-hand corner of the illustration until the ends nearest the cutters have been machined.

The table is next withdrawn, clamps *L* loosened and swung sidewise, plunger *J* lifted and body *A* revolved by means of a round bar inserted in either one of the holes *K*, until the plunger, as it rides on the finished surface of the base, springs into the bushing opposite the one in which it was placed during the first step. After clamps *L* have been retightened, the opposite ends of the work are fed past the cutters, and when the machining of these ends is completed, the table is again withdrawn and two new rods are mounted in the fixture. Base *H* is held in the correct alignment on the table by two keys attached by means of screws in slots on the under side of the base, these keys fitting the center T-slot of the table. The base is attached to the table by means of four bolts. It is preferable for a machine to be equipped with two of these fixtures, as then, while the work in either of the fixtures is being fed past the cutters, the other fixture may be indexed or reloaded with unfinished forgings. Thus an almost continuous milling operation will be obtained.

* * *

HYDRAULIC ACCUMULATORS AND PIPING SYSTEMS

By A. SEARLES

To the writer's knowledge, there is no class of factory equipment that requires more painstaking care in the design, installation, and operation than that included in hydraulic systems, on account of the severe service to which such equipment is subjected as well as the danger involved by storing up an enormous amount of energy, the release of which, due to the failure of some part to function properly, might cause serious damage. This is especially true of systems having an accumulator of large capacity, where the stored energy amounts to millions of foot-pounds, including floating ballast weighing several hundred thousand pounds.

To begin with, a consideration of the accumulator may be of interest. There are two types of accumulators in common use, namely, those having a stationary ram with the ballast attached to the floating cylinder, and those having a ram attached to, and movable with, the ballast weight. The former arrangement is the more common, although open to some rather serious objections as to accessibility for repairs to the parts most usually in need of attention, such as the ram, which may in time become so badly scored by the packing and foreign material that excessive leakage and consequent loss of power make it imperative that it be removed and refinished. If a cast-steel ram proves defective and leaky from sponginess, for instance, a total dismantling of the accumulator is necessary in case the ram is of the stationary type. This is no small task, involving as it does the removal of the cylinder, and ballast, the latter often weighing several hundred thousand pounds and consisting of such material as iron ore or steel punchings, the removal of which requires considerable manual labor. The movable ram, on the other hand, may be detached from the ballast tank and lifted clear without disturbing the other parts. This type also permits easy access to the gland bushing of the cylinder, which must be replaced on account of the reduction of the ram diameter if the latter is refinished. An accumulator of this design also has the advantage that the outside of the cylinder may be inspected for leaks without difficulty; while the ballast of the previously mentioned design hinders or prevents such an inspection.

Construction of Accumulators

The materials from which accumulators are constructed should be given careful consideration. For moderately high pressures of 1600 pounds or less, cast iron is satisfactory for both cylinder and ram, as the castings can generally be relied on to be free from blow-holes and such defects as result in leaks. Cast iron of a proper grade, namely, gray iron, also seems to lubricate easily, probably due to the graphitic content; at any rate, under reasonable conditions the ram soon takes on a glossy surface, thus promoting the best operating conditions. For higher pressures, the cylinder is usually made of cast steel, and while the same material is commonly used for the ram, it is not to be recommended, as a steel casting of such proportions is frequently honeycombed, and although it may withstand a pressure test, subsequent and continued operation may eventually force the water through, and open serious leaks in the spongy spots. Considering that such a condition may not be entirely corrected by plugging or electric welding, it is much more satisfactory to equip the accumulator with a forged steel ram in the first place. Although the first cost may be slightly greater, the additional insurance against leakage would seem to be justified.

Accumulator gland packing requires careful attention in that it must be fitted and compressed to avoid leakage, as all leaks represent a considerable loss of power since, for instance, a loss of 14.3 pounds of water per minute from a system operating under a pressure of 1000 pounds per square inch represents one horsepower and a proportionate power loss at other pressures. Soft metallic packings seem to give good results for accumulators, without wearing the ram unduly as is often the case where hemp and other hard fabric packings are used. A means of lubricating the ram is found advantageous when water is used as the fluid medium in the system. Lubrication may be accomplished satisfactorily by attaching a ring or swab of absorbent fabric to the outside of the gland and encircling the ram; this ring is kept saturated with oil which works off on the ram through contact with the ring.

To prevent such awkward and dangerous occurrences as the over-traveling of the accumulator due to the failure of the by-pass valve or pump regulator, which would result in pumping the moving element of the accumulator up to such a point that the ram emerges from the cylinder with the probability of a serious wreck from the falling of the moving element, manufacturers provide release holes in the ram which become uncovered or exposed when for any reason the accumulator over-travels. These holes are drilled radially in relation to the axis of the ram and enter the central hole in the ram, thus forming a vent to the whole system; they must be sufficiently large to relieve the system as fast as the pumps can deliver.

Design and Installation of Piping Systems

Hydraulic piping systems must be carefully designed and installed so as to avoid as far as possible any danger to life and property. A case is known where a large accumulator was wrecked, because the piping was of such capacity as to permit the accumulator to drop at an excessive speed. This may be avoided by so proportioning the piping as to prevent an excessive rate of flow, or by properly regulating the operating valve opening to the presses, but better still by installing a suitable check valve at the accumulator connection. This valve has a hole which regulates or throttles the flow from the accumulator, but opens, if necessary, to permit the pumps to deliver at a higher speed. This arrangement has the added advantage of safely regulating the lowering of the accumulator in case of failure in the system, such as a split pipe, joint gasket blow-out, or other causes tending to release the water at an undue rate. The piping of a hydraulic system must be rigidly restrained at short turns to avoid the danger of breaks due to the jarring and springing resulting from the sudden changes in speed of water flow due to the sudden opening and closing of operating valves. For this reason it is desirable to install piping with long bends of pipe, where possible, in place of short-radius fittings. Even when this is done, if the runs of pipe are of such length as to involve a large capacity of water, representing considerable force at high rates of flow, additional protection of the pipe from shock must be provided by the installation of shock valves.

Location of Pipes

Where possible, it is best to install high-pressure pipe in trenches below the floor level, as overhead installations increase the danger to operators from leaks due to splits in the pipe and failure of joints. It is also a better location for the restraining devices at the pipe elbows. An overhead system may transmit disagreeable if not dangerous vibrations to the building. Flanged pipe joints, which are commonly used, should be guarded by a metal ring as a matter of safety to operators in the event of a leak.

Oil and water are the liquid mediums used in hydraulic systems. Oil has the advantage of lubricating the moving parts throughout the system and maintains an excellent condition of such parts as accumulator rams, pump pistons, and press rams, but has the disadvantage of higher cost, while water is a fair substitute, if treated with a good emulsifying lubricant, such as used for cutting compounds.

Some systems give trouble from considerable heating of the fluid medium due to the small storage capacity, which does not present sufficient radiating surface to carry off the heat generated by the friction of the fluid flowing through small passages in the system, such as partially closed operating valves, or from by-passing when the pump regulator has cut the pump off the line. This is often destructive to packings, and it may be found necessary to discharge the liquid into a cooling apparatus before returning it to the storage reservoir.

Advantages and Disadvantages of Direct System

Generally a system which pumps directly to the presses without an accumulator is more economical from the standpoint of power, as many operations require full pressure for only a short portion of the stroke of the press. However, this arrangement has certain disadvantages. If the operation is such as to limit the stroke definitely at a certain point, the pressure will increase enormously, and probably cause damage to the equipment, although relief valves may be installed to safeguard against this condition. Again, unless the system is quite free from leaks, the pulsations of the pump strokes may be so amplified as to show in the product, especially extruded material. In order to effect a saving of power, a double-pressure system is frequently employed, which involves a double-pressure pump or two pumps —one for low and the other for high pressure. This further complicates the piping and valves, and may even require two accumulators. The low-pressure pump operates during the early portion of the stroke and when insufficient to continue its operation, is discontinued and the high-pressure pump applied. The direct system necessitates the use of individual pumps for each press, while the system including an accumulator may serve more than one press.

Operating valves may be considered as necessary evils, as they require the most constant and careful attention to insure against leaks; consequently the first consideration in their design is accessibility for repairs—they should be so constructed as to obviate the necessity of removal from the line for repairs and repacking. For pressures up to 1600 pounds per square inch, some forms of balanced piston valves give satisfaction, but pressures of 4000 to 5000 pounds require a poppet type of valve which may need frequent refacing of the seats due to wire drawing.

MAKING BLANKING DIES

By J. F. THORNTON

Antiquated methods and devices, many of which cause undue strain on the workmen's eyes, are still employed to a considerable extent in making blanking dies. The use of such methods and devices should be discouraged, and it is the purpose of this article to explain a method that should have a wider application in diemaking, and come into more general use among diemakers to replace the older, inaccurate, and time-wasting methods. Endeavoring to "split a scribed line with a file," that is, relying only on one's ability to determine by sight when the metal has been filed away until the center of the scribed line has been reached, is a practice that should be discontinued, as the method here described and illustrated will, in almost every case, give more accurate results and permit the work to be done in much less time.

An outline of the opening in a simple piercing and cutting-off die is shown in the upper left-hand corner of Fig. 1. The making of a die of this kind is facilitated by the use of hardened disks as guides for the diemaker's file, the posi-

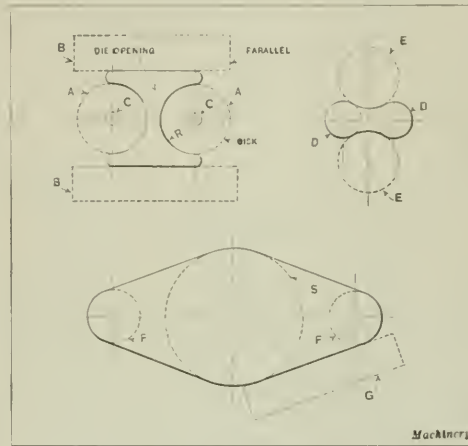


Fig. 1. Use of Hardened Disks and Parallels to guide File when filing Die Opening

tion of these disks being indicated by the dotted circles *A*. Hardened parallels, the positions of which are indicated by the dotted lines *B*, are also used as guides when filing the straight portions of the die-opening. The disks should ordinarily be made from stock 1/8 or 3/16 inch in thickness. As the profile of the punch used with this die is exactly the same as the profile of the work, the radius *R* of the die should be slightly smaller than the radius of the work. The metal to be punched in this case is steel, so 1/40 the thickness of the stock should be subtracted from the radius of the work in order to obtain the correct radius *R* for the die. For work requiring ordinary accuracy, or for work having limits of plus or minus 0.002 inch, the disks may be turned and bored on a lathe, and then hardened. When extreme accuracy is required, they should be hardened and ground all over and located by the use of gage-blocks or a height gage. The disks employed in making dies can be used over and over, so that it is not usually necessary to charge up the cost of making them to any one job. A set of parallels and disks consisting of four 2-inch and four 4-inch parallels, and a few disks of the more commonly used sizes will cover a surprisingly large range of work, and should be included in every toolmaker's kit. Disks which are not of a standard size should be stamped with the tool or die number on which they are used, to facilitate identification.

Since the forms or outlines of practically all dies consist of combinations of true geometric figures, it is evident that there are but few cases in which disks and parallels cannot be used to advantage. The disks and parallels, or "masters," as they are sometimes called, are intended to be used as guides for the workman's file, and thus prevent the opening in the die from being filed beyond the limiting profile line. It is true that a file in the hands of a careless workman will be quickly dulled by continually striking the hard edges of the disks, but the number of unskilled workmen to be found in tool-rooms is, or should be, very small.

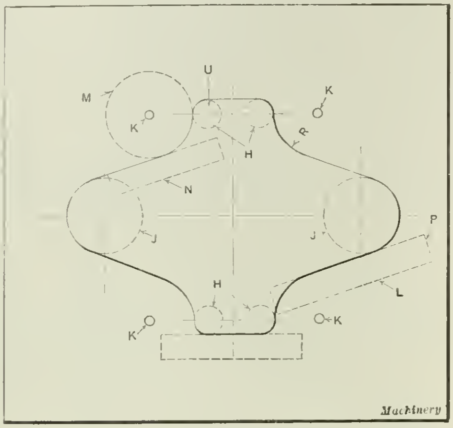


Fig. 2. Method of drilling Small Holes in Die to facilitate Location of Disks

Regarding the setting of the disks *A*, the two piercing holes *C* should first be laid out, drilled, and reamed. The disks in this case should have central holes of the same diameter as the piercing holes in the die. This permits the disks to be located by pushing small plug gages through the holes in the disks and into the die. The disks may be clamped or soldered in place, great care being taken, if they are soldered, to see that the heat does not change their position. Parallels *B* are then located in their proper relation to the disks, after which the core of the die is removed by drilling or sawing. The locating or attaching of the "masters" before removing the core will prevent drilling or sawing into the metal beyond the outline of the die profile.

In making a die having a profile such as indicated in the view at the upper right-hand corner of Fig. 1, it is evident that holes *D* should be laid out and bored first, after which plugs placed in these holes may be used in locating hardened disks in the positions indicated by the dotted circles *E*. After the disks have been attached to the die, the plugs are removed from holes *D* and the die opening filed to shape.

The method of using disks and parallels in making a die having an opening or profile such as indicated in the lower view in Fig. 1, is evident, and should require but little explanation. The positions and relative sizes of the disks required in making this die are indicated by the dotted circles *F* and *S*, while the position of one of the parallels is indicated by the dotted lines at *G*.

The contour or outline of the die shown in Fig. 2 is such that all the disks or "masters" required cannot be placed on or attached to the die at one time. After the four holes *H* and the two holes *J* have been bored, four small holes *K* should be drilled in the die, if this is permissible. The drilling of these small holes will facilitate the placing of parallels such as indicated by the dotted lines at *L*. After the sides of the die opening determined by these parallels have been finished, the parallels are removed, and disks having the correct radius *R* are attached to the die, being located by holes *K*.

The position of one of the disks located in this manner is indicated by the dotted circle at *M*. If it is not permissible to drill holes *K* in the die, the disks may be located against parallels clamped to the die. The correct position of a parallel used for this purpose is indicated by the dotted lines at *N*. With a parallel in this position, the disk can be properly located by bringing its edge into contact with both the parallel and a plug inserted in hole *H*. After attaching the disk to the die, the plug and parallel are removed, and the profile of the die filed to shape in the manner previously described.

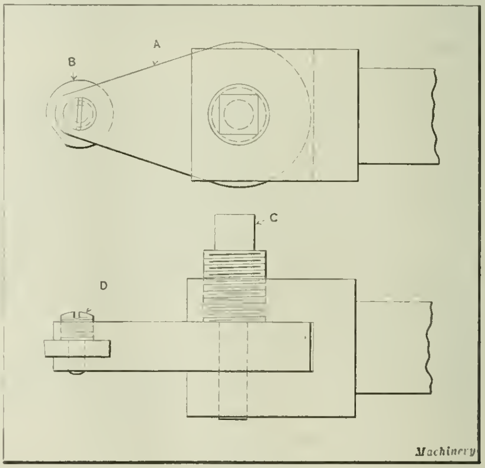
The "masters" are exceptionally useful when making shaving and burnishing dies having perpendicular walls or no clearance angle. For dies of this kind disks should be placed both on the face and on the back of the die blank. Care must, of course, be taken to see that the face of the die is parallel with the back of the die, and a height gage or other accurate gaging methods must be employed in setting the "masters." It is the writer's belief that using disks as described, instead of attempting to file to scribed lines will reduce the cost of diemaking as much as 60 per cent.

* * *

CHAMFERING TOOL

By HARRY MOORE

In cutting either internal or external threads on a hand-screw machine, it is necessary to chamfer the end of the work before bringing the threading die or tap into operation. The tool shown in the accompanying illustratiou was designed to perform the required chamfering operations, and it proved more satisfactory than the hand tool commonly employed for this purpose. In addition to performing chamfering operations, it is also used for cutting rings in faces of fittings which are required to be water-tight.



Adjustable Chamfering Tool

Referring to the construction of the tool, piece *A*, which holds cutter *B*, is drilled to receive the special holding screw *C*. The front end of part *A* is slotted and tapped for the screw *D*, which holds cutter *B* in place. All parts are made of machine steel except cutter *B*, which in this case is made of tool steel. In setting the tool, arm *A* is swung and cutter *B* adjusted to give the required chamfer. When properly set, screws *C* and *D* are tightened to hold the cutter in position. The advantage of using a cutter of circular form is that as the position of arm *A* is altered, the cutting face of the tool can be swung around to produce a 45-degree chamfer. The circular cutter can also be ground many times before it is necessary to replace it.

ASSEMBLING DEVICE FOR PULLEYS, HANDWHEELS AND GEARS

A motor-driven draw-bench is used by the Hopedale Mfg. Co., Milford, Mass., for forcing such parts as handwheels, pulleys, and gears on the ends of shafts which have previously been lined up in their machine bearings. This device is used primarily in connection with the erecting of cotton looms, the crankshafts of which extend beyond the sides of the frame and carry pulleys and similar parts which are regularly assembled after the crankshafts have been fitted in their bearings. Although this device was especially constructed, the principle involved is of general application where assembling methods of a like nature are encountered.

The device consists of a four-legged iron table on which is mounted a reversing motor which drives a train of reducing gears, compactly mounted on the top of the table. The table top is not more than 2½ feet square, and when not in use the entire device takes up very little space. The final gear in the reducing train is fitted to a hollow threaded arbor so that as the gear revolves it advances on this arbor. On opposite sides of the table top there are cast two slotted lugs, the slots being about 2 feet apart, the position of which is indicated in the diagrammatic sketch which accompanies this article. Two long reach-rods, yoked together as shown at *A*, are used when drawing the parts to be assembled on the projecting end of the crankshaft. The nuts for the threaded end of the two long rods form a bearing against the vertical surface of the lugs on the table, while the bar which joins the two rods rests against one arm of the crankshaft. The threaded arbor previously mentioned has a hole extending through it which is of sufficient diameter to receive the projecting end of the crankshaft, so that as the hub of the gear advances into contact with the handwheel, gear or pulley, as the case may be, the part will be forced on the shaft. The pressure exerted against the end of the part to be assembled has a tendency to force the table

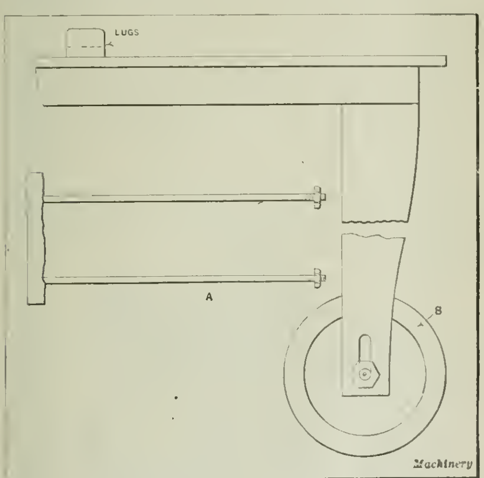


Diagram illustrating Features of the Assembling Device

away from the side of the loom, but this is prevented by the brace consisting of the two rods and yokes as previously mentioned.

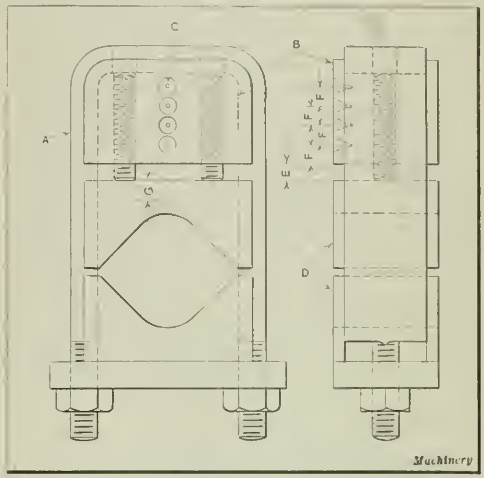
Obviously, there must be some means of adjusting the height of the table so as to bring the center of the threaded arbor into alignment with the center line of the crankshafts of different sizes of looms. This is accomplished by a very simple means. A circular sheave is attached to each leg in a fixed position by means of a bolt passing through an elongated slot. The sheave can then be secured so as to bring the level of the table to the required height, and for the purpose of locomotion a steel rim *B* revolves on the fixed sheave as a center. This arrangement also permits variations in floor levels to be quickly compensated for. By having a reversible motor it is a simple matter to strip such parts as handwheels, etc., from the crankshaft.

* * *

ADJUSTABLE OFFSET DEVICE FOR CRANKSHAFTS

By D. R. GALLAGHER

Automobile repair shops generally keep on hand a quantity of offset fixtures for use in mounting crankshafts between the centers of machines when desiring to turn or grind the crankpins, it being necessary to have a number of fixtures



Adjustable Offset Fixture used in re-turning or regrinding Crankpins

on account of the difference in dimensions existing between crankshafts of various makes and sizes of cars. Although the diameter of the end bearings may be the same on a number of crankshafts, the length of throw is likely to be different. The accompanying illustration shows an offset fixture which is adjustable for the diameter of the end bearings and for the length of throw. It consists essentially of a bent strap *A*, which is finished on all sides, a block *B* provided with four centers *C*, and two sliding V-blocks *D*. One of these devices is placed on each of the end bearings of the crankshaft, blocks *D* being slid apart enough to admit the bearings. The crankpins to be machined must, of course, be in alignment with one of the centers in block *B*. That center which is nearest to the center of the crankpin when the fixture has been placed on the crankshaft is selected as the one to be used in mounting the crankshaft on the machine. The axes of the crankpins are then brought accurately in line with the center to be used, through the adjusting screws in block *B* which control the distance between this block and the upper one of blocks *D*. Blocks *D* should be kept parallel, and feelers used to insure that distance *E* on both offset fixtures is identical. Each offset fixture is finally tightened on the crankshaft by means of the nuts on strap *A*. After a little practice a workman can make necessary adjustments quickly.

Strap *A* may be made from a forging, and block *B* from machine steel and pack-hardened or from a non-shrinking tool steel. The distance *F* between the various centers should be located accurately in each pair of offset fixtures. V-blocks *D* should also be made from steel, hardened and ground to a sliding fit. Dimension *G* must be the same in each fixture of a pair to obtain accurate results. This dimension may be determined by plug or ball measurement.

The Metal-working Industries

THERE has been but little change in conditions in the metal-working industries during the last month. The conditions in the industries throughout the country are practically the same as in the New England district, where the Federal Reserve Bank of Boston made a complete survey covering the month of July. This survey shows that in New England these industries as a whole are operating at approximately one-third capacity, but there is great variation as regards different plants; a few shops work full time, while some are entirely closed down. Activity is greatest in plants making tools, supplies, and hardware for the building trades, and some business is reported from drop-forging plants. A manufacturer of pumps reports the last six months as the best in the history of his business, this line having suffered relatively little from the depression.

While cancellations are now but few, as there are but few old orders on the books that would be subject to cancellation, manufacturers are frequently asked to suspend shipments of machines or other products. A Connecticut manufacturer says: "We have on our books a large volume of business which has been manufactured and is now being held in our shipping rooms, as our customers have held up the orders."

The price situation in the iron and steel industry has been one of the chief problems confronting manufacturers in the metal-working field, and one firm states that it is impossible "to look for improvements until steel prices are sufficiently stabilized so that customers feel reasonably assured that the bottom has been reached, at least temporarily."

The Iron and Steel Industry

There is still comparatively little activity in the iron and steel industry, pig iron production being estimated at 30 per cent of normal, and steel ingot production at slightly over 25 per cent of normal. The only mills reporting improved business are those engaged in sheet metal rolling, several mills having been reopened; but there is evidence of better demand for pig iron and inquiries and orders for steel are increasing, although much of this business is done at the expense of price cuts. A gradual if slow increase in the buying of railway and building materials is reported, and the pig iron market shows a tendency toward becoming more active, due, doubtless, to the low prices now being quoted for this raw material, various grades being sold at base points at from $18 to $20 a ton. The corresponding grades a year ago were quoted at $46 and $46.50 a ton. Prices of finished steel average 2.36 cents a pound, compared with 3.94 cents a pound a year ago. The average price for ten years previous to the war for the same grades of finished steel was 1.68 cents a pound.

The Automobile Industry

So far, seventy-two automobile manufacturers have announced reductions in the prices of their cars. Some of the prices announced are back to the 1918 level. While there has been some revival in sales in consequence of these price cuts, the reductions have not affected the market to the extent expected by the manufacturers. The public appears to be expecting still further reductions, losing sight of the fact that present conditions, taxes, increased overhead due to decreased production, are factors to be reckoned with in making a selling price that will not mean a loss to the manufacturer. Measured in percentages, the reductions range from 5 to 35 per cent; the average reduction announced by forty-five companies is 15 per cent.

The National Automobile Chamber of Commerce reports that production of passenger cars and motor trucks during the second quarter of the year was 87 per cent of the production figures for the corresponding period of 1920, which is a figure that will surprise a great many, and shows that the automobile business surpasses most other industries during this period of depression. Partly, this record is due to the high average maintained by the Ford factories, whose production schedule for August called for 117,800 cars and trucks from all the plants owned by the corporation. This is the highest production for any one month on record. The Buick, Hupp, White, Chandler, Jordan, and Dodge plants also report increased production, while the Willys-Overland reduced its August schedule and is laying off men. The Akron tire industry is reported operating practically on the 1918 level, which is considered normal.

Machine Tool Exports

The exports of machine tools during June, 1921, the last figures published by the Bureau of Foreign and Domestic Commerce, amounted to $460,000 as compared with $2,370,000 in June, 1920. Perhaps the most noticeable falling off in machine tool exports is to England, the June exports this year amounting to only about $28,000. It was $560,000 for June a year ago. Belgium took $60,000 worth of machine tools in June, 1920, and only $2,000 during the same month this year. The exports to Canada show a very decided falling off, amounting to over $44,000 in June, as against $101,000 in April, this year, and $410,000 in June, 1920. Mexico remains a good customer, taking nearly $50,000 worth of machine tools in June, France following closely with a similar amount. Japan heads the list with nearly $75,000, and China more than $25,000 worth. In May there was an unusually large shipment of machine tools to the Dutch East Indies, amounting to nearly $60,000.

Compared with 1913, the value of the exports of metal-working machinery (statistics prior to 1918 include machine tools under that general heading) in May, 1921, was at the rate of 110 per cent of the average monthly shipments of metal-working machinery in 1913; 145 per cent of the average shipments in 1912; 182 per cent of the average shipments in 1911; and 295 per cent of the average shipments in 1910. This indicates that present exports are low only when compared with the unusually large volume during and immediately after the war.

Labor Conditions

The announcement has been made that the Erie Railroad has leased its shop at Marion, Ohio, to a private company which can operate it without being bound by the labor union rules governing the railroad shops. This may prove to be the only way in which efficiency can be attained in locomotive repair shops, for it is only too well known that irrespective of the wages paid, these rules have increased costs. Union wages will be maintained in the shops operated by the private company, but the work and methods will be in accordance with the best manufacturing practice and free from rules which reduce efficiency without in any way benefiting the worker.

The building of small homes is brisk in many sections of the country, and wherever new wage arrangements have been made with the labor unions, increased activity is also noticeable in the construction of office and factory buildings. Employment in fourteen major industries reported upon by the Federal Reserve Bank in the New York district indicates improved employment conditions in nine industries, stationary conditions in two, and decreased employment in three industries—the iron and steel, car building and repairing, and paper-making.

NEW MACHINERY AND TOOLS

THE COMPLETE MONTHLY RECORD OF NEW AMERICAN METAL-WORKING MACHINERY

The New Tool descriptions in MACHINERY are restricted to the special field the journal covers machine tools and accessories and other machine shop equipment. The editorial policy is to describe the machine or accessory so as to give the technical reader a definite idea of the design, construction, and function of the machine, of the mechanical principles involved, and of its application.

Garrison Gear Grinding Machine

An automatic machine for generating and grinding the involute profiles of spur gear teeth has been placed on the market by the Garrison Gear Grinder Co., of Dayton, Ohio. Gears which have previously had their holes hardened and ground and been roughed out on a gear-cutting machine leaving a grinding allowance of from 0.008 to 0.012 inch on the tooth thicknesses, are mounted on the work-spindle of the gear grinding machine and have the teeth generated and ground to the correct form and size. This operation takes about the same time required for taking a finishing cut on a gear-cutting machine. The grinding wheel is dressed on both sides to the pressure angle of the teeth and to the correct thickness. It is traversed back and forth through the gear tooth spaces by means of a ram.

The gears being ground are indexed one tooth after each stroke and fed toward the wheel slightly after each revolution of the latter, thereby accomplishing the generation of an involute. The gears are rotated slightly each time the table is fed over, through a hardened and ground master gear on the outer end of the spindle and a master rack.

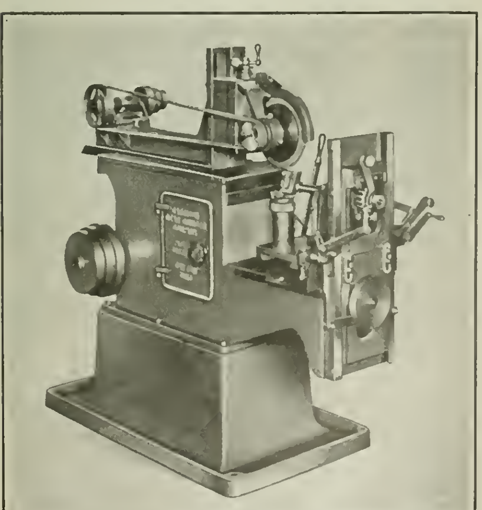


Fig. 1. Automatic Gear Grinding Machine developed by the Garrison Gear Grinder Co.

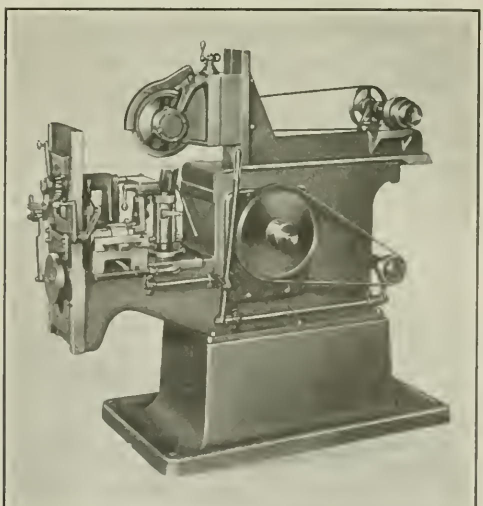


Fig. 2. View of Right-hand Side of Garrison Gear Grinding Machine

By this arrangement a new tooth surface is presented to a new surface on the grinding wheel after each revolution of the wheel. This prolongs the accuracy of the wheel by distributing the wear over a comparatively large area. As the master rack is meshed with the master gear at all times when the grinding wheel is in contact with the work, an accurate spacing of the teeth is insured. Any given tooth is not touched a second time by the grinding wheel until the gear has been indexed through a complete revolution; in this way, the generation of heat in the gears being ground is avoided.

The machine is so designed that after being adjusted for grinding a gear of given dimensions, an unskilled operator can run several of them on gears having as few as twelve teeth, and more machines in proportion to the number of teeth. No adjustment of the grinding wheel is necessary subsequent to dressing, and so, after the dresser is once set for truing a wheel to grind a certain size gear, the wheel may be dressed repeatedly without any change in the size of the gear teeth. The wheel is fed downward for the dressing step, diamonds being used for this operation. All feeds and the stopping of the machine at the completion of an operation, are automatic. It is not necessary to stop the grinding wheel in order to load or unload the machine as the work-table can be moved over to eliminate interference. The machine is suitable for grinding gears of from 2 to 9 inches in pitch diameter and any number having a combined width of 3 inches or less. It is adapted for grinding wheels of from 6 to 10 inches in diameter. The machine complete with a countershaft weighs approximately 1500 pounds.

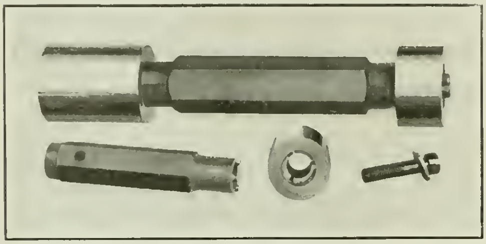


Fig. 1. Assembled and Disassembled Plain Plug Gage made by the Pratt & Whitney Co.

PRATT & WHITNEY GAGES

A new line of palin and thread plug and templet gages has just been placed on the market by the Pratt & Whitney Co., Hartford, Conn. The plain plug gages are made of an alloy steel and are machine-lapped by a modification of the Hoke process which results in a finely finished surface entirely free from circular grooves. The gages are of uniform size from end to end to such a degree that no errors are shown by measuring machines, fluid gages, or amplifying gages. The ends are reversible and their sizes are marked on them instead of on the handle. The "Go" ends are held to a small plus limit from the marked size to allow for wear, while the "Not Go" ends are held to a still smaller minus limit as they are subject to little wear. All blanks are well seasoned before lapping.

The handles are made of hexagonal stock and the plugs are secured to them by a novel method. Three prongs, whose sloping sides form an included angle of 90 degrees, are provided on each end of the handle; these prongs engage three grooves machined in the gage ends, the sides of the grooves forming included angles of 75 degrees. The wedge-like prongs are forced into the grooves by means of a single screw inserted through the plug. In this way, the gage ends are so secured that they can neither rock nor shake and so destroy the sensitiveness of the "feel." The head of the screw used in attaching the "Go" end to the handle is below the surface of the plug end, while the head of the screw on the "Not Go" end projects slightly. This design insures that the gage will always be in an upright position with the heavier end down. All sizes of handles are made in either the single- or double-end design. A hole is provided through the handle to permit of hanging the gage on a nail when desired, and if the gage becomes fast in work being inspected, a file tang or some other suitable object may be inserted in the hole and used to free the gage. These gages are now made in various sizes ranging from 5/16 to 2 inches in nominal diameter, but smaller and larger sizes are made.

The various styles of thread gages shown in Fig. 3 are made from the same alloy steel blanks as the plugs of the gages just described. The "Go" and "Not Go" ends are made interchangeable with the plugs and either length can be used according to a customer's preference. Short gages are particularly recommended for threads of fine pitch. The gages are secured to the handles in the same manner as the plug ends, so that the same rigidity is obtained and the sensitiveness of touch is not lost. The gages shown at *A* and *B* are single- and double-ended, respectively. That shown at *C* is a protected master gage, so called because it is impossible to screw it into a hole and thus impair its accuracy. It is used as a standard for checking thread plug gages by means of a measuring machine, micrometer, etc. The gage shown at *D* is used for setting thread gage templets, the threaded end being a duplicate of the thread in the templet, while the plain end is used for checking the root diameter.

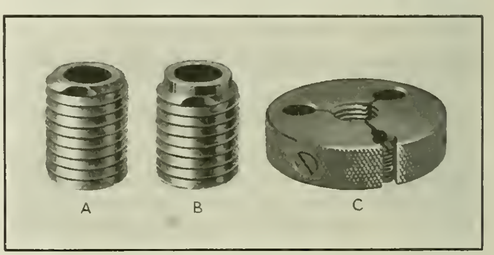


Fig. 2. (A) and (B). Gage End Details showing Chip Groove and Pilot. (C) Adjustable Thread Templet Gage

The gage shown at *E* is a non-reversible thread plug gage. This style is used for sizes ½ inch in diameter and smaller and for larger sizes where the reversible feature is not desired. The surfaces of the handle and thread plug in contact are tapered and so the parts cannot work loose after being driven together. Where the limits specified on the work are very large, extreme accuracy is not required of the gages, and so working gages made to tolerances recommended by the National Screw Thread Commission are made in different forms and sizes for such work. These gages have the same appearance and wearing qualities as master gages, but are not lapped, being ground to size instead, with an allowance of about 0.0005 inch for wear.

A feature of the plug thread gages is the groove provided for carrying dirt and chips ahead of the gage when the latter is being entered into a hole. This groove may be seen at the top of the thread plug shown at *A*, Fig. 2. It avoids the wedging of dirt or chips between the threads of the gage and those of the work. A modification of this style is shown at *B*, in which the first convolution of the thread is removed to form a pilot of the root diameter. This pilot is of assistance in entering the gage in running work or when the gage is held in a reversing speed lathe and the work fed to it while running.

A thread templet gage of the familiar round type, but having an improved adjustment, is shown at *C*, Fig. 2. The adjusting screw is short and tapered and is placed parallel to the axis of the gage. One full turn of this screw changes the effective diameter of the gage about 0.001 inch, and adjustments finer than 0.0001 inch can be made. The first thread of the templet is chamfered to the angle of the thread

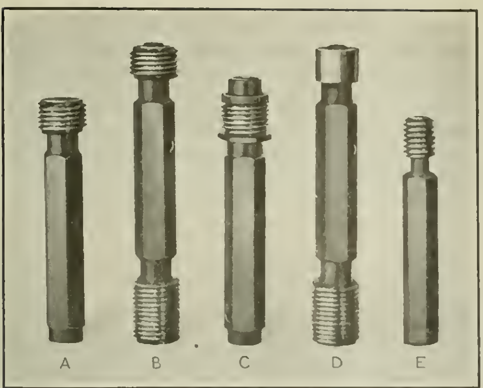
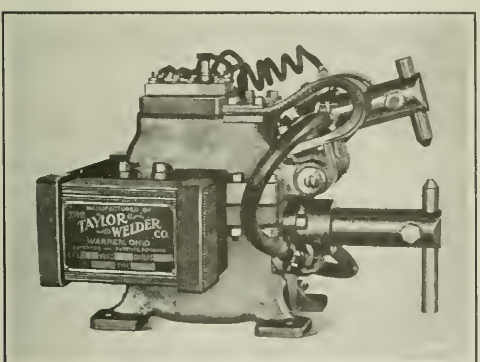


Fig. 3. Various Styles of Thread Plug Gages, with Reversible Ends on All but One

for ease in starting. The chip groove of the thread plug gage can be furnished on the templet gage but this is not usually necessary because a male thread can be more readily cleaned than the threads of a tapped hole, and moreover, the slots in the templet provide chip space.

TAYLOR BENCH SPOT WELDER

The type S-4-B bench spot welder now being built by the Taylor Welder Co., 12 Atlantic St., Warren, Ohio, is shown in the accompanying illustration. This machine is recommended for spot-welding sheet metal of light gage, cross-wire welding, welding contact points of platinum or tungsten to steel, and brazing and soldering small parts of electrical instruments, optical goods, etc. A special feature of this machine is the cast-copper frame which acts as a secondary. The lower horn may be set at three different heights on the

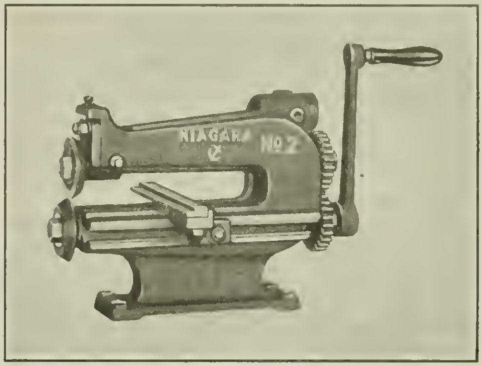


Bench Type Spot Welder built by the Taylor Welder Co.

frame to suit the work, by the provision of different sets of holes. A long electrode is provided on this horn to suit the various settings. Cooling of the machine is accomplished by the circulation of water in the upper and lower horns. The horns are made of cold-drawn copper and are $1\frac{3}{4}$ inches in diameter. The greatest movement of the upper electrode is 1 inch and when this electrode is lowered the minimum distance between the horns is 3 inches and the maximum, 5 inches. The machine is operated through a foot-pedal. One set of solid points is furnished with each machine and the weight of the latter is approximately 150 pounds. The machine is equipped with a 3-kilowatt transformer and a 4-step regulator for adjusting the current. The switch is of the automatic single-pole type.

NIAGARA ROTARY SHEAR GAGE

The Niagara Machine & Tool Works, Buffalo, N. Y., recently obtained a patent on a slitting gage that is being applied to rotary sheet metal shears. The accompanying illustration shows a hand slitter equipped with the gage. The gage consists essentially of a bar extending transversely through the gap of the machine and against which one edge of a sheet bears so that it is cut to the required width. The bottom of the transverse bar rests upon the frame of the machine and is connected at the ends to sliding blocks. These blocks may be clamped in any predetermined longitudinal position along the machine so that the distance from the rotary knives to the gaging bar may be altered to suit a job. They are clamped on machined surfaces of the frame by means of T-bolts. The only member of the gage subject to wear is the transverse bar, and this can be readily replaced, as it is located on the sliding blocks by means of

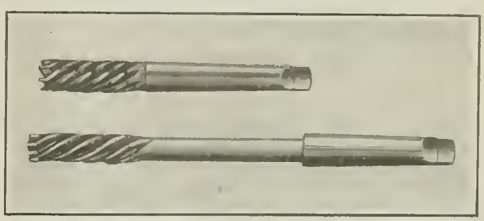


No. 2 Slitter equipped with Gage patented by the Niagara Machine & Tool Works

dowels and attached by bolts. The gage can be removed from the shear when it interferes with such operations as circle or ring cutting.

GAMMONS-HOLMAN END-MILL AND CHUCKING REAMER

The Gammons-Holman Co., Manchester, Conn., has introduced on the market the new types of end-mills and chucking reamers shown in the accompanying illustration. The end of the cutting portion of both tools is made in the usual way while the body is provided with helical cutting edges, the "hand" of the helix being opposite to that of the tool. That is, the chucking reamer and right-hand end-mill have left-hand helical cutting edges while the left-hand end-mill has right-hand helical cutting edges. It is stated that the helical body counteracts the tendency of the straight-fluted end to chatter, with the result that the reamer produces a true smooth hole and the end-mill leaves the surface it mills so smooth that further finishing is unnecessary. There is no chatter of the tools in use.



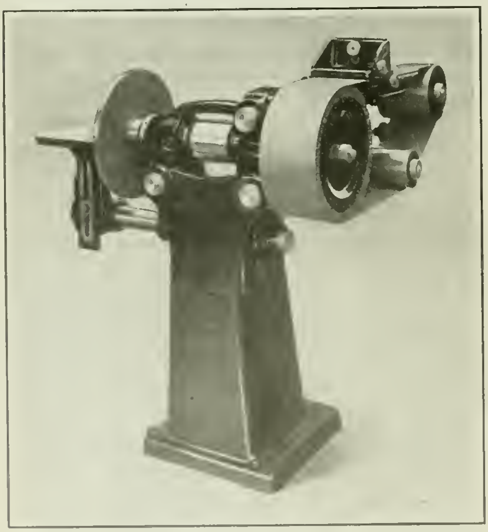
End-mills and Chucking Reamers placed on the Market by the Gammons-Holman Co.

GRINDING AND POLISHING MACHINE

A combination machine designed to handle the work of a disk grinder, a polishing wheel, and a belt-surfacing machine and which, in addition, can be converted into a double-spindle buffing machine or into a light snagging grinder has been developed by the Production Machine Co., Greenfield, Mass., and is known as the "Type R." This machine is adapted for a wide range of work, and the construction is such that three operators may work simultaneously without interfering with one another. The base and head are cast integral, so as to supply the necessary rigid support for the spindle and its bearings.

The spindle is equipped with Timken roller bearings, and these are packed in grease and sealed from dust. On one end of the spindle is mounted a double-faced disk grinding wheel, and on the other end, a patented leather cushion wheel over which an abrasive belt runs. This wheel, together with the belt, is used for a variety of polishing operations. The belt is 6 inches wide, endless, and kept under the proper tension by means of a swinging idler pulley. A table is furnished for use in surfacing operations, and this is equipped with an adjustable rest that facilitates the handling of articles having straight or angular edges. This rest is so hinged that it may be quickly swung over the back of the machine when it is necessary to change the abrasive belt. The idler arm is arranged with a latch, so that the idler may be lifted off the belt and held in a raised position while the latter is being changed.

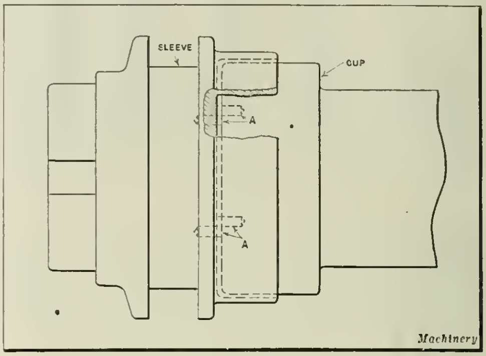
The double-faced disk wheel is reversible. A table is provided for supporting work being ground on this wheel, the table having a rocking seat which enables the supporting of angular work. The table has a vertical adjustment and a circular adjustment on the holding post. The machine is equipped with four holding posts, two in the front and one on each side, and these posts adapt the machine for the application of a variety of fixtures. Some of the principal dimensions of the machine are as follows: Diameter of disk wheel, 15 inches; dimensions of disk-wheel table surface, 9¾ by 8 inches; leather cushion wheel, 14 inches in diameter and 6 inches wide; and surfacing table, 14 by 6½ inches. The spindle speed is 1300 revolutions per minute, and the surface speed of the abrasive belt, 4760 feet per minute.



Combination Grinding and Polishing Machine developed by the Production Machine Co.

JOHNSON FRICTION CLUTCH

The design of the friction clutch manufactured by the Carlyle Johnson Machine Co., Manchester, Conn., has been modified to incorporate a positive locking feature. The load can only be started under friction, but when the clutch is completely engaged it becomes positively locked and so the driven member is rotated constantly at the speed of the driver without any possibility of slippage, due to variations in the load or to other causes. The clutch is operated by an outside shifter sleeve, which carries a sliding wedge between two toggle levers that expand a friction ring and cause the latter to grip the opposing surface of a cup member. On the faces of the cup and shifter sleeve are six pairs of opposing pins *A* spaced equidistantly around a circle. When the clutch is disengaged, both frictional surfaces and the opposing pins are out of engagement. However, as the shifter sleeve is thrown in, the frictional surfaces begin to take the load and practically carry it at full speed before the opposing pins come into contact with one another. Then, the full throw of the clutch having been accomplished, the pins are in engagement so that the clutch drives as a positively locked unit.



Friction Clutch with Positive Locking Feature, manufactured by the Carlyle Johnson Machine Co.

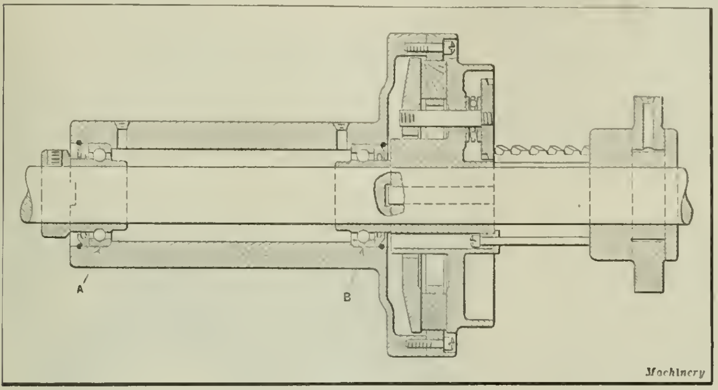
THERMIT-WELDING MOLDING MATERIAL

A new grade of molding material for thermit-welding has recently been brought out by the Metal & Thermit Corporation, 120 Broadway, New York City. It is stated that this material prevents blow-holes, stands up well under the preheating flame, and is extremely porous to the gases generated in the mold so that a sound weld with a clean exterior results. The mixture is composed of three parts clean sharp silica sand to one part of Welsh mountain plastic clay. The sand must pass through a screen of 0.03 inch square mesh, and 40 per cent must be retained on a screen having 0.012 inch square openings. In using the material, the sand and clay are thoroughly mixed together with 1/40 part "Glutrin" compound and sufficient water to bring the mixture to the proper consistency.

HILLIARD CLUTCHES AND COUPLINGS

The line of sleeve clutches made by the Hilliard Clutch & Machinery Co., Elmira, N. Y., is now being equipped with Fafnir ball bearings as shown at *A* and *B*, in order that the clutches may be satisfactorily used for high speeds up to 2000 revolutions per minute. The bearings are of the annular type and are fitted with caps provided with felt washers that exclude dust and retain the lubricant. The use of the ball bearings insures that the sleeve member will be kept in the proper alignment with the member keyed to the shaft, and that the frictional surfaces will always be in the proper plane with each other.

The friction cut-off couplings made by the same concern, for directly connecting centrifugal pumps, generators, and blowers to gasoline or electric motors are now furnished with a Fafnir ball bearing for the pilot. The driving member of the coupling is very similar to that of the clutch illustrated. Provision of the ball bearing in the coupling insures the proper alignment between the driving and driven shafts and satisfactory lubrication. Both the cut-off couplings and the friction clutches are made for shafts of various diameters from 1 3/16 to 3 15/16 inches.



Ball Bearing Modification to the Sleeve Clutch made by the Hillierd Clutch & Machinery Co.

GENERAL ELECTRIC CONTROL FOR DIRECT-CURRENT MOTORS

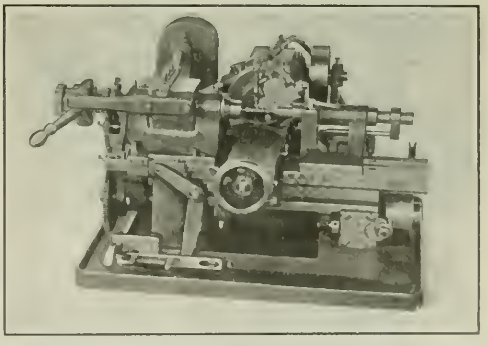
A type of control for direct-current motors of either reversing or non-reversing applications, which is a combination of time and current limit, allows high torque when necessary and minimizes current peaks on light loads, has been designed by the General Electric Co., Schenectady, N. Y. This control system is known as the "voltage drop," being so named from the fact that the relays controlling the accelerating contactors are operated by the voltage drop across the starting resistor of the motor. A current limit system of some sort is considered best for motors subjected to frequent starting and stopping and which are required to operate under varying conditions of torque. Such conditions include applications where the motor is required at infrequent intervals to accelerate loads as high as twice normal, and should be protected from such high current peaks the remainder of the time. This system uses an improved form of shunt contactor and is applied to standardized panels for the control of various types of motors.

WALTHAM AUTOMATIC THREAD MILLING MACHINE

The Waltham Machine Works, Newton St., Waltham, Mass., are now manufacturing an automatic thread milling machine which is intended for manufacturing purposes and is so designed that it may be equipped for a large variety of work. After the work has been placed in position either on centers or in a chucking device, the machine is started by raising a lever at the left end. The feeding of the cutter into the work to the required depth, the milling of the thread, the withdrawal of the cutter after the required length has been milled, the returning of the cutter to the starting point, and the stopping of the machine are wholly automatic. These automatic features enable a number of machines to be handled on some kinds of work by one operator. With multiple threads the operation is continuous until all threads have been milled, so that for a triple thread the cutter would engage the work for its entire length, three times before the machine would stop.

The length of a thread cut by the machine corresponds to the amount of rise on the cam that controls the work-slide, and its pitch is governed by the relation between the gearing from the work-head to the camshaft, and the lead of the cam. The indexing for multiple threads is obtained by a fractional proportion in the gearing and as the work-head revolves continuously there is no backlash to cause inaccurate spacing. The maximum travel of the work-slide is 2 inches, and threads of this length or shorter may be milled. Adjustments enable the milling to be done either close to the work-spindle or in any position not more than 6 inches distant. The approximate locating of the cutter-slide relative to the work-head is obtained by moving the support of the cutter-slide along tongued ways, while the exact location is obtained by adjusting the work-slide cam-shoe attached to a slide at the front of the machine. An angular adjustment of 45 degrees each side of the horizontal is provided for the cutter-head. A special high-speed cutter-head is provided for brass work.

A single belt drives the entire mechanism with the exception of the oil-pump. This is separately driven and pumps oil from a reservoir in the base upon which the machine is mounted. The work-spindle is made of hardened steel; it has a spring collet and is equipped with a lever-closing attachment. The mechanism for automatically stopping the machine can be adjusted to function at the end of one cam revolution or after any predetermined number of revolutions necessary for the cutting of multiple threads. The machine can be modified for cutting helical gears. It may be installed either on a bench or a cabinet base.



Automatic Thread Milling Machine developed by the Waltham Machine Works

DUPLEX CUTTING-END TOOL BITS

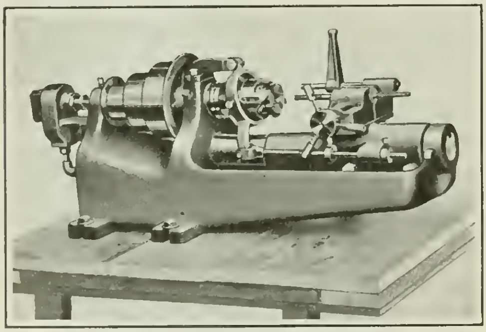
A line of tool bits of various sizes and shapes and having cutting edges ground on both ends, has been introduced by the New England Tool & Machine Co., Inc., 51 Taylor St., Springfield, Mass. A few styles are shown in the accompanying illustration. These bits are intended for being held

Tool Bits made by the New England Tool & Machine Co., Inc.

in tool-holders taking square stock, are cut from annealed bars of high-speed steel, and are hardened and ground. Their size permits them to be checked out from tool-cribs the same as drills and other tools, so as to reduce their loss. The line includes bits of the following styles: Right- and left-hand diamond point, right- and left-hand side, round nose, U. S. standard thread of all pitches, V-thread and cut-off. The sizes listed are from 3/16 to ½ inch square.

GEOMETRIC BENCH THREADING MACHINE

A bench threading machine equipped with a Geometric rotary die-head for the cutting of fine-pitch threads of from 1/16 to 5/16 inch in diameter is here illustrated. This machine has just been introduced by the Geometric Tool Co., New Haven, Conn. The bed consists of a single casting and has a spindle mounted in bronze bearings. This spindle is driven through a three-step cone pulley and carries the rotary die-head at its inner end. The die-head is operated by a yoke lever and trip-rod. Adjustable stops conveniently arranged on the trip-rod govern the opening and closing of the die-head. It is opened with a forward movement of the carriage and closed with a backward movement.



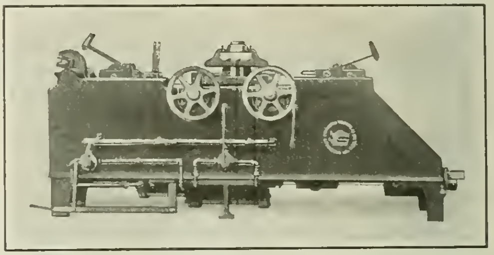
Small Bench Threading Machine recently brought out by the Geometric Tool Co.

The carriage is equipped with a two-jaw chuck operated by a handwheel, but collets, expanding arbors, or special holders can be furnished when the work requires such accessories. An adjustable swinging stop on the side of the chuck enables the accurate setting of work for the cutting of a thread to a predetermined length. The carriage is mounted on a round bar on which it is guided by a large bronze key that engages a keyway on the bar. An adjustment is provided for maintaining the proper fit of the carriage on its support. This construction facilitates the removal of chips from the bed of the machine. Oil from the reservoir in the bed is forced through the spindle and against the work by a geared pump having a direct drive from the spindle. The cone pulley furnishes proper spindle speeds for the rated capacity of the machine.

Different sets of chasers are required to cover the threading range of the machine and these may be readily removed from their slots after the die-head has been tripped and the stop plunger pulled out. Identification numbers are placed on the chasers and on their corresponding slots to insure the correct assembly of the chasers. This machine is arranged for bolting to a bench, or it may be mounted on a separate pedestal for floor use. Some of the specifications are as follows: Maximum length of thread which can be cut at one setting, 3¼ inches; with resettings, 18 inches; bench space required, 9½ by 29 inches; floor space required when mounted on pedestal, 16 by 29 inches; weight without pedestal, 90 pounds; and with pedestal, 175 pounds.

COVINGTON HOSE DISMANTLING AND ASSEMBLING MACHINE

A new development of the Covington Machine Co., Inc., Covington, Va., intended for use in railroad shops, is a machine for dismantling and assembling air-brake, signal and steam hose. It is claimed that with this machine no damage can be done to fittings and that a much better assembling job is accomplished than when the operation is performed by hand. On a test, one man dismantled one hundred pieces of air-hose in an hour and assembled twenty-five ready for service in another hour. The changing of the tools used in one operation for those of another averages less than two minutes. Air and signal hose are handled by the same tools except the nipple puller, and the latter can be put in place within ten seconds.

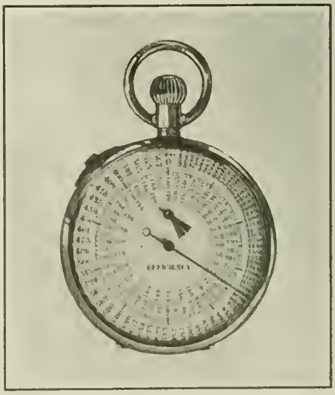


Railroad Shop Machine developed by the Covington Machine Co., Inc.

SILBERBERG TIME-STUDY WATCH

A time-study watch designed for the timing of from one to ten operations, up to and including five minutes' duration, has been developed by the Mortimer J. Silberberg Co., 122 S. Michigan Ave., Chicago, Ill. This instrument has three circles of numbers on the face of the dial, those of the outer circle being red, the middle circle, black, and the inner circle, blue. The large hand makes a total revolution in 100 seconds and the small hand near the center moves over red, black, and blue sectors to show which circle of numbers the large hand is indicating.

All figures on the dial denote production per hour based on the timing of ten operations at one



Duration Time-study Watch brought out by the Mortimer J. Silberberg Co.

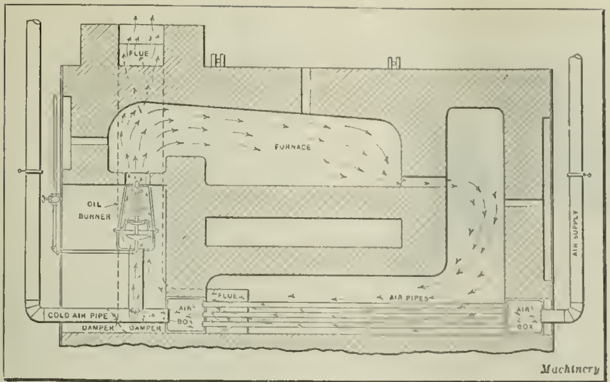
time. For instance, if one operation requires twenty seconds, the figure under the large hand in the red circle of numbers is 1800, but as this figure is based on ten operations being performed at one time, it is necessary to divide the number by 10 in order to find the total number of operations per hour. The result would be 180.

If the duration of an operation is 130 seconds, the large hand will have made a total revolution plus a partial revolution to the 30-second graduation. In the meantime, the small hand near the center of the dial will have passed through the first sector and indicate the second or black sector, thus denoting that the number of operations per hour should be read in the black circle of numbers. The figure in that circle of numbers beneath the large hand when the latter indicates the 30-second mark, will be 277, this again being for ten operations.

The instrument has a feature which permits an operator to start and stop the watch without returning the large hand to the zero graduation. When an operation is entirely completed, all hands are returned to the starting point by pressing down the crown of the watch. The dial is divided into half-seconds.

PITTSBURG OIL-BURNING APPARATUS

In some cities it is common practice to shut off the supply of natural gas to industrial consumers in the event of a shortage, in order that domestic users may have a sufficient supply. To meet such a contingency the Pittsburg Saw & Mfg. Co., 32nd and Smallman Sts., Pittsburg, Pa., is placing on the market the A.G.S. oil-burning apparatus which has industrial and domestic applications. The burner is of the gasification type. In the metal-working field it is especially suitable for forging furnaces and core-ovens. A forging furnace installation is shown diagrammatically in the accompanying illustration. The furnace is 4 feet wide, 8 feet long, and 5 feet high. Air may be supplied to the burner by a small fan or blower, and arrangements have been made in the furnace for the exchange of heat between outgoing hot gases and incoming fresh air. The imparting of heat to the incoming air contributes materially to the efficient use of the fuel and makes possible the attainment of high temperatures in the heating chamber.



Forging Furnace Installation of Oil-burner developed by the Pittsburg Saw & Mfg. Co.

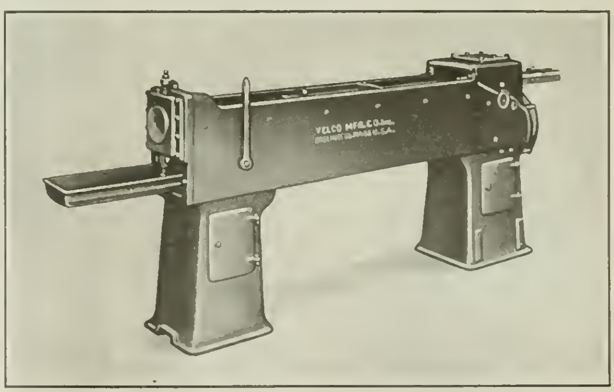
At no time has the temperature of the flue gases at a point six inches above the furnace been in excess of 650 degrees F., while temperatures of from 2600 to 2800 degrees F. have been maintained in the heating chamber. The consumption of oil in heating the furnace varies from 5 to 6 gallons per hour, and the time required is from 1 to 1½ hours. After the furnace has been raised to the desired temperature, the oil consumption necessary to maintain the temperature varies from 2½ to 3 gallons per hour. The oil used with this furnace must be free flowing at 32 degrees F., must have a flash point higher than 150 degrees F., must have less than 5 per cent residue at 700 degrees F., and must have a viscosity less than 100 Saybolt at 100 degrees F. Kerosene, mineral seal, mineral seal substitute and distillate, etc., can be used in connection with the burner. It is stated that the oil is consumed without producing smoke or odorous vapors. The installation of the burner is easy and its operation simple.

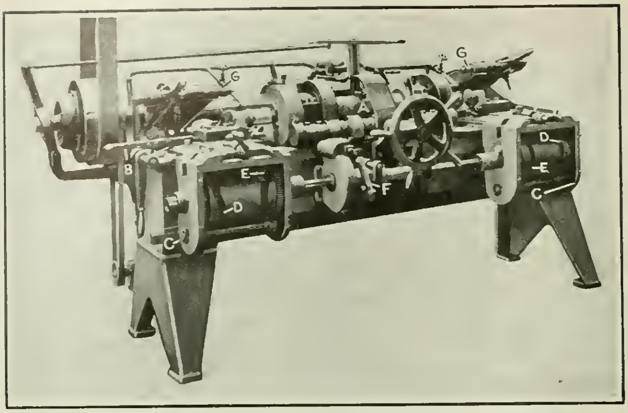
VELCO NO. 4 HIGH-SPEED BROACHING MACHINE

A heavy-duty high-speed broaching machine having several novel features has been developed by the Velco Mfg. Co., Inc., Greenfield, Mass. This machine has a cutting stroke speed of 15 feet per minute and a return stroke speed of 55 feet per minute. The broach holder is attached to a solid steel head and this is supported throughout its travel by bronze gibbed bearings sliding on steel ways. Power is applied to a rack that meshes with a pinion cut integral with a heavy shaft. The broach is attached to this rack so that the pull comes directly on the pitch line of the rack teeth. All vertical adjustments are made at the faceplate.

Stub gear teeth are provided on the rack and driving pinion. The teeth of the rack are on the under side, and the sides of the rack are guarded to protect the operator from injury. All other moving parts are completely enclosed. The rack is held in proper mesh with the pinion by means of rollers placed at the sides of the pinion and guide bars fastened to the sides of the rack, thus making a rolling contact on the pitch line. The pinion-shaft is driven through a phosphor-bronze worm-wheel and a hardened steel worm which runs in oil. The worm-shaft is provided with ball thrust and radial bearings.

The rapid return stroke is accomplished by means of an internal gear cut on the worm-wheel. This internal gear drives the return gear shaft, the return motion being applied through the driving pinion. The driving clutch is not operated during the cutting stroke and so acts as a positive coupling. All parts are protected from shock due to the operation of a positive clutch under load.


No. 4 Heavy-duty High-speed Broaching Machine built by the Velco Mfg. Co., Inc.



Semi-automatic Automobile Axle-shaft Turning Machine made by the T. C. M. Mfg. Co.

In operating the machine, the belt is first shifted on the loose pulley to relieve the load from the clutches. A further movement of the shifting lever causes a friction brake to be applied to the driving pulley and withdraws the positive clutch. A still further movement of this same lever engages the reverse clutch and then shifts the driving belt on the tight pulley, thus reversing the machine. Automatic stops are provided and these are quickly adjustable and positive in action. Non-removable emergency stops protect the mechanism in the event that an operator neglects to set the automatic stops. A single lever conveniently placed regulates every motion of the machine, and the direction in which this operating lever is moved corresponds to the direction in which the rack will travel.

Coolant is supplied to the broach by a gear-driven pump of large capacity. A pan which telescopes into the bed catches chips and returns the fluid to the reservoir. The bed is of box section and is supported at the front and back ends by cabinet bases. A three-point suspension is a feature of this assembly. The front cabinet has storage space for small equipment. The maximum pulling effort of this machine requires 15 horsepower, but ordinary broaching operations may be accomplished with a 10-horsepower motor. The machine is furnished for either belt or motor drive, there being no difference in the construction for the two driving methods.

T. C. M. AXLE-SHAFT TURNING MACHINE

The accompanying illustration shows the front view of a semi-automatic machine built by the T. C. M. Mfg. Co., Hunterdon and First Sts., Harrison, N. J., for machining rear-axle shafts of the full-floating type for automobiles and trucks. These shafts are made from nickel or chrome-nickel steel forgings, and are heat-treated and straightened before any finishing is done. The machine squares the ends of the forgings to length, turns down each end to the correct diameter, bevels one end, turns and bevels a small projection on the other end, and finally centers each end. The centers are necessary for supporting the work in succeeding operations in which the ends are finish-ground and splines are hobbed.

A forging to be machined is placed in the hollow spindle *A* with both ends projecting. Two chucks hold the forging close to the portions to be turned, and the forging is located in these chucks by means of a positioning stop *B*, which is brought up by operating the lever at the left end of the machine. When not in use, this stop is lowered out of the way as shown. The two chucks are operated together through the large handwheel at the front of the machine and a differential which enables the chucks to be brought equally tight on each shaft end, irrespective of any variations in the diameters of the surfaces gripped.

The machine is provided with four slides *C*, two at the front and two at the rear, and each of these slides is provided with a cross-slide. The slides at the front carry the tools for turning the ends, while those at the rear are equipped with tools for facing the ends to length, cutting the small projection on one end and beveling both ends. The front slides make two movements across the work during each cycle of the machine, and the rear slides, three. The tools are advanced into the work before each traverse is made. The slide movements are obtained through cams *D*, which are provided at the front and rear of the bed, and which engage cam rollers set in the bed. The cross-slide movements are controlled by cams *E*. The variations in the diameter of the work are compensated for by screw adjustments.

When a forging has been clamped in position, the cam-operating shafts are started by operating trip-lever *F*. Then the four tools simultaneously move over the work, and when the cycle is completed, the tools stop clear of the surfaces which they have finished. The operator then swings down the drilling spindles *G* and drills the centers while the shaft continues to revolve. The finished shaft is ejected from the machine by an extension of the positioning bar *B*, which pushes the shaft sufficiently out of the chucks to permit the operator to lift it out. A gear-box at the rear of the machine provides three spindle speeds and three feeds to suit shafts of various diameters.

The hollow spindle is telescopic and the position of slides *C* at one end of the machine may be altered, so as to accommodate shafts of various lengths from 36 to 48 inches. The diameters may vary from 1¾ to 2¾ inches. To enable quick adjustments to suit different lengths of shafts, the adjustable slides and the corresponding drilling spindle and spindle bearing are connected by bars to a bracket which can be moved along the bed by rotating a screw at the right-hand end. Therefore, by loosening the clamping bolts and turning this screw, all the required length changes are made simultaneously. A pump supplies coolant to the cutters and these may be either of the circular-formed or solid-rectangular types. The machine is driven through a single belt and a clutch pulley. The time required for machining an axle-shaft averages from four to ten minutes, according to the diameter of the portions turned and the quality of the forging.

"DUMORE" PORTABLE AND BENCH DRILLS

A small portable electric drill, known as the Model 1-BD, having a capacity for drilling holes up to ¼ inch in steel and ⅜ inch in wood is shown in Fig. 1, while a similar drill, model 2-BD, of the same capacity, but mounted on a stand for bench use, is shown in Fig. 2. These drills are

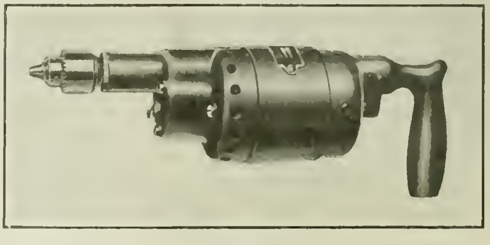


Fig. 1. Model 1-BD "Dumore" Portable Drill made by the Wisconsin Electric Co.

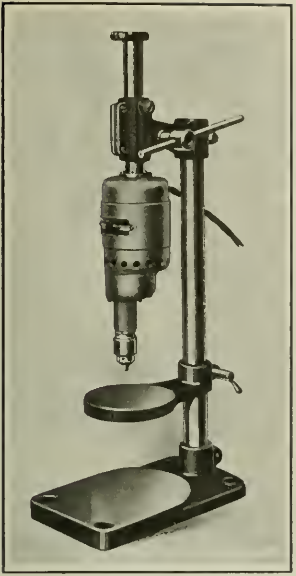


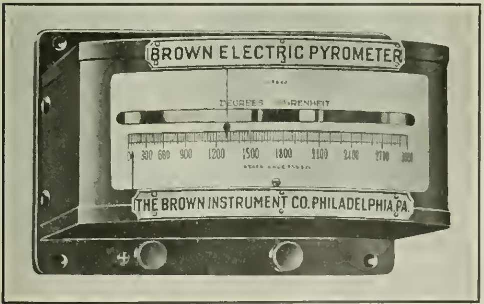
Fig. 2. Model 2-BD "Dumore" Drill

manufactured by the Wisconsin Electric Co., 2539 Sixteenth St., Racine, Wis. The drills are equipped with motors which operate on either direct or alternating current. The drill spindle is driven through helical gears made from steel and heat-treated. The surfaces on which these gears are mounted are ground to size.

The drill spindle is offset 31/32 inch from the center of the housing and runs in two self-aligning annular ball bearings. The column of the bench drill is nickel-plated and the over-all height of the machine is 20½ inches. The feed is 3¼ inches and is obtained through a rack and pinion. The table is adjustable for height and may be swung to the rear when desiring to drill work resting on the base. Both drills are furnished complete with ten feet of cord, a plug, a switch and a No. 1 Jacobs chuck. The net weight of the bench drill is 21 pounds, and that of the portable drill, 5 pounds.

BROWN COLD-JUNCTION COMPENSATED PYROMETER

It is well known that the millivoltage developed by the thermo-couple of thermo-electric pyrometers is dependent upon the difference in the temperatures of the hot and cold ends of the thermo-couple, and in order to secure accurate measurement of temperatures the cold end should be maintained at a constant temperature or else the pyrometer should compensate for the changes of temperature at this junction. On the pyrometer illustrated, which has been developed and patented by the Brown Instrument Co., 4512 Wayne Ave., Philadelphia, Pa., such a compensation is automatically obtained. The pointer of the instrument can be set to zero in the usual manner.

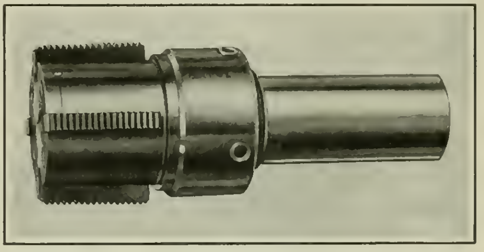


Improved Thermo-electric Pyrometer patented by the Brown Instrument Co.

It is common practice to use extension or compensating leads to transfer the cold junction from the binding posts of the thermo-couple to a distant point where a constant temperature can be maintained. With this pyrometer, however, the extension or compensating leads are brought to the meter as the changes in the temperature at the end of the leads also take place in the meter and can be compensated for. In using the pyrometer, the pointer is set by the zero adjuster to correspond with the index on the scale. If the values of a thermo-couple are based on a cold junction of 75 degrees F., the index will indicate that temperature, provided the atmosphere surrounding the instrument is of that temperature. If the instrument pointer does not correspond with this index, it is set accordingly. When the temperature of the atmosphere surrounding the instrument rises to 90 degrees F., the index automatically shifts to 90 degrees F. and the instrument pointer also moves to that graduation. Any number of thermo-couples with their extension or compensating leads can be brought to one instrument. Recording instruments can also be equipped with this automatic compensation.

GEOMETRIC ADJUSTABLE TAP

The accompanying illustration shows an adjustable tap which has been placed on the market by the Geometric Tool Co., New Haven, Conn. This tap does not have a collapsing device, as it is intended for use on machines that are not provided with a means of closing collapsible taps. The chasers are easily removed for regrinding, and as they are adjustable, the correct size of the tap can always be maintained. Each size of tap accommodates chasers for a range of diameters, and when the chasers become worn, they can be renewed at a small cost, as compared with the cost of a new tap.



Adjustable Tap made in Various Sizes by the Geometric Tool Co.

THIBERT SELF-LOCKING NUT

The new type of self-locking nut shown in the accompanying illustration is made in all sizes from ¼ to 1 inch, and with either S. A. E. or U. S. form threads. This nut has been introduced recently by the Industrial Lock Nut Co., 306 Main St., Worcester, Mass. The locking member consists of a circular wire spring, one end of which projects outward and the other, inward. The outer face of the nut is counterbored and recessed to receive this spring, and the latter is forced to turn with the nut due to the outwardly projecting end engaging a groove cut on the nut face. The other spring end engages the thread of the bolt or part on which the nut is screwed, and although it does not interfere with screwing the nut in place, it prevents the nut from being loosened by vibration.

Thibert Self-locking Nut sold by the Industrial Lock Nut Co.

PRATT & WHITNEY SCREW PLATE SETS

The Pratt & Whitney Co., Hartford, Conn., is now marketing screw plate sets made up from their regular line of products, for cutting either U. S. standard, S. A. E. or Whitworth threads. These sets are sold in various combinations to suit the requirements of small shops, garages and toolrooms, and are packed in nicely finished and suitably marked cases. They may be furnished with either plug or taper taps, or both. The set here illustrated consists of eighteen taps, nine adjustable round split dies, one diestock, two tap wrenches, and a screwdriver for adjusting the dies.

One of the Screw Plate Sets now being sold by the Pratt & Whitney Co.

STOLP LOCK-SEAMING MACHINE

An automatic machine for bending and lock-seaming sheet metal parts from strips or coils of stock by a patented process is illustrated in Fig. 1, while Fig. 2 shows some of the sections which can be formed. This machine is a recent development of the Stolp Co., Inc., Geneva, N. Y. The machine is equipped with a self-feeding attachment. The stock, on being fed into the machine, is first pressed into a U-shape by a punch, after which a round mandrel enters the blank from the rear and pushes it endwise through lock-seaming dies. The mandrel is fastened to a crosshead connected to a chain. This chain runs continuously and carries the crosshead back and forth the entire length of the frame.

As the mandrel reaches the farthest back position, the U-shaped punch descends and presses the blank into a position in line with the mandrel. The mandrel enters the blank as the punch leaves it and carries the work forward as previously explained. The lock-seaming dies have no moving parts, but they are so constructed that the blank is closed and the lock-seam produced in one operation. The machine will lock-seam taper tubes within certain limits. Among the many parts which can be produced on this machine are tubes for automobile mufflers and radiators, blowers, and ventilators.

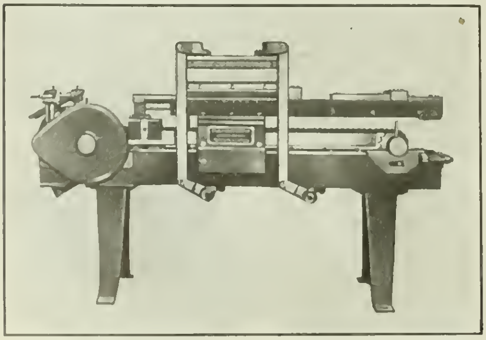


Fig. 1. Automatic Lock-seaming Machine patented by the Stolp Co., Inc.

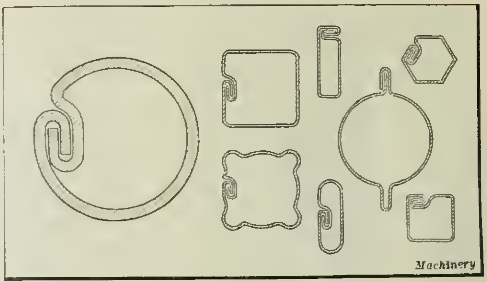
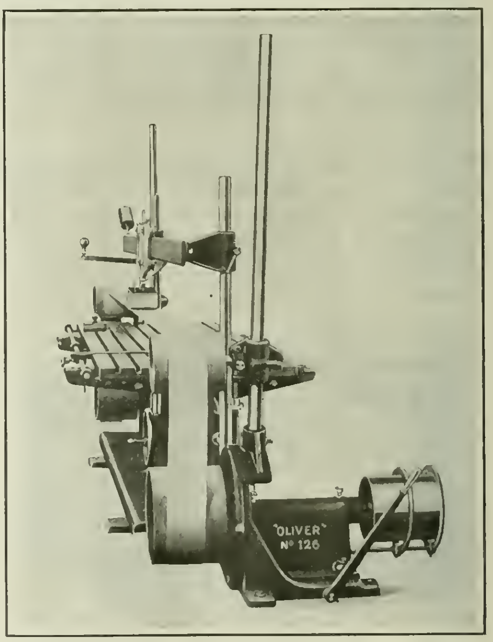


Fig. 2. Various Tube Sections formed on the Lock-seaming Machine

OLIVER UNIVERSAL BELT SANDER

A No. 126 universal belt sander has just been brought out by the Oliver Machinery Co., Grand Rapids, Mich., for the rapid sanding and polishing of line and edge moldings, patterns and various other parts made from wood. It may also be used in the polishing of metals. The abrasive side of the sand belt is in contact with the pulley faces. In addition to the safety features obtained by this arrangement, the breaking of sand from the belt is avoided and so the longevity of the belt is increased. The table rolls on ball bearings and is so easily moved that a slight push causes it to roll the full travel of 36 inches. This construction is covered by a patent. The table top consists of plain wooden strips, spaced one inch between each strip. The different gaps allow any dust which may accumulate to drop through



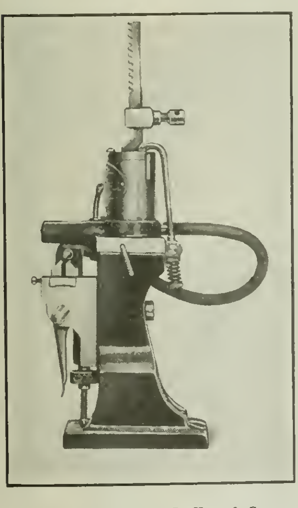
No. 126 Universal Belt Sander built by the Oliver Machinery Co.

the table, and thus serve to keep the top clean. The table is 36 inches wide by 96 inches long and is provided with an adjustable bar to hold the work.

Means are provided for taking up slack of the sand belt so that a suitable tension for the work in hand may be obtained. An idler is supplied for this belt and this idler is adjustable up and down to the height of the work. It can also be placed in a tilted position to prevent the belt from running to either side of centers. An attachment is furnished for the power stand arm for use in sanding edge work. This attachment has an adjustable table that can be tilted 45 degrees up or down and raised or lowered to suit conditions. Attachments are also supplied for sanding edge moldings and irregular shapes, and the machine may be arranged either with or without a sanding pad attachment. The machine may have a motor drive or it may be driven by belt from a roller-bearing countershaft. The machine will sand to a center of 72 inches, and will take work on the table up to 54 inches in height and on the floor plate, up to 72 inches in height. The table has a vertical adjustment of 14 inches, and sanding belts up to 10 inches in width may be used. The machine occupies a floor space 72 inches wide and any preferable length. The over-all height is about 80 inches, and the weight, approximately 1400 pounds.

CAULKINS AUTOMATIC DRILL JIG

An improved automatic drill jig designed especially for use with Avey and Leland-Gifford high-speed drilling machines, is shown in the accompanying illustration. This attachment has recently been brought out by E. L. Krag & Co., 50 W. Randolph St., Chicago, Ill. It is provided with a V-block to enable the drilling of holes for cotter-pins, etc., up to 3/16 inch in round, square, or hexagonal stock of various sizes up to 1 inch in diameter or across flats. More elaborate holders can be provided for indexing work to suit the drilling of two or more holes, or for cross- or end-drilling regular or irregular shaped pieces. The jig is operated through a foot-pedal, the work being clamped, drilled, and ejected by a forward movement of the pedal. The drilled work is removed by hand and a new piece inserted during the backward movement of the foot. By thus working the hands and one foot in unison, high rates of production are secured. All parts of the jig are accessible and readily adjusted for any size or length of stock within the capacity of the device. Lubricant is supplied to the point of the drill.



Drill Jig sold by E. L. Krag & Co.

NEW MACHINERY AND TOOLS NOTES

Sheet-heating Furnace: Electric Furnace Co., Alliance, Ohio. A portable resistance-type electric furnace used in the heating of sheet metal for forming automobile body parts and fenders. The hearth is 3 feet 4 inches wide and 6 feet 5 inches long. The furnace can heat 750 pounds of material per hour to a temperature of 1800 degrees F.

Tap-holder: Apex Machine Co., Dayton, Ohio. A friction-slip tap-holder which permits slippage within the holder itself in case a tap becomes wedged or strikes the bottom of a hole. It is thus particularly suitable for tapping blind holes. The holder is made in two sizes, one of which will hold taps up to and including 1/2 inch in diameter, while the other holds taps from 1/4 to 3/4 inch in diameter.

Drill Chuck: American Equipment Co., 5928 Second Boulevard, Detroit, Michigan. A slip-collet drill chuck which permits the rapid insertion or removal of the tool while the machine spindle is running. Drills, reamers, counterbores, and taps may be held in the collets. Two driving keys prevent crowding to one side and give a balanced drive in either direction so that the chuck is suitable for tapping operations.

Burning-in and Running-in Machine: Theodore W. Jansen Machine Co., 739 Twenty-first St., Des Moines, Ia. A burning-in, running-in and testing-out machine developed for use in the repairing of automobile engines. It will hold all types of engines without special blocking or fixtures. The work is mounted on the stand by securing it at each end to pivoted holders so that it can be rotated about its crank-shaft and held in any desired position.

Cylinder Reboring Tool: International Purchasing & Engineering Co., Inc., 506 McKerchey Bldg., Detroit, Mich. A device which was originally intended for driving by hand or by means of a drilling machine, but which has now been fitted with an individual motor drive. The original type was described in May MACHINERY. The motor is mounted as a part of the tool and drives through a friction clutch which enables slippage in the event that the cutter-head becomes wedged.

Cylinder Reamers: New Britain Tool & Mfg. Co., New Britain, Conn. A set of expansion reamers for machining the cylinders of gas engines. It is intended that they be used in pairs for roughing and finishing. The pilot of the roughing reamer is ground to fit the normal bore of the cylinder and the cutting blades remove about 0.030 inch of stock. The pilot of the finishing reamer fits the bore left by the roughing reamer and its blades remove about 0.005 inch of metal.

Tool Grinding Machine: Wheeler Co., Railroad, Pa. A tool grinding machine provided with ball bearings for the spindle, countershaft and loose pulley. The head can be used on a bench or mounted on a pedestal. The countershaft is mounted at the rear of the pedestal and is provided with a shifter operated by a foot-pedal at the front of the machine. The head is made in two sizes, one for wheels 10 inches in diameter and 1 1/2 inches thick, and the other for wheels from 12 to 14 inches in diameter and up to 2 inches in thickness.

Protractagraph: Turner Devices, Inc., 5 S. Newstead Ave., St. Louis, Mo. An instrument which is intended to take the place of such drafting tools as triangles, scales, and protractors, and which may be used with any parallel ruler attachment. It consists of a plate formed at its lower end into a semicircular protractor graduated in 1/2 degrees. Various scales and a transparent inking blade are easily attached to this plate. A knob on the axis of the device is used to revolve the scale. The instrument can be slid along the straightedge to place it in the desired positions on the drawing-board.

Surface Grinding Machine: William Osterhom, 2301 N. Knox Ave., Chicago, Ill. An automatic surface grinding machine intended for the grinding of surfaces up to 12 by 40 inches. The work is locked in a fixture which is mounted on a table pivoted about a swinging arm and moved past the surface of the abrasive wheel by means of a cam. Upon the completion of a cam cycle, the fixture is tilted 45 degrees away from the wheel to enable the operator to remove the work. The length of the swinging arm stroke may be varied from 2 to 24 inches. The feed of the wheel is automatically controlled by a cam.

Combination Lathe, Milling and Drilling Machine: Dalton Mfg. Co., Sound Beach, Conn. A combination machine especially designed for use in garages, etc. A single hollow spindle serves both the lathe and the milling equipment. The lathe and the milling equipment or the lathe and the drilling equipment may be used simultaneously. The lathe has a swing of 13 inches over the ways and by removing a section of the bed, a gap 6 1/2 inches wide is obtained which will permit the handling of work 18 1/2 inches in diameter. The milling table has a working surface of 24 by 7 1/2 inches and a longitudinal feed of 15 inches in either direction. The transverse movement is 6 1/4 inches.

SPOKE NIPPLE DRILLING AND TAPPING MACHINE

The machine described in this article was especially designed and constructed by the Langelier Mfg. Co., Arlington, Cranston, R. I., for drilling and tapping in large quantities, cold-rolled steel nipples such as are used on the wire spokes of automobile wheels. The machine is semi-automatic in operation, five nipples being inserted by hand at a time into a row of steel bushings in the drum *A*. Aside from the loading of the drum the machine is automatic. The drum is mounted on the main shaft which extends through to the rear of the machine and there carries a stop-cam *B*, Fig. 3, to which there is attached on the inner side, a gear driven by another gear on the index-shaft *C*. This gear is enclosed by a suitable guard. The drum revolves intermittently, as determined by the index mechanism, to bring the work into position for loading, drilling, tap-drilling, tapping and ejecting the nipples. The first drilling head *D*, Figs. 1 and 2, carries the drills for producing clearance holes three-quarters through the nipples; the second head *E*, the tap-drills for finishing the holes; and head *F*, the taps. The knock-out arm is shown at *G*.

Main Drive and Safety Device

The driving side of the machine is shown in Fig. 2. The machine is belt-driven, and the flanged pulley transmits motion to the driving shaft by means of a friction clutch which is operated by the shipper rod *H*. This clutch must be engaged by hand, but may be disengaged either by an automatic safety device, or a foot-lever connected to this device. This foot-lever is not shown in the illustrations. For hand operation, lever *I* is employed to turn a segment gear which engages rack teeth cut on the under side of the shipper rod. The safety device for automatically disengaging the clutch is illustrated in Figs. 1 and 2 and its purpose is to instantly stop the machine whenever a nipple is improperly seated in a bushing. In case any of the five nipples which are simultaneously loaded into a row of bushings should project sufficiently to strike the arm *J*, the safety device would immediately operate. This arm, by means of its lever connections, moves a latch carried in slide *K*, which releases finger *L* on the shipper rod, and, with the aid of coil spring *M*, disengages the friction clutch and engages a multiple disk brake.

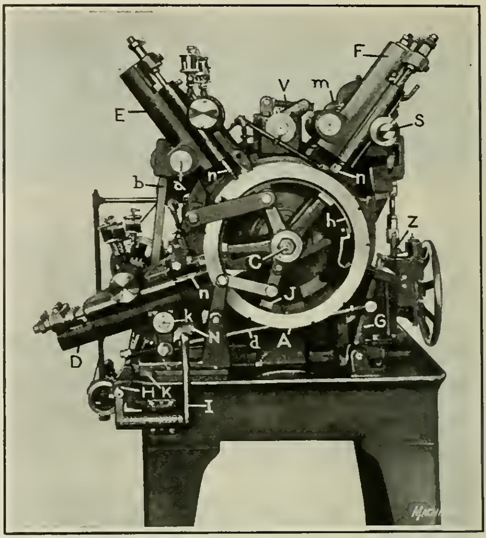


Fig. 1. Front View of Machine used for drilling and tapping Wire Wheel Spoke Nipples

Driving Mechanism for the Heads

The main shaft which carries the drum *A* and stop-cam *B* runs through a perforated cast-iron sleeve which is stationary and which provides the bearing for a large worm-wheel, on the hub of which the indexing- and feeding-cams are fixed. The driving shaft carries a bakelite gear *N*, Fig. 2, (also shown in Fig. 1) for driving the drilling head shaft *O* by means of a pinion, and the tap-drilling head shaft *P* by means of a belt. The driving shaft also carries a bevel pinion *Q* for driving a cross-shaft that extends through the machine at the rear, and at the opposite side (see Fig. 3) drives the tapping head *F* by means of suitable bevel gearing. This cross-shaft projects at *R* sufficiently to allow a handwheel to be assembled, this handwheel being the means provided for turning the rotative parts by hand, when so desired. Shafts *O* and *P*, Fig. 2, as well as a similar shaft *S* for the tapping head (see also Fig. 3) carry suitable spiral gears for driving the five spindles in their respective heads. It will be noticed also that shaft *O* has a flanged pulley belted to the pulley of the lubricant pump, and that this lubricant pump is piped direct to the three heads. This is more clearly shown in Fig. 1.

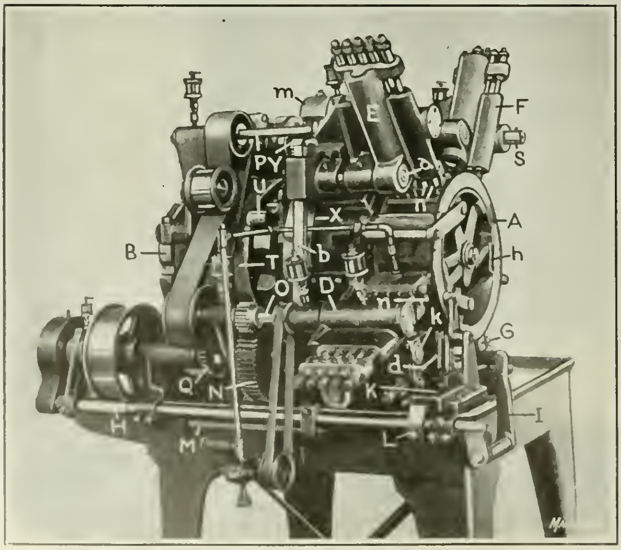


Fig. 2. Driving Side of the Machine shown in Fig. 1

Indexing and Feeding Arrangement

The cross-shaft *R*, Fig. 3, carries a worm located just back of and above shaft *C*, and this worm drives the aforementioned large worm-wheel mounted on the perforated cast-iron sleeve through which the main shaft of the machine operates. This worm-wheel with the index-cam *T* and the feed-cam *X*, Figs. 2 and 3, revolves as a unit on the stationary cast-iron sleeve. The index-cam carries a single gear tooth *U*, Fig. 2, on its side, so that as the cam is revolved a five-tooth index-pinion located directly beneath it on a short shaft will be intermittently revolved part of a revolution with each complete revolution of the index-cam. The short-index shaft carrying this five-tooth pinion extends to the rear of the machine, being the one previously mentioned and

indicated at C, Fig. 3. With every movement of the five-tooth pinion it is evident that the stop-cam B will be revolved, turning the drum A at the front of the machine, as required to index it from station to station during the operation of the three multiple heads. The notched stop-cam B is temporarily locked in position by a steel toe carried in slubber arm W, this steel toe engaging with inserted steel cradles in the stop-cam. The synchronization of the movement of this arm with the indexing movement is accomplished by a roll that runs in a cam groove in the side of the index-cam, the movement being assisted by coil spring V, Figs. 1 and 3, directly above the shaft which carries slubber arm W.

Located slightly to the front of the index-cam on the worm-wheel hub is the feed-cam X, Figs. 2 and 3. This feed-cam has two cam grooves, one for radially operating the short rack Y, Fig. 2, and the other for operating a rack on the opposite side of the machine, shown in Fig. 3 at Z. The first of these racks meshes with a double spur gear for the purpose of revolving the tap-drilling head feed-shaft a,

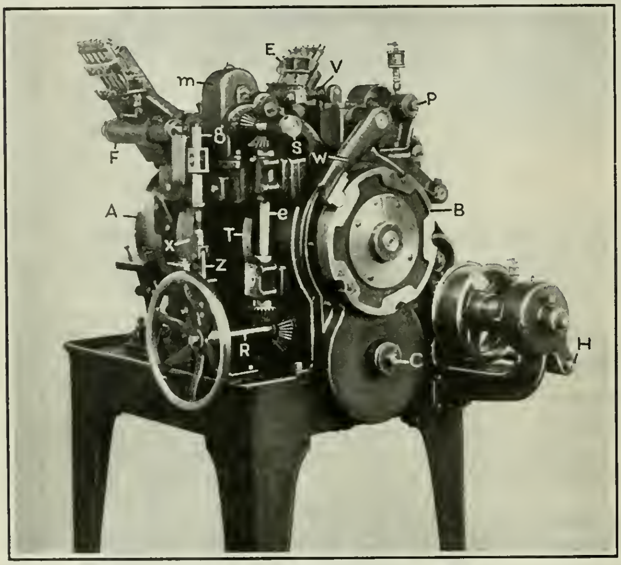


Fig. 3. View from the Rear showing Indexing Cam and Tapping Head Drive

Figs. 1 and 2 and for operating the vertical rack b. The teeth at the lower end of this rack mesh with a spur gear on the drilling head feed-shaft k, so that the feed movement for both heads D and E is controlled from one groove in the feed-cam. The spindle feed for the two heads is obtained by a spur gear and rack contained within each head. The drill-head feed-shaft k carries a finger at its front end so that as the feed is transmitted to the drill-head, the knock-out rod d will rock the arm G in which the knock-out pins are carried, and so dislodge the finished work from the bushings before the next index movement of the drum.

The other cam groove on the feed-cam controls the vertical movement of rack Z, Figs. 1 and 3, by means of which the reversal of the tapping-head shaft S is accomplished. The vertical bevel gear shaft c drives one end of this shaft, the other end being connected in gear-box n by a specially designed gear-and-segment reversing mechanism which is alternately shifted by post g as the rack Z moves up and down. The provision for changing the gearing of this reversing mechanism is the only means required for altering the feed of the taps, the mechanism being provided with change-gears so that it may be set up to furnish the correct speed to follow the lead of the tap that is employed.

Other Details of Construction

The feed-cam also carries a lug at its periphery for releasing the locking mechanism for drum A. This mechanism is located beneath the bed of the machine and consists of a lever hung at one end so that it can be pushed down by the cam lug, causing the opposite end of the lever to release a V-shaped detent from engagement with the drum. The drum A is provided with a hardened and ground steel spider h Figs. 1 and 2, which is held stationary by an arm so that as the drum revolves the ends of the nipples which project from the inside of the drill bushings will ride nicely over this spider and furnish the thrust backing for the drills and taps during the performance of the various operations. It will be seen that the spider is so fashioned that when the nipples are knocked out they will be prevented from dropping down to the lower part of the drum and thus will not interfere with the loading of the bushings. All the drilling and tapping spindles of this machine are provided with radial ball bearings as well as ball thrust bearings for the feed movement. The tools have straight shanks and are carried in split collets. They are driven by tangs ground on their shanks so that as the collets are pinched together by nuts m the tools will be securely chucked. The output of this machine is twenty drilled and tapped nipples per minute.

* * *

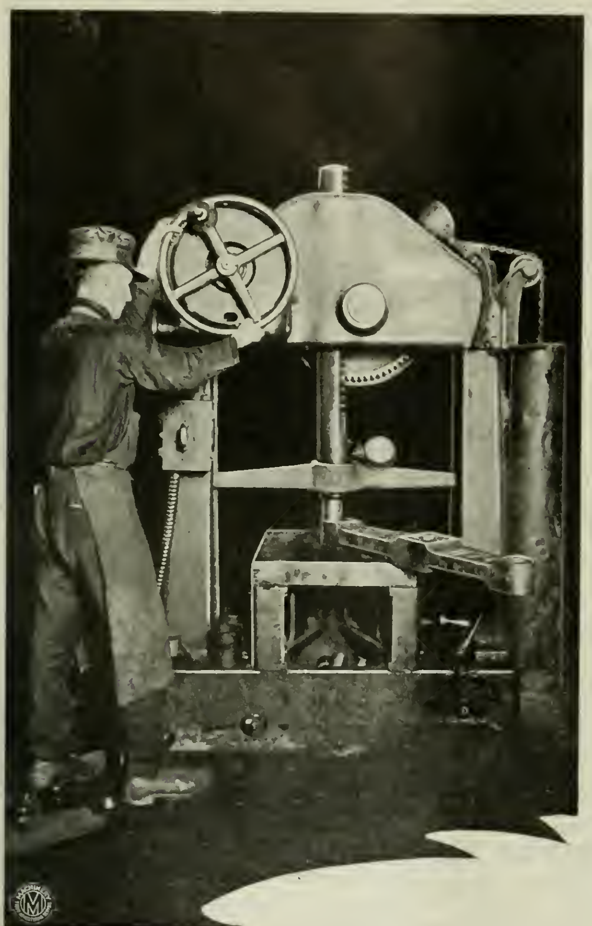
REVIEW OF INDUSTRIAL CONDITIONS

A general review of the main industries of the country shows the greatest activity in the textile field, especially in New England. The woolen and worsted mills are operating at the rate of from 75 to 100 per cent capacity, and the cotton mills at about 75 per cent capacity. An improvement is noted in the New England shoe factories, which have steadily gained until they were working up to 60 per cent of full capacity on July 1, with operations continually being expanded. Business in the retail field is from 10 to 20 per cent in physical volume of goods over the business done for the corresponding month last year, although, on account of reduced prices, the business in dollars and cents is slightly less than it was a year ago.

Improvements in railway traffic is indicated by the report of the American Railway Association, which shows that a gradual increase in the number of loaded freight cars. The reports for June, covering 144 railroads, also show that the net operating income of these roads amounted to over $48,000,000, as compared with a deficit of $10,600,000 on the same roads during the corresponding month last year. The total operating expenses in June, 1920, were $220,000,000, while in June, 1921, they were only $171,000,000, which accounts for the improvement in the net revenue. As the railroads are not yet operated to full capacity, it may be expected that when their operating revenue rises to a normal level, the net income will be further improved. The removal of the taxes on transportation provided for by the new revenue bill will doubtless help to stimulate traffic, particularly if the railroads themselves, in view of their improved financial condition, find themselves able to reduce the present high rates and fares.

* * *

Out of a total of 19,106 locomotives in good condition before the war, there are at present in Russia from 5500 to 7500 locomotives reported in working order. This represents a decrease of motive power of about 66 2/3 per cent. Of this number of locomotives, approximately 1000 are idle owing to lack of fuel.



A LUCAS

Power Forcing Press at Work in the D L & W's Scranton Shop

There are two of these simple and effective machines in this busy railroad shop—one a 30-ton press, the other with 50 tons capacity. The oldest has been in use for five years and both are giving excellent satisfaction.

The operation shown is forcing a bushing 4″ long by $2\frac{1}{2}$″ diameter into a locomotive hanger forging to be used in brake rigging, and is readily accomplished with 3 to 4 tons of pressure.

The sphere of the Lucas Power Forcing Press covers that big tract of "no man's land" where the hand or screw press is too small and the hydraulic too large to work to advantage.

Control and adjustments center in the wheel, which automatically applies power when the ram meets with the resistance of the work. Action is rapid and positive.

Power is obtained from a worm-wheel on the pulley shaft through a friction clutch and is transmitted to the ram by means of gearing controlled by the handwheel.

No valves to leak—no pipes to freeze—no packing to renew. "A good all-around tool" is the verdict on this machine wherever it is installed, whether for bending, straightening, forcing, marking, forming or broaching and new uses develop for it every day.

WE ALSO MAKE THE

"PRECISION"

BORING, DRILLING AND MILLING MACHINE

Illustrated Circular tells the whole story.

LUCAS MACHINE TOOL CO. NOW AND ALWAYS OF **CLEVELAND, OHIO, U.S.A.**

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry. Societe Anonyme Belge, Alfred Herbert Brussels. Aux Forges de Vulcain, Paris. Allied Machinery Co., Turin, Barcelona, Zurich. Benson Bros., Sydney, Melbourne. V. Lowener, Copenhagen, Christiania, Stockholm. R. S. Stokvis & Zonen, Rotterdam. Andrews & George Co., Tokyo.

PERSONALS

Frank A. Power, for the last fifteen years with the Garvin Machine Co., New York, has resigned as sales manager.

Lyman M. Waite, formerly of the National Acme Co., and recently with the Springfield Automatic Screw Machine Corporation of Fitchburg, Mass., has been appointed sales manager of the Garvin Machine Co., New York City.

Ralph C. Schwarz has taken over the northwestern New York territory for the distribution and sale of Stewart industrial furnaces and appliances, made by the Chicago Flexible Shaft Co., Chicago, Ill. Mr. Schwarz will be located at 921 Granite Bldg., Rochester, N. Y.

Herman Voges, Jr., has resigned as president of the Webster & Perks Tool Co., Springfield, Ohio, in order to take a much needed rest from business. He has been continuously connected with the Webster & Perks Tool Co. for nearly thirty years, and has served in practically all capacities with that company. He will remain as a director of the company.

Clarence H. Landsittel, for three years director of purchases for the Templar Motors Co., Cleveland, Ohio, and prior to that director of purchases for the Haynes Automobile Co., Kokomo, Ind., has become associated with the Climax Motor Devices of Chagrin Falls, Ohio, in the capacity of sales engineer. This company manufactures magneto and generator couplings.

Alexander Gabay, formerly tool and efficiency engineer for the Western States Machine Co., Salt Lake City, Utah, is now production manager and assistant superintendent with the Baird Lock Co., Chicago, Ill., manufacturer of locking devices and non-pickable cylinder locks. Mr. Gabay, before he came to the Western States Machine Co., was connected with the Cincinnati Milling Machine Co., Cincinnati.

Robert B. Moir has been appointed manager of the New York branch of the W. A. Jones Foundry & Machine Co., 4401-4451 W. Roosevelt Road, Chicago, Ill. Mr. Moir will assume his new duties immediately, making his headquarters at the present sales office and transmission warehouse of the company at 20 Murray St., New York City. Mr. Moir has been actively connected with the home office and factory of the company for a number of years, and is well qualified to assist in power transmission and general engineering problems.

Julius Klein, who was appointed by the President as Director of the Bureau of Foreign and Domestic Commerce, to fill the position made vacant some time ago by the resignation of R. S. MacElwee, has assumed his duties. Dr. Klein first came to the bureau in September, 1917, as chief of the Latin-American Division. He remained in that capacity until May, 1919, when he was made commercial attaché to the Department at Buenos Aires, Argentina. He resigned from his position in October, 1920. Dr. Klein has specialized in Latin-American economics and trade.

Walter H. Rastall has been appointed by Secretary Hoover chief of a new division in the Department of Commerce, which has been especially created to give attention to the foreign trade in industrial machinery; this is one of the new divisions provided for by Congress in making appropriations under the recent Export Industries Act. It is the plan of this division to cooperate with American manufacturers and exporters of factory machinery, and to take such steps as may be possible for a government department to assist manufacturers in solving their foreign trade problems. Mr. Rastall has had extensive experience, both in domestic and in foreign trade, and has spent nine years in the sale of machinery in Asia, from where he has recently returned after an investigation of the machinery markets in that part of the world. He is a graduate of Cornell University and a mechanical engineer.

Arthur H. Adams, for twenty years active in the manufacture of telephone and telegraph apparatus, is opening offices on October 1 for consulting work at 41 Park Row, New York City. Mr. Adams was for some years superintendent of the Bell Telephone Mfg. Co. of Antwerp, Belgium, during which time he was called upon to inspect in a consulting capacity a number of European plants; he has since done development and design work for the Western Electric Co., Inc.; and for the last three years has been successively factory superintendent and chief engineer of the North Electric Mfg. Co. of Galion, Ohio. He has developed and patented several special machines in these years, including rotary thread-rolling, coil-winding, braiding and telephone switching machinery, as well as printing telegraphs. He will specialize in the field of lighter mechanics, with special emphasis on the coordination of design with manufacturing equipment.

* * *

STATISTICS OF THE AUTOMOBILE INDUSTRY

In a pamphlet recently published by Leonard P. Ayres, vice-president of the Cleveland Trust Co., Cleveland, Ohio, some interesting statistics are given relating to the automobile industry and its future. Since the beginning of the automobile industry in America twenty-five years ago, the number of cars manufactured up to January, 1921, was 11,775,000, of which more than 700,000 were imported. About 9,000,000 cars are in use in the United States, 2,000,000 having been worn out or destroyed by accidents. The average length of life of an automobile is estimated at about six years. At the end of 1920 there was approximately one car to every twelve persons in the United States. If, instead of considering the entire population, the basis for comparison is the number of white, native born men above the age of 21, it will be found that there are 42 cars in the United States to every 100 men. The number varies in the different parts of the country from about 22 cars to 100 men in the South Central States to 60 cars per 100 men in the Pacific States.

COMING EVENTS

September 7-28—Shipping, Engineering and Machinery Exhibition, Olympia, London, W., England. General Manager, Frederic W. Bridges, 36-38 Whitefriars St., Fleet St., London, E.C.4.

September 12-17—Fall meeting of the American Institute of Mining and Metallurgical Engineers in Wilkesbarre, Pa. Secretary, Bradley Staughton, 29 W. 39th St., New York City.

September 14-18—Annual convention of the National Association of Cost Accountants in Cleveland, Ohio; headquarters, Hotel Cleveland. Secretary's address, 233 Woolworth Bldg., New York City.

September 19-24—Third annual convention and exhibition of the American Society for Steel Treating in Indianapolis, Ind. Secretary, W. H. Eisenman, 4600 Prospect Ave., Cleveland, Ohio.

September 28-October 8—New York Electrical Exposition at the 71st Regiment Armory, Park Ave. and 31th St., New York City. For information relating to exhibits, apply to Norman Maul, the Electrical Show Co., 130 E. 15th St., New York City, Room 828.

October 3-4—Regional meeting of the American Society of Mechanical Engineers in Cleveland, Ohio; headquarters, Hotel Winton.

October 5-8—Twelfth annual convention of the American Manufacturers' Export Association in New York City; headquarters, Waldorf-Astoria Hotel. Secretary, A. W. Willmann, 160 Broadway, New York City

October 5-7—Fall meeting of the Society of Industrial Engineers in Springfield, Mass.

October 17-22—Twenty-fourth annual convention of the American Mining Congress in the Coliseum, Chicago, Ill. In conjunction with the convention there will also be a national exposition of mines and mining equipment.

October 17-22—Twenty-seventh annual convention of the National Hardware Association of the United States in Atlantic City, N. J.; headquarters, Marlborough-Blenheim Hotel., Secretary, T. James Fernley, 120 High St., Boston, Mass.

October 17-22—National exposition of mines and mining equipment in Chicago, Ill., under the auspices of the American Mining Congress, Washington, D. C.

October 18-20—Annual convention of the National Machine Tool Builders' Association in New York City; headquarters, Hotel Astor. General Manager, Ernest F. DuBrul, 817 Provident Bank Bldg., Cincinnati, Ohio.

November 4-5—Regional meeting of the American Society of Mechanical Engineers in Kansas City, Mo.

December 1-3—Fall meeting of the Taylor Society in New York City. Secretary, Harlow S. Person, 29 W. 39th St., New York City.

May 8-11, 1922—Spring meeting of the American Society of Mechanical Engineers in Atlanta, Ga. Assistant Secretary (Meetings), C. E. Davies, 29 W. 39th St., New York City.

SOCIETIES, SCHOOLS AND COLLEGES

Michigan College of Mines, Houghton, Mich. Year book for 1920-1921, containing calendar and announcement of courses for 1921-1922.

University of Nebraska, Lincoln, Neb. Fifty-first annual general catalogue, containing announcements for 1921-1922, an outline of the various courses offered, and general information.

NEW BOOKS AND PAMPHLETS

Wages in the United States and Foreign Countries. 103 pages, 6 by 9 inches. Published by the Government Printing Office, Washington, D. C.

This book, copies of which may be obtained free by addressing a request to the Ways and Means Committee, House of Representatives, Washington, D. C., has been prepared for the use of the Committee on Ways and Means of the House in connection with pending tariff legislation. It covers, mainly, wages paid in the United States, Germany, Japan, England, France, Belgium, and Italy. The sources of information are furnished in each case, so that the reader may judge for himself as to the authoritativeness of the figures presented. Often the figures quoted are given in the United States currency, which is somewhat unsatisfactory, because the rate of exchange upon which the conversion has been based is not stated. In many instances, however, the wages are given in foreign currency, which is far more satisfactory because the corresponding figure in United States currency can then easily be obtained by using the current rate of exchange. The book is somewhat misleading for present use, because in many cases it reports wages in the United States for that period of 1920 when they were at their high peak, and in the general resume of wages for ten selected industries in seven of the leading countries, no statement is made of the year when these wages

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were paid. Hence it is difficult to determine the value of the figures given, particularly for the important work of tariff legislation. If Congress bases its work upon 1920 wages, or wages in July and August, 1920, as given in some instances, the figures will be from 15 to 25 per cent higher than present wage rates in most industries.

NEW CATALOGUES AND CIRCULARS

Bausch & Lomb Optical Co., Rochester, N. Y. Circular descriptive of the Bausch & Lomb stereoscopic eye-piece, for use with monocular microscopes.

Pawling & Harnischfeger Co., 38th and National Aves., Milwaukee, Wis. Pamphlet TX, illustrating and describing the new Skimmer scoop attachment for P & H Types 205 and 206 excavator cranes.

New Departure Mfg. Co., Bristol, Conn. Loose-leaf data sheets, 134, 135, and 136 FE, containing illustrations and descriptions of ball bearings in a hydraulic dynamometer, pneumatic grinder, and steam turbine.

Bell & Gossett Co., 609 W. 30th St., Chicago, Ill. Circular folder advertising "Caseite," a hardening material for use in the cyanide process. Also circular giving dimensions and weight of carbonizing boxes and cyanide pots.

Electric Controller & Mfg. Co., Cleveland, Ohio. Bulletin 1033-A containing data on direct- and alternating-current automatic pressure regulators. Bulletin 1042-C illustrating and describing E. C. & M. automatic compensators for alternating-current squirrel-cage motors.

Union Switch & Signal Co., Swissvale, Pa. Folder entitled "Drop-forgings" illustrating types of drop-forgings made by the company for trucks and tractors, including axles, crankshafts, camshafts, connecting-rods, steering knuckles, gear blanks and pinions, crank and gear-case covers, etc.

Electric Dynamic Co., Bayonne, N. J. Bulletin 300, showing pictures of the facilities of the company's factory for producing electrical machinery. The illustrations show electric motors in process of manufacture ranging in size from ½ to 1000 horsepower, both for alternating and direct current.

H. D. Smith & Co., Plantsville, Conn. Circular illustrating and describing the "Perfect Handle" tool kit, comprising three different sizes of screwdrivers, tire tool or pry bar, hammer, standard wrench, pipe wrench, monkey-wrench, regular punch, nail punch, cold chisel, and offset slip joint pliers.

Hart Roller Bearing Co., Orange, N. J. Pamphlet on "Increasing Production," containing a discussion of the application of roller bearings in machinery, and the possibility of increasing production through their use. The construction of Hart staggered roller bearings is illustrated and described.

Pierce, Butler & Pierce Mfg. Corporation, 437 E. 162nd St., New York City. Catalogue of Pierce packless valves, illustrating and describing valves for different purposes manufactured by the company, and also putting forth briefly some of the underlying facts that determine the serviceability of valves.

Goddard & Goddard Co., Detroit, Mich. Leaflet No. 1, entitled "Real Production Tools" illustrating and describing the "Go and Go" half side mill. The advantages claimed for the design and construction are clearly set forth, and the possible saving by the use of these cutters specifically pointed out.

Medart Patent Pulley Co., St. Louis, Mo., manufacturer of complete lineshafting equipment, including shafting, couplings, bearings, hangers, pulleys, friction clutches, belt tighteners, rope drives, gearing, sprockets, etc., is issuing a monthly publication known as "The Dart," containing matter relating to the personnel, methods, equipment, and products of the company.

Cutler-Hammer Mfg. Co., Milwaukee, Wis. Catalogue containing 40 pages, 8½ by 11 inches, descriptive of Cutler-Hammer elevator controllers and accessories. A discussion of the types of motors best suited to elevator work is presented, as well as an outline of the usual method of selecting motors of the right horsepower and starting torque to insure satisfactory performance.

Sterling Grinding Wheel Co., Tiffin, Ohio. Circular describing the application of "Sterbon" grinding wheels in foundry practice, and for cylindrical grinding, internal grinding, and surface and edge grinding. The circular also gives a grading table for "Sterbon" wheels, which specifies the grain and grade of wheels to be used for different classes of materials and various operations.

George Cutter Works of the Westinghouse Electric & Mfg. Co., South Bend, Ind. Booklet containing wiring tables and illuminating data relating to the problems of wiring and lighting offices, factories, etc. Tables of foot-candle intensities recommended for different classes of service are included, as well as a discussion of lighting installations. Lighting accessories, such as reflectors, fixtures, hangers, plugs, and receptacles are shown.

Bastian-Blessing Co., 125 W. Austin Ave., Chicago, Ill. Catalogue 23, containing data relative to "Rego" welding and cutting apparatus, including welding and cutting torches, manifolds, welding and cutting regulators, cutting, welding, and soldering outfits, adapters, nipples and fittings, wrenches, etc. A number of new products are shown in this catalogue, and some of the prices have been revised. Copies of the book will be sent upon request.

Diamant Tool & Mfg. Co., Inc., 91-97 Runyon St., Newark, N. J. Catalogue describing Diamant standard punch and die sets, the unit parts of which are made on an interchangeable basis, thus giving an opportunity to select from a wide variety of sets different combinations to suit the parts to be produced. Tables are included giving the capacities and dimensions of the different sets, the standard parts being designated by letters on the accompanying diagrams.

Boston Gear Works, Norfolk Downs (Quincy), Mass. 1921 edition of general catalogue G1, covering 600,000 standardized Boston gears, carried in stock in 1500 sizes. A list of additions to the stock sizes is given on page 4. Complete data including dimensions, prices, etc., are given for brass, iron, and steel bevel and spur gears, worm-gears, sprockets, etc. The booklet also shows ball bearings, steel bushings, gear gages, pulleys, racks, and universal joints.

W. S. Rockwell Co., 50 Church St., New York City. Bulletin entitled "Selection of Fuels," containing a series of papers relating to the selection and use of fuels and equipment for industrial heating operations. The bulletin contains five specific papers, as follows: Factors Governing the Selection of Fuels; Comparative Fuel Prices on B. T. U. Basis; Comparative Heating Value of Industrial Fuel Gases; Composition of Industrial Fuel Gases; and the Utilization of Fuel Resources.

Nazel Engineering Works, 4043 N. 5th St., Philadelphia, Pa. Catalogue entitled "The Nazel Hammer Book," illustrating and describing in detail the construction, operating principle, motive power, and other features of the Nazel air hammer. The different types of hammers are illustrated, and complete specifications are given for each. A diagram of this type of hammer, with the various parts numbered and designated in the accompanying list, is included for the user's convenience in ordering repair parts.

Greenfield Tap & Die Corporation, Greenfield, Mass. New 400-page catalogue No. 46, describing the line of small tools and pipe tools made by this company. The tools shown include screw plates, taps, dies, drills, reamers, milling cutters, bits, arbors, countersinks, hobs, tap and drill kits, mandrels, sleeves, sockets, stocks, tap wrenches, pipe vises, and pipe wrenches. In addition to the descriptive material relative to the tools, seventy pages of tables and general information are included. A copy of the book will be sent to anyone who mentions MACHINERY.

Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. Catalogue 9-C, illustrating and describing the new line of electric furnaces which has been added to the products of the company. The furnaces described include the multiple unit type, small "hevi-duty" furnaces, and "hevi-duty" industrial furnaces. Applications for annealing, hardening, drawing, and enameling are described. Special publication 1643, treating of the application of oil circuit-breakers, including an outline of the characteristics of the several types of Westinghouse oil-circuit breakers.

General Fireproofing Co., Youngstown, Ohio. Catalogue entitled "Saving with Shelving," containing illustrations of the different types of GF all-steel shelving and their application in storerooms, vaults, tool-rooms, libraries, and for a wide variety of uses. A complete list of sizes is included. This shelving is made on the unit principle, a few fundamental pieces forming a foundation from which may be developed installations of many sorts to handle various kinds of loads and materials. Catalogue entitled "Efficient Record Protection," containing illustrations and specifications covering the all-steel safes made by this company for the preservation of business records.

Heald Machine Co., Worcester, Mass., has published a book comprising a treatise on cylinder regrinding, the purpose of which is to assist those entering the business of regrinding automobile cylinders. The book contains 116 pages, 6 by 9 inches, and the material is divided into eight chapters. The first chapter deals with the field for cylinder regrinding, outlining the advantages and possibilities, and giving actual figures concerning the possible profits, as well as information on shops best adapted for regrinding, and where work of this kind can be obtained. The second chapter treats of the equipment required by an average shop for regrinding and fitting pistons, rings, and pins, and describes in detail Heald cylinder grinding machines. The third chapter discusses why motors should be reground, and the fourth chapter gives a number of kinks of value in regrinding work. The fifth chapter contains a detailed description of the operation of the Heald cylinder grinding machine. The sixth chapter covers advertising and publicity. The seventh chapter treats of assembling the motor and, though short, is considered very important, as many a regrinding operation is spoiled by improper assembling. The eighth chapter contains general information relating to the Heald line. The data contained in the book should be of considerable interest and value to those entering this field of work.

TRADE NOTES

Peter A. Frasse & Co., Inc., 417 Canal St., New York City, have been appointed sole agents for the Metropolitan district for Sibley drilling machines made by the Sibley Machine Co., South Bend, Ind.

Oxweld Acetylene Co., Newark, N. J., manufacturer of "Oxweld" welding and cutting equipment, has removed the offices of its foreign sales department from Newark to 30 E. 42nd St., New York City.

Tool-Bit Specialty Co., Syracuse, N. Y., has been organized to manufacture high-speed steel tool-bits. A full line of sizes will be carried in stock. The bits are made by the hammering process, it being claimed that this method produces a better bit than can be obtained by the rolling process.

Frostholm-Treiber Co., Rochester, N. Y., has been incorporated with a capital of $24,000 by C. C. and J. H. Frostholm and W. C. Treiber to manufacture tools, piston rings, and kindred products. For the present, correspondence should be addressed to Frostholm Bros., 221 Washington Square, Syracuse, N. Y.

Brown & Sharpe Mfg. Co., Providence, R. I., announces that its annual vacation, starting July 29, will be extended this year to September 6. During this time the stock-room and offices will remain open as usual, and essential operations will be carried on in the shop, so that satisfactory deliveries can be made on supplies and on any of the Brown & Sharpe standard products.

Garvin Machine Co., Spring and Varick Sts., New York City, manufacturer of milling machines, screw machines, and numerous other types of machine tools, announces the resignation of its sales manager Frank A. Power, and the appointment to this position of Lyman M. Waite, formerly with the National Acme Co. and recently with the Springfield Automatic Screw Machine Corporation of Fitchburg, Mass.

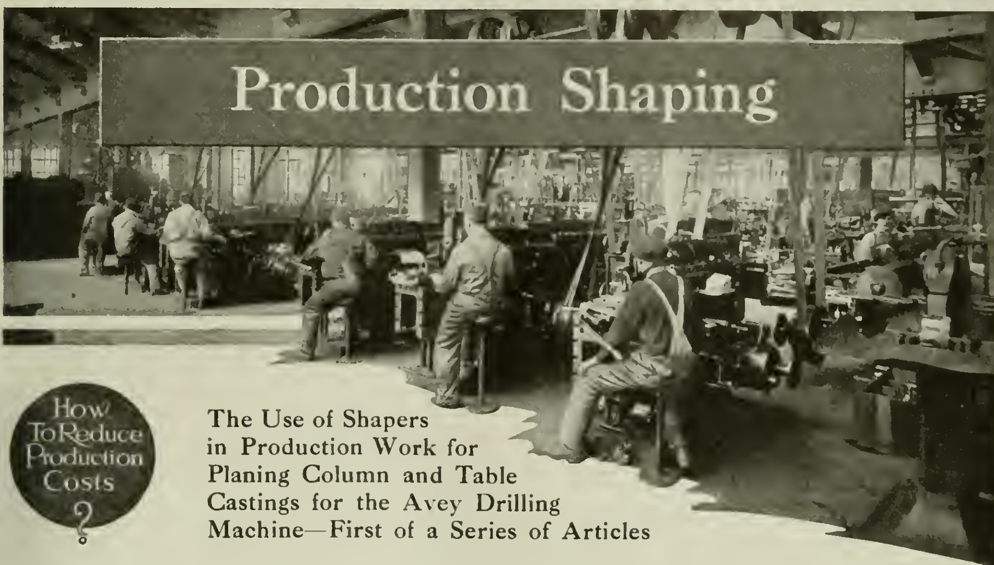
Webster & Perks Tool Co., Springfield, Ohio, has sold the grinding and polishing stand and accessory department of its business to the Hill-Curtis Co., Kalamazoo, Mich. This change has been made in order that the company may concentrate all its facilities on the exclusive manufacture and sale of the W & P line of universal and plain cylindrical grinding machinery. The Hill-Curtis Co. is an established concern operating a foundry, forge, and machine shop, and is well equipped for manufacturing this line.

Dodge Sales & Engineering Co., Mishawaka, Ind., manufacturer of transmissions and heavy oil engines, announces that work on its new $1,000,000 building at 49 Park Place, New York City, has been started, the excavation being practically completed. Present plans call for a twelve-story building, but the foundation and construction will permit of an additional four stories, if needed. The new building will occupy 165 feet frontage on West Broadway, 50 feet on Murray St., and 75 feet on Park Place.

W. A. Jones Foundry & Machine Co., 4409 W. Roosevelt Road, Chicago, Ill., at a recent meeting elected T. A. Jones president of the company to succeed the late William A. Jones. The other officers elected are as follows: W. G. Jones, vice-president and treasurer; J. A. Sizer, secretary; and G. W. Page, assistant secretary. The general policy of the company is in no way altered by these changes and W. G. Jones continues to hold the position of general manager in addition to acting as vice-president and treasurer. T. A. Jones, the new president, has been associated with the company for many years as its secretary and treasurer.

Reeves Pulley Co., Columbus, Ind., announces that arrangements have been made with Manning, Maxwell & Moore, Inc., 119 W. 40th St., New York City, whereby the latter firm assumes the exclusive agency for the Reeves variable-speed transmission in the New York territory. Manning, Maxwell & Moore will carry a complete assortment of repair parts for these transmissions for immediate delivery. They will also carry a large stock of complete variable-speed transmissions of various sizes and types, and will have a completely organized variable-speed transmission department in charge of capable engineers. Manning, Maxwell & Moore will also handle and carry in stock the Reeves wood split pulley.

Production Shaping



How To Reduce Production Costs?

The Use of Shapers in Production Work for Planing Column and Table Castings for the Avey Drilling Machine—First of a Series of Articles

SHAPERS are extensively used in tool-rooms for such work as the forming of die-blocks. By employing the various combinations of feed movements provided on machines of this type, pieces of intricate form can be machined—hence, the name "shaper." It is a general impression that the profitable use of these machines is restricted to tool and experimental work and similar operations, but although shapers are not extensively used on production work, there are many shops which have found them efficient for the performance of short planing and other similar operations on a production basis. For work that comes within their range they have several advantages. Among these may be mentioned a low initial investment, small maintenance cost, small amount of floor space required, and simplicity of operation, enabling them to be attended by low-priced labor.

The majority of the production jobs which are satisfactorily done on the shaper are those where the nature of the work is such that it is impracticable to take advantage of the increased efficiency resulting from the stringing up of a number of pieces of work on the table of a planer. It will be evident, then, that in cases where a choice must be made between setting up a single piece of work on a planer or on a shaper, the lower item of overhead that must be charged against the latter type of machine is usually of sufficient importance to represent a determining factor, provided the production time is not unreasonably high.

At the plant of the Avey Drilling Machine Co., in Covington, Ky., the possibilities of the shaper as a production tool are well demonstrated. This firm uses shapers for five different manufacturing operations on the top column, the lower column, and the table of drilling machines, and as the dimensions of these parts vary considerably for different sizes of machines, it is necessary to have a number of shaper fixtures available.

Before starting upon a detailed description of the operations performed on these shapers, it may be well to make a general statement concerning the nature of the shaper work that is done. Obviously, planers are used in building Avey drilling machines, but there are certain castings, such as those for the table and the lower column for multiple-spindle machines, which are too wide to pass between the housings of any planer in this shop. Consequently, the machining of these castings presented the alternative of either purchasing a larger sized planer or of devising some other means of handling the work.

As there were only a moderate number of these pieces to be planed, the management felt that the investment in a planer of sufficient capacity for this work would not be warranted. A study of this problem made it apparent that, as the length of the surfaces to be planed on even the largest castings was quite short, a shaper with a 32-inch stroke would have sufficient capacity to handle the work, provided it was equipped with a fixture that would support the casting rigidly under the shaper ram. Such a machine could be purchased at a lower first cost and it would possess the further advantage of occupying less floor space.

The other type of planing operation for which shapers are used in this plant, is the machining of surfaces on castings that have a shoulder at the end of the finished surface, which makes it impracticable to set them up in a row on a planer table. For jobs of this

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Shapers are not generally thought of as production machines, because their more common application is for tool-room, experimental and repair shop work; but it is a fact that shapers are capable of giving highly satisfactory results for the performance of short planing operations on a production basis, and for other production work within their range. This article describes the classes of work of this kind for which the shaper is adapted, and gives specific examples of advanced practice in production shaping.

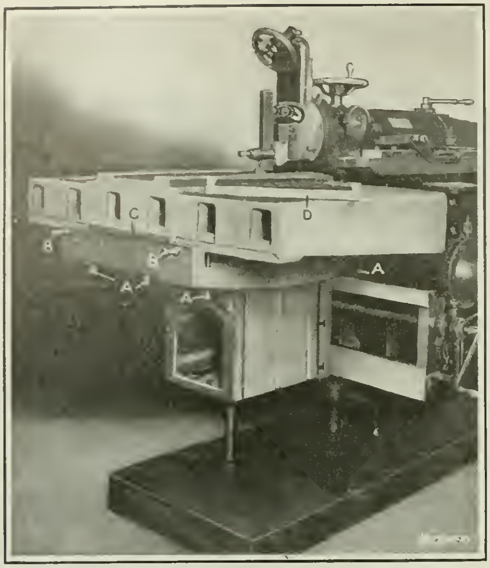


Fig. 1. Thirty-two-inch Shaper equipped for planing the Table Bearing on Columns of Multiple-spindle Drilling Machines

kind, the shaper is often found a more desirable tool than the planer because of the absolute control of the stroke, and as previously stated, when only one piece of work can be machined at one time, the smaller amount of floor space taken by the shaper is also an advantage.

Planing Dovetailed Bearing on Drilling Machine Column

Fig. 1 illustrates a 32-inch back-geared crank shaper built by the Cincinnati Shaper Co., Cincinnati, Ohio, which is used for planing the dovetailed table bearing on the lower column of an Avey No. 2 six-spindle drilling machine, this being the first operation performed on the casting. This dovetailed bearing is used as the locating point for the performance of subsequent operations. Naturally it must be located in approximately a central position on the casting and planed in accurate alignment with the side walls. To insure obtaining these results, a preliminary setting is made by first measuring from the two extreme outer edges to locate the center line of the casting, and then setting the tools in the proper position to plane the dovetailed bearing central with this line.

After this preliminary location has been accomplished, the casting is leveled up by means of five screws, four of which are shown at *A*. At the rear, the casting rests against two horizontal screws which may be adjusted to square it up with the line of travel of the shaper ram. The final clamping is accomplished by means of two screws *B* which are tightened against the casting and secured by means of lock-nuts. The tools are set for planing the dovetail by means of a gage *C*, and after the operation has been completed, the accuracy of the finished work is tested with a gage *D*.

In planing this dovetailed bearing, one roughing and one finishing cut are employed. Round-nosed roughing tools are used on the horizontal surfaces, while special rough-dovetailing tools are used on the angular faces. For taking the finishing cuts, the horizontal surfaces are machined with a square-nosed tool, while special finish-dovetailing tools are used on the angular faces. The fixture shown in Fig. 1 is also adapted for use in planing the lower columns of Avey No. 3 drilling machines with either four or six spindles. It will be seen that this fixture is set up on the regular table of the shaper.

Planing Dovetailed Column Bearing in Drilling Machine Table

Fig. 2 shows a 32-inch Cincinnati shaper equipped with a special extension at the front of the base to adapt it for the use of a fixture for holding the tables of Avey No. 3 four-spindle drilling machines while the dovetailed column bearing is being planed. As the castings come to this machine, a planing operation has been performed on the working surface of the table, which is at the back in the illustration; and the lower edge *A* of the casting has also been planed. These surfaces are utilized as locating points for setting up the work on the shaper. The operation consists of planing a dovetailed bearing at one side and a square seat for a dovetailed gib at the other side of the table bearing on the column. This bearing must be centrally located, and with that object in view, the casting is centered in the fixture by measuring from the two ends of the planed working surface of the table.

The casting rests in the fixture on blocks *B* that support the planed edge *A*, and by using blocks of different heights the same fixture may be employed for planing tables for different sized drilling machines. It will be apparent from the illustration that this work-holding fixture is of the so-called box form, and that the casting is slid in from one end and lowered into place on the supporting blocks *B*. This fixture is hung on the saddle by bolts in the T-slots, and takes the place of the regular table of the machine. When ordering a machine for handling this work, a special extension base *C* was specified, so that a support could be used at the front of the fixture to carry its weight, which is quite considerable. The work is clamped back in the fixture against a finished face that is arranged to come in contact with the previously planed working surface of the drilling machine table.

After adjusting the position of the casting so that it is properly centered, a preliminary clamping is accomplished by means of two screws *D* that force the casting back against the locating face at the rear of the fixture. Two screws *E* are next tightened to hold the casting down, and a screw inside the fixture is then raised under the center of the part to be planed, in order to support the thrust of the cut. Finally, the main clamping screw *F* is tightened, this screw being relied upon to accomplish the major part of the clamping action. In order to place control of adjust-

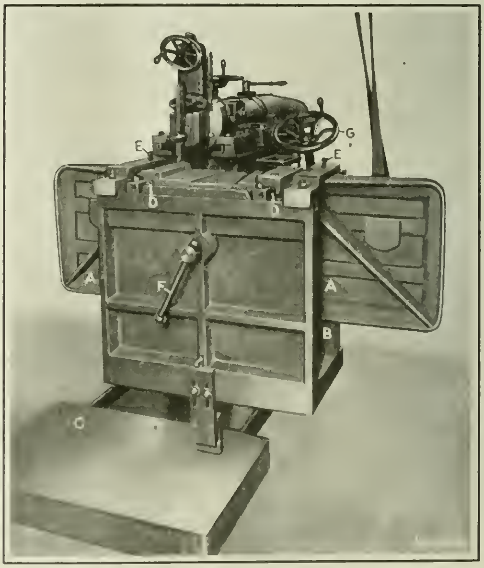


Fig. 2. Thirty-two-inch Shaper equipped for planing the Column Bearing in Tables of Multiple-spindle Drilling Machines

ments of the saddle on the shaper cross-rail within easy reach of the operator while at the front of the work-holding fixture, a special set of gearing, manipulated by a handwheel *G*, has been placed on the machine.

In planing the surfaces of the table bearing on the column, one roughing and one finishing cut are required. For the horizontal surfaces at the bottom of the bearing, a round-nosed roughing tool is employed, while a square nosed tool is utilized for running down the vertical side of the bearing, and a special rough-dovetailing tool is used for taking the first cut on the inclined side. For the finishing cuts, a square-nosed tool is used on the horizontal surfaces and for running down the side of the vertical surface, while a finish-dovetailing tool is utilized on the inclined side. The recess between the finished horizontal surfaces of the bearing is roughed out with a round-nosed tool, and no finishing cut is taken. The dovetailed bearing planed on this shaper is 12 inches long by 18¾ inches wide by 1¼ inches deep. The material is cast iron, and the time required for the job is about two hours.

Planing Top Columns for Avey Drilling Machines

There are three planing operations to be performed on the top column of Avey drilling machines. Two of the surfaces to be machined are located in such a way that there is not sufficient clearance for a tool to pass over a string of castings when set up on the table of a planer. Consequently, the necessity of handling one casting at a time makes it a more economical proposition to perform this work on a shaper, for reasons that have already been mentioned. The third surface to be planed on these parts is the relatively small bottom face, where the top column is connected to the lower column member; and the fixture for holding the work for this operation is so designed that three castings may be set up at a time. In this way, the shaper is able to give a very satisfactory rate of production, and the output from a single machine is adequate to fulfill the requirements of the production schedule on this class of work.

Method of Setting up Top Column Castings for the First Operation

The first operation on these castings consists of planing the dovetail for the drilling head, and as this bearing is not only an important factor in governing the efficiency of operation of the drilling machine, but is also used as the locating point in setting up the work for all subsequent operations, it will be evident that great care must be taken in setting up the work and in planing this important bearing surface. Referring to Fig. 3, which shows a Cincinnati 24-inch shaper equipped for the first operation, it will be seen that the work is held in a box type of fixture that is bolted to the saddle T-slots in place of the regular shaper table.

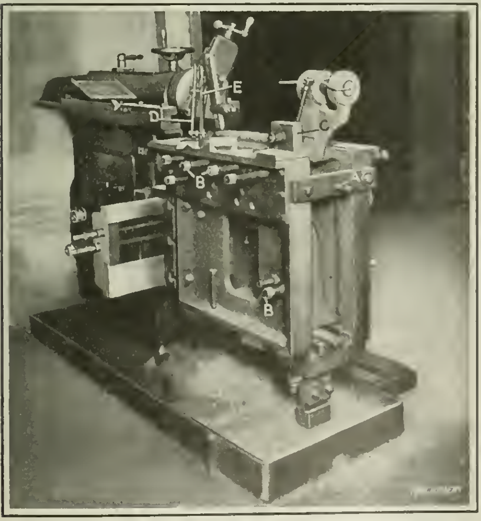


Fig. 3. Twenty-four-inch Shaper equipped for planing the Drilling Head Bearing on Columns of Single-spindle Drilling Machines

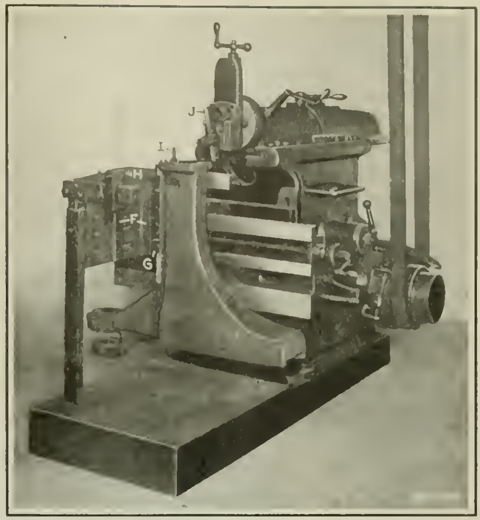


Fig. 4. Twenty-four-inch Shaper equipped for planing the Base of the Columns of Single-spindle Drilling Machines

Inside the box fixture there are two adjusting screws on which the casting rests, and they may be manipulated to provide for leveling the work so that the dovetailed bearing will be planed in proper relation to other fixed points. At the end nearest to the machine, there is provision for using a clamping bolt and strap (not shown) to hold the casting down, and at the opposite end of the fixture there will be seen a cross-bar and screw *A* for supporting the end thrust of the tool. Sidewise location and clamping of the casting in the fixture is accomplished by five bolts *B* at each side, which are tightened against the casting to locate and hold it in the desired position for planing.

Aligning Casting with Line of Travel of the Shaper Ram

Attention has been directed to the importance of lining the casting up accurately before starting the planing operation. The methods by which this result is accomplished are as follows: First, it is necessary to so locate the work that a line from the center of the spindle bearing hole to the center of the base of the column is parallel to the line of travel of the shaper ram. For obtaining this alignment, use is made of a special gage *C* that is carried on a base having a shoulder that fits over the inner edge of one of the top rails on the work-holding fixture, which is accurately finished for this purpose. A wooden plug is placed in the spindle bearing hole and rubbed with chalk so that the center of this hole can be marked, with reference to both the center of the opening and the outside of the boss.

Similarly, a chalk mark is placed on the top of the casting at the opposite end, so that a central line can be scribed in this chalk. After the fixture has been set up with the finished edge of the top rail in alignment with the line of travel of the shaper ram, gage *C* is used, as shown in Fig. 3, to compare the position of the scribed center of the spindle bearing opening with the center line scribed on the base of the column. The arm on which the measuring bar of gage *C* is carried is mounted on a pivot so that it may be swung against the tension of a coiled spring. In this way, it is an easy matter to first reach the spindle opening, and then move the gage to the opposite end of the casting and swing the measuring bar down into engagement with the work. This tool affords a convenient means of measuring the distance from the edge of the top rail of the fixture to the two scribed lines. If the work has been properly aligned for planing, these two distances should be equal.

Adjusting the Horizontal Position of the Work

The next step in setting up the work is to bring the casting into a horizontal position, that is, to have it so located that as the casting lies in the work-holding fixture, the center of the spindle bearing hole will be at exactly the specified distance above the top surface of the opposite end of the casting, namely, 7⅛ inches for the size machine referred to. The test for this setting is accomplished by means of a surface gage and a special gage-bar on which there is scribed a graduation mark at 7⅛ inches from its lower end. The surface gage *D* is first set so that, with its base standing on the top rail of the work-holding fixture, the point of the scriber comes into contact with the center scribed on the wooden block in the spindle bearing hole. Then the special gage-bar *E* is stood vertically at the center of the opposite end of the casting, and the surface gage is moved over so that the position of the spindle center may be transferred to this gage. If the horizontal setting of the work is accurate, the point of the scriber will come into contact with the 7⅛-inch graduation on the gage-bar; otherwise, the horizontal position of the casting must be adjusted by means of the screw on which it is held in the fixture.

Testing Vertical Setting of Work

One other adjustment is still necessary to bring the work into the desired position for planing, namely, to ascertain whether it is standing in a vertical position. By first placing gage-bar *E* at one corner of the rear end of the casting and testing the position of the graduation line with the surface gage *D*, and then repeating this test with the gage-bar at the opposite corner of the work, a comparison can be made of the positions of the opposite corners of the casting relative to the horizontal top face of the work-holding fixture. The point of engagement between the scriber on the surface gage and the graduation line on bar *E* should be duplicated for the two settings if the work is properly located for planing. When all three of these adjustments of the setting of the work have been made, the screws *A* and *B* are finally tightened to maintain the accuracy of the location.

After the casting has been set up according to the previously described method, the outline of the dovetailed bearing to be planed is laid out on the work, in order to indicate the amount of excess metal that must be removed by planing. The first cut across the horizontal surface at the top of the bearing is taken with a round-nosed tool, and then a special rough-dovetailing tool is used on the inclined surfaces. The horizontal surfaces are next finished with a square-nosed tool, and a special finish-dovetailing tool takes the final cut on the inclined surfaces, thus completing the first operation. The production time on this job is forty-five minutes.

Planing the Bottom Surface on the Top Column

Mention has already been made of the fact that the dovetailed bearing, previously planed on the top column casting to receive the drilling head, is used as the locating point in setting up the work for performing subsequent operations. Fig. 4 shows a 24-inch shaper built by Gould & Eberhardt, Newark, N. J., on which this work is performed; and in this connection, attention is drawn to the fact that although the shaper fixture is designed to hold three castings at a time, only one casting is shown in position in order that the arrangement may be more clearly illustrated. The method of setting up the work and the actual machining operation to be performed are quite simple. On the fixture there are three strips *F*, each of which has an inclined surface to bear against the angular face at one side of the dovetailed bearing that has been planed on the column.

After a piece of work has been slipped into place under locating strip *F*, a second adjustable strip *G*, which is secured to the fixture by bolts, is pushed into place against the opposite side of the dovetailed bearing and drawn up tight by the bolts, thus securing one piece of work in place for planing. Three pieces are set up in this way, and when they have all been set up, a clamping screw *H* is tightened to hold them securely in place and to support the end thrust of the tool. The planing operation is quite simple, consisting of facing off the bottom of the casting and of planing a tongue to fit into a groove planed in the top of the lower column casting.

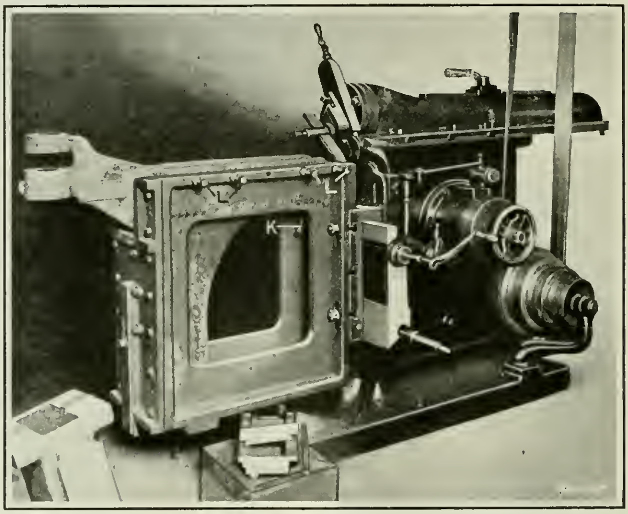


Fig. 5. Twenty-four-inch Shaper equipped for planing Bearing for Top Carriage on Drilling Machine Columns

The sequence of cuts taken during the performance of this operation is as follows: A round-nosed tool takes a roughing cut at the top of the casting, and the same tool is fed vertically downward to produce the necessary clearance at each side of the tongue. A duplex straddle tool is next used to finish-plane the sides of the tongue, and the accuracy of this job is tested with a snap gage *I*. Finally, the top of the work is finished with a round-nosed tool which has had a small flat surface stoned on its point. This tool is set at an angle, as shown at *J*, for convenience in reaching the work as it is held in the fixture. The production time on this job is twenty-five minutes.

Final Planing Operation on the Top Column

The final planing operation on the top column of the Avey drilling machine consists of planing the dovetailed bearing for the top carriage. This operation is performed on a 24-inch shaper as shown in Fig. 5, which is built by the Milwaukee Shaper Co., Milwaukee, Wis. This machine is equipped with a box jig similar to the one used for the first operation, except that the work is set differently. For taking the final cut, the casting is located from the dovetailed bearing planed in the first operation, the arrangement being similar to that explained in connection with the work-holding fixture illustrated in Fig. 4, with the exception that in the present case the dovetail in which the casting is held is located at the forward end of the fixture.

Castings are brought to this fixture by a trolley hoist and lowered through a space in the top, after which the clamping bolts are tightened. After a preliminary setting has been accomplished in this manner, the weight of the casting at the opposite end is supported by tightening a screw *K* that engages the under side of the work; and screws *L*, which are furnished with lock-nuts, are next drawn up in order to hold the sides of the work and prevent them from springing away from the cut. This is a matter of importance, because the walls of the casting are thin at the point where the dovetailed bearing for the top carriage is planed, and they require support in order to prevent distortion of the work.

After the roughing cut has been taken, it is also a matter of especial importance to loosen up the clamping bolts, which were tightened with a wrench before taking the roughing cut, and then screw these bolts up by hand until their points come into engagement with the casting, after which the lock-nuts are again tightened with a wrench. The purpose of resetting before taking the finishing cut is to prevent excessive pressure of the bolts which would spring the work out of shape and destroy the accuracy of the planed surface. On this job, roughing and finishing cuts are taken with the same sequence of tools previously referred to for operations on dovetailed bearings. The production time is seventy-five minutes.

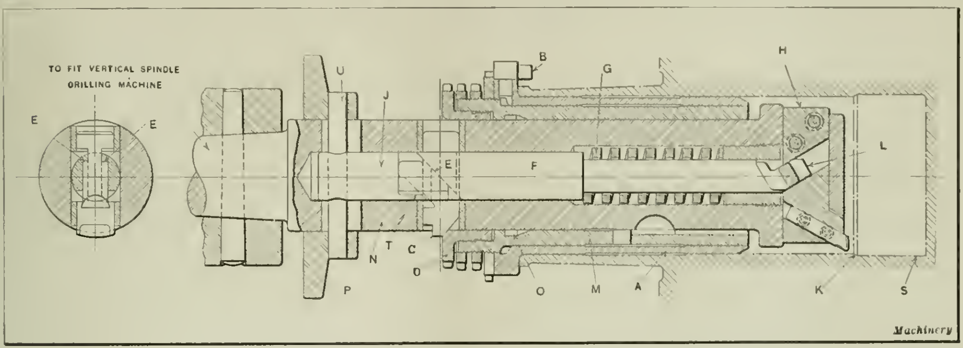
* * *

ROUGH-RECESSING TOOL FOR MOTOR CYLINDER BORE

The accompanying illustration shows a single-point boring tool which was developed to take the place of a wide forming-blade tool employed for the roughing operation in the combustion chamber of a motor cylinder. The wide blade originally used gave a fine finish, but its use necessitated the employment of extremely slow feeds and speeds, and on several occasions it had spoiled the cylinder bores by scoring them while being withdrawn from the work. In addition to these objectionable features, it proved an expensive tool to keep in proper condition. The design shown was adopted with the idea of producing a more satisfactory tool, which would be nearly automatic, positive in action, and not too expensive to make.

It will be noticed that bushing *A* acts as a pilot in the bore of the cylinder and is prevented from rotating by pin *B*, which comes into contact with the tangent wall between the two cylinders. When the spindle is fed downward, dog *C* comes in contact with the angular surface of collar *D* and is thrust inward. This inward movement causes shoulders *E* to bear on push-rod *F* against the action of spring *G*, which develops about 330 pounds pressure when compressed. As push-rod *F* moves forward, compressing spring *G*, the forged angular end *L* seated in tool-block *H* imparts an outward movement to the tool-block. Collar *D* is locked to bushing *M* which, in turn, is keyed to the main driving bar *N*. As dog *C* travels inward at the same time that it is being carried downward by bar *N*, the point of the tool is moved both radially and axially. The angles of the shoulders *E* and end *L* are, of course, calculated so that the walls of the combustion chamber and the walls of the cylinder bore will be joined by a conical surface *K* of the required taper, which in this case is 30 degrees.

Dog *C* travels downward inside bushing *M* for the full length of the cut or until the point of the tool is in the extreme downward position. At this time the point of the dog drops into slot *O*, or rather, the moment it passes over the slot the action of spring *G* forces it out, at the same time withdrawing the point of the tool from the surface *S* of the work. The stop on the machine also comes into play as a further safeguard, although a click that may be heard several feet away, which is made by the dog dropping into the slot, serves as a signal to the operator that the end of the cut has been reached. When in this position the tool may be withdrawn from the work without danger of scoring the cylinder walls.



Rough-recessing Tool for Combustion Chamber in Motor Cylinder

A new cut cannot be started until the tool has been completely withdrawn from the cylinder bore and placed in the correct position. To do this the operator must elevate the spindle to a sufficient height to bring flange *P* against adjustable pins (not shown), held in the nose of the machine. Flange *P* is pinned to the upper knock-out bar *J* and is a loose fit on the main driving bar *N* which is slotted to accommodate pin *U*. The force of the blow resulting from bringing flange *P* into contact with the pins in the nose of the machine forces the flange downward carrying with it knock-out bar *J* which seats on push-rod *F*. This action also carries rod *F* downward, providing clearance between its shoulders and the shoulders on dog *C* so that the beveled end *T* on the end of the knock-out bar will drop into the angular slot in dog *C*, thus forcing this member inward and allowing the outside nest of bushings to drop down, at which time the tool is ready for another cycle of operations. It will be noticed that the construction of the bushings and lock-nuts is such that a wide range of adjustment is provided.

W. W. R.

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In 1920 Italy imported from Germany machinery and machine parts to a value of nearly 210,000,000 lire, as compared with imports to a value of 70,000,000 lire in 1913. In quantity, the imports amounted to 36,400 tons in 1920, as compared with 46,900 tons in 1913.

THE COST FACTOR IN FOUNDRY PRODUCTION

By J. P. GLYNN
Production Manager, The Elmwood Castings Co., Cincinnati, Ohio

Much of the cost burden entering into the manufacture of machinery can be lightened by putting the foundry on a more efficient productive basis. The manufacturer of machinery has never had a better opportunity than the present to go over the pattern situation and clean out obsolete types of patterns from his equipment. The development of new processes for turning out castings in quantity has done much to promote efficiency in the foundry. The manufacturer should not overlook these developments, but should take advantage of the modern equipment of the foundries and cooperate with the foundry by fitting his patterns so that they can be used for machine molding and other modern foundry appliances. The production of castings by hand methods, using the old type of pattern, is still followed by many manufacturers, and it is a vital consideration from an economical point of view to arrange such jobs for machine molding. In making or in contemplating changes of this kind, the manufacturer should solicit the cooperation of his foundrymen, and he will usually find that information will be freely given. An increase in the foundry production rate will be appreciated more in the days to come, when the labor shortage will again become acute. This shortage will be a big factor, especially in foundries where the percentage of apprentices is very low.

An example will best illustrate the savings that can be realized by making these change-overs. Consider a small bushing, say 3 inches in diameter and 4 inches long, with a 1¼-inch cored hole. Ordinarily this casting would be made by using one wood pattern, and if made on the bench would be run with other small patterns in order to fill up the flask, since in most cases only one pattern is furnished to the foundry. The molder can be expected to ram about twenty flasks per eight-hour day. Consider now this same job produced on a molding machine, under which conditions not less than six patterns would be mounted on a board or plate. It is safe to state that the molder, under ordinary conditions, would put up 100 molds per day, using a squeezer type machine. In many foundries a job of this kind is run on a piece-work basis and an even greater production obtained. It is evident that the old type bench-work patterns make this class of molding expensive and that the manufacturer is bearing this uncalled-for expense.

A certain machinery manufacturer once built and sent to his foundry an aluminum pattern for a 14-inch lathe apron plate. The pattern was to be used in conjunction with a wood follow-board by hand-ramming on the side floor. If the castings had been molded as intended, it would have been impossible to get much more than twelve per day. The pattern cost $50. In making the pattern to be molded this way, the foundry had not been consulted, so when the job reached the foundry a plated pattern was requested to be used on the molding machine, which would involve an additional cost of $62. The customer did not feel disposed to assume this extra cost, so the foundry management considered it economy to have a new pattern made at their own expense and run the job on a squeezer machine. This was done, and the production attained was forty pieces per day, as against twelve by the hand method. The weight of the casting was 43 pounds, so that 1720 pounds of castings were produced by machine instead of 516 pounds, which would have been the production by hand molding on the side floor

One other factor which the production of castings by machine molding brings out is that the castings are drawn with the aid of a vibrator on the machine, and are always uniform in size, showing practically no parting line. This eliminates much grinding and chipping. By hand-molding methods, the pattern is rapped by using a hammer and a bar, and this often causes the castings to lack uniformity of size and weight. The money represented by this lack of uniformity often amounts to more than would be required to re-rig the patterns.

In connection with these changes the core-box equipment should receive attention. A large percentage of the dry-sand core work can be eliminated by changing the patterns to the machine-molded aluminum-plated type, because patterns of this type can often be so made as to produce their own core in green sand. In cases where dry-sand cores are required, the core-boxes should be so arranged that several cores can be made at one operation. There are many types of core-making machines in use, and it is just as important that the core-boxes be properly arranged for quantity production as it is that the patterns be so arranged.

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ADVERTISING MACHINE TOOLS

By J. M. HENRY, Engineer, Pratt & Whitney Co., Hartford, Conn.

The editorial "Publicity that Pays" appearing in June MACHINERY refers to the class of information commonly contained in circulars and catalogues of machine tools and accessories. The writing of machine tool advertising is somewhat prosaic at its best, and time-worn shop expressions come naturally to the writer who must necessarily have a technical education in order to write intelligently. The vocabulary is limited to technical descriptive terms and, yet, copy must be so written that it carries an appeal to everyone concerned in the purchase of the machine. The copy must be general enough to interest everyone, and to write it is "some job," to say the least.

General managers and superintendents are concerned with production, longevity, ease of repairs and adjustments, elimination of breakdowns, and quality of materials, while the purchasing agent is mainly interested in the price. Here enters another factor that is frequently commented on: Why are not prices included in descriptive literature and advertisements? The answer is that in nine cases out of ten the customer has certain jobs in mind when looking for a machine. Extra equipment is usually necessary for the operations, and if prices were quoted in the circulars, inquiries would undoubtedly come in asking whether the price included a taper attachment, compound rest, etc. Thus, additional correspondence would be required that otherwise would be avoided when a clear direct inquiry is received for a specific price on a machine with certain equipment.

To convince an engineer that the machine described is the best on the market for his purpose requires clear forceful technical copy and illustrations. There was a time when the showing of illustrations of certain detailed mechanisms, together with clear descriptions of their functions, was considered as playing into the hands of one's competitors. In some quarters this idea still prevails, but it has been largely done away with, because any manufacturer who desires to know the construction of a machine built by a competitor has numerous other convenient ways of studying the machine minutely.

The description of machines must be clear enough to suit the foreman and the operator, and there is no reason why technical advertising cannot be clear, concise, and fully explanatory. The matter of phraseology should be carefully considered; for instance, is a machine "controlled" or "operated" by a lever? Is a brake "automatically applied" when it is dependent on the action of the operator, even though his action does not relate directly to the brake? Many similar examples might be mentioned. If phrases such as "unusual depth" and "ample bearings" are resorted to, suspicion is aroused, but the copy seems bare without them. Cooperation between the engineering and advertising departments is indeed imperative, and the writer does not see how satisfactory results can be obtained when this practice is not followed.

A PHASE OF SHOP PRODUCTION COSTS

By FREDERICK A. POPE, Assistant to General Superintendent, Blake & Knowles Works, East Cambridge, Mass.

While considerable progress has been made in developing systems for determining shop production costs, there are, nevertheless, many details of this work that are not always given adequate consideration. A factor which seriously affects the cost records, but which often escapes detection or is given little attention, is the cost of materials and labor entering into remachining or salvage work. The actual or total cost of spoiled parts that must be scrapped, including the cost of stock and machine work, may be entered in the spoiled-work account to be absorbed as part of the burden; or it may be added to the cost of machining the pieces that pass inspection and the material account credited for whatever scrap is recovered. In either of these cases the fact that work has been spoiled is readily shown by some form of replacement order, or by the scrap card.

The repair or remachining work, however, is a rather elusive element which, nevertheless, creeps into the labor costs in some shops and is not always shown up as clearly as that of work actually scrapped. The extra cost of time spent in remachining, or in some way making usable, pieces which are not correctly machined, but which can be corrected and used, may be considerable. When the work is subjected to a rigid inspection between practically all important operations, the regular inspection reports will give all data regarding necessary salvage work of this nature; so that with a knowledge of the facts thus provided, steps toward remedial measures can be taken by those responsible for production. But in a great many shops where a varied product is made, and process steps cannot be definitely established, such detailed inspection all along the line is not practicable. The duty of inspection then falls heavily upon the department foremen; this is, of course, admittedly unsatisfactory, but sometimes unavoidable.

Furthermore, where the product is of such a nature that much of the work is done without the extensive use of accurate limit gages, the skill and touch of the workman becomes one of the leading factors in the control of quality. Under such conditions it is inevitable that parts will occasionally pass through which are not quite up to standard. For example: A hole bored for a bushing may be found too small when the parts reach the assembling department, so that the piece must be sent back to be rebored; a set of bosses may not be faced off square and must therefore be returned for refacing; or the tapered end of a piston rod may be turned too small for the drive fit and for that reason be sent to the welder to be built up for re-turning. In such cases this work is commonly done on the authority of some department foreman, the regular order number being used. The cost of extra labor required therefore finds its way into the cost of that job.

Segregating Salvage Costs

As in the case of complete spoilage, this salvage expense may be considered, under some conditions, a necessary part of the cost of the job, but it is essential that some means be provided for segregating in the records the cost of all this extra work, at least temporarily, so that weaknesses in the shop methods or incompetence in the personnel may become known quickly and be traced by the management, and the necessity for these corrections reduced to a minimum. Even though the final cost of the job may carry this item and so be passed on to the purchaser, a disregard of its causes will encourage carelessness which results in increased production costs. Attention should be directed to this kind of expense by some special form of job ticket so that later, when making up the cost summaries, that proportion of the labor spent in remachining work will comprise a separate item.

The exact form of the remachine ticket is immaterial, the essential thing being that it include the data indicating the department and person responsible for the incorrect work, and that it have some prominent and distinguishing feature (color or name) so that it can be easily separated by cost clerks from the regulation job tickets.

With such a method, imperfect work may, by a simple routine process involving practically no additional clerical work, be brought to the attention of the proper executives. An analysis, based on this information and incorporated in a report to the various department heads concerned as well as to the management, will place the responsibility for errors where it belongs, and will stimulate greater care in those departments.

It may be remarked that without a separate inspection force, or thoroughly standardized detail costs to check this extra expense, a foreman can, if he wishes, correct and hide defective work before it leaves his department. While this is true to a certain extent, the greater part of such errors in machining will be discovered in subsequent operations by some other department through inability to get a proper set-up, or in the assembly department through failure to assemble parts without excessive and out-of-the-ordinary hand fitting.

* * *

COMPARISON OF WAGES AND PROFITS

Employes, in general, usually have no conception of the profits realized from their labors, and to this ignorance of facts may be attributed many of the prevailing erroneous impressions among employes that their employers make enormous profits. For instance, a workman knowing the selling price of a part which he has produced is likely to deduct his wage and the probable cost of the raw material from which the product is made, and believe that the remainder approximates the profit of the concern on the part. Obviously, this is not so, because he has neglected to allow anything for taxes, insurance, and other overhead charges, or for a reserve or surplus fund so necessary to pay expenses during periods of depression and for enabling enlargements to the business.

Actually, the profits of a concern are small in comparison to the wages paid its employes, and if the latter were educated to understand this, much of the dissatisfaction among wage earners would be avoided. The General Electric Co., Schenectady, N. Y., with its usual farsightedness, gives each employe annually a statement showing the actual profits in cents resulting from a dollar's worth of business, as well as the sum which the employes received. The last statement was an average for the three years 1918, 1919, and 1920.

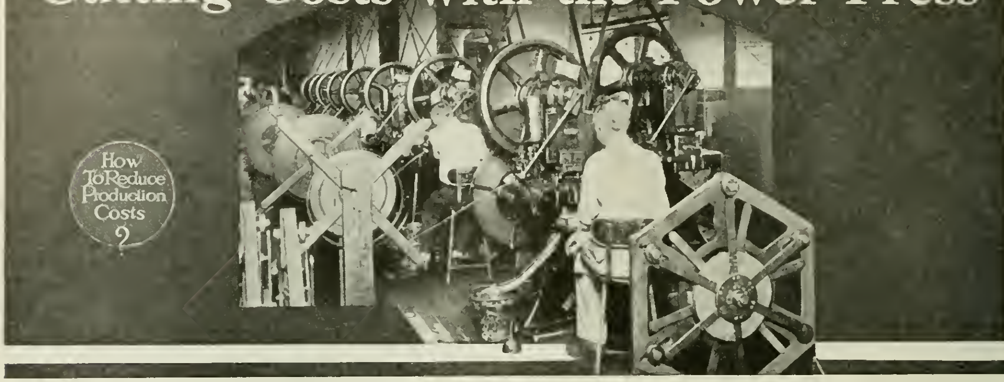
DISTRIBUTION OF EACH DOLLAR OF THE INCOME OF THE GENERAL ELECTRIC CO. FOR 1918, 1919, AND 1920

Distribution	Amount, Cents
Materials, supplies, etc.	40.6
Wages and salaries	41.7
Taxes	5.3
Transportation, telegraph, and telephone charges	2.5
Interest on bonds and notes	1.2
Dividend paid to stockholders	4.0
Surplus fund	4.7
Total	100.0

Machinery

The accompanying table shows the way in which each dollar of income was distributed. It shows that while the sum of 41.7 cents was paid in wages and salaries to the employes, only 8.7 cents was realized as a profit. Of the latter amount, 4 cents was paid to stockholders while 4.7 cents was placed in the reserve or surplus fund. Thus, it is evident that all the stockholders together received only about 9 per cent of the earnings of the employes.

Cutting Costs with the Power Press



How Material and Labor are Saved by the Use of Power Presses

By EDWARD K. HAMMOND

MANY executives in the mechanical industries, who pride themselves upon being well informed as to the latest methods applicable in manufacturing their products, do not realize the rapid strides which have been made in the design of dies for the performance of many operations not ordinarily expected to be done in a power press. Several advantages are to be gained by the substitution of stampings or drawn work for parts produced by other methods. Most important among these are the reduction in the cost of labor and material; the possibility of making parts of equal strength, but with a weight of only one-third that of parts produced by other methods (thus saving two-thirds the amount of metal formerly used); and last, but far from least, when rapidity in the filling of orders is an important factor, the ability of the power press to handle its work with extreme speed. A single downward and return stroke of the ram completes an operation, and, therefore, the rates of output attained in the production of all classes of stampings and drawn work are likely to be far in excess of those secured where the same parts are produced by some other method. For these reasons the power press is often an important factor in reducing costs.

Range of Work Done by Power Presses

Probably there are few machines that are employed for the production of as wide a range of work as power presses. The work handled by power presses extends all the way from small instrument parts, which are frequently made by treadle-operated presses of small size, up to such work as motor car bodies and parts of steel railway cars. Sheet steel of a thickness up to about ½ inch is easily worked under large presses. The machines themselves run all the way from small bench equipment, operated by foot pressure, up to machines with crankshafts over 2 feet in diameter, strokes of 4 feet, and a capacity up to 24 feet between the housings. Some machines constructed during the last few years weigh 700,000 pounds and over. One press for forming motor truck rear axle housings, recently constructed, weighs over 400,000 pounds.

Influence of Welding on the Range of Press Work

Mention of a machine constructed for use in the manufacture of rear axle housings brings to mind the influence of welding upon the range of work for which the power press is adapted. The development of electric and acetylene welding methods has enabled these processes to be employed in conjunction with the power press, for the economical manufacture of many parts that could not be produced in single pieces. As a case in point, consider rear axle housings for motor cars. It is common practice to draw these parts up in two pieces, and then to weld the two halves together in order to give the desired result. Mechanically operated torches are often used to good advantage, as they not only give more uniform results, but also handle the work with greater rapidity than would be possible if the torch were manipulated by hand.

Development of Dies

An investigation of what is actually being accomplished will reveal the fact that there seems to be practically no limit to the complexity of work that can be performed, if the problem of designing suitable dies for the purpose is submitted to an experienced and skillful diemaker. Many parts are now being made in dies, which were formerly made at a greater cost by other methods; and the design of these tools is even more varied than that of the power presses by which they are operated. The extreme range extends from the simple blanking die ring and punch up to the automatic follow-die, which takes ribbon stock and performs a sequence of operations on it, each of which brings the work one step nearer to completion, until it is finally stamped out or cut off. These dies are made

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During periods of great industrial activity, when there is a strong demand for most manufactured products, and prices exhibit a rising tendency, production costs are not always as carefully scrutinized as they should be; but when business slows down and prices begin to fall, the need for economy in production becomes apparent, and manufacturers begin to examine their methods and seek new ways for reducing production costs. In many instances, it will be found that work formerly produced on other types of machine tools may, by a slight modification in the design of the piece, be performed equally well by the use of the power press at a decided saving in the cost of material, labor, and overhead.

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with a number of stations under which the work is stopped as it progresses through the die, so that at each downward stroke of the ram one piece is operated upon at each station of the die, and one finished part is produced by each downward stroke of the press ram.

Drawing Roller Bearing Raceways

It has already been stated that one of the chief advantages to be secured by using power presses is the saving of labor and material. As a case in point, consider the work involved in the manufacture of sleeves for the outer raceways of a well-known type of roller bearing. These parts were formerly made from bar steel, worked in a screw machine which bored out the inside and turned the outside of the sleeve, preparatory to cutting it off the bar. The exact percentage of a solid bar of steel that is lost in the form of scrap produced in the making of sleeves by this method would naturally vary according to the diameter and thickness of different sleeves, but it would be safe to say that the average loss of material would be in the neighborhood of 80 per cent. The wages paid to a screw machine operator would also place quite a heavy labor charge against the job.

With a view to reducing the percentage of raw material converted into scrap, a change was made in the method of manufacture by substituting steel tubing for solid bars. The tubes were worked on a screw machine in exactly the same way as solid bars and it was still found necessary to bore the inside diameter and turn the outside of each sleeve before cutting it off. This improvement in the method of manufacture resulted in a substantial saving in the amount of steel that was scrapped, but the labor cost still remained about the same. Recently, a further noteworthy advance has been effected in the making of these parts. It consists of using dies for drawing the sleeves up from cold-rolled flat strip steel. By this method of manufacture, a deep shell is first drawn, and then this shell has the ends cut off, thus bringing the sleeve to the proper length. The dies have been developed in such a way that there is assurance of keeping the inside diameter and the thickness of every sleeve within the required limits, without resorting to subsequent machine work. Sleeves can be produced in these dies at a far lower cost than when the work was turned and bored on a screw machine, and the amount of material that goes to the scrap pile is not excessive.

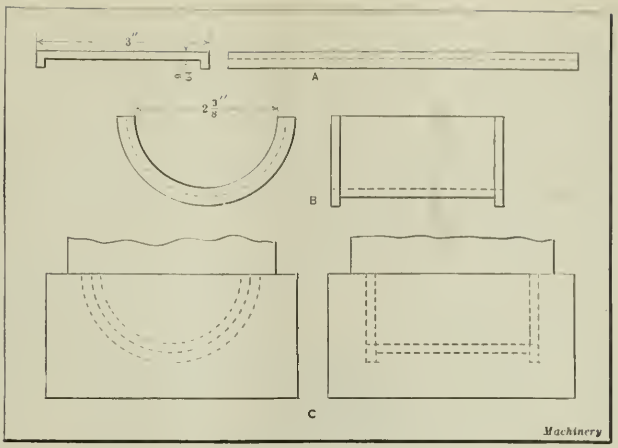

Fig. 1. Diagrams showing Successive Operations in forming Flanged Bronze Bushings

It is of interest to note that in order to obtain satisfactory results in the making of roller bearing raceway sleeves by this method, it is important to use cold-rolled steel of a perfectly uniform thickness. The material is purchased from the steel mill under specifications covering this point, and as it is delivered to the plant, the first step is to subject each strip of steel to a gaging process, in order to ascertain that its thickness comes within the required limits. This is done by passing the strips through an electrically operated gaging machine, equipped with contact points which touch opposite sides of the strip of steel. Any variation in thickness exceeding the specified limits is at once revealed by this machine, and all strips of steel that fail to pass inspection are rejected.

Last but not least among the general considerations involved in the substitution of press work for other methods of manufacture, on such classes of work as this, comes the important fact that, where automatic dies are used in the manufacture of small metal products, the material is fed to the die in the form of ribbon stock. After a machine is set up, it is only necessary for the operator to pay general attention to it. As a result, one man is able to look after about eight machines. This effects a substantial reduction of the labor cost as compared with cases where one operator is required for each machine.

Making Flanged Bronze Bushings

Fig. 1 shows successive steps in the production of bronze bushings which are made in halves and flanged at both ends. These pieces were formerly machined from castings, involving the usual steps of making molds, melting and pouring the metal, cleaning the castings, and machining

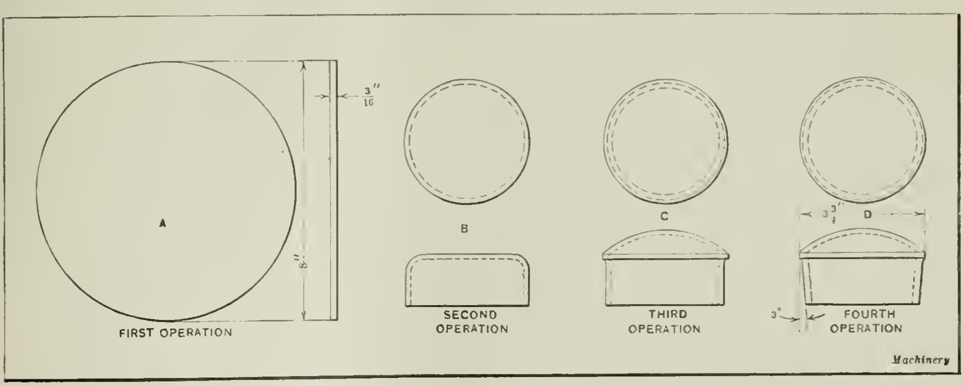

Fig. 2. Steps in the Production of Hand-hole Plugs for Boilers or Petroleum Stills

them. As compared with this procedure, the bushings are now completed, ready for assembly into the machine, by three power press operations. For making this product, strip metal is brought from the brass mill already flanged at each edge. The first operation consists of cutting off blanks *A* to the proper length. This is done on a No. 3 Stiles press. The second operation is performed in a 100-ton Bliss press, and consists of forming the blank to a U-shape, as shown by diagram *B*. Finally, the work, which has now been brought to approximately the required form, is finished in a 600-ton knuckle-joint embossing or coining press, equipped with a punch and die in which the metal is completely enclosed, so that it may be squeezed to the required shape and finish.

Bushings produced in this way do not require any subsequent machine work. Important among the advantages of making them under the power press are that there is a saving of material amounting to approximately 10 per cent of the total cost, while the rate of production under the press is about thirty times as high as that attained by the molding and machining of castings. For the first operation, blanks *A* can be cut off at twice the speed at which the second and third operations can be performed. Hence, the press used for cutting off blanks is only run half the time. Working on this basis, 2400 half bushings can easily be produced in an eight-hour day.

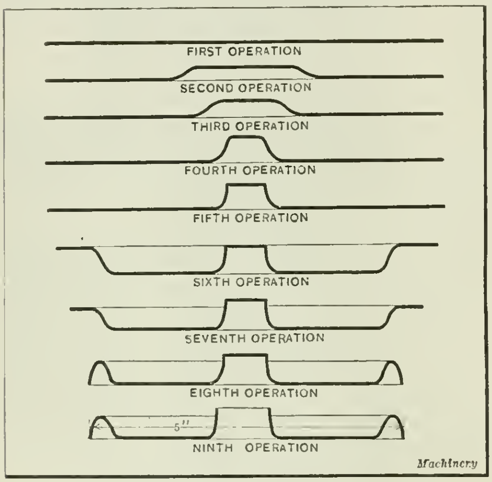

Fig. 3. Successive Steps in producing Half of a Pressed-steel Caster Wheel

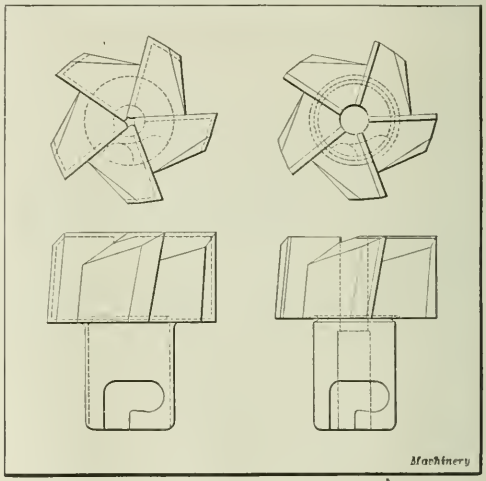

Fig. 4. End-mill Forging, produced on the Power Press within 1/16 Inch of Required Size

Making Conical Shaped Hand-hole Plugs

In the design of some types of stills used for the fractional distillation of crude petroleum, and also in some types of boilers, there is use for a number of plugs of the form shown in Fig. 2. They are pushed into hand-holes which give access to the tubes in the still or boiler, and the pressure from the inside forces each tapered plug into its seat, so that complete sealing of the holes is insured by the pressure applied to the rear of the plugs. When it is desired to have access to the tubes, it is merely necessary to drive the plugs out of their holes. Plugs of this kind are made in various sizes, but the method of procedure in manufacturing is the same in all cases. Before it was shown that this was a job that could be economically handled on the power press, the method of procedure was to make steel castings and then to turn the 3-degree taper on a lathe equipped with the usual attachment for handling such work.

Under the present method of making them, four power press operations are involved. The first step is to cut a blank *A*, 8 inches in diameter, on a No. 5 Bliss-Stiles press. The second step is to draw a straight cup *B* on a No. 76½ Bliss power press equipped with a double die, so that two cups can be drawn at a time. Reference to diagram *C* will make it apparent that there is a small ridge formed on the outside at the closed end of the cup, which forms a shoulder that engages the hole into which the plug is driven. This ridge or shoulder is formed in a coining press, which squeezes the metal in such a way that it is extruded outward to fill an annular groove in the die. Finally, a fourth press operation is performed to produce the 3-degree taper on the outside of the shell; and at the bottom of the punch there are embossed letters which come into contact with the inside of the cup at the bottom and press the trademark into the work. On this job, it is estimated that the power press gives a production over ten times as great as that attainable in making steel castings and machining them in accordance with the method which has been briefly described. By making the plugs under the power press, an operator is able to produce 2000 plugs in an eight-hour day.

Making Caster Wheels from Sheet Metal

Until recently, it has been general practice to make various forms of caster wheels of cast iron or hard wood. Both methods are likely to prove unsatisfactory, as either gray iron or wood is likely to break under heavy pressure or shock, and the cost of making caster wheels from these materials is high. Dies and methods have therefore been developed for making casters of various sizes and styles under the power press. These methods vary according to the size of the caster, but, in general, they are quite similar.

Fig. 3 shows the procedure in making a 5-inch caster wheel, two of the finished blanks of the form shown being riveted together to form this product. A study of the diagrams will make the sequence of operations quite clear. The first operation consists of stamping out the blank. Next come four drawing operations which bring the hub of the wheel successively to the conditions shown. The sixth is a so-called "dishing" operation, which raises the edge of the blank; this is the first step in forming the rim of the wheel. In the seventh operation, the edge of the blank is trimmed off Next, the edge of the blank is turned down to complete forming the rim of the wheel. Finally, a ninth operation pierces the four rivet holes and also punches out the end of the hub. The advantages of a sheet-metal caster wheel of this kind are that its weight is one-third of that of a cast-iron wheel of the same strength, and the material costs only about one-quarter as much as cast iron. The labor charge involved in making a steel wheel is about one-third the cost of molding, casting, and machining wheels from wood or cast iron. On this basis, it is estimated that the cost of making wheels from sheet steel is about 29 per cent of the cost of iron wheels; and the steel wheels are superior on the basis of strength and durability. All the operations are performed on Bliss No. 20 power presses, with the exception of the ninth operation, which can be done on a No. 19 or a No. 18 press. The rate of output is 4800 blanks per day; and two operators can assemble 300 casters in eight hours.

Forging under the Power Press

Power presses are now finding application for the performance of certain hot-forging operations that were formerly done exclusively under drop-hammers. In some cases, this work has been developed along lines which provide for holding the dimensions of the forging within extremely close limits, so that the cost of performing machining operations is substantially reduced. Also, this is the means of effecting a substantial saving in material, which is especially important when a high-priced steel or other metal is being forged. Another advantage claimed for the pressing operation is that a refinement of the grain of the material is obtained by squeezing it while hot.

As an example of work of this kind, consider the forging of tool-steel blanks for end-mills, as shown in Fig. 4. This is done on a Bliss No. 75½ geared press which is capable of developing 100 tons pressure. The blank is forged within 1/16 inch of the desired size on all surfaces, and an experienced operator is able to produce 1200 forgings in an eight-hour day. It will be evident that with a forging having only 1/16 inch surplus metal on all surfaces, instead of a cylindrical blank cut from a tool-steel bar, the cost of producing a cutter will be greatly reduced. Of course, the exact ratio will vary according to the steel being handled, the size and form of the cutter, and other similar conditions.

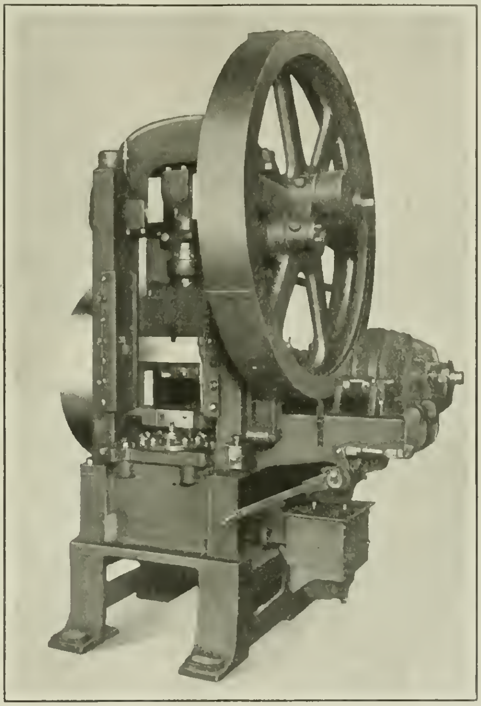
Fig. 5. Power Press with Dial Feed equipped for Broaching Operations on Bronze Bushings

Use of the Power Press for Broaching

Where broaching operations are to be performed on pieces of such a form that the broach need not be of considerable length, the power press may be utilized to advantage. The broach is pushed through the work instead of being pulled through as on a regular broaching machine. The chief advantage of the power press lies in the fact that for many classes of work it is possible to utilize a dial feed mechanism, thus greatly increasing the production.

Fig. 5 shows a Bliss press equipped for broaching bronze bushings 1 inch in diameter by 2 inches long. The press is run continuously, and the operator is merely required to take the cast blanks from the container in which they are delivered to the machine, and drop them into successive pockets of the dial. The dial carries the work around under a broach, which is stepped in such a way that the beginning of the broach roughs the outside diameter while the final teeth complete the broaching operation. The dial then carries the work around to a point where it is brought under a knock-out located above a chute under the hole in the dial. As the finished bushing is knocked out of the dial, it falls down the chute into a container beneath. On this job the rate of production is 18,000 broached bushings in an eight-hour day.

Making Pressed-steel Connecting-rods

It cannot be said that pressed steel connecting-rods are at present finding application as a substitute for machined forgings; but the possibilities of extending the range of the power press to cover this field, in order to take advantage of the economies that may be effected through the rapidity with which the work could be handled, are shown in Fig. 6. This illustration shows the steps in making connecting-rods from pressed steel. The body of the rod is made in halves, and the cap is produced in a single piece. Each of these parts is made under the press by three operations. After blanking, the body or cap is completely formed by the second operation, with the exception of trimming, which is done separately. It is not the intention to make comparisons between the relative merits of rods produced in accordance with standard practice and by this means of manufacture. However, there is no doubt that in so far as rates of production are concerned, the pressed steel parts can be produced at a much lower cost.

Forging Ends of Connecting-rod Bearings

When connecting-rod blanks are made from forgings, the usual procedure is to bore and face the holes for the crankpin and wrist-pin bearings. A variation from this procedure which reduces production costs, has recently been developed. It consists of performing a cold-forging operation on the blanks to make the bearing faces uniform, without the necessity of facing. By handling this work under the power press, it can be done at a lower cost. A press equipped for this operation has dies of the form shown in Fig. 8 with flat upper and lower members which engage the two sides of the crankpin or wrist-pin bearings on two forgings the one to the right only being shown in place; at the center of the dies there are two buttons over which the previously bored hole at the opposite end of the work is dropped prior to swinging each blank into place for the cold-forging operation. On this job the rate of production is 6000 rods in an eight-hour working day.

Cold-forging Parts of Instrument Mechanisms

In Fig. 9 are shown three examples of the successive steps in blanking and cold-forging parts of instrument mechanisms under the punch press, and a study of these examples will reveal the economies that are effected through the adoption of this method of manufacture. Obviously, there is no comparison between the cost of making these parts on the press, and turning blanks and then generating the teeth by hobbing or some other method. The dies in which this work is done are made with a sufficient degree of accuracy so that these instrument parts will possess the required degree of precision.

Little description is required to make the successive operations clear. In each case, there is a preliminary blanking operation, and this blank is worked through successive dies, until the work reaches the desired form. It is interesting to note in this connection the provision that has been made for producing the irregular forms. Take the case of the gear for which the sequence of operations is shown at the top of Fig. 9. To provide for forming the small dog on the hub of this gear, it will be seen that one tooth of the preliminary blank is made considerably larger than the rest, so that sufficient metal is left to give the desired formation. This principle is often employed and is one that will be found useful in handling many jobs of this kind. Formerly, composite parts of this kind had to be made in two separate pieces and riveted together. As compared with such a procedure, the economy of doing the job on the power press will be obvious.

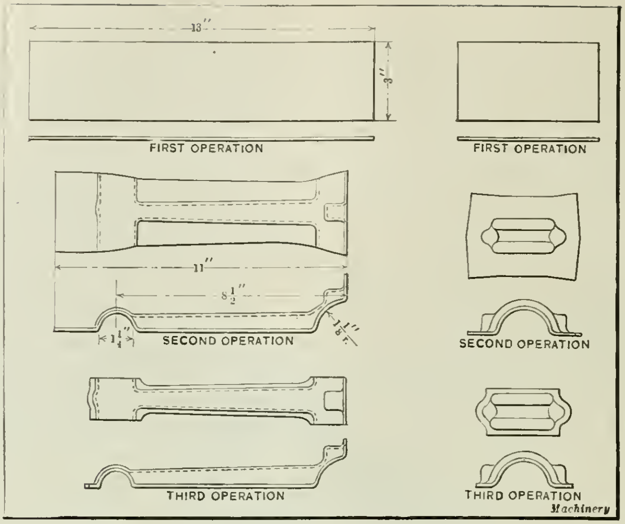

Fig. 6. Successive Steps in the Manufacture of Connecting-rods from Pressed Steel

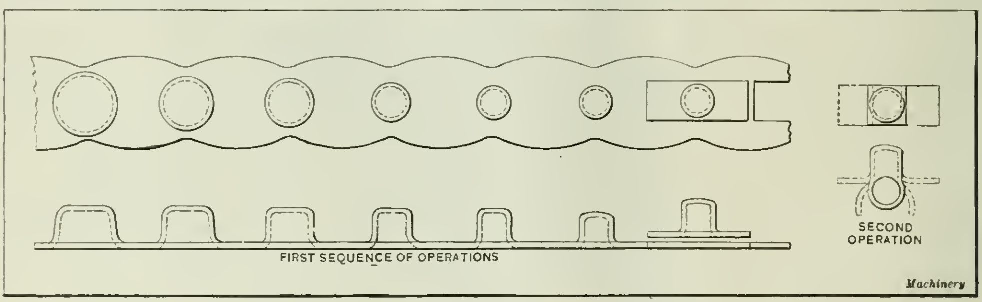

Fig. 7. Sequence of Drawing and Blanking Operations performed in a Follow-die to produce a Cam Pin Blank

Making "Whistler" Valve Cams

In the "Whistler" motor car tire valves made by the Automatic Products Corporation, Long Island City, N. Y., provision is made for setting the valve to hold a given air pressure. When this point is exceeded, the tire begins to blow off, and this is indicated by the whistling of the valve. Provision is made for setting the valve to hold 50, 60, 70, 80, or 90 pounds by means of a graduated cam of the form shown in Fig. 10. These cams were formerly made from brass tubing worked on an automatic screw machine, which graduated the cam with a rolling tool carried on the rear cross-slide and cut it off with a parting tool at the front of the machine. Then the pieces went to a special profile milling machine which cut the edge of the cam to the required contour. The production time was about seven seconds for the two operations, giving an output of 3840 per eight-hour day.

The preceding method of production was not entirely satisfactory, and the problem of making these parts under the power press was submitted to the Nelson Tool Co., of New York City. This concern developed dies for doing the work in two operations, as indicated in Fig. 10, and is now manufacturing these parts for the Automatic Products Corporation. At the first operation, the piece is blanked and graduated; and the blanks produced in this way then go to a curling die which folds them to the finished form, as indicated by the diagram for the second operation. It will be noted that the ends of the blanks are dovetailed, so that after they have been curled they are locked together. By the use of the power press on this job, the high rate of production of 32,000 cams per eight-hour day was attained.

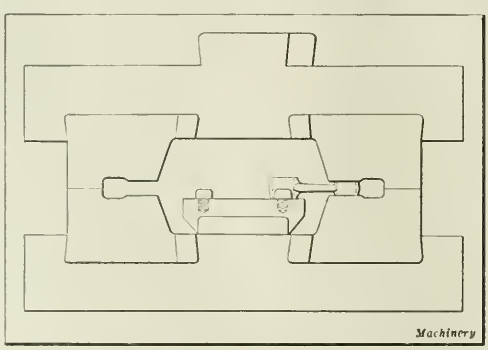

Fig. 8. Dies used for cold-forging Ends of Connecting-rod Bearings, instead of facing the Surfaces

Procedure Followed in Making Cam Pins

At the right-hand side of Fig. 7 is shown the cam pin which runs in contact with the cam of the "Whistler" valve. Formerly these pins were made from square brass bars worked in an automatic screw machine, and when handled in this manner the method of procedure was to turn the round trunnion and then cut off the blank in such a way that a square block was left behind the trunnion. In this condition, the work was sent to a special drilling fixture, which was provided for drilling a hole through the square block. Handled in this manner, the total time for the two operations was about five seconds, making the production 5760 per eight-hour day.

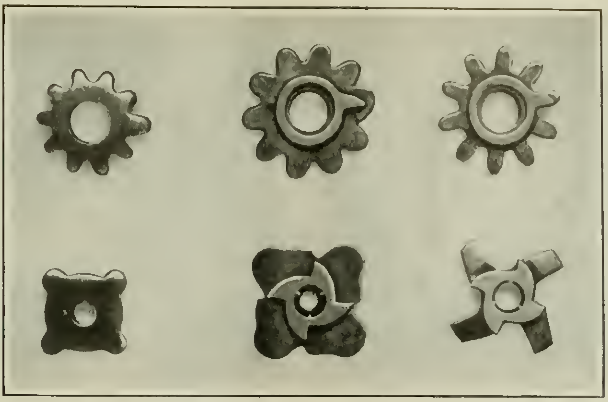

Fig. 9. Successive Steps in blanking and cold-forging Two Instrument Parts

This problem was also taken over by the Nelson Tool Co. The method of procedure finally worked out consists of running brass ribbon stock through a follow-die, which performs six successive drawing operations, and then shears out the blank as indicated by the diagram for the first sequence of operations. The blanks produced in this manner are then sent to a curling die which rolls up the flat ears at each side of the shell that forms the cam trunnion, to produce the bearing that was formerly made for drilling a hole through the square block. On this operation, the rate of output is 500 cam pins per hour for the two operations, making the daily production 4000 in eight hours.

* * *

REMOVING DENTS FROM METALLIC SHELLS

By FRANK E. CHACE

In manufacturing articles in the form of thin metallic shells or tubing, great care in handling is required to prevent denting the surface of the work. Even when special care is taken, dents are often made, and the loss from this cause may be considerable, especially if the material is expensive or the work near completion. Therefore, attempts are often made to repair such work in order to make it salable. The methods described in the following for removing dents from metallic shells are interesting, because they are out of the ordinary and are not met with in regular lines of manufacture.

If the shell has an opening at one side, large enough to permit a suitable tool to enter, the dent can sometimes be removed by placing the end of the tool on the bent-in portion and driving outward. If the work to be repaired is a cylindrical tube, a sizing plug may be entered to force the metal outward. If the shell is thin and spherical in shape, with an opening small enough to be plugged, it may sometimes be repaired by first filling with water and then plugging the hole, and lightly tapping the outer edge of the dent with a wooden mallet. By keeping the opening tightly sealed, and allowing no air space in the shell, the blows struck with the mallet will compress the liquid and force the center of the depressed metal outward. This method of procedure, of course, is applicable only when thin metal is being handled.

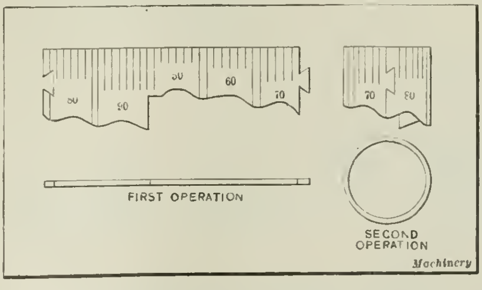

Fig. 10. Blank and Finished Cam for a "Whistler" Tire Valve, produced in Two Operations under the Power Press

The following is a method of forcing out a dent in a shell having a small mouth or opening. This method utilizes the expansive properties of melting rosin. The first step is to fill the shell with melted rosin. As the rosin cools it contracts greatly, and while it is cooling and contracting, more rosin is added so that when it is thoroughly cooled the rosin entirely fills the interior of the shell. When entirely cooled, a hot flame from a blowtorch is applied directly on the depression which it is desired to lift. The rosin beneath the depression will soften and expand, thus lifting the metal upward. Care must be used to apply the heat quickly to the proper spot and keep the other parts cool. The pent up forces are tremendous, however, and if too much heat is applied, an accident may result.

If there is no means of working from within a shell, a wire nail having a large head may be soft-soldered by its head to the surface of the depression. This nail can then be grasped with vise jaws or strong pincers and the metal pulled outward. Still another method of eliminating dents that can sometimes be used to good advantage is to grip at one end, in a bench vise, a round iron or steel rod, several feet long. The length of the rod must be in such proportion to its diameter that it will vibrate or spring vigorously when struck with a hammer. Too large or too short a rod will be too stiff. Too small or too long a rod will be too weak, and will therefore be bent. When the rod is struck a sharp downward tap or blow with a hammer, at a point near the middle, but on the side toward the vise, a vigorous upward "kick" is given by the free end.

A small portion of the free end should be bent at right angles to the rod, and when in position for use this short end should project upward. Two operators may be required to use this device. One operator inserts the rod end into the mouth or open side of the shell, resting the depressed spot upon and directly over the upward projection of the rod end. Another man strikes a sharp blow downward at a spot on the rod between its center and the end gripped by the vise. A vigorous "kick" results, and the metal is driven upward at the free end of the rod.

In some of these methods, when driving outward from within, the metal may of course be driven too far, but since the hump is then on the outside, it is an easy matter to tap it back into place with a mallet, or force it back by other means until the desired contour is produced. Filing or buffing and polishing will hide the lesser tool marks.

* * *

The first International Congress of Aerial Navigation will be held in Paris, November 15 to 26. All correspondence relating to this congress should be addressed to the Secrétaire Général du Congrès International de la Navigation Aérienne, 9, rue Anatole de la Forge, Paris 17, France.

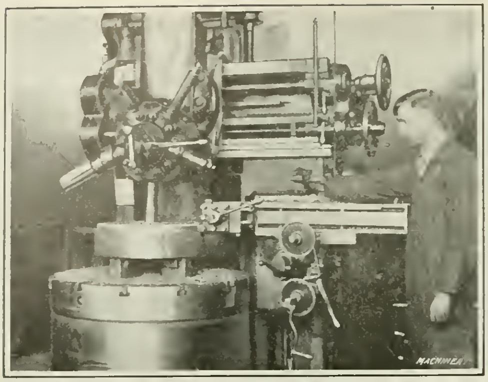

Fig. 1. Rough-boring and turning the Outside Diameter of a Locomotive Piston-head

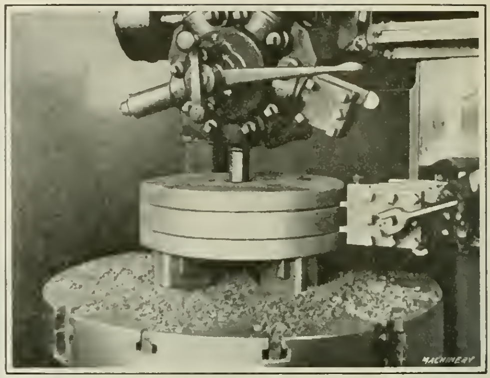

Fig. 2. Piston-ring Groove Turning Operation, in which Two Tools are used in the Side-head Turret

Production Work in the Locomotive Shop

Application of the Bullard Vertical Turret Lathe to Locomotive Shop Practice, with Typical Examples and a Description of the Tooling for Each Job—First of Two Articles

The high cost of production in railroad shops has been the subject of many comments in both the daily and the technical press, in public speeches, and in governmental reports. Costs can be reduced in railroad shops in three ways—by capable management; by the efficiency of labor; and by the employment of labor-saving and cost-reducing machines and methods. The present article deals with the last phase, and shows a number of examples of economical production by the use of the vertical turret lathe in combination with carefully laid out tooling equipments.

THE machining of piston-heads and piston-rings is a common job in the locomotive machine shop. The piston-head machining lay-out shown in Fig. 3 is a typical one for this class of work. It will be seen that this piston-head has a tapered hole for the piston-rod, so that in machining it, a method is involved which is commonly employed when tapered holes are finished on the Bullard vertical turret lathe. Also, it will be seen that this hole is counterbored on the under side, and that special means have been provided in chucking the work to enable this recess to be machined without the necessity of rechucking it. The piston-head is machined complete in five operations, and is chucked by employing special jaws *A* in which there is a stud that enters the hole on the under side of the work. This arrangement furnishes a positive drive, holds the work securely, and allows plenty of clearance space for the boring-bar that was used in the under-cutting operation, previously referred to

Machining Operations on Piston-heads

In the first operation, a tool of special form is employed to face the raised surface surrounding the tapered hole and the remaining end surface of the piston-head. During this operation, the outside diameter is rough-turned by a tool carried in the side-head turret. The second operation is that of rough-boring the tapered

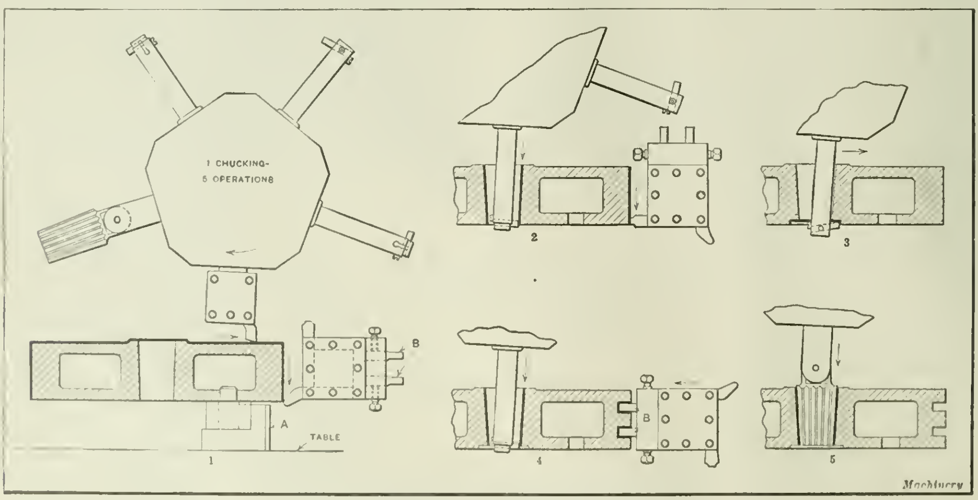

Fig. 3. Tooling Lay-out for a Locomotive Piston-head

hole while another tool in the side-head turret is finish-turning the diameter. It will be noticed that the main turret is set at an angle corresponding with that of the taper of the hole, and that the turret occupies this angular position throughout the sequence of machining operations.

In the third of the series of operations, the under-cut on the lower side of the piston is machined as indicated in the tooling lay-out, using a boring-bar in the main turret. The next operation is that of tru-

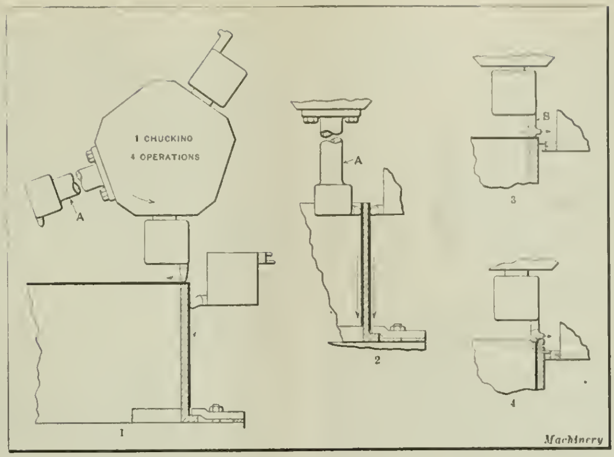

Fig. 4. Sequence of Operations and Tooling Arrangement for producing Piston-rings from a Pot Casting

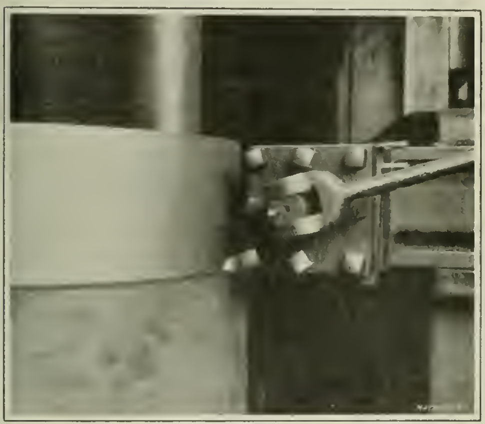

Fig. 5. Close-up View of the Second Operation in machining the Piston-ring Casting illustrated diagrammatically in Fig. 4

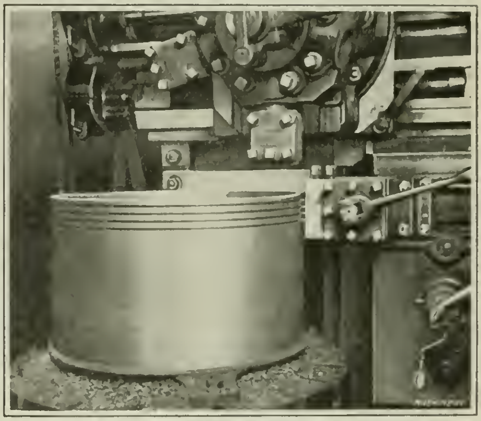

Fig. 6. Using the Set-up illustrated in Fig. 7 for cutting off Piston-rings with a Gang of Parting Tools

ing up the tapered hole, and for this a separate boring-bar is employed. During the truing cut, two tools *B*, carried in a special tool - holder attached to the side-head turret, are engaged in machining the piston-ring grooves.

For the final operation, a floating reamer peculiar to this type of machine is employed. This floating or hinged reamer hangs vertically downward from the shank to which it is pinned, and by its use the resetting of the main turret, which would be required with an ordinary reamer, is unnecessary. In this operation, the previously bored hole is finished. This piston-head is 23 inches in diameter, and the machining time required to complete the series of operations is forty-eight minutes per piston-head, including chucking work.

Figs. 1 and 2 illustrate two of the machining operations on the piston-head. In Fig. 1 the outside of the piston is being rough-turned, while Fig. 2 shows the fourth operation, in which the piston-ring grooves are machined, and the central hole is trued up, simultaneously. These illustrations also show how the work has been raised by the use of special chucking jaws. There is one other detail in the tooling arrangement which might be of interest; that is, the use of a tool in every face of the turret, rather than the use of combination tools, such as a special multi-cutter, boring-bars, and tool-holders, which are often used when conditions require it. In this case, however, the use of a separate bar in each station is an advantage in that the tur-

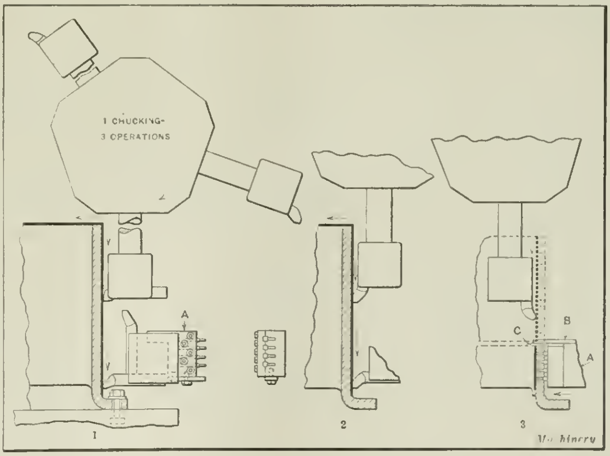

Fig. 7. Tooling Arrangement in which the Piston-rings are cut off with Multiple Tools carried in a Special Holder in the Side-head Turret

ret is thus better balanced. This piston job is fairly representative of work of this kind, and should enable a good idea to be obtained of the adaptability of the vertical type of turret lathe for finishing locomotive piston-heads.

Machining Piston-rings

The machining of piston-rings is a job which may be tooled up in a variety of ways, according to the conception of the set-up man for obtaining the best results. Fig. 4 illustrates one tooling arrangement used. In this instance, the pot casting from which the piston-rings are produced is clamped by suitable straps and jaws to the machine table, and is machined in four operations as follows:

The end of the casting is first rough-faced, and the exterior rough-turned; in the second operation, the tool carried in the extension tool-holder *A* rough-machines the inside of the casting while the exterior is being finish-turned by a tool carried in the side-head turret. A special tool *B* is employed in the third operation, first to finish-face the end of the casting, and then to break down the interior edge. The same tool is employed in the fourth operation, in which the casting is finish-bored. While the finish-boring operation is in progress, two parting tools, carried in the side-head turret, are engaged in cutting off the rings. The parting tools are fed in to a sufficient depth so that as the finish-turning tool feeds down, the rings will be severed. By using only two parting tools, instead of a gang, as is sometimes done, a better job results, because the rings do not have to be faced after being cut off.

Fig. 5 is a close-up view showing the second operation on the piston-ring job. These pot castings are approximately 24 inches in diameter and 16 inches high. The table speed used in producing these rings was 7 revolutions per minute, and the feed 1/32 inch per revolution. The time required to machine this casting and cut up twenty-two completely finished piston-rings was six hours and fifteen minutes.

Another piston-ring job is shown in Fig. 7, and as the illustration shows, three operations complete the job. These piston-ring castings are cut up into sixteen complete finished rings, the tooling arrangement being somewhat different from that described in connection with Fig. 4. The exterior of the casting is rough- and finish-turned by using two tools simultaneously, one carried in the main turret and one in the side-head turret. These are clearly indicated in the first and second operations. The tool carried in the main turret, in each of these two operations, also machines the top of the casting, as indicated by the arrow. In the final operation, use is made of a gang of parting tools, carried in a multiple holder *A*. The proper vertical position of these multiple tools is obtained by the use of a parallel *B* and a size block *C*. It is necessary to employ this means of adjusting the parting tools after each feeding-in traverse of the tools has been completed. Fig. 6 is a view of the beginning of the cutting-off operation, and gives an excellent idea of the appearance of the work and the tools. The time required to produce these sixteen rings is from two to two and one-half hours.

Machining Locomotive Cylinder Heads

A job on which the vertical turret lathe is used to good advantage is that of finishing locomotive cylinder heads. In the illustration Fig. 8, a complete tooling lay-out is shown of both chuckings required to finish this casting. Special sawtooth jaws, by means of which the work is chucked in the first setting, prevent the cylinder head from lifting from its seat on the locating buttons on which it rests.

The first operation of the first chucking is shown in Fig. 9, as well as the complete turret tooling employed. This

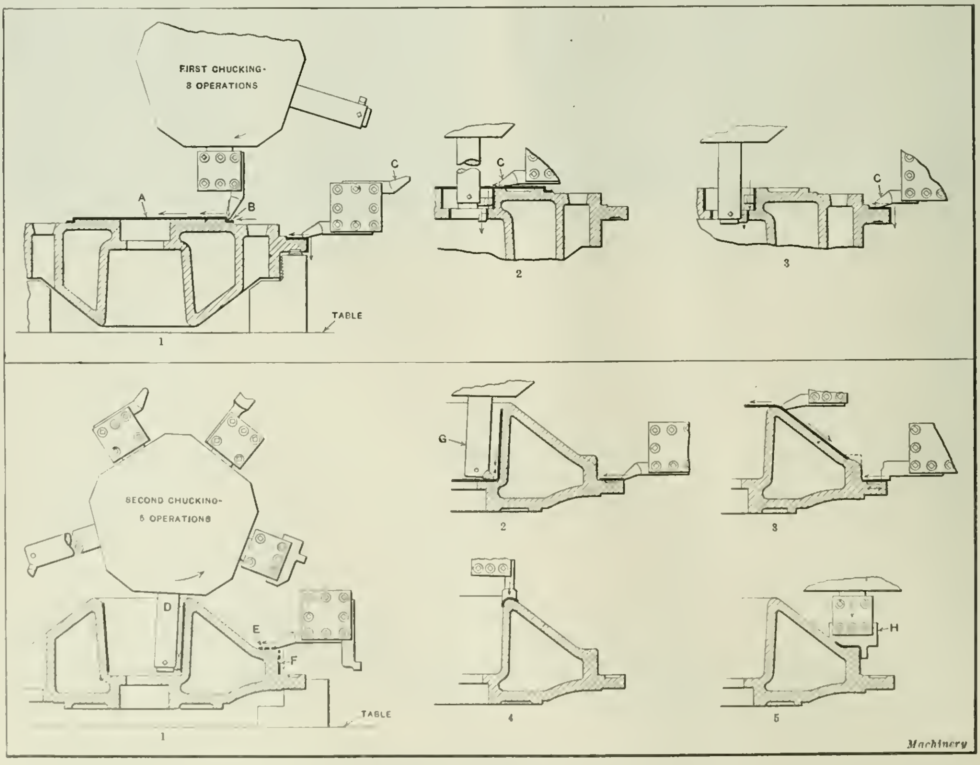

Fig. 8. Tooling Arrangement used in the Two Machine Set-ups shown in Figs. 9 and 10 for machining a Locomotive Cylinder Head

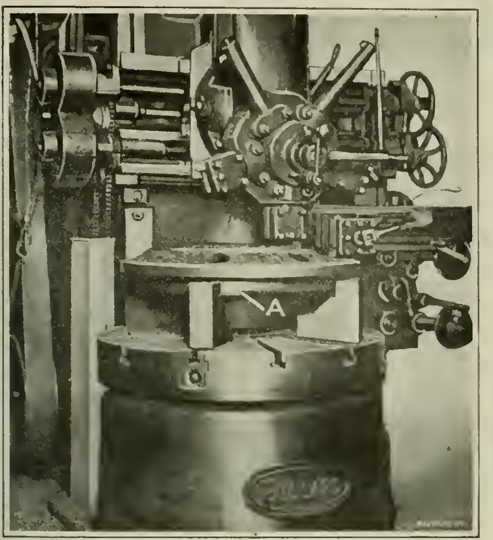

Fig. 9. First Operation on the Locomotive Cylinder Head

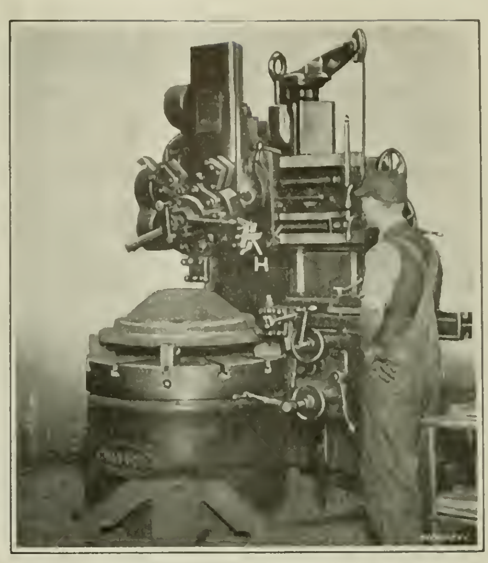

Fig. 10. Fourth Operation on Opposite Side of Cylinder Head

operation consists of rough-facing surfaces *A* and *B*, Fig. 8, and rough-turning the shoulder connecting these two surfaces with a tool carried in the main turret tool-holder, and rough-facing and rough-turning the flange with a tool in the side-head turret. In the second operation, surfaces *A* and *B* and the connecting shoulder are finished with tool *C* in the side-head turret; at the same time the special boring-bar carried in the main turret is employed to rough-bore the two diameters of the central hole, as indicated by the arrows. The last operation in the first chucking finishes the central hole in the work, a finishing cutter being substituted for the roughing cutter, while the flange is simultaneously finish-faced and turned, still using tool *C* in the side-head turret.

In the second chucking, there are five machining operations on the other side of the cylinder head, as shown, the first of which is the rough-boring of hole *D* while surfaces *E* and *F* are rough-turned with the side-head turret tool. The central hole is next finish-turned and cleaned up on the bottom with a special tool carried in the boring-bar *G*. While this tool is in operation, the upper surface of the flange is rough-faced with a side-head turret tool, as shown. In the third operation, both turrets are simultaneously engaged to machine the angular exterior surface of the cylinder head and to finish-face the flange. The fourth operation is that of forming the radius connecting the hole and the angular exterior surface, using a special formed turning tool in the main turret tool-holder. As indicated by the dotted line in the sectional view of the work shown in the diagram of the first operation in the second chucking lay-out, and as also clearly shown at *A*, Fig. 9, there is a built-up section or lug, extending about two-thirds around the circumference at the lower part of the angular surface, which must be machined. In the last operation on the cylinder head, a special form cutter *H* (shown also in Fig. 10) is required to finish this lug and cause it to blend nicely with the adjacent surfaces. This completes the machining of the cylinder head, the approximate diameter of which is 36 inches. The production time on this job is four hours—one hour for the first chucking, and three hours for the second.

In the second and concluding installment of this article the tooling up for machining cross-heads and main throttle valves will be dealt with.

CONVENTION OF THE SOCIETY FOR STEEL TREATING

At the convention of the American Society for Steel Treating held in Indianapolis September 19 to 24, a great number of papers relating to all phases of steel treating were read. The papers were grouped under special sections covering tool steel, metallographic research, heat-treatment of steel, carburizing, management, alloy steel, properties of carbon and alloy steels, heat-treating equipment, and furnaces. Under the heading of tool steel the papers read dealt with tool steel specifications; forged high-speed milling cutters; physical tests on high-speed steel; providing properly rolled tool steel for the steel treater; tool steel manipulation; heat-treatment and uses of high-speed steel; a comparison of American and English methods of producing high-grade crucible steels; and the effect of tungsten content on the specific gravity of high-speed steel. The papers on the heat-treatment of steel dealt with modern methods of heat-treating; the efficiency of annealing overstrained steel; coarse-grained forgings, their detection and correction; the problem of the influence of mass on heat-treatment; the whys of warping; malleable iron; theory of hardening steel; tests showing the effect of high temperatures on malleable iron; a coiling and heat-treating plant for helical springs; fracture test on steel to determine its quality; and "Dow-metal," and its application. A complete list of all the papers and copies of such papers as may be desired may be obtained from the secretary of the American Society for Steel Treating, 4600 Prospect Ave., Cleveland, Ohio.

The following officers were elected for the coming year: F. P. Gilligan, president; F. C. Lau, first vice-president; R. J. Allen, second vice-president; and J. V. Emmons, treasurer. A. E. White, the retiring president, was elected a member of the board of directors, as was also J. J. Crowe. During the year just passed the society has had a satisfactory growth. Today the membership is 3200, a substantial increase over a year ago.

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SAVINGS BY THE USE OF JIGS

In these days of interchangeable manufacture, when machines or parts are made in great quantities, jigs and fixtures are universally employed. In the machine tool industry where machines are built in smaller lots, special tools and fixtures are not always warranted, but they could be employed to a greater extent than is usual; and it has been shown in many cases that this would prove economical. The great expense of a complete tooling equipment acts as a deterrent, and many operations are performed year after year in a relatively wasteful way because of the fear of a large original outlay.

One machine tool builder has used the present slackness in business to make a thorough study of his manufacturing methods and to provide special tools, jigs and fixtures wherever it seemed profitable to do so. He has not hesitated to make the necessary investment, even during this period of depression. On one of his machines alone he has reduced the time required in the assembling department from 47 hours to 12 hours by making parts strictly interchangeable through the use of jigs and fixtures, and in addition the machining time has been reduced from 300 hours to 250 hours.

In this case there is a gain of 85 hours on each machine. Figuring at $1.50 an hour, including overhead, the total saving per machine is $127.50, which is a little more than 6 per cent interest on an investment of $2000. Assuming that 50 machines a year of this size were built, it will be seen that an investment of $100,000 might be warranted in jigs and fixtures, if an interest of 6⅜ per cent were considered sufficient and depreciation were not taken into account, as, of course, it would have to be. The tooling equipment for a single machine would seldom be as high as this, the figures being given merely to show that quite a large investment is warranted where an appreciable number of working hours can be saved on each machine.

It is necessary in each case to make an estimate of the number of machines likely to be built annually, the saving that can be effected by the use of jigs and fixtures, the cost of such equipment, and how soon it is likely to become obsolete, before going ahead with the design and building of special tools. It is true that serious mistakes have been made in overdoing special tooling equipments, and in every case a decision must be based on a careful consideration of all the factors involved. But no manufacturer can lose anything today by studying every detail of production in order to reduce costs.

* * *

IMPORTANCE OF SHOP TRANSPORTATION

The problem of transporting materials within the shop is more important than many executives realize. It is expensive to move heavy materials to and fro in a shop, particularly when they have to be lifted by elevators from one floor to another, or transported long distances either by hand or electric truck.

Any plant of appreciable size should be so laid out that the material can move in a continuous route from the receiving to the shipping department. If no consideration is given to the movement of material through the plant, it is likely that routes will gradually develop by which thousands of dollars will be lost annually for trucking and transporting expense. The executive of a large concern was recently asked to help in the reorganization of another plant employing about 3000 hands, and the first thing he called for was a blueprint of the whole lay-out of the plant on which was shown by a red line the route of an average part from the moment it entered the receiving room until it reached the shipping room as part of a completed machine. The blueprint he obtained showed that the part selected for the test had traveled 4½ miles during its course through the shop and crossed its own path forty times.

In another case it was found that in a five-story shop, certain castings went up and down the elevators twelve times, traveling three times from the basement to the top floor. By rearranging the machinery it was necessary to lift these castings by elevators only once from the basement to the top floor, from which they descended by gravity conveyors from floor to floor, as required.

A third example shows that the product of one plant was doubled without adding a single man to the force for trucking and moving materials, simply by systematizing the shop arrangement and the moving methods. In this plant it was found that one part moved nine times from one building to another before its completion.

In one large factory a distinction is made between short hauls and long hauls, and methods have been developed which meet the requirements in each case. For the short haul—that is, movements within the same department—casters are placed under the platform on which the material is moved, so that it can be rolled from one part of the floor to another. Electric trucks are used for the long hauls from one department or one building to another. These trucks are so arranged that platforms provided with casters as previously mentioned can slide directly on the truck, which, being electrically operated, is then quickly moved to its destination. A careful examination of the routes of material in your plant may develop some worthwhile economies.

* * *

UNNECESSARY LOSS OF POWER

To attain maximum economy in the operation of a shop or factory, it is of importance to maintain accurate alignment of the lineshaft bearings. Many manufacturers have their lineshaft bearings lined up at regular intervals, thereby keeping the friction load as low as possible; but this practice is not general, mainly because the amount of power wasted through inaccurate alignment of the bearings is not realized and because tests to show the actual loss are expensive and difficult to make.

In a few instances where such tests have been made, the value of periodically lining up the bearings has been conclusively proved. Needless to say, the alignment of lineshaft bearings should be undertaken only under the supervision of a man experienced in this kind of work. Whenever possible, the power required to drive the shafting under the friction load before and after re-alignment should be determined as accurately as possible. When bearings which are badly out of line have been re-aligned, it is found that the saving in power is quite considerable throughout the year. It is the attention to details like this that often makes it possible to show a favorable balance at the end of the year. It is not only the big savings that count, but the aggregate of the smaller economies; and power, after all, is not one of the minor items of the cost of running a manufacturing plant.

Reducing Production Costs

Through More Efficient Equipment and Methods

PRICES have come down on practically every article produced directly or indirectly by means of machine tools—from automobiles to lawn mowers. Costs must follow until a balance of costs and prices is reached. The tides that rise regardless of the marooned are not more certain or indifferent in their destructive power than this law of business which destroys those who are unable to adjust themselves to its reactions.

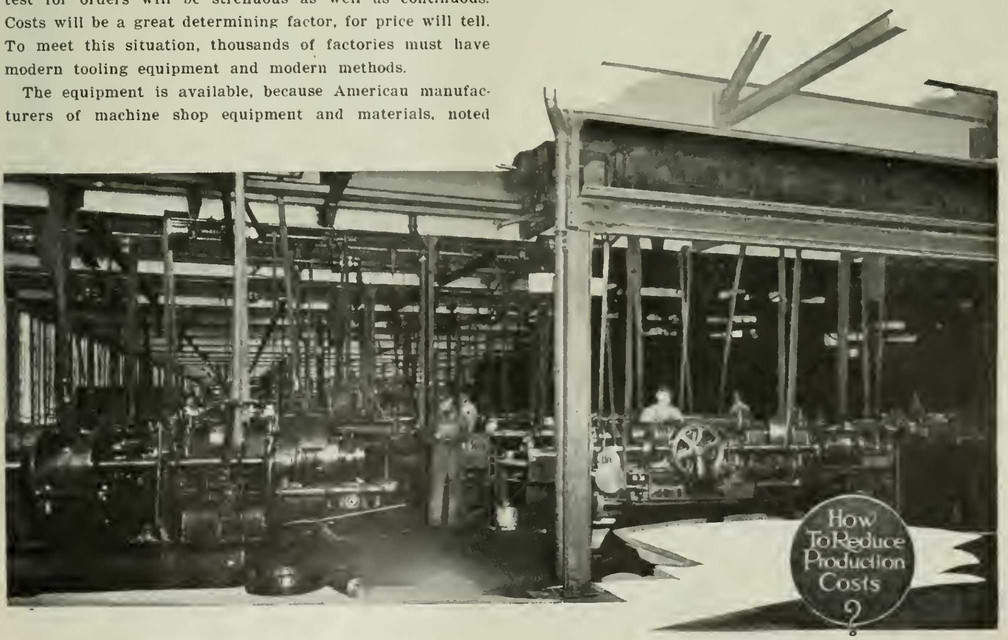
Cost reductions will come partly through more systematic and efficient management and reductions in wages; but in the field of metal-working manufacture, at least, they must come chiefly through more efficient manufacturing methods, through the use of up-to-date cost-reducing machines, tools and tooling equipment, through modern means for handling material in the plant, through using the divers time- and labor-saving methods and devices which characterize the most efficient practice. These cost reductions cannot be made with equipment that was all right a few years ago. The changes have been great as well as swift. There are new methods, devices and facilities. The pace is faster. Results are totally different from what were considered good only six years ago.

Hundreds of metal-working shops throughout the country are badly handicapped with equipment and methods which should have been discarded long ago. These factories will have to re-equip with more efficient tools and will have to bring their practice up to date. Economic law is a great steam roller. Under its cold, incessant and remorseless operation, the able and enterprising thrive and the others fail. We are in a new period of searching test—a buyer's market—with the buyers still very scarce. The contest for orders will be strenuous as well as continuous. Costs will be a great determining factor, for price will tell. To meet this situation, thousands of factories must have modern tooling equipment and modern methods.

The equipment is available, because American manufacturers of machine shop equipment and materials, noted always for inventive genius and progressiveness, made great practical use of the severe but invaluable lessons they learned in the strenuous war period, when production was the first consideration. They are ready with tools and devices capable of reducing production costs to a point hardly believed possible a few years ago. They have worked out important changes and improvements which are incorporated in the metal-working equipment now on the market.

Exhortation to reduce costs is timely and valuable, but it is better still to show the way. MACHINERY is endeavoring to do this, and in four numbers, of which this is the first, this journal is concentrating on specific descriptions of existing methods, machines, systems, tooling equipments, etc., that make definitely for economy in production. The data covered in this number and in the succeeding issues represent practical results achieved in leading shops throughout the country. Machine tool manufacturers, with their well-equipped plants and capable organizations, will be able to reproduce in any plant the unusual results recorded in these numbers of the Cut-the-Cost series.

Periods of depression like periods of prosperity are never static. The world is ever moving, and is now moving toward business recovery. This is a great and vital period of preparation. The factories best equipped when business is going well again will gain an advance over competitors. Forward-looking manufacturers are reducing their costs. There has been, very naturally, hesitation and indecision, but now the time is ripe for active preparation. The plant in need of new equipment for reducing manufacturing costs cannot afford to delay. It is a buyer's market.



The Foreign Situation and the Machine Tool Industry

By JOSEPH KUCERA

The author of this article left for Europe early in 1919 and studied economic conditions there for over two years, paying special attention to the conditions in the machinery trade and the demand for machine tools and industrial machinery in general. After having visited twelve different countries for this purpose, he returned to the United States in the spring of this year. He went to Russia in August, 1920, and left there in December of the same year, after having visited both Moscow and Petrograd. Mr. Kucera is well acquainted with the machine and tool fields, having been connected in an executive capacity with several tool and gage concerns in New York City since the outbreak of the war in 1914.

UPON my return from Europe, I found that many machine manufacturers failed to grasp the international situation, which has a direct bearing on business conditions here. Most manufacturers, referring to the present industrial crisis, made various predictions as to its duration; these predictions, however, were based on their experience with the preceding depressions of 1908 and 1914. That was six months ago. Since then, because we have had time to study the international market, we have come to realize that our industries, being partly dependent on the prosperity of the industries in Europe, cannot expect to revive fully until the old world places her factories on a pre-war footing, at least. Had we done nothing else but study the international markets for the last few months, it would have been worth while. An optimist may even go so far as to claim that the industrial depression was the best thing that could have happened to us, since it made our study of international markets compulsory, thereby fitting us to cope successfully with a situation which we shall have to face in the near future.

There are still some manufacturers in the machinery line who hold the pessimistic view that their business will be the last to come back to a state of prosperity. They claim that other industries will be able to run with their present equipment for a long time to come, keeping the machinery, particularly the machine tool demand, at a minimum for a long period. These men, fortunately, are becoming less in number, for our compulsory international education makes new graduates every day.

German Competition and Credits

So much for the general conception of the present outlook. When we consider details, from a pure business standpoint, another pessimistic argument comes up, as follows: Germany, because of money exchange in her favor, is capturing all the European machine tool markets. But the fact is that Germany is not doing this. True enough, we have evidence of Germany exporting machine tools to other countries at prices far below our competitive capacity. She can well afford it, since her labor cost is only one-sixth of ours. But there is one thing that Germany cannot afford to do, and that is to grant credit, which means that she is not in a position to supply the demand. Therefore, the German export of machine tools will meet a very small percentage of the demand, and will remain at this point for many years to come.

Long-term credits on a large scale are necessary for the rehabilitation of Europe. Only the big financial interests of the United States can and will extend these credits, since non-productive Europe means the ruin of many industries in America. As a common-sense business principle, this credit will not be advanced to a competitor—in this case Germany. The credits will go to consuming nations, excluding Germany as the intermediary that she was before the war, if for no other reason than that the present limited purchasing capacity of Europe cannot afford to have business pass through so many hands.

Personal investigators and statistics may prove that Europe is not in great need of machine tools—that prior to these she wants raw materials to put idle machinery into motion. That is true enough; yet Europe is coming to realize that her economical rehabilitation does not depend only on resuming pre-war production, but on producing far in excess of that, not only in order to pay her debts, but also to regain her pre-war living standards, poor as they were compared to the standards in the United States. And to attain this end will require the Americanization of production, with American machine tools to begin with.

Russia as a Potential Market

Even though Europe were satisfied to retain her present economic standards, and not become the eager customer for our machine tools that we expect, there is still one country that cannot get along without our machines, and that is Russia. Russia needs everything, but particularly machinery of every description, including machine tools. She will be able to get along for a few more years with her old clothes and to live on small rations; but she must have railroad equipment, locomotives, mining machinery, and machine tools to begin with, if she expects any credit from the United States at all.

Russia is richer in natural resources than the United States. Considering this as an asset, we might say that Russia is the only solvent country in Europe. Yet she must go into the hands of a receiver if machinery is not put into motion to exploit her wealth immediately, for her wealth is worthless unless it is turned into products. Directing the export of our foodstuffs and clothing into Russia, without at the same time providing the country with the machinery of production, would be equivalent to giving credit to a concern in the receiver's hands. It cannot be done.

For the time being we may discard our worries in regard to political complications. Even though Russia remains under the present régime we shall, nevertheless, finally be obliged to do business with her. If she should abolish her present system of government before we entered into commercial relations with her, the international economic situation would remain very much the same as it is today. However, since we are considering political eventualities, suppose that the present régime were overthrown some time after we had begun to do business with Russia. It might be thought that if the Bolsheviki were overthrown a new destructive struggle would arise in Russia. People well informed on the Russian situation, however, are convinced that the Bolsheviki are too exhausted for any formidable struggle in the event of their overthrow by the Russian people. In such a case trade with the United States would go on as usual, and the economic life would not be deranged any more than by a change of cabinets in other countries.

Germany cannot reconstruct Russia. It will be done by the only nation today capable of a work of such magnitude —the United States. Germany and other countries in Europe have been doing business with Russia for over a year, yet Russia is still sending calls of distress for everything necessary to save a sinking nation from complete economic shipwreck. Why have Germany and these other nations not exported to Russia at least enough to keep the wealthiest country in Europe from appealing at this hour for help to save it from destruction by famine? Because Russia needs credit, which no other country but America can afford to give her.

Conditions in Russian Industries

During my stay in Russia in 1920, I visited a great many factories. In the clothing industry, I saw people doing the work in their homes, sewing entirely by hand, and this was being done even in the garment factories, while many sewing machines stood idle. One of these machines, I observed, was in perfect order, except for the flywheel bracket. Bringing this to the attention of the superintendent, I expressed amazement at the piece of cast iron not being replaced, so that the machine could take the place of a few of the hand workers. "I know," he replied instantly, "but where will we get the cast iron?" This is typical of the situation throughout all the Russian industries—where to get the cast iron—while there is enough of it in Russia to supply half the world.

In a machine shop in Moscow, equipped to employ several hundred men, I saw an engine lathe idle because it had no apron. The foreman stated that it had been taken off because it contained a pinion that was needed elsewhere. I saw rust eating away a shaper—one of those heavy European imitations of an American machine—apparently for no other reason than that a gib, which presumably was taken to be used on another machine, was missing. I could give endless examples of instances in which machine tools are idle and useless, and becoming fit for nothing but scrap, simply because the Russian workmen have no more mental or physical energy left to think out a way of making at least one working shaper out of several of similar make.

The same conditions prevail in the textile industry—in fact, everywhere in Russia where a wheel used to turn. Imagination is not sufficient to picture the industrial breakdown of Russia. I had to see it with my own eyes—machines without gears, gears without teeth, a huge scrap heap. Germany and other European countries have been selling agricultural machinery, motor trucks, and other machinery to Russia for some time past. These, of course, have all been spot cash transactions, mostly in gold. Today Russia's ready gold is exhausted, and she has nothing in the line of raw materials to offer. Therefore, it is left entirely to the United States to put the Russian industrial scrap heap on a productive basis, and in this task the American machine tool will play the most important part.

Pre-war Trade Channels

Russia's total exports in 1913 exceeded her imports by 240,100,000 rubles (gold). Her imports from Germany alone, however, exceeded her exports to that country by 190,100,000 rubles, while her exports to all countries except Germany exceeded her imports by 430,200,000 rubles. These figures prove clearly how Germany made other countries pay for her business in Russia, particularly for German machines, since machinery and manufactured goods formed the bulk of the Russian purchases abroad, while her exports consisted chiefly of foodstuffs and raw materials. In the past Germany was practically the exclusive agent for American machine tools on the continent, and it goes without saying that she naturally discouraged the purchase of American goods for the sake of stimulating her own production. In Russia, a German concern acting as agent for an American manufacturer charged $1350 for an engine lathe bought for $600 F. O. B. New York.

Credits the Chief Problem

As the situation in Russia stands at present, it will require untold millions to meet the country's needs in machinery alone. Even assuming that western Europe is capable of supplying half the requirements, there will still be a market for large quantities of machinery from the United States, and this source of supply will be drawn upon in preference to any other, because the United States will extend credits. In mentioning credit to Europe or Russia in these days, it does not mean that any individual manufacturer or group of manufacturers is expected to advance credit, as has been customary in the past. It is being generally appreciated that our economic problems of today are a part of the problems of the whole economic structure of the world, and cannot be solved by any group of industrial or financial organizations alone. The solution lies in concerted action, and arrangements are already being made to approach this difficult subject.

The best proof of European inability to extend long credits to Russia today is the attempt made to solve the Russian economic problem by barter, which amounts to an exchange of goods or raw materials in kind—in other words almost a cash transaction. In Sweden, corporations with two hundred million dollars capital have combined for the explicit purpose of doing business with Russia on the barter basis, and no doubt other countries will follow Sweden's example, especially now since many of them have already had experience in business by barter. There is no doubt that the United States will launch much of her international business on a bartering basis. Of course, barter is only resorted to in this emergency because the trust in the capability of certain countries of meeting bills has been shaken, and as soon as positive signs of the restoration of an economic balance are in sight, it will be abandoned. In the meantime, in order to facilitate the economic regeneration of the world, the industries will have to draw on the capital that is left, and that is concentrated in the United States. This country cannot escape from extending credits; otherwise, our industries will have to run at a low capacity. And it takes machine tools to act as an insurance on this credit—to facilitate quick payments on the money advanced. It takes production to pay the debts, for no one will advance money to an idler; yet Russia cannot begin to produce until she is fitted out with machinery. It is a problem of vast proportions, and one not easily solved; but it will do a great deal of good to begin thinking about it.

* * *

FRENCH BUREAU OF INDUSTRIAL AND SCIENTIFIC RESEARCH

During the war France mobilized her scientists and laboratories into a Bureau of Industrial and Scientific Research and of Inventions. The French Government has decided to maintain the existing organization, and to adapt it to the needs of peace. It works in conjunction with both public and private laboratories, and encourages inventors, assisting them to turn their often vague and impractical ideas into concrete and useful form. Proposals of inventors are first brought before a committee which eliminates Utopian ideas and those without practical value. The promising projects are referred to competent technical committees, who get in touch with the inventor, aid him in his research, assist him in making models, guide him to a definite embodiment of his conception, and, in some cases, point out to him practical applications that he has not previously thought of. Since 1919 more than 500 proposals have been considered.

Another phase of the work is the assisting of scientists who have a valuable idea, but lack material, apparatus, or other means to conduct experiments, until it is embodied in a practical application. The bureau is also ready to assist the industries, and a constantly increasing number of managers of industrial concerns are submitting problems.

New Type of Thread Gages

An Accurate Method of Determining the Correctness of Screw Threads by Vision as Well as by Touch

By B. M. W. HANSON, President, Hanson-Whitney Machine Co., Hartford, Conn.

Fig. 1. New Type Thread Gage with U. S. Form of Thread

THERE are four dimensions that are important in the making of a good screw: First, the lead; second, the diameters on the top, at the pitch line, and at the bottom of the thread; third, the shape or angle of the thread; and fourth, the roundness and parallelism of the screw. All these dimensions can be determined by separate gages used by a skillful operator, and when accurate work is required, the inspection of all these dimensions becomes expensive and tedious.

The common practice of gaging screws, as is well known, is to use a thread gage composed of a tapped hole, sometimes solid and sometimes adjustable, and to determine the size and correctness of the screw by simply screwing it into the gage. If it goes in without shake, it is generally accepted as being of correct size. If it does not go in, the screw is regarded as too large, and the thread cutting tool, of whatever construction it may be, is adjusted so as to reduce the size of the screw until it goes into the gage; but it is impossible by this method to determine whether the screw thread has proper contact with the gage. The bottom of the screw thread may fit the thread in the gage on its smallest diameter and yet not fit anywhere else. The top of the screw may fit the largest diameter of the thread in the gage and the rest of the dimensions have no fit, and the angle of the screw cutting tool may be different from the angle of the thread in the gage. A screw may go into the ordinary thread gage a few threads and not go any farther, not because the shape and diameter of the thread are wrong, but because the lead of the thread on the screw is different from the lead of the thread in the gage. A screw may be out of round, and will fit the gage at two points, but not fit all the way around. All of these conditions cannot be tested by a thread gage of the type generally used.

Assume that a hole is tapped with an accurate tap and is deep enough for the screw to go in two diameters. Assume further that the screw has been gaged with a gage that is three-fourths of the diameter of the screw in thickness. While the screw may fit this gage, it does not necessarily mean that the screw will go in the full depth of the hole. The difference in the lead of the thread on the screw and the thread in the hole may cause trouble. If, on the other hand, a gage is made the same thickness as the depth of the hole, the screw is supposed to fit. In that case the operator generally reduces the diameter of the screw until it will go in the full depth, and if the work is important and an accurate fit is required, the screws may all be spoiled, as the operator has no means of determining the accuracy of the lead.

The illustrations in connection with this article show a thread gage that will determine whether all dimensions of a screw are accurate or not. This gage is composed of a C-shaped frame in which are mounted two hardened jaws, each jaw having grooves corresponding in shape and pitch to an accurate screw plug. These grooves are finished correctly after hardening, so that they are parallel with each other and at an angle corresponding with the lead of a plug gage. In one of the jaws there is a groove that crosses the thread grooves at approximately right angles. The opposite jaw has no such groove and is adjustable on the frame for different diameters. The adjustment is accomplished by a wedge at the front end of the jaw and a push-screw at the rear end of the jaw. The jaw has a tongue that fits in a groove in the frame, and two screws enter the jaw approximately in the middle of the tongue and pull it tightly against the wedge and the push-screw.

A double-ended plug, accurately finished, is furnished with the gage, for setting it correctly, as shown in Fig. 2. One end of this plug is generally made the maximum diameter desired, and the other end is finished to the minimum diameter required on the screw. In setting the gage, the front end of the adjustable jaw is adjusted with the wedge to the maximum diameter of the plug, and the rear end of the jaw is adjusted with the screw to the minimum diameter of the plug. Therefore, it is clear that this adjustable jaw is set at a slight angle to the opposite jaw, in order to obtain the maximum and minimum dimensions on the gage.

In gaging a screw, it is simply passed into the front end of the gage, and if it goes in without passing through the opposite end of the gage the screw is correct as to diameter within the limits desired. The groove running crosswise of the threads in one jaw aids in determining by touch when the screw has reached the ideal diameter; if the screw crosses the groove into the remaining part of the thread the operator can determine how near it is to the minimum diameter. The thread grooves in both jaws being at a slight angle corresponding with the lead of the thread, and the angles being opposite to each other on the two jaws, it would be impossible

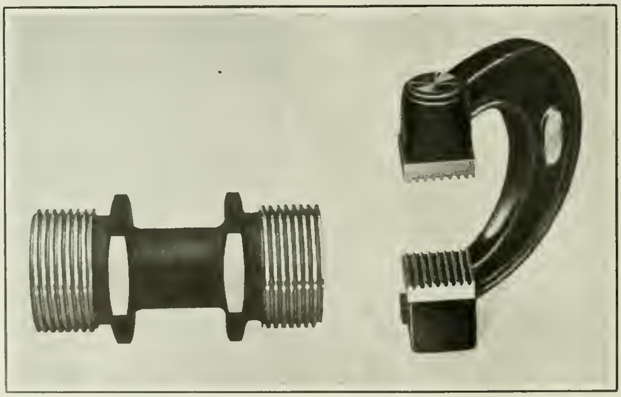


Fig. 2. An Acme Thread Gage with Plug for setting to Size

to pass a screw through the jaw if the jaws were rigidly connected with the frame. Therefore, the construction is such that the jaw opposite the adjustable one can slide in the direction of the axis of the screw being gaged. This slide is accurately finished, and the jaw is held against the frame by spring tension, so that no dirt can work in between the jaw and the frame at any time.

The C-part of the frame being at an angle of approximately 45 degrees with the grooves of the jaws, makes it possible to hold the gage up to the light without having the frame obstruct the view. Therefore, when a screw is put in the gage, by holding it up to the light, it is possible to see how the thread in the screw corresponds with the thread in the gage. If the bottom of the thread in the screw touches the top of the thread in the gage, it is easily detected by holding it to the light. The same is true if the angle of the thread does not correspond with the angle of the gage, or if the lead of the screw does not correspond with the lead of the gage. By turning the screw around in the gage it is easy to feel whether it is round or not.

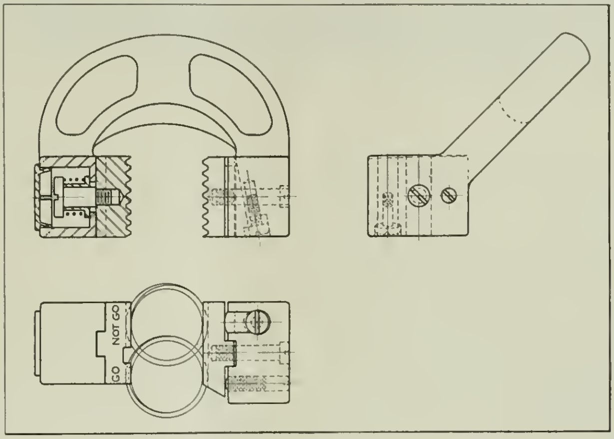


Fig. 3. Construction of the New Hansen Thread Gage

The frame is so designed that the gage can be snapped on a screw of any length, as it will not obstruct the passing of the gage entirely over the screw. The width of the jaws can be made to any desirable dimension, but the practice is to make the jaws for all screws over ½ inch in diameter, 1 inch wide; for screws between ½ and ⅛ inch in diameter, ½ inch wide; and for screws smaller than ⅛ inch in diameter, ¼ inch wide.

In places where thousands of screws have to be gaged every day it is an expensive and tedious task to do this work with an ordinary gage. By the use of this new gage the work can be done speedily and with very little effort. When setting up a screw machine, the screw can be gaged before it is cut off from the rod in the machine, and the die can be adjusted until the correct size is obtained. Fig. 1 shows a gage for the U. S. standard form of thread, and Fig. 2 for the Acme form of thread, but any form of thread gages can be just as easily made.

After long usage, the jaws of the gage may become slightly worn. In that case they may be readjusted to the plug very quickly. If they have been used so much that the measuring points are worn away, new jaws may be attached to the frame, as all the jaws are made interchangeable with the frame. From the illustrations and description it may be seen that in gaging screws with this type of gage, vision as well as touch is used, and that the speed and accuracy of gaging are very valuable features of this gaging method. A number of gages of this type are now in use, and have proved to be entirely practical. They are manufactured by the Hanson-Whitney Machine Co., Hartford, Conn.

* * *

Indications of increased activity are apparent in the Canadian iron and steel industries. Two of the largest steel plants in Canada are working on orders which will keep them busy for some months, and several of the large steel plants are now occupied at about 70 per cent of their capacity, according to a recent report by Consul F. S. S. Johnson.

LET US GO TO WORK

By J. E. KELLEY, General Sales Manager, Simonds Mfg. Co., Fitchburg, Mass.

For the last twelve months we have been liquidating. We have all been wearing out our old shoes and our old clothes, patching up our tools, reducing our stocks, and getting along without purchasing, except for essentials absolutely necessary to carry along our very much depleted business. We have cut out extravagance in so far as purchasing materials is concerned, but statistics prove that we have added another far greater piece of extravagance to our list than any heretofore indulged in, and that is the extravagance of wasted time. We have reduced our energies in greater proportion than our expenses, and most of us find ourselves today wastefully waiting and watching for the gold nuggets to come to us. In other words, we have stopped hustling.

It was the writer's personal privilege to visit Japan shortly after the Russo-Japanese War, going as far north as the island of Hokkaido and as far south as Nagasaki, and at that time all Japan had been advised by a circular letter from the Emperor to curtail all expenditures possible—to get along with as little as possible. They were certainly doing that. People were without shoes in the coldest part of winter and were using ordinary sacking to wrap their feet in. They had no knives and forks to eat with, no chairs to sit on, and hardly any of the ordinary comforts of life. They were getting along without much of any expense, but they were not producing. They were undergoing hardships and were not profiting by it. They had allowed the idea of curtailment and penury to supplant action and work.

As I view the last twelve months here, I can see a considerable similarity to conditions in Japan after the Russo-Japanese War. We can get along on very little if we force ourselves to do so, but what do we gain by it? The world needs products, and all kinds of products. In our opinion the best thing for all of us to do is to take our losses and start in to work and build up again; mark the prices of our goods down, and cut the price of labor down; and insist on more hours work from every employe and more active work from all salaried employes. By the reduction of prices those working for a lower wage will procure as much, or nearly as much, as during the war period. We all need to stimulate activity in business. This slothful waiting is going to hurt everyone.

Let us think this over and see if we cannot adopt a new trend of thought which will help us to get busy, for that is the one thing that will change present conditions.

* * *

American automobiles dominate the South African market. In 1920 nearly 7500 cars were imported, and in 1919 over 4000. These imports are practically double those of all other countries combined. Canada is credited with having exported 2350 cars to South Africa in 1920. These are, however, from Canadian branches of American companies, the cars being shipped from Canadian factories whenever possible, because of lower freight rates and lower import duty.

Production Control by Graphics

A System Employing Graphic Charts for Controlling Shop Operations, in Use in the Plant of the Hopedale Mfg. Co., Milford, Mass.

By FRED R. DANIELS

How To Reduce Production Costs?

THE system described in this article was formulated to suit the requirements of the Hopedale Mfg. Co., builder of cotton looms and automatic attachments for looms, by L. V. Estes, Inc., Chicago, Ill. The success of this system, as of all systems, lies in the definite functioning of the members of the organization after a plan has been accepted as suitable. At the time of installation it was realized that certain readjustments and changes in equipment were necessary in order to pave the way for the work which the system was designed to control. First, the control of material was felt to be of such vital importance that proper storage space was sought which would facilitate the handling of all material in storage. In the designing of the stock-room, certain features were incorporated which aid greatly in receiving material, making inventories, and delivering stock. A portion of the stock-room is shown in Fig. 1. Desk room is provided for the storekeeper at the left and there is a similar open area beyond the bins for the storage of large bulky material.

At the rear of the bins there is a passageway running along one wall of the building from which steps lead up to sets of bins located about four feet from the floor level. Between these sets of bins are other passages on the floor level through which the material is transported to and from storage. Other bins are located on each side of these passageways, accessible from the floor, the arrangement permitting all bins to be reached without the use of step ladders; good natural lighting is obtained from the windows in the passageway at the rear.

General Principles of the System

The details of the control system require the use of graphic charts, the information for these being obtained from a standard part analysis, which is made for every part that is handled. Boards carrying the cross-section paper used for charting are erected, which are capable of handling rolls of fifty yards of paper, so that as the graphs are laid out the paper may be rolled on the left-hand roll. The boards are arranged to slide vertically to suit the convenience of the control board operator. These boards will accommodate several rolls of paper, and are installed in the office of the production department, under whose direct supervision the control system functions. Fig. 2 is a view of a section of one of these control boards. In conjunction with the operation of the control boards a dispatch board is used. The dispatch board is dependent upon the operation of the control boards, and forms the link between the planned and the accomplished work. Each of these elements in the control system will be dealt with in detail in this article.

The dispatching and scheduling of jobs to work stations, or machines, gave rise to the necessity of rearranging many of the machines and numbering them by groups, or individually, as determined by the production supervisor. The tote boxes are also numbered, for the distinct location of jobs going through the factory requires not only that the work station be designated but also that the particular receptacle in which the parts are contained be recorded. Three branches of the organization are involved in the system.

The engineering department makes up master specifications of all parts to be made. These master specifications are one of the three controlling factors of the system, and furnish the manufacturing committee and the production department with information for conducting the routine.

The manufacturing committee, with the aid of the master specifications, determines upon the rate of production, and establishes a production period which is of such duration as to enable work in process to reach the shipping room in time to meet the promised delivery. In the present case this period is taken as one month, and all orders for material such as castings are based upon this monthly period.

The production department, under the direction of the pro-

Without an adequate production system and suitable means for controlling and checking up production, even the best machine tool equipment and the most advanced methods may prove of little value in reducing production costs. If the superintendent or production manager cannot at all times keep in close touch with the flow of production through the plant by means of an adequate system, it is not possible for him to rectify errors quickly and stop wasteful practices that may clog the channels of production. In a large plant especially, costs are reduced not merely by up-to-date equipment and a well-trained corps of workers, but also by proper methods of following the results obtained in production, so that steps can be taken immediately to check any waste and leaks that would prove costly in the long run.

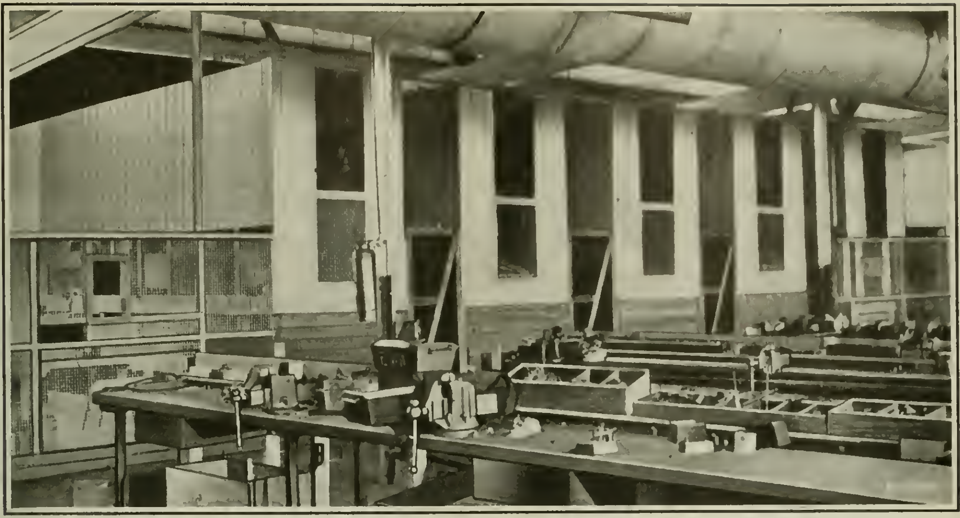


Fig. 1. Stock-room arranged so that the Bins may be reached without the Use of Ladders

duction supervisor, is responsible for all material both in process of manufacture and in stock. The routine within the storage room before and after making and at the dispatch board during the process of manufacture, as well as the actual laying out of the graphs on the control boards, is directly under the supervision of the head of the production department.

Important Factors in the System

There are three important factors that form the basis for the graphic control of parts in process of manufacture. These are (1) master specifications; (2) stock records; and (3) standard part analyses. The master specifications are simply complete lists of all units and sub-assemblies which are used in the construction of any one product. They furnish the production supervisor with definite knowledge regarding quantity.

In conjunction with the master specifications, records must be made on the stock record card, Fig. 3. This card shows at a glance if material must be requisitioned to meet an order, or what part of the order must receive such attention. The upper right-hand corner of this card gives the information relative to the location of the material in the stock-room, and does not pertain to the control elements of the system. The entries in the upper left-hand corner "Minimum to Carry" and "Maximum to Carry" furnish the production department with the information for determining the number of pieces required to be ordered.

In the present case the card shows that it is necessary to carry fifty friction collars H-892 as a reserve, but that it is permissible to carry as many as two hundred of these parts. The closer the limits between the minimum and maximum quantities permissible to carry in stock, the better, because it is inadvisable to tie up a considerable amount of money in stock except when this is necessary to safeguard against shortage in filling an order. This maximum quantity is usually established by estimating the largest amount that would be needed at any time to carry the shop along for a period sufficient to complete another lot.

The entries in the requirements section are first made, and if these requirements cannot be met by the balance available (see the column at the extreme right) and still leave a reserve above the minimum, an order is immediately entered which will supply the deficit and bring the balance available up to the requirements. For example, the first entry shows that 475 parts were required and that but 500 were carried in stock at that time, so that there would be a balance of only 25 castings, which is below the minimum specified. It was therefore decided that an order of 325 would bring the balance available (after meeting the requirements of order No. 520) up to a point which would be considered safe.

The disbursements for the first item entered under the requirements section were made on the 5th and 6th of the month, respectively, and the quantities properly deducted as shown. At the same time receipts are shown to have come in on order No. 1325, which was entered on the 3rd of the month, and these are carried over and included in the new available balance. This procedure enables the quantity

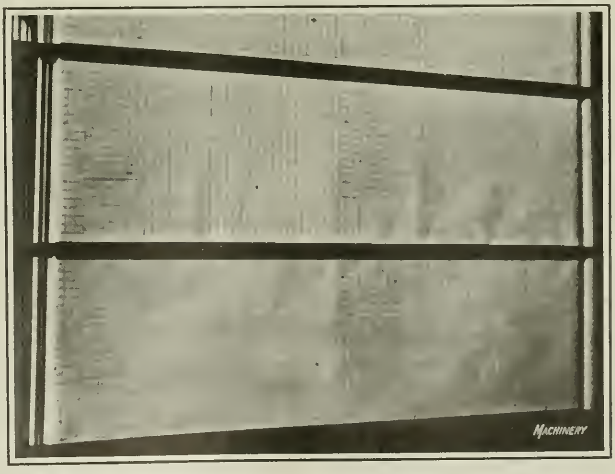


Fig. 2. Arrangement of Control Board for holding Charting Paper on Rolls

actually in storage to be determined at any time, this being the last entry under the "Balance Available" heading—in this case 150 friction collars.

The rough stock and the finished stock are recorded on the same kind of cards, except that they are of different colors. The entries on these cars are made from foundry manifests, material requisition slips, etc., the requirements being determined by the production supervisor. In the case of rough stock, the immediate procedure, after consulting the stock record card, is to issue a foundry order, if the rough stock is not adequate to fill the order, and the data on the foundry order are then placed on the stock record card.

The Standard Part Analysis

The standard part analysis is an indispensable factor in the operation of the system, and forms the basis from which the time to start work upon subsequent operations, care must be taken to allow sufficient time so that the finished pieces from the preceding operation will continue to flow at a steady rate, making it unnecessary to wait for them and thereby lose time.

The overlapping of the operations is termed "compacting," and as will be seen from the comparison at the bottom of Fig. 4, the total time required for finishing all the operations upon a lot of pieces is considerably reduced by this overlapping. In the present case fifteen hours are gained —all the operations are performed on the 100 pieces in fifteen hours less time than would be the case if each operation on the entire lot was entirely completed before the following operation was started. Compacting is permissible and recommended in assembling work, but in the machining of a part it is inadvisable to start lots of less than 100 before the operation on the preceding machine has been fin-

PART NO. H - 892 | PART NAME OR DESC. Friction Collar | LOCATION T - E - 16
MIN. TO CARRY 50 | USED ON Model A- Loom | QTY. REQ'D PER UNIT One
MAX. TO CARRY 200 | **Stock Record Card** HOPEDALE MFG. CO. MILFORD. MASS. | PURCHAS'D IN UNITS OF Piecee

REQUIRMENTS					ORDERED				RECEIVED				DISBURSED				Balance
Date	Req'd for	Q'I'y	Acc. Qty.	Bal. Req'd	Date	Order No.	Qty.	Acc. Qty.	Date	Order No.	Qty.	Acc. Qty.	Date	Lot No.	Qty.	Acc. Qty.	Available
1	520	475	475	25	3	1325	325	325									500
													5	520	300		200
									6	1325	50		6	520	175	475	75
									7	1325	100	150					175
									10		175	325					350
11	620	550		0	12	113	350	675									
													13	620	150	625	200
									14	113	100	425					300
									15	113	150	575					450
									17	113	100	675	17	620	400	1025	150

H M Co FORM L.V.E 138

Fig. 3. The Stock Record Card which shows the Balance Available at Any Time

the time element is derived. Figs. 4 and 5 show the form in which these analyses are made. Fig. 4 is for a friction collar assembly, and the information regarding duration of time for this and all other standard part analyses is taken from a time study of each operation. The time unit used is the hour, and the quantity of parts upon which the analysis is based is 100 parts.

It will be seen that the first operation is performed at the work station or machine number B-41, and that ten hours are required for the operation. The time is shown graphically by a horizontal line, extending from 0 to 10, and the time for the subsequent operations is shown in a similar manner. The time allowed for the subsequent operations so overlaps the time determined for preceding operations that when an operation has been completed on a certain number of parts in a lot, the subsequent operation is started before the entire lot is completed. This is shown by the overlapping of the graphs in Fig. 4. In this way it is possible to finish all the operations on a lot of pieces in a much shorter time than would be possible if one operation was completed on all the pieces before the following operations on the same lot were started. In determining upon

ished. In assembling, however, dividing the lots into quantities as small as twenty-five will not result in confusion, but on the other hand, will greatly aid in maintaining the continuity of flow of finished work.

An inspection of the standard part analysis for the friction collar H-893, Fig. 5, shows that no attempt is made to save time by overlapping the operations, although in handling quantities of 500 or 1000 it is permissible to split the order into lots of 100 and compact the operations without causing confusion. Thus the total schedule time and the operating time in this case are equal. Attention is called to the fact that the time required for setting up and taking down a machine for each operation is also included in these part analyses. By so doing it can be definitely established when a machine is again ready to handle another operation. It will also be seen that a section of the form is provided for the cutting speeds and feeds, as these data are of value in establishing standard time factors.

The Graphic Scheduling of Material

Two different control boards are used for scheduling material and operations. The material is scheduled by graphics on standard cross-section paper, and this chart is called a material and flow board. The scheduling of operations, or "loading" as it is called, is graphically shown on a similar control board, called the load board. Scheduling and flowing is the first phase in production control by graphics, and applies only to the turning out of finished work. For this reason attention need be centered only on the last operation, and it is the scheduling and flowing of the last operations which are entered on the schedule and flow board and which definitely determine the starting and finishing hours for all operations later entered on the load board. On both charts colored crayons are used to differentiate between scheduled or anticipated time and the flow or actual attainments. Fig. 6 shows a section of the material and flow board, illustrating how the friction collar assembly HA-892 and the friction collar H-893, which is used in the assembling, are scheduled. Three distinct colors are used for the graphs—blue for rough material; red for finished material; and green for spoiled material.

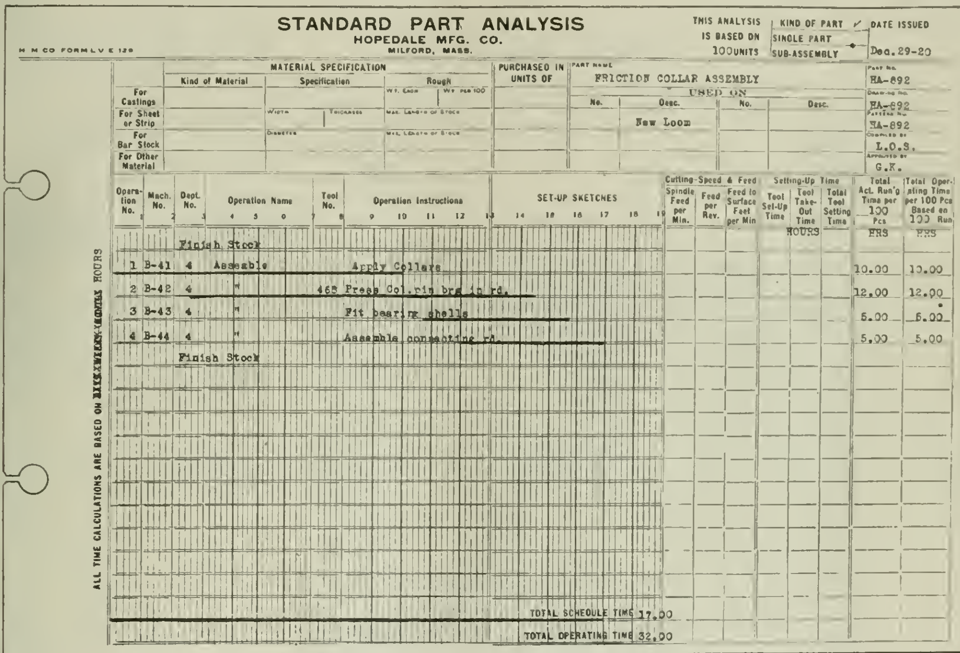
The right-hand vertical blue lines show the anticipated time for completing the last operation, these being located correctly with reference to dates determined from the date of shipment. For the friction collar assembly it will be seen that there is no horizontal blue line, showing that there is no rough material to be considered, and the horizontal red line is all that is required to show the flow of this operation between the dates determined by the schedule. In the case of the friction collar, however, the horizontal blue line representing rough material and the red line for the finished material appear side by side from time to time, as the receipt of these materials has been made known to the production department.

To better illustrate the methods employed in showing graphically the relation between anticipated and actual production, examples will be selected and followed through from the master specifications to the final assembling. The July master specifications, when delivered to the production department, may show that there are required 500 friction collar assemblies and a like number of friction collars, and that these should be ready for shipment on July 20.

The production department determines that ten day's work will be required on the assembling floor so that the machining operations should be completed at the end of July 9. This is indicated by a vertical blue line as shown in the chart. Reference to the standard part analysis shows that the last operation on the friction collar assembly requires five hours for a lot of 100; consequently twenty-five hours would be the time allowance for 500 of these subassemblies. For convenience, ten hours is here considered as the length of the working day, so that noon on July 7 is indicated by another vertical blue line as the starting time for the flow of this last operation.

Reference to the stock record card shows that there are 100 of these sub-assemblies in stock; also, that a minimum of 25 must be retained, so that it is permissible to apply 75 of these units to the production schedule. The vertical line which indicates the start of the flow is referred to as the zero hour. To the left of the zero hour the reserve is indicated in red, and to the right the 75 units which are applicable to the schedule are similarly indicated. The length of these lines corresponds to the time required for machining these quantities. This shows that the actual time for commencing the operations is about 4:45 P. M., July 7, rather than at noon as indicated by the zero hour.

The continuing of this red line is the duty of the man in charge of the control board, and the extending is done during the process of manufacture, the information being furnished from a daily report made out by the timekeeper to whom the reports of the actual work accomplished are submitted. This detail will be referred to later in connection with the routine of dispatching. Before the graphs can be made for the friction collar, it is necessary to consult the load board in order to establish the starting time for the first operation on the friction collar assembly, for it is in relation to this starting time that the schedule on the last operation of the friction collar is established.


STANDARD PART ANALYSIS
HOPEDALE MFG. CO.
MILFORD, MASS.

H M CO FORM L V E 129

THIS ANALYSIS IS BASED ON 100 UNITS | KIND OF PART: SINGLE PART / SUB-ASSEMBLY | DATE ISSUED Dec. 29-20

MATERIAL SPECIFICATION: Kind of Material | Specification | Rough — For Castings; For Sheet or Strip; For Bar Stock; For Other Material

PURCHASED IN UNITS OF

PART NAME: FRICTION COLLAR ASSEMBLY

USED ON: No. | Desc. | No. | Desc. — New Loom

Part No. HA-892; Drawing No. HA-892; Pattern No. HA-892; Compiled by L.O.S.; Approved by G.K.

Operation No.	Mach. No.	Dept. No.	Operation Name	Tool No.	Operation Instructions	Set-Up Sketches	Spindle Feed per Min.	Feed per Rev.	Feed to Surface Feet per Min	Tool Set-Up Time	Tool Take-Out Time	Total Tool Setting Time	Total Act. Run'g Time per 100 Pcs	Total Operating Time per 100 Pcs Based on 100 Run
											HOURS		HRS	HRS
		Finish Stock												
1	B-41	4	Assemble		Apply Collars								10.00	10.00
2	B-42	4	"	465	Press Col. pin brg in rd.								12.00	12.00
3	B-43	4	"		Fit bearing shells								5.00	5.00
4	B-44	4	"		Assemble connecting rd.								5.00	5.00
		Finish Stock												

TOTAL SCHEDULE TIME 17.00
TOTAL OPERATING TIME 32.00

ALL TIME CALCULATIONS ARE BASED ON [illegible] HOURS

Fig. 4. Standard Part Analysis Form, showing how Operations are overlapped

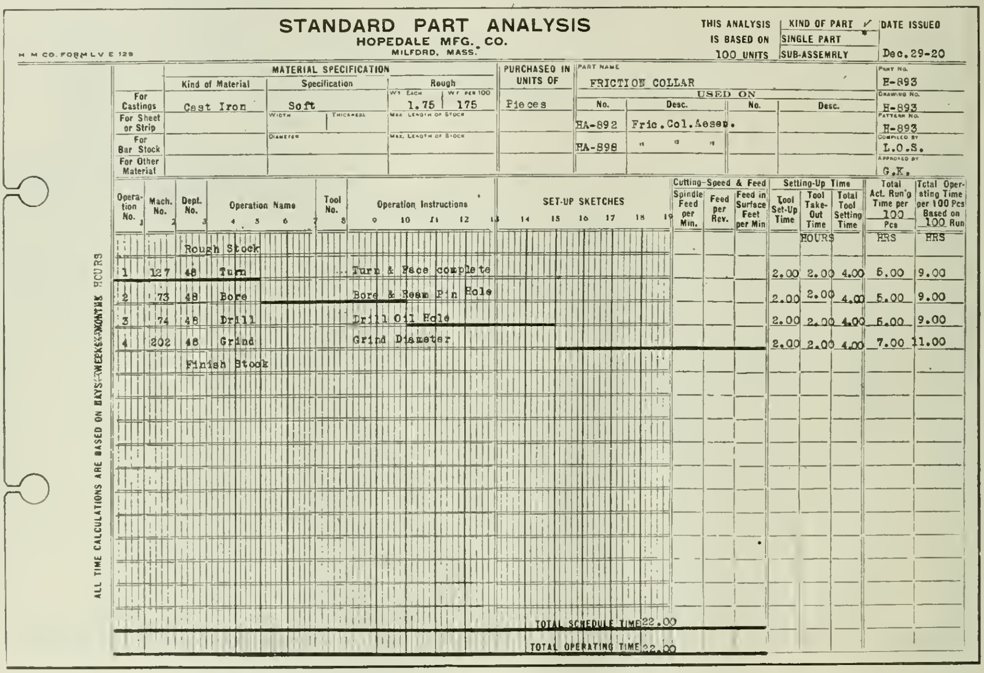
How the Operations are Represented Graphically

A section of the load board is shown in Fig. 7. Information relative to the delivery of work from one machine to another and the daily production rate is entered above the graphs. The standard part analysis Fig. 4 has shown that the last operation on the friction collar assembly is performed by machine No. B-44; consequently opposite B-44 on the load board the starting and finishing time for this operation are indicated. In order to preserve continuity and steady flow of operations, it is advisable to have one day's production ahead of the schedule; also a cértain time should be allowed for inspection and handling the work. The latter factor will be determined by experience and knowledge of the actual conditions, but for the purpose of illustration it may be assumed to be one-half day. This means that Operation 4 will start one and one-half days, or fifteen hours, in advance of the actual scheduled time for start of flow as defined on the material and flow board, Fig. 6. Fifteen hours in advance of 4:45 P. M., July 7 brings the actual starting time for this operation to 10:45 A. M. on July 6, and this is indicated on the load board by a vertical line as shown.

The total consignment calls for 500 units, but since 75 have been taken from stock for this order, it is only necessary to make 425 new units, and this is the amount which will be shown graphically on the chart. It requires 21¼ hours to make 425 units, based on the time estimate for this operation as determined from the standard part analysis, Fig. 4. This makes the finishing hour at 12 o'clock, July 8. Having established the limits within which this operation should be completed, and loaded the starting and finishing dates properly on the chart, the other operations are loaded against their respective work centers in the proper time relation, as defined on the standard part analysis for this sub-assembly. The notation 720 is the order number, 7 standing for the month and 20 for the year, and all parts entered on a July order bear this number. The part number is also shown, as well as the operation number, the machine to which the material is next delivered, and the estimated daily production.

Further Details in the Charting of Materials and Operations

This loading of the operations has placed the starting hour for assembling these units at 11 A. M., June 28, and it is in relation to this date that the starting time for machining the collars required in this assembly is determined. It is advisable to have one standard lot, or 100 finished units, of friction collars H-893 in readiness for assembling before the first operation in assembling is commenced, which, with a time allowance of ten hours for handling and inspecting the parts, makes a period of seventeen hours that Operation 4 on part H-893 should start in advance of the assembling work. This fixes the zero hour as 9 A. M., June 25, and this is indicated in Fig. 6 by a vertical blue line. Fig. 5 shows that seven hours are required to finish 100 parts on Operation 4. The anticipated date for completion is then indicated by another vertical blue line thirty-five hours to the right of the zero hour, since it requires that length of time to perform the last operation on 500 units.


STANDARD PART ANALYSIS
HOPEDALE MFG. CO.
MILFORD, MASS.
H M CO. FORM L V E 129
THIS ANALYSIS IS BASED ON 100 UNITS — KIND OF PART: SINGLE PART / SUB-ASSEMBLY — DATE ISSUED Dec. 29-20
MATERIAL SPECIFICATION: For Castings — Kind of Material: Cast Iron; Specification: Soft; Rough: Wt. Each 1.75, Wt. per 100 175
PURCHASED IN UNITS OF: Pieces
PART NAME: FRICTION COLLAR — PART NO. H-893
USED ON: No. HA-892, Desc. Fric. Col. Assem.; No. HA-898, Desc. " " "
DRAWING NO. H-893 — PATTERN NO. H-893 — COMPILED BY L.O.S. — APPROVED BY G.K.

Operation No.	Mach. No.	Dept. No.	Operation Name	Tool No.	Operation Instructions	Tool Set-Up Time	Tool Take-Out Time	Total Tool Setting Time	Total Act. Run'g Time per 100 Pcs	Total Operating Time per 100 Pcs Based on 100 Run
			Rough Stock				HOURS		HRS	HRS
1	127	48	Turn		Turn & Face complete	2.00	2.00	4.00	5.00	9.00
2	73	48	Bore		Bore & Ream Pin Hole	2.00	2.00	4.00	5.00	9.00
3	74	48	Drill		Drill Oil Hole	2.00	2.00	4.00	5.00	9.00
4	202	48	Grind		Grind Diameter	2.00	2.00	4.00	7.00	11.00
			Finish Stock							

TOTAL SCHEDULE TIME 22.00
TOTAL OPERATING TIME 22.00
ALL TIME CALCULATIONS ARE BASED ON HOURS

Fig. 5. Another Example of the Use of the Standard Part Analysis Form

The stock record card for the friction collars, shown in Fig. 3, indicates that there are 150 of these collars available for use, but that 50 must be held in reserve. The 100 friction collars that may be applied to the production schedule are indicated graphically to the right of the zero hour in Fig. 6, and this brings the time for actual machining to about 5 P. M., June 25. The reserve of 50 is also indicated in red to the left of the zero hour. There are 400 friction collars required to be ordered from the foundry, and the production clerk immediately issues a foundry order for this quantity to be delivered by June 24, and at a daily rate which will be in accordance with the daily rate of production. The foundry order will stipulate the minimum daily shipment and the date on which shipment is to start.

It can readily be seen that this method of recording the progress of finished work relative to the receipt of rough material from the foundry enables the production depart-

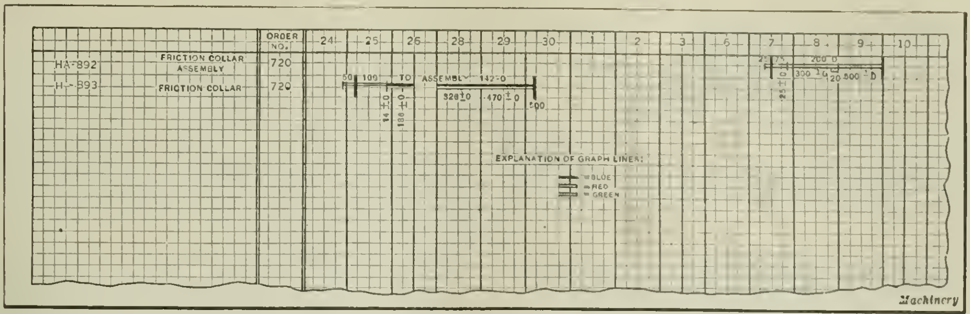


Fig. 6. Section of the Material Schedule and Flow Chart for showing graphically the Relation between Anticipated and Actual Accomplishment

ment to be in constant touch with the actual conditions, both in regard to the material being received and the relation of the progress of each operation to the established date for completion of the work.

Referring again to Fig. 7, it will be seen that the starting point of the last operation is loaded against work center 202 and scheduled to start at 5 P. M., June 25. The time for completion of the operation is also indicated by a vertical black line, this being done for each operation and the several operations being overlapped. An inspection of this load board will show that, due to compacting, 43 hours from the time that Operation 1 was started, the friction collars were completed. If overlapping or compacting were not resorted to and the standard part analysis, Fig. 5, strictly adhered to in loading, it can readily be seen that it would require 88 hours (4 × 22) to machine this lot of 400 collars. This represents a gain of 45 hours. The time required for setting up and taking down a machine is shown in advance of and at the end of each operation, respectively, this being indicated by a black line so that the exact time at which a machine will be available for a new job is at once seen.

Forms Used in Routing the Work

No actual flow of material has yet been charted—merely the loading of the operations against the various work centers in Fig. 7, and the scheduling of the last operation in Fig. 6. With the starting and finishing times indicated on both the schedule and flow board and on the load board, the control board comes into use for recording the actual production. Before production is started, however, three forms are made out by the production department. These are the productive material requisition, Fig. 8, the routing card, Fig. 9, and the dispatch order time cards, Figs. 10 and 11. These three forms are made out at the same time, and reference is made to the standard part analysis when issuing the cards.

Productive material requisitions are issued in duplicate copy and are used only for material that goes into the regularly manufactured product of the company. One copy of the routing card is made out, its purpose being to identify the work in process and to furnish the information for delivering the work in the proper sequence from operation to operation. It will be seen in Fig. 9 that provision has been made on this card for splitting lots, as would be done in machining the friction collar H-893; the routine recorded on this card is made out from the standard part analysis. When a lot is split, information relative to the number of the tote box and the quantity contained in it are entered on the card; also the quantity in the entire lot, and the number of the box from which the material was taken. When

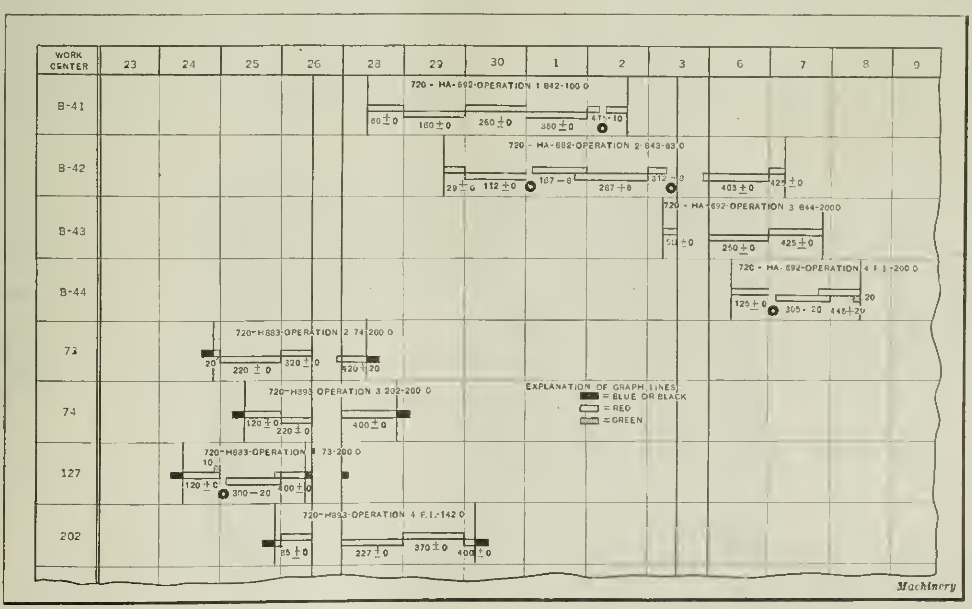


Fig. 7. A Portion of the Load Board on which the Schedule of Each Operation is indicated graphically Relative to Dates and Work Centers

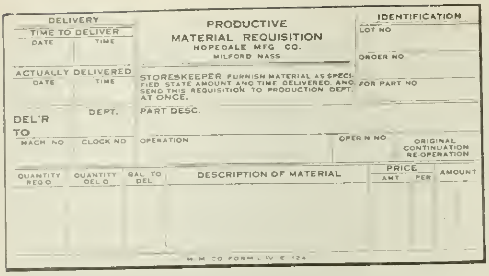


Fig. 8. Form used for requisitioning Productive Material

an order is split, a duplicate card is issued and the proper entries are made in the deliveries section in order to permit the various lots on the order to be traced during the process of manufacture.

The dispatch order time card is issued in duplicate, the original in white, Fig. 10, and the duplicate on a buff card, Fig. 11. It will be seen that the original, Fig. 10, has provision for inspectors' reports under the headings "Deliveries" and "Spoiled" in place of the space on the buff card, Fig. 11, for the stamping of starting and stopping times by a clock recorder. These cards—the productive material requisition in duplicate, the routing card, and the dispatch order time card, also in duplicate, are then clipped together and placed in a clip on the dispatch board.

The dispatch board is the center from which the orders for material and the shop orders are dispatched, and also the center from which the machining of the work is controlled. Divisions are made on the board for each work station, properly indicated by number, and all work either about to be made or in process of manufacture, is relegated to this section of the board. This is in charge of the dispatcher, and his duties are primarily to maintain a systematic steady flow of operations, and prevent the occurrence of idle machine time. Under each machine division on the dispatch board there are three wire clips which are designated as "jobs planned," "next job," and "jobs done." The dispatch order time cards, with the routing card and productive material requisitions attached, are then filed in a "to do" file at the dispatcher's desk, and this file is drawn from as jobs are placed on the dispatch board.

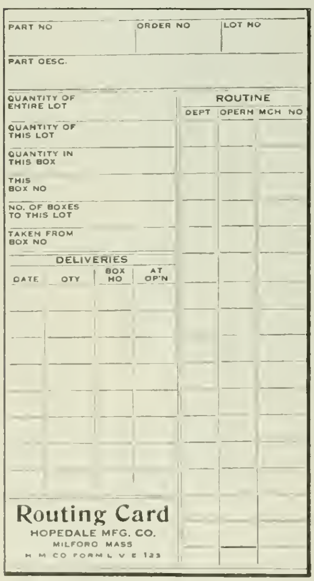


Fig. 9. Routing Card which accompanies the Material through the Plant

Dispatch Board Routine

As time goes on, the dispatch order time cards are advanced to the "jobs planned" clip for the machine on which it is desired to perform the work, but before this is done the original copy of the dispatch order time card is placed in a "jobs working" file on the timekeeper's desk where it is filed numerically. This original (Fig. 10) will later carry the inspector's reports and will furnish the information (after the completion of a job) for the control board operator to indicate the flow on the material and flow board. After a job has been completed, the dispatch order time card is placed in the "next job" clip. When the dispatch order time cards reach the "next job" clip, the dispatcher removes the material requisition, Fig. 8, and the routing card, Fig. 9, and forwards both to the storekeeper. The operator's clock number and name are then entered on the buff dispatch order time card, Fig. 11, which is then placed under the "next job" clip.

As soon as the storekeeper has received the material requisitions and routing card, it is his duty to forward the material to the machine designated, together with the routing card, and send the duplicate copy of the material requisition to the production department, retaining the original for his own files. It is of course necessary to so organize the trucking department that the material will be delivered as designated on the routing card.

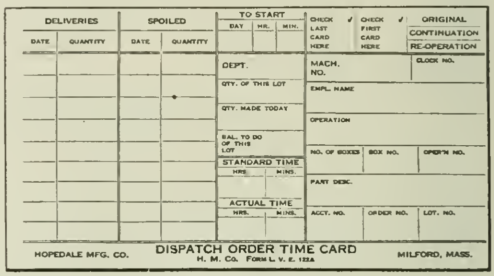


Fig. 10. Original Dispatch Order Time Card with Provision for Inspector's Report at the Left

When an operator is ready for a new job he goes to the dispatch board, removes the buff card, Fig. 11, from the "next job" clip, stamps the starting time on it, and then proceeds to his work, retaining the card until after the operation has been finished, or until the end of the day, when all dispatch order time cards have to be turned in. Upon reaching his machine, the operator should find the material already delivered from the storekeeper. After the operation has been finished, or at the end of the day, the operator enters on the card the quantity made, and the balance to be made, and stamps the stopping time on the card, placing the card in the "jobs done" clip and taking a card from the "next job" clip. He then proceeds with the second job as before.

As soon as the card appears in the "jobs done" clip it is a notice to the dispatcher and trucking department that material is ready for transfer from a particular machine. The truckers then remove these cards, drop them into a box provided for the purpose at the dispatch board, and proceed to make the transfer of material. In making the transfer,

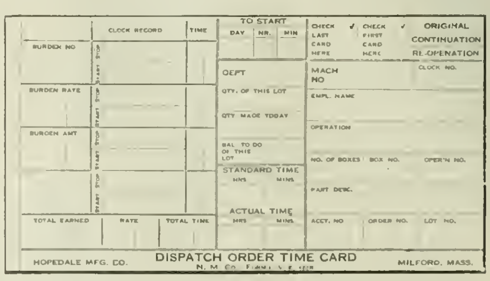


Fig. 11. Duplicate Form of Dispatch Order Time Card with Spaces for Time Recorder Stamp

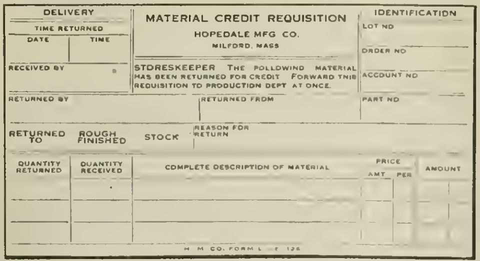


Fig. 12. A Material Credit Requisition used when returning Overdrawn Material to Stock

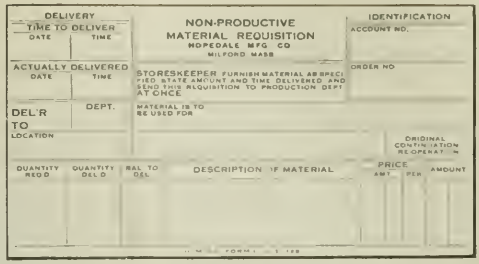


Fig. 13. Requisition for Material used for other Purposes than for Regular Manufacture

the routing card, which has remained with the lot, furnishes the information for routing the material. If it so happens that a job is not finished at the end of the day, the time card is placed in a box on the timekeeper's desk, and the timekeeper will then issue a new dispatch order time card (in a different color). When the operator starts the job again the next morning, he will find the new card properly located in the "next job" clip, where it has been placed by the timekeeper the night before.

After the dispatch order time cards have been made use of by the timekeeper they are forwarded to the payroll department for computing the operator's wages. The information which the timekeeper obtains from the dispatch order time cards is arranged in report form and delivered to the production department every morning. It is this report to which the control board operator refers when indicating the flow of finished work. As previously stated, the flow of rough material (that is, its receipt from the foundry) is obtained daily from foundry reports.

It will be seen that if this procedure of reporting every morning to the production control center is followed in each department in the plant, complete information will be obtained of exactly what is happening throughout the entire plant, and this can best be shown by the use of charts.

Load Board Routine

On the morning of June 25 the production report for the 24th is delivered to the control board operator, showing that Operation 1 on the friction collars was completed on 120 units; this is accordingly shown graphically in red on the control board to the right of the starting hour, 11 A. M., and opposite machine 127. This report carries also the number of spoiled parts, as determined from the inspector's report entered on the original of the dispatch order time card, Fig. 10. There were ten defective collars on June 24, and this is indicated by a green line, the amount being written directly above it (Fig. 7). Below the red line the notation 120 ± 0 is made, which means that 120 collars were produced with no excess or under production. On the morning of the 26th the report for the preceding day shows that work did not start at 7 A. M., due either to absence or tardiness of the operator. When such a condition exists, the failure to start is immediately noticed by the departmental foreman, who then notifies the production department that work has been held up on machine 127, giving the reason therefor. This fact is immediately indicated on the load board in the form of a red and blue bulls-eye, located at the gap where the interrupted production occurs.

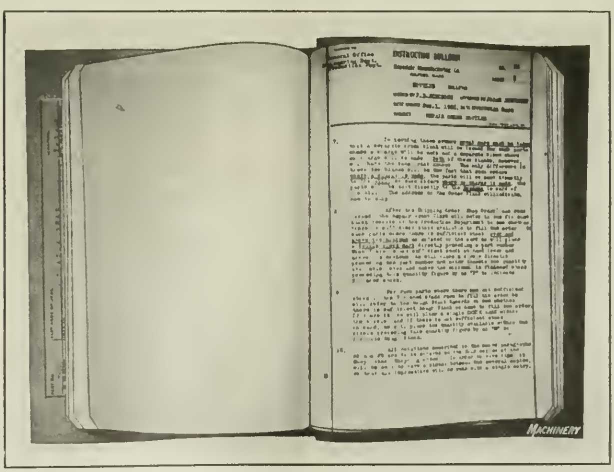


Fig. 14. Inspection Bulletins bound in Loose-leaf Form

The next day's report shows that production was resumed on the machine at 8 o'clock and that 180 units were machined on the 25th, this being indicated as shown, with the space left indicating the idle machine time. The production of 180 is then added to the preceding day's production and the notation 300 — 20 is entered as shown, to indicate that the 300 figure is 20 below the estimated production for the two days. The daily report for the 26th, which was received on the morning of the 28th, shows that 100 units were turned out, which is 20 in excess of the schedule requirements for that period of time. In charting this production, the excess 20 units is indicated by extending the line to the left of the space provided for the 26th of the month, so that it overlaps the preceding day's production. The accumulated total is 400 ± 0.

Although the entire lot of 400 has been turned out within the scheduled time, it is seen that there are ten defective pieces, leaving a balance of 390 perfect castings. This shortage can be conveniently handled by drawing on the reserve, or ten additional units can be made. In the latter case, the dispatch order time card will have indicated on it in the upper right-hand corner (see Figs. 10 and 11) that this is a reoperation job.

The remaining operations are indicated graphically in a similar manner, and above each graphic representation there is entered a notation giving the order number, part number, operation number, machine or work station to which the next operation passes, and the required daily production.

The control board operator is thus furnished with the information which will enable him to inform the production manager regarding all cases where failure to meet the production rate has occurred. A daily report issued to the production supervisor by the control board operator shows definitely the extent and seriousness of any falling behind in production, and enables immediate steps to be taken to remedy the trouble. The red and blue bulls-eye on the load board focusses attention upon any stoppage of production.

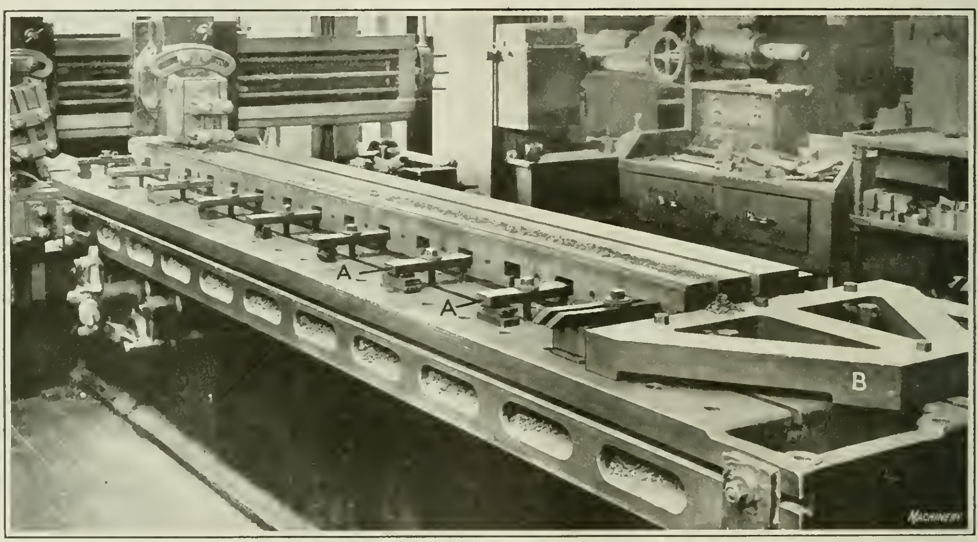
Measures for Preventing Haphazard Methods

It will be realized that in addition to the few forms which have been shown in this article, numerous other cards and requisitions are required in order to take care of exigencies that arise in the functioning of the system. For example, there is the material credit requisition, Fig. 12, which is sent to the storekeeper whenever material is to be returned to storage, enabling the stock records to be readjusted. Such a condition is frequently encountered when material has been withdrawn from storage and charged to a non-productive job. A non-productive material requisition, such as that illustrated in Fig. 13, must be issued for the withdrawal of stock which is to be used for non-productive purposes, such as repairing and general mill-wrighting. A definite knowledge of all material which goes into any branch of the industry, be it productive or non-productive, must be under the control of the production department. There is also the issuance of non-productive time cards for such workers as truckers, stock-room men, house electricians and carpenters, millwrights, oilers, watchmen, etc.; and further, the readjustment of ratings, the handling of repair orders, the issuance of foundry orders, and the routine connected with the control of stock within the stock-rooms.

These several auxiliary parts of the system are all correlated, and must each be definitely taken care of. When the graphic control system was installed, these facts were fully appreciated, so that it became at once apparent that some definite clearly defined routine would be necessary. Consequently all correspondence from the heads of the various departments and the executives relating to any phase of production is required to be handled in the form of instruction bulletins. These instruction bulletins have been issued on every phase of the system, and have to do with all internal house routine. They are neatly prepared and bound in loose-leaf form, as shown in Fig. 14. It will be seen that copies of these instruction bulletins go to all departments concerned in the issuance of any instructions. These instruction bulletins are numbered and carry at the head the subject and the names of those responsible for the issuance of the bulletin, together with the current date and the date effective. Written instructions are insisted upon.

PLANING CROSS-SLIDES FOR NATIONAL-ACME AUTOMATICS

On automatic screw machines built by the National Acme Co., of Cleveland, Ohio, the cross-slide for the forming side of the machine is required to interchange with the cross-slide on the cut-off side. To insure this interchangeability, a high degree of accuracy must be attained in the performance of the planing operations on these castings. The accompanying illustration shows a string of the forming slides on which a T-slot is being planed, and the particular point of interest in connection with this job is the method of setting up the work. In addition to applying the multiple set-up principle, which enables a substantial increase to be attained in the rate of production, it will be seen that advantage is taken of the fact that each slide has been undercut at both sides to afford the necessary means of supporting it on the machine. As the castings are set up for planing, these under-cuts come together, forming the equivalent of a T-slot into which the end of straps *A* may be inserted in such a way that each strap grips both of the shoulders on two castings and holds them firmly in place. End thrust is taken by a stop *B*, which is carefully finished to engage the finish-planed end of the first piece of work, thus substantially assisting in the set-up, by forming a reference point from which to start to align the string of castings with the line of travel of the planer table.



Multiple Set-up used in planing the T-slots in Cross-slides

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COST REDUCTION A FACTOR IN THE FUTURE OF THE AUTOMOBILE INDUSTRY

In a comprehensive study of the automobile industry and its future, made by Leonard P. Ayres, vice-president of the Cleveland Trust Co., Cleveland, Ohio, the conclusion is drawn that extensive price adjustments will be made in that industry in the next few years, and this conclusion, if accurate, makes it inevitable that the automobile business will finally be concentrated into fewer competing hands and curtailed more than it is now. For a long time to come the machine tool market offered by the automobile industry will not be on the same basis as it was in the past, during the great development of the industry. The survival of the concerns now in the automobile field will depend upon their ability to reduce costs of production; that means that there should be a market for machine tools of high productivity.

Economic Value of Factory Investigations

By ALBERT A. DOWD, President, and FRANK W. CURTIS, Chief Engineer, Dowd Engineering Co., New York City

A FEW plants are taking advantage of the present dull period to overhaul their equipment and make improvements here and there in their methods of handling work and materials, thus taking a step in the right direction in their preparation for future business. It is the progressive man who realizes that something of this sort is necessary. Others will continue with obsolete machine tools or those that need overhauling, and will wait until business really improves to such an extent that they will need their equipment before they spend any money in preparation work. This attitude simply means that they are not far-sighted, and will get skim-milk while their more progressive competitors take the cream. Methods and tool equipment should both be considered in any planning for future work, and those who are doing this preparatory work now will be rewarded when business improves, for they will then be ready to operate and make early deliveries.

Matters of this sort are of vital interest to every manufacturer in planning for future business, and there are a number of points that he must consider with care. The labor problem is one; the question of salaries for office workers and wages in the factory must be given consideration. The conditions under which the men will work, together with such things as heating, lighting, ventilation, and the sanitary provisions for the workmen's comfort should be looked into. Now is the time to think of these matters in a broad-minded way, and at the same time to put into operation some of the ideas for improvement that may be suggested by past experience. It is no time to be idle and to say that one cannot afford to waste money by doing any of these things now when there is no business. It is really the opportune time to do preparatory work.

The Value of Outside Perspective

The majority of manufacturing plants need a certain amount of reorganization at the present time, largely on account of the changes which have taken place in business conditions in the last few years, especially the changes that the last year has brought about. The reorganization which is required may be either radical or moderate. If the factory has been greatly enlarged and many departments added to handle other kinds of work than those for which the factory was originally intended, it is necessary to look over the equipment carefully and see for what class of work it is best suited, and then make an attempt to obtain or manufacture work of this class.

Investigation of the factory by an outside engineer, together with an analysis of matters as he finds them, has been found to be of great value at this time. Ordinarily the executive says: "I know my own plant best. No one can tell me how to operate it, as I know every machine in it." It does not always follow, because an executive feels this way about it, that the statement is really accurate. The outside engineer, if he is a capable man with sufficient mechanical experience, can look over a factory and see many things in it which would be entirely overlooked by the executive who might be familiar with all of them, yet underestimate their importance. The outsider brings an open mind into the situation, and is therefore impressed by things as he finds them, and not by matters as he expects to find them, as may be the case with the executive familiar with the conditions. Largely for this reason, the investigating engineer is able to look at the matter without being influenced by anything except the conditions as he finds them, and as a consequence his report is of great value on account of its freedom from restraining influences.

Such an investigation at the present time may seem, at first, an unwarranted expense which will not be likely to produce any immediate results. So-called "efficiency experts" are not always expert, nor do the results achieved meet the expectations. But there are consulting engineers who know their business, and the executive can investigate before he engages a man.

The Investigator and His Work

A consulting engineer can be brought in from outside for one day a week, or two days a month. All he does is to go through the various departments, noting conditions and making a report on them with suggestions, at a cost that is not excessive. The total cost may run to from $1200 to $2400 a year. It is quite possible that with an arrangement of this kind great savings may be effected in the methods of manufacture, provided the man selected for the work has had sufficient experience to enable him to analyze conditions as he finds them and suggest improvements where needed.

Some executives consider it more or less of an insult if any suggestion is made by a director or stockholder of the company regarding an investigation of the methods used. As a matter of fact, this attitude is a mistaken one, because a capable executive should welcome any assistance either from the inside or outside which will tend to reduce production costs. Instead, therefore, of being antagonistic to the idea, he should give careful thought to the subject and look at the matter in an open-minded way. As an executive, he should certainly welcome any suggestion which would show him how to increase his production from 10 to 25 per cent without adding to the production cost, or, what is the same thing, to reduce costs a corresponding amount without reducing production. In looking into the matter, therefore, let us see how the investigator works and how he obtains his results, keeping always in mind the fact that the outside viewpoint enables the engineer to look at a thing fairly as well as analytically.

Cost Reductions Resulting from Factory Investigations

Let us take two or three specific examples of savings which have been effected by the suggestions of an outside investigator in factory work. A small spur gear, approximately 2 inches in diameter by 3/16 inch thick, had been made for some years from a steel blank, bored, reamed, the keyway cut, faced, and finally teeth cut on a gear-cutter. A method suggested to replace this was the use of punches and dies, the work being turned out in this way in somewhat less than half the time formerly required. The work was also held within very close limits of accuracy by the use of shaving dies. The number of machines required was reduced and their cost was much less than that of the types formerly used. The old method gave a production of 1200 per day and utilized five machines for the purpose, namely, one screw machine, two engine lathes, one broaching machine, and one gear-cutter. The new method gave a production of 2600 per day with four punch presses. These machines are much cheaper than those used in the other operations, and it will be seen that the actual saving in time was more than 50 per cent. The cost of dies was somewhat more than the tool equipment previously used, but this extra cost was soon absorbed by the savings effected.

Another revision of methods which brought about extensive savings was that of a small shouldered stud 1¼ inches in diameter by 2½ inches long, which was formerly made on an automatic screw machine. This method required considerable forming and a slow cutting-off operation. The production obtained was 120 pieces per day. By making this part in the form of a drop-forging and handling it by another method consisting of short simple operations on the drilling machine and engine lathe, respectively, a production of 200 pieces per day was found to be easily possible. In addition to this, the new method did not waste as much material as the old so that there was a saving in this regard also.

Improved Method of Manufacturing a Long Rod

Another factory had as an important item in its manufacturing schedule, a rod 48 inches long by ½ inch in diameter having a head on one end with a ½-inch hole drilled through it. The old method of manufacturing this unit was to bulldoze the end of the rod to flatten it out, and after this to mill both sides of it and drill a hole. The operation of bulldozing was not so very slow, but the work was awkward to handle in the subsequent operations of milling and drilling, thus making a very slow method of handling. In the improved method the end of the rod was made in a punch press from ¾-inch flat stock, blanked and pierced with the hole required. After this operation, this end was welded to a rod cut off to the proper length. The only thing then remaining to be done was to dress off the fin at the joint where the work was welded. The new method gave a production more than double that obtained by the old process.

These examples are given specifically in order to show the opportunities for improvement which may be brought about by a wide-awake man in the investigation of methods in the factory. A number of other important matters not directly connected with the machining of the work are also subjects for analysis. Several of these points are mentioned in the following in order to show the scope of a thorough factory investigation.

Definite reductions in costs have been shown to result from factory investigations. In one case a production of 1200 small spur gears per day was increased to 2600 per day, and a less expensive machine tool equipment was used for the greater production. In another case a production of 120 shouldered studs per day was increased to 200 pieces per day by a change in the machining methods; and in still another case production was doubled by making a part in two pieces and welding them together, instead of making it entirely from one piece as had formerly been done. Next month additional examples of cost reduction by increased production through the use of improved methods will be given in another article by Mr. Dowd and Mr. Curtis.

Handling Materials

There are very few factories where the material is handdled with maximum efficiency. Work is often piled up where it is in the way of both operators and trucks. Simple conveyors which often may be gravity-operated, together with suitable racks and stands for placing the work so that it can be conveniently handled, are always of assistance in carrying the material through the factory without waste of time. The investigating engineer studies the requirements and determines how the work, both raw material and finished product, can be most conveniently arranged and carried from one department to another.

Inspection and Salvage

The inspection of the raw material and the finished product are important factors in production. Much unnecessary work may be done in the machine shop due to a careless method of inspecting the raw material. Defective castings may be put through and machined, with the result that they will be scrapped before or after completion. The study of these matters is often the means of saving considerable money. Work that goes through the factory and does not pass inspection on account of errors in machining may often be salvaged in one way or another, so that the material and the time expended in the manufacture are not totally lost. Much depends upon the nature of the work as to how it may best be adapted or refinished to suit some other condition. A hole which is bored over size in a casting may be again bored and the hole fitted with a bushing of the correct size in order to save the piece. Many other opportunities are found by the careful investigator, which reduces the amount of work scrapped to a minimum.

Many products require painting or japanning in order to give them a certain finish after the machining work has been done. The methods used for the process of painting are often very wasteful, both of time and paint. A process of spraying may be found economical for the application of paint in connection with suitable dryers and conveyors. In japanning, the work may be automatically dipped and carried through the baking ovens by means of conveyors. By thus considering each process, the investigating engineer can suggest economies not always apparent to the owners.

Time Studies

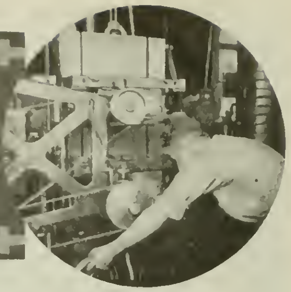
Time studies showing the length of time necessary to perform this or that operation are often not favored by the shop executive because they may be objected to by the shop men. It is possible, however, to institute such a system for this purpose that no trouble will be caused. In the establishment of piece-work prices, time studies are an important factor in determining a price which will be fair to manufacturer and operator alike. The matter of speeds and feeds for the various machines is an extremely important matter and it is safe to say that a large part of the losses in production in the average factory are the result of incorrect feeds and speeds.

Assembling

The assembly department often presents to the investigator many problems for solution. A great deal of labor is wasted by inefficient methods, and there is more hand fitting than there should be. Time saved in the final fitting of parts which are to be assembled is an important item of manufacturing, and the cost of the product is often greatly reduced by efficient work in the assembly department. The process of gaging and the limits used have a pronounced effect on assembling. If allowances and tolerances are not correctly determined in the first place, the final assembly is much hampered, and considerable extra fitting becomes necessary. This part of investigation work requires diplomatic treatment and a careful analysis.

The various points mentioned in this article are intended only to give an executive a general idea regarding the value of an investigation of his factory by an outside engineer. No attempt has been made to go into detail regarding the various methods used by the investigator, although it will be realized that a certain amount of diplomacy is necessary in order to avoid conflict with foremen and operators. Much of the work mentioned can be done by a comparatively rapid survey, but many results of value can be obtained only by a careful and logical analysis of conditions as found, resulting in suggestions for improvements in methods which do not appear to be as efficient as they might be. The belief that present-day practice is not susceptible of improvement is often the reason for high production costs.

Design and Making of Drop-forging Dies



Methods of Heating, Quenching, and Drawing Carbon and Alloy Steel Dies

In August and September MACHINERY the design of dies and modern diemaking methods were described. The present article on drop-forging dies deals with the heat-treatment. It was stated in August MACHINERY that the blocks when received from the steel mill are usually in the annealed state; but sometimes they are so heat-treated that they do not require any further heat-treatment and are put into immediate service after the impressions have been sunk. The types of dies which are heat-treated at the steel mill are those that are unusually large or those alloy steel blocks that demand in their heat-treatment certain methods which the steel manufacturer is better equipped to use than is the die manufacturer. The scleroscope reading of these heat-treated die-blocks ranges from 40 to 50, which is the limit for machineability, under ordinary circumstances. The present article deals almost entirely with the heat-treatment which annealed untreated blocks require after the die impressions have been sunk.

Heating for Hardening

After the impressions have been sunk, the annealed blocks should be heated in the following manner preparatory to quenching for hardening: The blocks should be allowed to heat gradually, absorbing the heat already in the furnace from the previous run, before the heat is again turned on. The initial temperature of the furnace should not be more than 600 degrees F., and if care is not exercised in permitting the blocks to become thoroughly permeated with the low furnace heat, rupture is likely to occur, because it is during the low temperature changes that the most trouble in this respect is encountered.

Before placing the dies in the furnace, they should be set, face down, in a shallow iron box or tray, the bottom of which has been previously covered with powdered charcoal, or spent bone. The tray should have projecting lugs, to accommodate the arms of the truck used in transporting the loaded tray in and out of the furnace. When it is necessary to harden unusually large die-blocks, it may be impracticable to use a pan, and in such cases the blocks are set directly on the furnace hearth, shank down in order to facilitate handling them, the truck arms straddling the die shank and extending under the die when it is being moved. The faces of the dies should be covered with a thin layer of powdered charcoal, held in place by a suitable iron plate. This precaution prevents the formation of scale and the decarburization of the impression surfaces.

After placing the dies in the furnace, the temperature is raised steadily to from 1375 to 1500 degrees F., and the blocks are permitted to remain in this heat until all dark spots have disappeared. Although the heat-treater is governed considerably by experience, in judging the time for leaving the blocks in the furnace, the appearance of the red-hot block furnishes a more definite indication of the proper withdrawal time. A 12-inch cube of steel will heat thoroughly, starting from a furnace temperature of 600 degrees F., in about seven hours, and other sized blocks in proportion.

The furnace, which for convenience should be located near the die-sinking department, should preferably be of the under-fired semi-muffle type, although there are a number of standard furnaces on the market which are designed especially for handling this kind of work. Excellent results have been obtained from specially designed furnaces, burning either gas or oil, constructed with a high arch and with provision for conducting the heat to the die by radiation rather than by direct contact.

Quenching

Carbon steel blocks may be quenched for hardening either in water or oil. All dies should be quenched immediately from the hardening heat (1375 to 1500 degrees F.). Good results will be obtained if the blocks are permitted to become only partly cooled in the bath, so that when withdrawn a finger can be held in the deepest impression for several seconds, after which the blocks may be immediately drawn on a hot plate, before the dies have had time to cool completely. Of course, if the blocks are completely cooled in the quenching bath, they may be drawn to the correct hardness by reheating in a furnace or oil bath, and quenching. The recommended tempering heat for the steel (about 450 degrees F.) should be employed.

If the blocks are massive and are hardened in water, a quenching tank should be employed which can accommodate a plentiful supply of circulated water. The blocks should be dipped face downward to a depth which will bring the deepest impression about an inch below the surface of the water. The tanks should be equipped with means for spraying water against the die face, to prevent steam pockets and uneven shrinkage.

The proper heat-treatment of drop-forging dies is perhaps one of the most important steps in the economical operation of a drop-forging plant, for nearly all other economies may be nullified by improper heat-treatment. On the one hand, careless handling in the heat-treatment may spoil the dies and cause a waste not only of the material from which they are made, but of all the labor that has been put into the sinking of the impressions. On the other hand, even though the dies may pass from the hardening room in what may appear to be first-class condition, if they are not of the right hardness and toughness, they will not stand up under the hammers anywhere nearly as long as if correctly treated, and as a result the cost of dies will increase rapidly. Too much attention cannot be paid to the heat-treating department in any plant, and this is especially true in a drop-forging plant where dies are hardened and drawn; hence, the emphasis laid on this subject.

If the face of the block is approximately square, a 2-inch outlet for this stream will be about right. If the block is long, the stream should be so distributed that it will extend at least the full length of the block. While the die is being quenched in this manner, the shank should be cooled by playing a stream of water on it as a means of preventing distortion, and this stream may be so manipulated as to keep the shank level. As the face cools, the amount of water applied to the shank should be gradually diminished. By this method the amount of distortion can be controlled so that the shank will not be out of level more than 1/32 inch on a large die. These precautions are not required when oil is used as a quenching medium. Any convenient means may be employed for suspending the dies, but if they are heavy and awkward to handle a cradle is sometimes employed, attached to the side of the tank, which may be adjusted to hold the block at the proper height relative to the surface of the liquid.

The die may be ruined in quenching, especially when water is used; consequently this work should be carefully performed, and should be entrusted to no one but a man who has had extensive experience in hardening dies. If the die impression is at all intricate and has sharp corners and edges, these should first be "checked" with a piece of water-soaked waste or a piece of soap. The shank should be dipped long enough to chill it, and the die then turned over and quenched, face down. Water should be splashed on the sides of the die while the face is cooling in the water.

Although water is generally used for hardening when carbon steel dies are being quenched, oil is often used for dies that do not require such a degree of hardness as is obtainable with water. In quenching alloy steel dies, oil should always be used in preference to water. Oil will produce less distortion and cause less risk of breakage than water. The oil should be circulated through coils in the tank and maintained at a temperature of about 100 degrees F. In quenching alloy steel blocks, they are entirely submerged, face downward, until they are covered to a depth of 12 inches. The blocks should be kept in motion and remain in the quenching oil until they have cooled to a temperature of 300 degrees F., when they are drawn. The determination of this temperature may be obtained by the use of a thermometer or by applying tin-lead alloy shavings, which melt at a temperature slightly above that required for withdrawing the block.

Drawing the Temper

All die-blocks should be drawn immediately to a hardness of from 50 to 80 scleroscope, the exact hardness depending on the work to be done, the nature of the impression and the material the dies are made from. Oftentimes, the hardness requirements are determined solely by the hardener's personal experience and judgment, so varied are the factors to be considered. Under no conditions should dies be allowed to lie on the floor after heating, as they are likely to become injured or accumulate a coating of rust before being drawn. Practice regarding the drawing of die-blocks varies in different shops, and is influenced considerably by the size of the block. In one shop where all blocks are drawn back in a furnace, they are permitted to cool completely in the quenching bath, and are then drawn at a temperature of from 400 to 500 degrees F. for a period of about three and one-half hours and allowed to cool in the furnace. It has been found that this procedure will give the desired scleroscope reading for the particular kind of steel used.

If the die-blocks are drawn before they are permitted to cool completely, as mentioned in an earlier paragraph, excellent results will be obtained without the use of a furnace. The method used for small and medium-sized carbon steel blocks is to place the blocks, still very warm, shank downward on a hot iron drawing plate, leaving the impression in full view, and permitting scleroscope readings to be taken from time to time as the color indicates the approach to the proper hardness. The drawing plate may be heated by placing it on a gas or oil-fired brick oven, or by any other convenient means. Readings should be taken in several places, the surfaces being wire-brushed before the readings are taken. An allowance should be made of from three to five scleroscope numbers for the steel to gain in hardness during cooling. This amount will be governed somewhat by the size and shape of the die and the kind of steel from which the block is made. As soon as the desired hardness is obtained, which will be after the die impression becomes blue, the die is removed from the plate and the draw checked by pouring oil in the die impression.

The following modification of the treatment frequently used, will give excellent results for large annealed carbon steel die-blocks, this being the only heating that the dies receive. After heating, quench the dies, face downward, all over for a few seconds in circulating water; then raise until the face is submerged about 3 inches, keeping a spray of water, which rises from within the tank, in contact with the face of the die for about 1½ minutes. The shank will then show a dull red, caused by the heat radiated from the center of the block, which has been reduced but slightly by the quenching. In drawing alloy steel blocks without using a furnace, they should be quenched all over in oil to reduce the red exterior heat to a dull red color. The dies, whether carbon or alloy steel, are then set shank down on the floor and permitted to cool gradually. It is during this cooling period that the refinement and drawing back of the face occurs. The heat for drawing the temper is that retained in the center of the die.

Records of Heat-treatments

The following detail connected with the hardening of dies is followed by a large drop-forging concern located in the Pittsburg district. The dies are numbered and a card index file is kept, by means of which there are recorded the length of service of the die before it is necessary to resink the impressions, and its entire history as regards the nature of the work produced and the number of forgings received from the impression. This is an excellent check on the hardening process, and may be used to good advantage to so modify or alter the hardening procedure that failures rarely reoccur on the same type of die-blocks. In this way, if any question as to the proper heat to use or any data relative to quenching should arise, the correct method may be determined by reference to the record of similar cases.

The actual production of drop-forgings will be dealt with in a later article of this series, which will appear in November MACHINERY, in which a description will be given of the method of drop-forging different classes of work. The information contained in this series of articles has been furnished mainly by the J. H. Williams Co., Brooklyn, N. Y., and the Union Switch & Signal Co., Swissvale, Pa.

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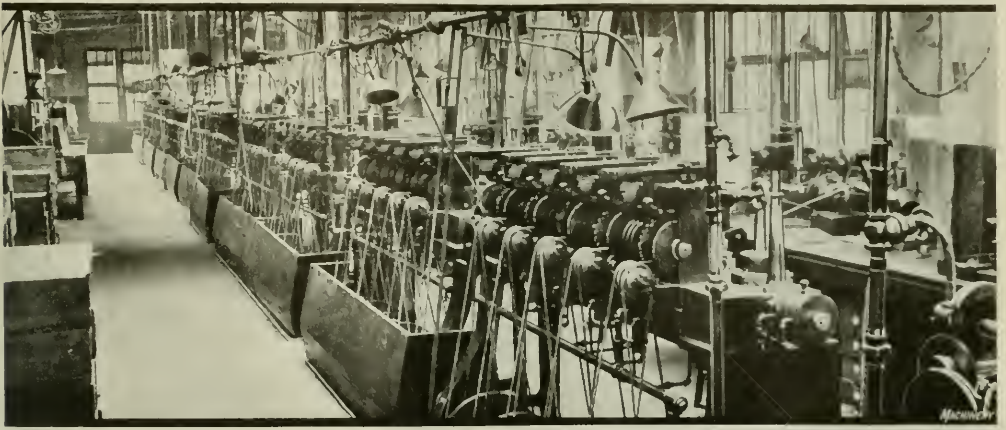
BRITISH ENGINEERING STANDARDS ASSOCIATION

At the annual meeting of the British Engineering Standards Association recently held in London, the annual report presented reviewed the work of the association. There are now more than 1500 engineers who give their time and experience to this important work in Great Britain, often at great personal expense and inconvenience. While engineers generally have taken the keenest interest in the various problems submitted to the association, business men, it was stated, have not been as thoroughly impressed as they should be with the commercial value of standardization. Last year about $60,000 was expended on this work, of which the industry of Great Britain contributed about $40,000, the remainder being government grants. The various national standardization committees are assisting the trend of international agreement in engineering matters, as far as practicable.



Automatic Machines in a Watch Factory

Machines, Devices, and Methods Employed in the Plant of the Waltham Watch Co., Waltham, Mass.—Third of a Series of Articles

THE automatic machines described in the first two articles of this series (see August and September MACHINERY) are used in performing the various machining operations on pillar plates, barrel and train bridges, and balance cocks, which enter into the construction of a watch. A number of additional ingeniously constructed automatic machines are described in the present article.

Pinion-making Machine

One of the interesting machines is that used for producing the various pinions of a watch complete from bar stock. Some of these pinions are so small that a piece of dough is used to pick them up, and they are removed from the dough by tweezers. It is interesting to note that these tiny pinions are in most cases machined with two cuts for each surface—a roughing and a finishing cut—just as in machining larger work.

A view of the top of the pinion-making machine is shown in Fig. 15. Each pinion has a number of leaves (or more properly, teeth) and this machine also cuts these leaves. The end of the stock can just be seen at *A* projecting from the chuck. The chuck which holds the work is air-operated, and can be advanced or receded to carry the work under the cutters which mill the leaves and to return it for the beginning of the next cut. The circular cutting tools, of which there are nine, are carried in a circular cutter-head. The cutter-head is indexed by means of a ratchet, located at the center of the cutter-head spindle and covered by a guard. The ratchet indexing mechanism carries a retainer pawl for locating the cutter positively, when the cutter-head is indexed. A set of individual stops provides for setting each tool after grinding, so that in relocating the tools, the previous position of each will be maintained. The collar which carries the set of stops is indicated at *B*.

Two cuts are taken in machining the teeth in a pinion, a slitting saw and a forming cutter being carried on one cutter-spindle *C*, with provision for proper location of each, this being determined by the feed movement of the slide on which the cutter-spindle arm *D* is carried. These milling cutters are fed down by air pressure exerted through the cylinder *E* and the finger *F*, and the cutters are raised by a spring to permit indexing of the work preparatory to taking the next cut. The index mechanism is a ratchet device which operates when the air countershaft is reversed, during which time the driving belt slips on the pulley. The cam shown at the front of the machine actuates lever *G* to advance and recede the work during the machining of each pinion. There is another cam in back of the spindle-feed cam which controls the operation of the cutter-head slide by the regulation of the air valves by means of which this movement is actuated.

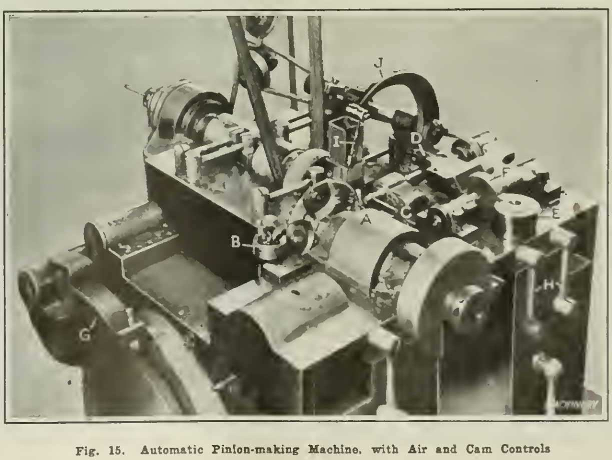


Fig. 15. Automatic Pinion-making Machine, with Air and Cam Controls

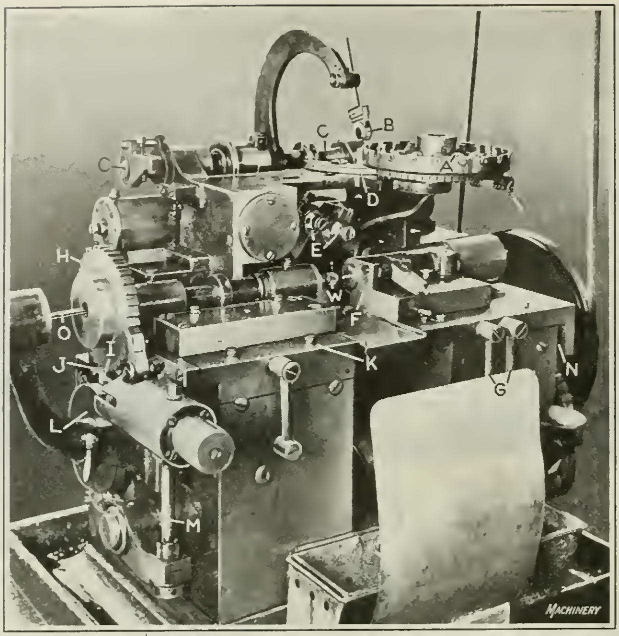


Fig. 16. Automatic Machine in which the Teeth are cut in Steel Wheels or Pinions

The air connections which deliver the air directly to the slide are shown at *H;* similar air delivery tubes are also shown at the opposite end of the machine.

A wire clip *I* picks up each piece as it is being cut off, and this clip is swung into position by an air valve which controls the movement of the shaft to which the over-arm *J* is attached. As soon as the pinion has been severed and picked up and the arm has been raised to the elevation shown, the shaft is given a quick longitudinal movement which results in snapping the pinion from the clip, and letting it drop into a receptacle. The work which this machine produces must be accurate to a very high degree, because the ends of the pinion staff pivot in the jewels or bushings of the watch, and the limits of manufacture allow no variation in size, although it is, of course, necessary to select the jewel bearings so that the holes will receive each pivot properly.

Steel Wheel Cutting Machine

A machine which cuts the teeth in steel wheels, or gears, for watches is illustrated in Fig. 16. Ten or twelve of these wheels are loaded on an arbor, and the arbors are located in suitable pockets in a disk feeder-plate, as shown at *A*. The arbors are picked up by a clip *B* attached to an over-arm that is fastened to shaft *C*. This shaft may be oscillated to swing the work held in the clip down in line with the centers between which it is held during the cutting of the teeth. An air-operated plunger produces this downward movement and the arm is returned to its normal position by spring action. The shaft is also moved to the right pneumatically, when picking the arbors out of the feeder-plate, and this movement causes pawl *D* to index the plate and bring the next arbor into position to be picked up by the clip. The movements of this shaft are governed by the cam action which releases the various air valves.

There are two cutter-heads *E*, one for roughing and one for finishing, each of which is lowered into the operative position by a connecting arm. These connecting arms are operated by air cylinders, one at each side of the machine. The tailstock *F* has a female center to engage the work-arbor, and is given a sliding motion, to permit the arbors to be loaded, by the direct application of compressed air. The two tubes by means of which the air is delivered from the cylinder to the tailstock are shown at *G*.

The work *W* is indexed by ratchet *H* and a retainer and take-up pawl. The take-up pawl *I* is especially designed with a heel that forms a wedge between the engaging toe of the pawl and pin *J*. The reciprocating motion of this pawl is air-actuated, and constitutes a locking device which locates the work positively as it is indexed. The air cylinder for operating the indexing mechanism is shown at the left-hand end of the machine.

After each index movement has been completed, and during the time that the saws are in the operative position, the slide *K* is fed forward by cam *L* and a fulcrum lever which raises and lowers stud *M*. The end of this stud bears against a lever which operates the air valve by means of which the feed motion is actuated. A single air tube which delivers air directly to the slide is clearly shown in the illustration. At the opposite end of the slide, in the space shown at *N* are placed two springs which return the carriage after the feeding movement has been completed. An air cylinder and plunger *O*, supported by an outboard bracket at the left end of the machine, constitutes the knock-out mechanism for displacing the arbors from the spindle at the completion of the operation.

Plate Numbering Machine

Train bridges and pillar plates carry identification numbers, and these numbers are stamped by an automatic machine, such as illustrated in Fig. 17. By the use of this automatic machine, it is possible to number forty-three pieces per minute, with six figures each. Slide *A* carries the holder *B* in which the plates are located, and this slide is fed back and forth under the numbering tools by cam *C* on the end of the camshaft and a lever *D*, the fulcrum point of which may be changed by relocating the knurled pin *E* in one of three holes, in order to vary the rate of feed as

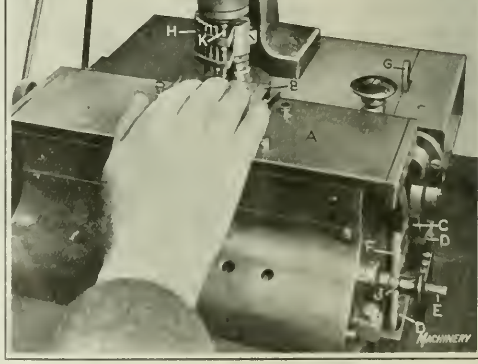


Fig. 17. Numbering Machine for Pillar Plates and Train Bridges

required for different spacings of the numbers. The fulcrum lever operates the vertical stud *F*, the upper end of which bears against a lug on the under side of the slide to produce the forward movement, and springs at the opposite end of the slide provide for its return. The camshaft of the machine extends through the frame at the rear, and is driven from the driving shaft at the front by gears, the gear on the camshaft being operated by a friction clutch to engage or disengage the two shafts. Lever *G* operates this friction clutch, permitting the feed of the slide to stop, as well as the movement of the turret. Under ordinary operating conditions, however, the machine runs continuously with the friction clutch engaged.

The turret *H* is reciprocated by cams or numbering dials carried on shaft *J*. A series of pawls and ratchets, operating in conjunction with springs, positions the number dials so that various stops carried on collars located between the ratchets control the timing and positioning of the angular movement of the turret. There are ten numbering tools or holders, the downward movement of which is actuated by the hammer *K* and the return by individual springs. The hammer is operated in both directions by air, the air cylinder being shown at *I*. The rapid trip-hammer action which is produced by this mechanical arrangement results in accurately spacing the numbers, which progress consecutively by the cam arrangement that brings different numbering tools under the hammer.

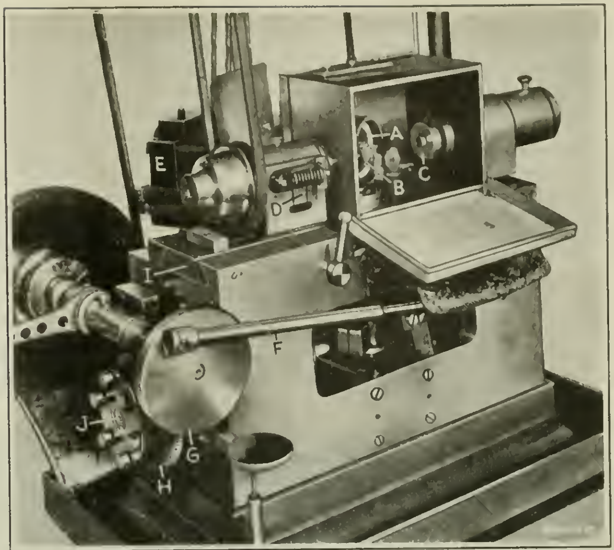


Fig. 19. Air-operated Radial Grinding Machine on which the Screw-heads are ground Convex

Wheel Reboring and Recessing Machine

Small brass wheels, used in the gear trains of watches, have their central hole produced on the machine illustrated in Fig. 18. The operation performed on this machine is that of enlarging the previously drilled hole and of cutting a recess around the hole, forming a shoulder with the rest of the hub. The wheels are loaded into a vertical magazine *A*, and are fed upward by the application of air and gripped by a pair of jaws on arm *B*. The jaws are operated by a toggle-jointed lever *C* when a pin *D* is brought against the vertical post *E*. The position of this post may be adjusted by releasing a pin-lever, which clamps the plate on which the shaft is carried.

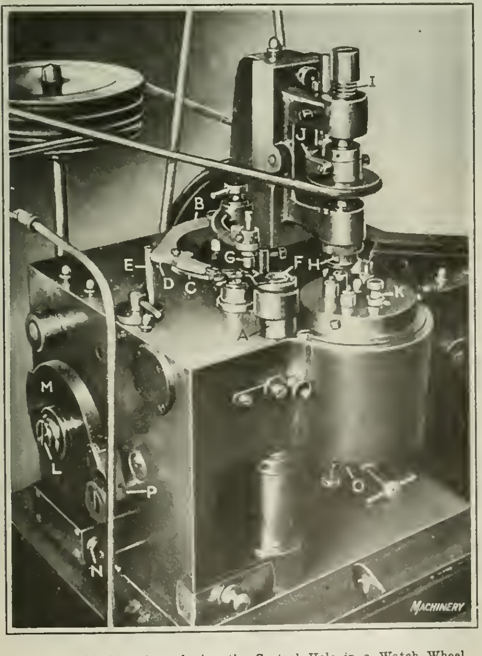


Fig. 18. Machine for reboring the Central Hole in a Watch Wheel and cutting a Recess around the Hole

The air in the vertical magazine forces up the wheels (one of which is shown at *F*) until they contact with stop-pin *G*, at which time they are gripped and deposited in the chuck of the machine. The arm which carries the stop-pin is lowered by cam action and raised by means of a spring, the mechanism being enclosed within the machine frame. The turret of the machine is indexed from station to station, but the tools do not revolve during the cut. To permit the wheels to be deposited in the chuck, it is necessary to stop the spindle so that an opening *H* will always be in the same position, so as to permit the work to be passed through it. The spindle is stopped at a definite place by a cam which controls the vertical feed movement of the spindle head, so that the spindle will be raised by the coil spring *I* to a higher point than it would be ordinarily between each index movement. The additional upward travel brings a dog, on the top of the pulley, into engagement with a finger at the rear of the spindle yoke *J*. This not only stops the spindle in the correct position, but also locks it during the loading operation, the belt slipping while the spindle is thus locked.

The nose of the spindle chuck has a back taper so that as the wheels are released from the jaws, after arm *B* swings the work through opening *H*, they drop down and are supported from the outside diameter, seated against the tapered surface of the hole, in which position they are held down by a spring plunger. Post *K*, mounted at the first station of the turret, acts in conjunction with the spindle plunger to seat the wheels evenly in this back-tapered spindle hole. At the completion of the various operations post *K* is raised by means of the cam, thus dislodging the wheel from its position and permitting it to be swept to the right into a chute.

In addition to the upward feed of the spindles, which is produced by lever *O*, controlled by cams, there is a slight lateral feed movement imparted to the spindle that carries the facing tool by means of which the recess is cut. This movement is taken care of by a specially designed cam, which is timed by the turret index device. This mechanism is operated by a sector gear actuated by air, the turret being locked by the familiar ratchet and pawl arrangement. The machine is equipped with the usual worm and worm-wheel drive to the camshaft *L*, which carries the various cams to trip the air valves, as well as the feed-cam for governing the vertical travel of the spindle. The feed-cam *M*, working in conjunction with air plunger *N*, operates lever *P* on which the feed-lever *O* is carried. The production rate of this machine is from 210 to 250 wheels per hour.

Finishing Watch Screw-heads

The steel screws used in a Waltham watch have convex heads, which are finished by a rather ingenious method to produce the mirror finish required. Referring to Fig. 20, it will be seen that these screws are assembled into steel balls. These balls, which are hardened and ground, contain holes in which the screws are carried during the finishing of the heads, and the method of loading these balls is of considerable interest.

A quantity of screws is placed in a hopper *A*, when the spindle frame is in a vertical position, and then the spindle frame and hopper are swung to a horizontal position, as shown in the illustration. The steel balls have a central tapered hole and are placed on the end of an arbor in sliding spindle *B* and advanced into the hopper and brought into contact with the screws. An agitator is provided for the hopper, and the spindle is hollow, so that by applying a suction air line to the spindle and providing suitable holes in the nose of the tapered arbor on which the ball is assembled, the screws will be sucked into the holes as the ball is revolved. A thirteen-pound pressure produced by suction is employed, and by simply sliding the ball into the revolving hopper and withdrawing it, every hole in the ball will carry a screw, although occasionally the operator is required to reset a screw which is not properly entered in a hole. After the ball has been withdrawn to the position shown in the illustration, it is treated to a solution of silicate of soda and placed on the spindles as shown to the right, directly over a hot-air line connected to an electric stove *C*. The spindles on which the balls are thus suspended are driven by a belt and pulleys. As the balls revolve, the silicate of soda is dried on, and the screws are thus prevented from being dislodged when the heads are subsequently machined.

The heads of the screws are machined by stoning on a pneumatically operated radial type grinder, using a cup-wheel *A*, Fig. 19. A loaded ball *B* is shown located on the work-spindle. The loaded balls are pressed on the work-head spindle by the air-operated head *C*, which positions the ball accurately relative to the center of rotation of the wheel-head *E*. The spindle bearing has provision for locking the spindle after the position has been established, and for releasing it when a ball carrying unground screws is to be located. The locking of the spindle is accomplished by the application of air to the slotted section *D*, and the release by a coil spring attached to the front of the bearing.

The wheel-head *E* is oscillated through its angular travel by the connecting-rod *F*, which has a telescopic connection with the head and which is given a crank motion by connection to the disk *G*. The disk is driven through a clutch on the worm-shaft so that it may be disengaged from the constantly running worm-shaft. Worm-wheel *H* is attached to the outer end of the camshaft *J* and is driven by the previously mentioned worm. On this shaft at the opposite end of the machine there is a cam which operates a lever arrangement for feeding the work-slide *I* forward as the grinding wheel is oscillated over the heads of the screws. The release for the friction clutch which connects disk *G* with the worm-shaft is controlled by a cam on the outside of the worm-wheel.

After the heads have been stoned, they are finally polished by mounting the balls received from the stoning operation on the spindle of a similarly designed machine, which has two opposed spindles that are operated by hand-levers. The polishing is done with boxwood laps, cylindrical in shape and cupped out on the end to conform to the curvature of the steel balls. These wooden laps are charged with "Acme" polish, made by the George Zucker Co., Newark, N. J. This abrasive is of finer grain than either flour emery or crocus. The production time for both the stoning and polishing operations on average size work is 250 balls per day. These balls have a holding capacity of from 30 to 150 screws each.

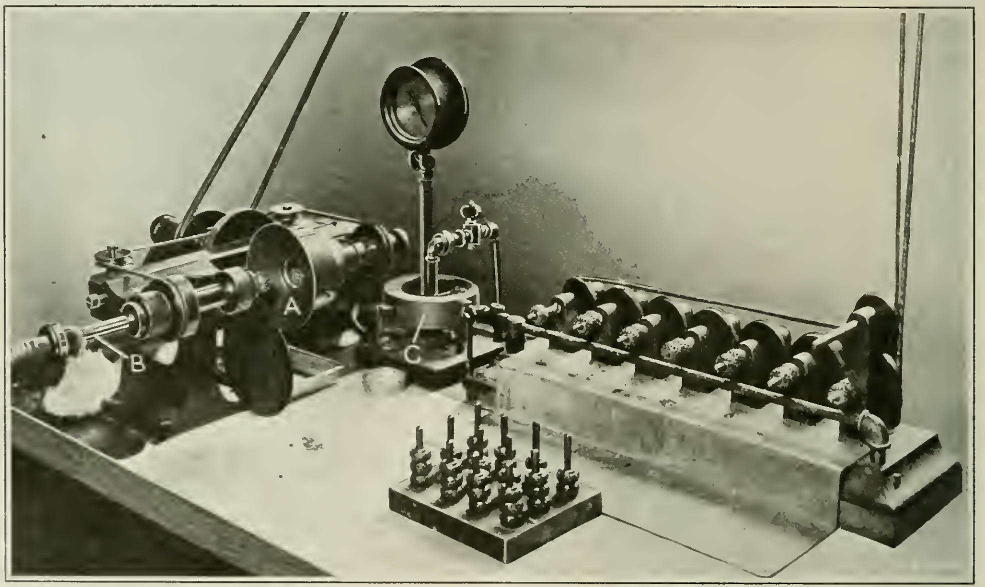


Fig. 20. Equipment used for loading Steel Balls with Watch Screws preparatory to grinding and polishing the Heads

ADAPTING MACHINE TOOLS TO MOTOR AND SILENT CHAIN DRIVE

By EDWARD H. TINGLEY

While there may be a difference of opinion as to whether it is preferable to drive machine tools by a belt from a countershaft, or by a direct motor drive, or a motor drive through a silent chain, the conditions are frequently such that a silent chain drive is the only type of drive that can be used satisfactorily. The advantages of a silent chain drive need not be enumerated here, but in working out new designs, machine tool builders should take into account the fact that many of their customers will use chain drives with their machines. The application of motors and chain drives to a variety of machine tools in a certain shop brought up the following problems.

Method of marking Ends of Machine Tool Drive Shafts

Changing Machine Tools from Belt to Motor Drive

The first problem encountered in changing a machine from belt to motor drive is that of determining the proper speed of the drive shaft. The latest catalogues of the machine builders usually give the speeds for new machines, but when a machine which has been driven by belt for several years, for instance, is moved to another part of the shop where conditions make it impossible to use a countershaft, and a motor and chain drive have to be installed, it becomes something of a problem to determine the proper shaft speed. Old catalogues are not always available and new catalogues in most cases do not give specifications for old type machines. The speed at which the drive shaft has been driven is not an indication of the speed that should be employed with a chain drive.

A chain drive once installed is not easily changed, while in the case of a belt drive it is a simple matter to change the pulleys in order to obtain a change in speed. Nowhere on any of the machines which were converted from belt to motor drive, in the shop referred to, was there any information relative to the speed at which the designer intended the drive shaft to run. Therefore, it was necessary first to determine the spindle speeds, then calculate the drive shaft speed, taking into consideration all gearing or intermediate belt drives, and install the chain drive accordingly. Why is it not possible to have the manufacturers of machine tools mark the correct speed in the end of the drive shaft? The speed should not be painted on the belt guard nor printed on a tag tied to the countershaft, as more than likely neither will be in evidence a year or more after the machine is purchased. It is also necessary to know the direction of rotation of the drive shaft when setting up a machine. The accompanying illustration shows how the end of a drive shaft could be marked to give the necessary information regarding speed and direction of rotation.

Correct Motor Speed

Some manufacturers have already adopted the plan of marking the ends of the drive shafts of their machines. The marking of a shaft in this way is most important in machines that depend on the splash system of lubrication for the gearing. The daily loss in production resulting from too slow a speed may be hardly noticeable, and yet the yearly loss may reach a considerable amount. Many machines of the latest design have a constant-speed drive shaft with change-gears to obtain a variety of speeds. This type of machine can be easily equipped for operation by a constant-speed induction motor. However, designers should so determine the drive shaft speed of a machine that it will have the proper ratio to the 1150 or 1750 revolutions per minute of standard motors. About the smallest motor pinion used with silent chain drives contains nineteen teeth of possibly $\frac{1}{2}$- or $\frac{5}{8}$-inch circular pitch.

Using the two customary motor speeds—1150 and 1750 revolutions per minute—the drive shaft speed must be such as to allow a sufficient number of teeth in the silent chain gear to provide for the necessary mechanical construction of the hub, flange, etc. A speed of 400 to 450 revolutions per minute of the driving shaft will give a satisfactory ratio with motors having a speed of 1150 revolutions per minute. Most manufacturers of chain drives advise against using a high peripheral speed of the chain, as this has a tendency to lift the chain off the teeth. Experience seems to indicate that (considering repairs to motors, interchangeability, and general adaptability of motors to machine tools) 1150 revolutions per minute is the best speed for all shop motors, either belt or chain drive, and 1750 revolutions per minute is satisfactory for direct gear-driven automatic machines.

Location of Motors

Another problem encountered in installing motor chain drives is that of finding a suitable place on the body of the machine on which a bracket for the motor can be mounted. If the drive shaft is located near the floor, the motor can be bolted to the floor, provided the center distance between the motor shaft and drive shaft is not more than 30 inches. If the drive shaft must be located a considerable distance above the floor, provision should be made in the design of the machine to permit the mounting of a suitable sized motor bracket. A flat surface or machined pads cast integral with the frame of the machine will make the work of mounting a motor much easier.

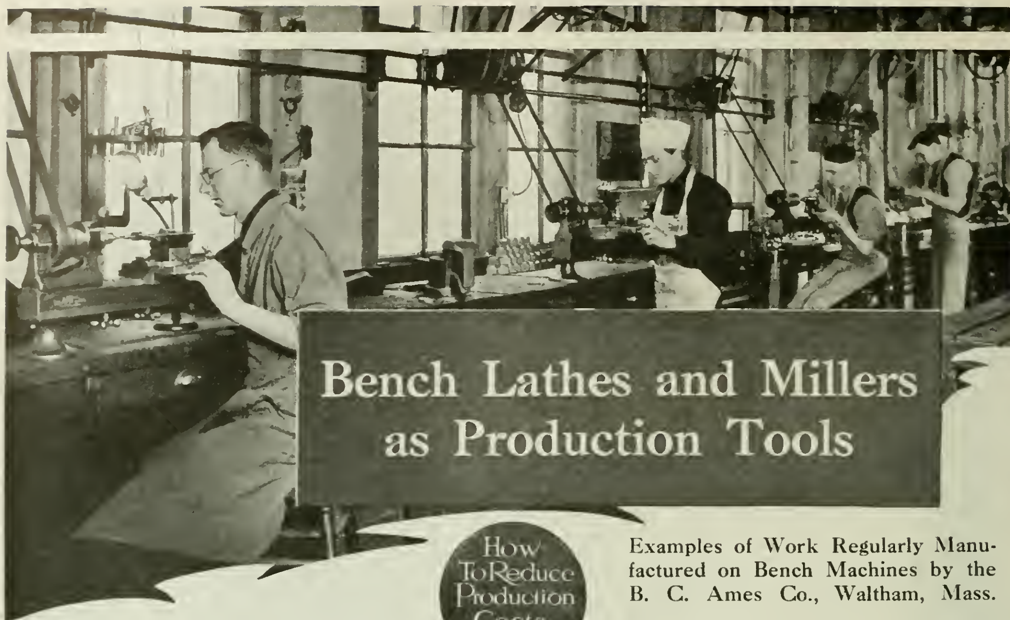
Selection of Motor

Within the last year, one of the largest motor manufacturers has put a motor on the market, which, when run at full load will attain a temperature rise of 50 degrees C., but no overload capacity is guaranteed. Compared with the old rating of a full load at a rise in temperature of 40 degrees C., it would seem that the new motors are over-rated about 15 per cent. When the machine tool catalogue calls for a 5-horsepower motor, will a motor having a rise in temperature of 40 degrees C., with a 25 per cent overload capacity be required, or will the motor with no overload capacity, but a permitted rise in temperature of 50 degrees C., prove satisfactory? When the catalogue reads "3 to 5 horsepower" the motor selected should be either a 5 horsepower, no overload, or a 3-horsepower motor having a rise in temperature of 40 degrees C.

In the majority of cases, too large a motor is used on machine tools, thus giving poor load conditions on the motor and resulting in low efficiency and unnecessary expense for unused power. Even in the steadiest of production work, there are always intervals in the cycle of operations when the motor is pulling only the friction load of the machine. This makes the average load on the motor considerably lower than would be expected, and should be borne in mind by those who write the specifications for machine tool catalogues. The requirements should be made to agree with the standard sizes, that is, the catalogues of machine tools should specify standard size motors or motors of sizes most easily obtained such as 1, $1\frac{1}{2}$, 2, 3, 5, $7\frac{1}{2}$, 10 and 15 horsepower, etc.

* * *

In a recent Commerce Report, it is mentioned that an American manufacturer who has been investigating the market for bolts and nuts in Norway states that German firms now almost completely control the Norwegian market in this field. It is stated that German firms are now quoting lower prices and filling orders in less time than domestic Norwegian factories.



Bench Lathes and Millers as Production Tools

How To Reduce Production Costs ?

Examples of Work Regularly Manufactured on Bench Machines by the B. C. Ames Co., Waltham, Mass.

BENCH machines are rarely considered as production equipment. In most cases they are regarded as precision tools, but are not regularly made use of where quantities of parts are to be made even though a high quality of the product is desired. There appears to be no reason, however, why certain classes of work should not be manufactured on a production basis with machine tools of the bench type. Although these machines are regarded as precision equipment, and are suitable for high-grade production work, when large quantities of high-grade work are to be made the hand screw machine or the floor type milling machine is generally selected for the work; but the bench machine is often just as suitable for general manufacturing purposes. There are also the factors of lower first cost, conservation of floor space, and general applicability of bench machines, which should receive consideration.

In order that machines of the types mentioned may be better appreciated as production tools, a number of operations regularly performed on bench lathes and milling machines by the B. C. Ames Co. in their factory at Waltham, Mass., have been here selected. These jobs are performed with Ames equipment, most of which is standard, and all of which can be readily applied to the machines. The Ames lathes and bench millers are made with standard size ways, so that the headstocks, tailstocks, index-heads, and other fitted members may be used interchangeably on these two machines. The spindle heights are also the same, and the collets used are identical.

Grinding Bearings in Collet Chucks

The spring collets used in the Ames machines are ground internally to form a bearing surface for the work to be chucked. This is one of the regular production jobs handled

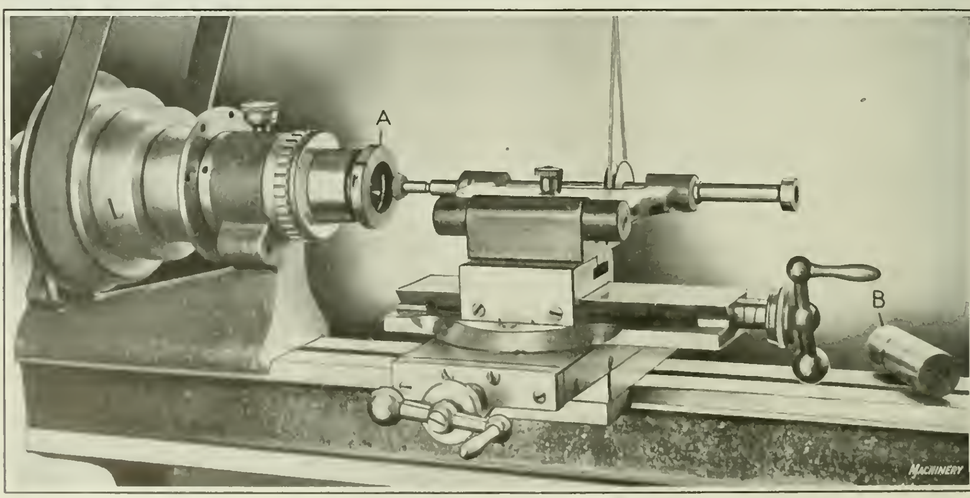


Fig. 1. Bench Lathe Set-up for grinding Internal Bearing Surfaces in Spring Collets

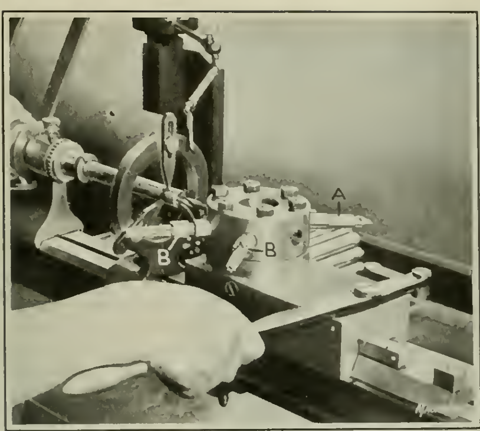


Fig. 2. Machining the Taper Hole in Tail-spindles on a Bench Lathe

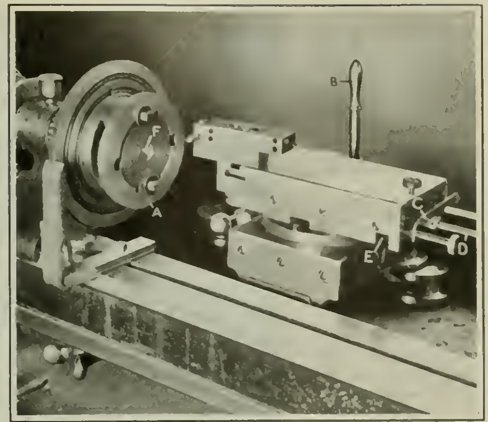


Fig. 3. Equipment used for graduating on a Bench Lathe

on a bench lathe, and the set-up used in the operation on a 1-inch collet is illustrated in Fig. 1. The traversing grinder spindle runs without oil in steel bushed bearings mounted on the compound slide rest of the lathe and driven by a round belt as shown. The grinding wheel used in this operation is a Norton alundum 36-60 K wheel and operates at a speed of 10,000 revolutions per minute. To prevent the collets from springing while being chucked, a grinding liner *A* is used. This is simply a collar which fits over the end of the collet and which has three spacing pieces to fill the slots in the collet and prevent contraction. The operator feeds the spindle to the proper radial depth with the cross-feed screw and then pushes the spindle in and out until the bearing surface is ground to the proper diameter and to a length of about one inch.

The machine spindle is driven at 1800 revolutions per minute, and this, in combination with the grinding wheel speed, brings the surface cutting speed up to approximately the recommended grinding speed of 5000 surface feet per minute. A "Go" and "Not Go" plug gage, shown at *B*, is used for inspecting the hole. Production for the 1-inch size of chuck is sixty pieces per day. Beyond the ground bearing surface machined in this operation, another grinding operation is performed subsequently which provides a clearance of from 0.006 to 0.008 inch extending through the chuck. Chucks of small size (less than ¼ inch) are ground on their internal bearing surfaces by using diamond laps. The smallest of these diamond laps is 0.005 inch in diameter, and the operation is performed by simply replacing the grinding wheel with a lap, which has a standard taper shank to fit the grinder spindle.

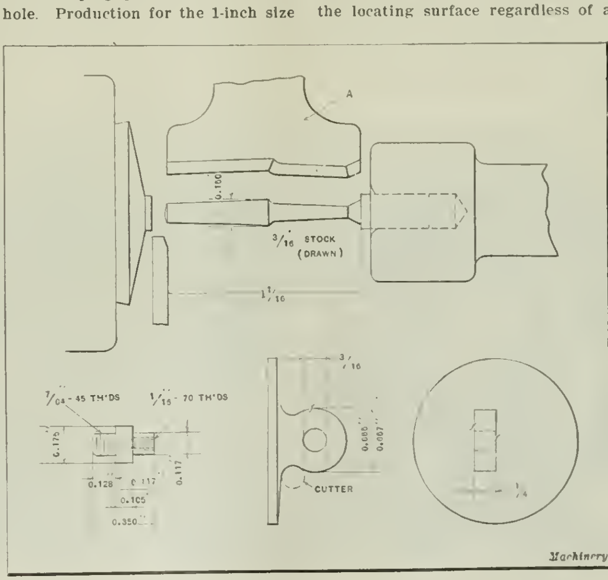


Fig. 4. (Above) Diagrammatic Tooling Lay-out for making Taper Points for Dial Gages: (Below) Two Examples of Work machined with Bench Equipment

Machining Morse Taper Hole in Lathe Tail-spindle

The operation shown in Fig. 2 is that of drilling and reaming a taper hole 2 3/16 inches deep in the end of a tail-spindle for a No. 3 Ames lathe. This work is perhaps a little heavier than is usually conceived of as suitable for a bench lathe, but this is a regular production job which is handled in good time with the set-up shown. The work is held in a steel step-chuck, the step being 3/16 inch deep. The opposite end of the work is supported by a three-jaw brass steadyrest having a foot to fit the lathe bed.

The first operation is spot-drilling with the centering tool *A*, after which the hole is drilled to the required depth, as determined by the regular turret-slide stop. Rough- and finish-reaming operations are next performed in order, with two taper reamers furnished with special stop-collars *B*. By this provision the depth of the tapered hole will always be correct, regardless of variations in the length of the work or in the method of chucking. By bringing the stop-collars up hard against the end of the work, this surface becomes the locating surface regardless of any other consideration. The hole has a standard No. 1 Morse taper, and the time required on this job is five minutes per piece, which includes chucking time. In chucking the work, it is necessary for the operator to use both hands, and to aid him in getting a firm grip on the work, the step pulley is locked by a pin to prevent rotation. These tail-spindles are made of cold-rolled steel, and are casehardened.

Graduating Base of Vise

Another bench lathe job regularly performed is that of graduating the base of milling machine vises, and for this work certain special equipment is needed, as shown in Fig. 3. A rack-and-pinion slide-rest, which is standard Ames equipment, is attached to a right-angle shoe which extends from the rear of the machine and which is located properly by the regular T-slot on the back of the lathe bed. An ordinary pointed drill-rod tool is used for graduating, this being attached in the simplest possible manner to a block carried on the slide-rest in the position shown in the illustration. The work to be graduated is shown at *A*, and is located by a pilot *F* over which the work is slipped. Holes in the work are made use of in attaching the castings to the driving plate on which they are located. The index-plate has 360 ratchet teeth and is held in position by a suitable spring finger. The side of the index-wheel also is graduated, so that the operator can tell at once when he must change the length of the graduation lines which he is cutting on the work; that is, every 5 or 10 degrees a longer line is scribed, and when these marks are reached, adjustment of the tool traverse is made accordingly.

Fig. 5. Drilling the Hole in a Small Stud preparatory to tapping

In cutting the short graduations, the operator simply moves the top slide longitudinally back and forth by means of handle *B*. The other hand is kept constantly on the spring finger with the thumb on the index-plate, so that with each withdrawal of the tool, the spring finger is sprung outward and the thumb used to advance the plate another notch. After a little practice this operation becomes automatic and by observing the graduations on the side of the index-plate, the operator can readily see when the longer lines are to be cut. At this point, he simply throws the latch *C* out of contact with the nut on screw *D*, which permits the top slide to advance on the next forward movement an additional distance equal to the difference in length between the long and short lines.

The tool-block is provided with an adjusting screw for bringing the cutting point of the tool into the same horizontal plane as the center of the work. In cases where the work does not overhang from the driving plate as it does in the present instance, the tool is increased in travel from the beginning of the cut rather than at the end, and when this practice is followed, a spacing block is used for a stop, which is removed from between the end of the stop-screw and surface *E* when cutting the longer graduations. These vise bases are made of cast-iron, and are graduated through 360 degrees in thirty minutes. The lines produced by this method of graduating are even and accurately spaced, and the work can be done much more quickly than by employing an index-head on the milling machine, and in a more satisfactory manner than by rolling the graduations with a knurling tool.

Machining Lever Studs for Dial Gages

Lever studs used on Ames dial gages are first turned and threaded and then faced on one end, center-drilled, and tapped with the equipment shown in Fig. 5. A detail of the lever stud which is made of cold-rolled steel, is shown in the lower left-hand corner of Fig. 4, from which the size of the work and the nature of the operations performed may be readily seen. The collet chuck in which the studs are held, to assure correct facing length, is furnished with an independent stop. The first operation is that of facing to length, locating the work by this stop and using the tool shown in the front tool-holder on the cross-slide. The end of the work is then centered with tool *A*, the spindle in which this tool is carried being laid in the half-open tailstock and fed into the work by the hand-lever *B*.

The next operation is drilling the hole with a No. 50 drill. This is the operation shown in process, and the illustration indicates how the hand-lever is operated to advance the tool-holder until stop-collar *C* is brought into contact with the rear face of the back bearing of the tailstock. The last

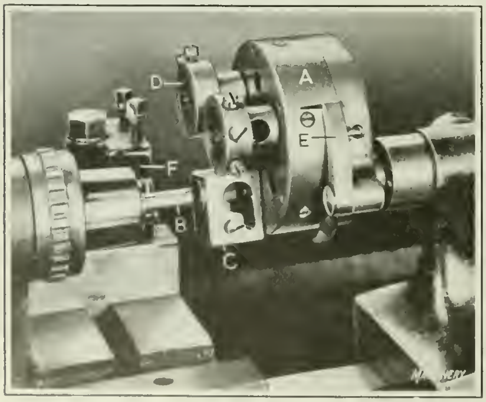


Fig. 6. Bench Lathe with Turret Head, used in making Fillister-head Machine Screws

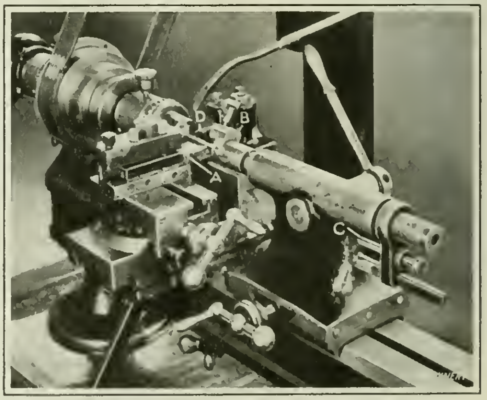


Fig. 7. View of the Bench Lathe Set-up used in making Taper Points for Dial Gages

operation consists of tapping the hole, the tap being shown at *D*. It will be seen from Fig. 4 that this is a 1/16–70 thread tap, and the hole is 0.117 inch deep. Each tool is provided with a stop-collar similar to the drill spindle, so that the depth of hole is accurately maintained from the end of the work after it has been faced, rather than from the collet stop against which it is located for facing to the proper over-all length. In the tapping operation, the operator holds the tap spindle in the half-open tailstock bearing, with one hand, and works the belt back and forth similar to the action of hand-tapping. These lever studs are machined as described at the rate of thirty per hour.

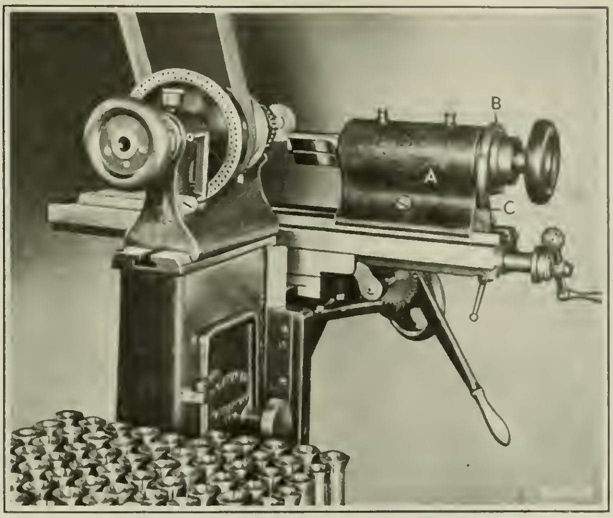


Fig. 8. Bench Milling Machine, and the Set-up used in slotting Spring Collets

Making Fillister-head Screws on a Bench Lathe

The production job, the set-up for which is shown in Fig. 6, is that of making fillister-head machine screws from cold-rolled steel. These screws are ¾ inch long and have a 3/16–32 thread. The tail-spindle which carries the turret-head *A* is located against a stop which bears on the rear end of the tailstock, thus definitely locating the tools relative to the work. The stock, which is shown projecting from the chuck at *B*, is then advanced through the lathe spindle, against a stop located on the face of the turret-head between the box-tool *C* and die-head *D*, in which position it is secured by the lever-chuck closer regularly provided on Ames bench lathes. In turning the stock to the correct diameter, the box-tool is provided with a separate stop on its inside wall in alignment with the stock, which governs the turned length. This stop is adjustable to accommodate various lengths of the same diameter stock. Rough- and finish-threading dies are next brought successively into operation by indexing the turret; this is accomplished by depressing latch *E* which, when the turret-head is in the operative position, is held by spring tension in the registry notches. The threading dies may be adjusted for wear by the screws shown on the outside of the holders. Finally, the work is cut off and the screw-heads chamfered by a tool carried in the rear tool-holder *F*. The production time for this job is three hundred screws per nine-hour day.

Making Taper Points for Dial Gages

Taper points for Ames dial gages are made with the bench lathe equipment illustrated in Fig. 7. A diagrammatic tooling lay-out of this job is also shown in the upper part of Fig. 4, which gives an idea of the size of the part and the relation of the tools used in producing it. The pins are 1 1/16 inches long and they are made from 3/16-inch drawn stock. It will be observed that in Fig. 7 the position of the forming tool and cutting-off tool is reversed from that shown in the diagram, but the method of setting the job up is flexible enough to permit either arrangement. The special forming tool *A* produces a 1-degree taper 9/16 inch long for the body, and a 1½-degree taper ½ inch long for the shank. The stock is fed against a stop *B* attached to the tail-spindle and this stop carries a spring pin having a knurled head. This pin bears against the stock after it has been brought into contact with the stop and acts as a steadyrest for the end of the work, which rests in a V-block directly beneath the stop, and is held in this position by the pressure exerted by the spring pin.

The adjustable stop for the tailstock, shown at *C*, is of similar construction to the one referred to in connection with Fig. 6, and is of vital importance in setting up the job. The tailstock is operated by a rack-and-pinion feed to bring it against this stop, and establish the location of the stop. The tail-spindle is relocated for each piece, which permits the stock to be fed through the spindle further than required for actually making the piece, so that with the end of the stock against stop *B*, the tailstock may be advanced, pushing the stock back, thus facilitating chucking to the correct length. The wide-faced, special forming tool *A* is secured in a rugged tool-holder, and the cut-off tool *D* is carried in a block at the rear of the cross-slide. Although there is nothing unusual about the set-up for this operation, the fact that these pins are produced in quantity, free from chatter marks and to size, with bench equipment at the rate of thirty-six per hour, is noteworthy.

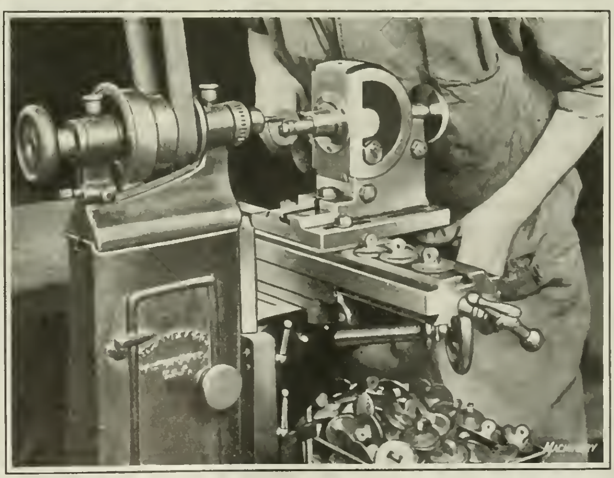


Fig. 9. Milling the Circular Lug on Ames Gage Back on a Bench Miller

Typical Bench Miller Work

A set-up which shows the value of the bench miller as a production tool is illustrated in Fig. 8, the job performed with this equipment consisting of slotting collet chucks. The milling machine is provided with an index-head *A* which has an index-plate *B* and a spring index-finger *C* for positioning the spindle of the head for every 120-degree revolution of the work. The draw-in tube screws into the collet to be slotted, similar to the construction of an ordinary draw-in chuck. The collet has a taper bearing in the spindle and is also located by a stop so that it cannot be drawn in so far as to cause the work to spring together and bind on the saw during the slotting operation. Thus, although the work is chucked on the end that is slotted, the tension is so regulated that the collets are held firmly but without binding on the slitting saw. Hand feed is used for traversing the table during the operation, the length of the table traverse being determined by a stop. It will be noticed that the nose of the spindle is slabbed on three sides to give clearance for the arbor, and to allow the saw to reach through the collet. A 1¾-inch saw, 0.027 inch thick, is used for this operation, and the production time is from fifteen to twenty-one collets per hour.

The hand milling operation shown in Fig. 9 is milling the circular lug on gage backs for Ames indicators. The detail of this part is shown in the lower right-hand corner of Fig. 4, the surface to be milled being indicated by the limit dimensions for the lug, the tolerance on the diameter being 0.002 inch. The operation is performed with an end-mill, which when new is 5/16 inch in diameter, and which is used until it has worn down 1/16 inch. These cutters are made of plain drill rod, and are manufactured in quantities, because the nature of the work causes frequent replacements. The work is clamped to the end of a spindle carried in the index-head, and is then swung around until the cutter fits in the curved surface which joins the lug and the flange of the work, as indicated by the dotted lines in Fig. 4. The index-head is attached to a right-angle shoe secured to the milling machine table, and after the table has been adjusted to position the work for starting the cut, the index-handle of the head is turned by hand, thus swinging the work around under the cutter until the cutter has reached the joining curved surface on the opposite side of the work. The end-mills are necessarily made long in order to reach by the flange of the work, and being slender, care must be exercised to prevent excessive breakage of the tools.

In making the work-arbor, an interesting construction is used. This consists of extending a long center stud through a hole in the arbor, this stud being driven by a pin extending through the arbor. The end of the stud is threaded and extends beyond the arbor, and on it the work is located by the central hole, and then secured in position with a nut. If the arbors were made solid with a projecting threaded slender end, the percentage of breakage of this threaded portion would be high and the expense of making the arbors great. The illustration shows the position of the end-mill at the beginning of the cut and the convenience with which the operator works in the performance of this operation. The end-mill is rotated at 1600 revolutions per minute, and the production is fifty gage backs an hour.

* * *

STEELS RECOMMENDED BY THE GEAR MANUFACTURERS' ASSOCIATION

At the fifth annual meeting of the American Gear Manufacturers' Association in Cincinnati, Ohio, the list of forged and rolled steels given in the accompanying table was recommended for use in the manufacture of gears. These steels were selected with the aim of eliminating, as far as possible, steels which overlap one another in physical properties. The steels are to be identified by the specification numbers employed by the Society of Automotive Engineers, although the properties of some of the steels differ slightly from those of the S. A. E. steels having identical numbers.

Steel 1020 is a straight carbon steel suitable for casehardening. Steel 1030 differs from the regular S. A. E. steel of this number in that the maximum phosphorus content is 0.050 instead 0.045 per cent. This steel is intended for use mainly in an untreated state against an iron or steel casting. When it is desired to harden it somewhat, this may be accomplished by heating it and quenching in water. Steel 1045 is to be known as S. A. E. 1045 special. It differs from the regular S. A. E. steel of this number in the manganese content, the percentage of this element specified being 0.30 to 0.50, instead of 0.50 to 0.80 per cent. This modification gives a steel more suitable for water-quenched gears. Steel 2315 is a standard 3.5 per cent casehardening nickel steel, while steel 2345 is a standard 3.5 per cent oil-hardening nickel steel, and the companion steel to 2315.

Steel 3115 is a chrome-nickel steel suitable for casehardening, both the chromium and nickel contents being low. Steel 3215 is a chrome-nickel steel, also suitable for casehardening, in which the chromium and nickel contents are medium, while steel 3245 is another medium chrome-nickel steel suitable for oil-hardening. Steel 3315 is a casehardening chrome-nickel steel in which the chromium and nickel contents are high. Very high physical qualities can be secured in this steel when it is correctly treated. Steel 3340 is an oil-hardening chrome-nickel steel in which the chromium and nickel contents are high. It is the companion steel to 3315, and like it, high physical properties may be secured by heat-treatment. Steel 6120 is a chrome-vanadium steel suitable for casehardening, while steel 6145 is an oil-hardening chrome-vanadium steel, and the companion to 6120.

COMPOSITION OF STEELS RECOMMENDED FOR USE IN THE MANUFACTURE OF GEARS BY THE AMERICAN GEAR MANUFACTURERS' ASSOCIATION

S. A. E. Specification	Carbon, Per Cent	Silicon, Max., Per Cent	Manganese, Per Cent	Sulphur, Max., Per Cent	Phosphorus, Max., Per Cent	Nickel, Per Cent	Chromium, Per Cent	Vanadium, Per Cent	Manufacturing Process
1020	0.15–0.25	0.10–0.25	0.30–0.60	0.050	0.045	....	....	....	Open-hearth
1030*	0.25–0.35	0.10–0.25	0.50–0.80	0.050	0.050	....	....	....	Open-hearth
1045*	0.40–0.50	0.10–0.25	0.30–0.50	0.050	0.050	....	....	....	Open-hearth
2315	0.10–0.20	0.10–0.25	0.50–0.80	0.045	0.040	3.25–3.75	....	....	Open-hearth
2345*	0.40–0.50	0.10–0.25	0.50–0.80	0.045	0.040	3.25–3.75	....	....	Open-hearth
2350*	0.45–0.55	0.10–0.25	0.40–0.70	0.045	0.040	3.25–3.75	....	....	Open-hearth
3115	0.10–0.20	0.10–0.25	0.50–0.80	0.045	0.040	1.00–1.50	0.45–0.75	....	Open-hearth
3215	0.10–0.20	0.10–0.25	0.30–0.60	0.040	0.040	1.50–2.00	0.90–1.25	....	Open-hearth
3245	0.40–0.50	0.10–0.25	0.30–0.60	0.040	0.040	1.50–2.00	0.90–1.25	....	Open-hearth
3315	0.10–0.20	0.10–0.25	0.30–0.60	0.040	0.040	3.25–3.75	1.25–1.75	....	Electric
3340	0.35–0.45	0.10–0.25	0.30–0.60	0.040	0.040	3.25–3.75	1.25–1.75	....	Electric
6120	0.15–0.25	0.10–0.25	0.50–0.80	0.040	0.040	....	0.80–1.10	0.12–0.25	Open-hearth
6145	0.40–0.50	0.10–0.25	0.50–0.80	0.040	0.040	....	0.80–1.10	0.12–0.25	Open-hearth
6150	0.45–0.55	0.10–0.25	0.50–0.80	0.040	0.040	....	0.80–1.10	0.12–0.25	Open-hearth

Machinery

*Also to be known as A. G. M. A. specifications.

How To Reduce Production Costs?

Efficient System of Hiring Men

Methods Adopted by a Large Manufacturing Plant for Insuring the Selection of the Applicants Best Suited for the Work

By RUSSELL J. WALDO

ONE of the principal factors affecting the cost of production is the human equation, and if industrial engineers expect to lower costs, only capable men who are reasonably certain to remain with a concern should be hired. Such employes are to be had if the man responsible for hiring them has any method whereby he can recognize them among other applicants. Satisfactory results along this line have been obtained by the Studebaker Corporation through the use of the methods outlined in the following, and it is believed that by careful application of the same methods, equally good results may be secured by other organizations.

When this system was instituted, a vast amount of work was imposed upon the employment department, owing to the fact that a new plant was being opened, which required a large number of new employes to be hired, in addition to those taken on to meet the ordinary demand. Therefore, it was necessary to have an employment department personnel which would seem a burden to many. This organization is represented diagrammatically in Fig. 1, the employment manager being in general charge of all phases of the work. The assistant manager interviewed all applicants and hired desirable ones. There were four write-up clerks, whose duties consisted of making complete records of all men hired. All of these clerks were usually busy on Mondays and Tuesdays on this work, but during the remaining days of the week when a less number was required for this purpose, some of them were assigned to other duties in connection with the employment department, such as research, completing records, and making out reports. This scheme made it possible to handle all the work of the employment department with a smaller number of employes than would otherwise have been necessary, and gave the write-up clerks a variety of work. The physician was in charge of the physical examination of applicants. The general duties of all other members of the staff of the employment department should be obvious from their titles which are given in the illustration Fig. 1.

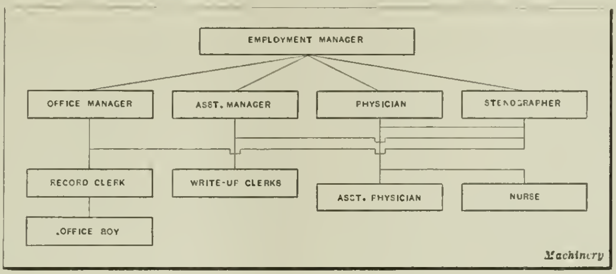


Fig. 1. Chart representing Organization of Employment Department

Plan of Operation

The floor plan of the employment department is illustrated in Fig. 2. An applicant enters door *A*, receives a numbered slip from a clerk seated at *B*, and then takes a seat in either of the waiting rooms *C*. A fence three feet high encloses both of these rooms on the entrance corridor sides. A seat large enough to accommodate four applicants is placed at *D* and this is kept constantly filled by those who are to be interviewed. The men in charge of the waiting rooms seat applicants upon this bench in the order in which they apply. The interviewer, or assistant employment manager, is located in room *E* where he carefully examines each applicant by a system to be described later, and then sends him through the rear door into corridor *F*.

Here a successful applicant waits his turn to have a complete record made by the write-up clerks in rooms *G*. The latter are large enough for a desk and two chairs, and still have sufficient space for moving about. When the record has been completed, the applicant passes into corridor *H* and

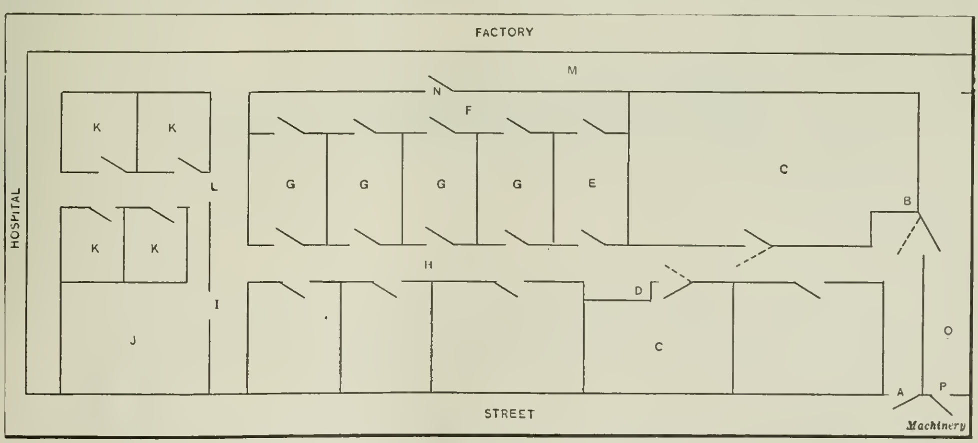


Fig. 2. Arrangement of Waiting Rooms, Offices, and Corridors in the Employment Department

through door *I* into the waiting room *J* of the physical examination department. These examinations are conducted in dressing rooms *K*. After being examined, the applicant passes through door *L* and into corridor *M*, from which he goes to the pay department to receive a clock number. While in the waiting room of the latter department, the new employe is instructed in the use of the time-clock, and his card is stamped.

Studebaker

REQUISITION FOR HELP

0 1165 | Requisition No.

INSTRUCTIONS:—Made in duplicate by Foremen requiring help; both copies forwarded to Labor Superintendent to approve, fill in requisition number and forward original to employment office as authority to hire; duplicate retained by Labor Superintendent.

Plant No ______
Department No. ______
Date ______

Kind of help wanted ______ Rate

When wanted ______ (Date) on shift 1 2 3 at ______ A M / P.M ______ Replacement / Additional

Equipment ______ Book rate ______ Piece work / Day work ______

Remarks ______

______ Dep't Head ______ Labor Supt.

Fig. 3. Requisition filled out by the Foreman of the Department requiring Additional Workmen

If an applicant is undesirable, he passes from corridor *F* through door *N*, up corridors *M* and *O* and out door *P* to the street. When an applicant is to report for work at a later day, he leaves the office in the same manner, and his record is made by a write-up clerk when he reports for duty. This scheme prevents a man from passing by the general waiting rooms of the employment department.

Forms Used by the Employment Department

When a person applies for a position by mail, a form is sent to him to be filled out, containing questions as to the age, height, and weight of the applicant, whether the applicant is married or single, whether he speaks the English language, what sort of position he desires, where he has been previously employed, and in what capacities. The application form, when returned, is filed according to the position asked for, until a place is available. The requisition used by a shop when additional help is needed, is shown in Fig. 3. This is made out in duplicate, the duplicate being retained by the labor superintendent, while the original is sent to the office manager of the employment department. If the latter is satisfied that an additional man or men are required by the requisitioning department, the form is forwarded to the office of the assistant employment manager where it is filed according to the requisitioning department until a man is assigned to the job. When this occurs, the requisition is sent to the write-up clerks with the man employed. Thus, it not only becomes a part of the record of the employe, but also, when the form is initialed by the interviewer in the upper right-hand corner, gives the write-up clerks the authority to make a record of the man being hired.

A daily record of all requisitions on file is kept on a sheet, so that it is possible to tell every position open by simply glancing at the record. As each man is hired a suitable indication is made on this record so that not more than one man will be employed for the same job. In this way the record serves to keep track of the number of men sent to each department a day. When new requisitions are received, suitable notations are made on the record before the requisition slips are filed.

The information on the daily record sheet is later transferred to a permanent record, which gives the total number of men sent to each department, according to the classes of work for which they were employed. This record includes only those who start to work immediately. A man instructed to return for work at a later date is not recorded until he actually begins working. Such a man is given a slip showing that he has been hired, the department number in which he is to work, and the rate of pay he is to receive. When he returns at the proper time, this slip takes the place of that which an applicant ordinarily receives upon entrance. Persons with employed slips have precedence in going through the routine of the employment department.

A record of each employe is made by the record clerk on the front and back of a large card on which all information obtained by the write-up clerks and from the examining physician is included. There is also plenty of space for recording changes of address and clock number, transfers about departments, wages received per day, etc. The employe is required to sign this card. A notice of factory employment, made in duplicate, accompanies this record. This notice is shown in Fig. 4. The original is used by the cooperative representative in presenting the new employe for physical examination, to the pay department, and to the foreman of the department for which the man was hired. The foreman notes the starting time thereon, and returns the card to the cooperative representative, who delivers it to the pay department where the name of the employe is entered on the payroll, after which it is forwarded to the time department. The duplicate is filed in the employment department as a permanent record.

A small yellow slip is used by the employment department when a man is to be transferred from one department to another. Fig. 5 shows the front of a card filled out by the foreman when a new man is sent to him. The reverse side, shown in Fig. 6, is filled out by the foreman when the man is transferred from the department, is laid off, or leaves of his own volition. When an employe is transferred to another foreman by the cooperative department, notice of the transfer is made on the form illustrated

W415

Studebaker

NOTICE OF FACTORY EMPLOYMENT

INSTRUCTIONS:—Made in duplicate by Employment Department for each person employed. Original used by Co operative representative in presenting new employee to physician for physical examination, to Paymaster for clock number and Three-Day Pass, and to Foreman for employment. Foreman notes starting time thereon, signs and hands to Co-operative representative who delivers to Paymaster's Department which enters name on roll and forwards to Time Dept., except in cases where applicant does not accept employment, in which event allotment of clock number is cancelled and original sent to employment Department. Duplicate retained by Employment in alphabetical file.

Plant No.
Dept. No.
Clock No.

Mr. ______ Foreman ______ 19 ___

As per your requisition for a ______

Mr. ______ Age ______

has been employed to report ______ 19 ___ Rate ______

Remarks ______

Signed ______ Employment Dept.

TRANSFERS					
DATE	FROM DEPT	TO DEPT	DATE	FROM DEPT	TO DEPT.

FINALED

Date ______ 19 ___

Reason:

Fig. 4. Notice of Employment, which follows the Route given in the Upper Left-hand Corner

O-1349 Studebaker Number
STARTING OF EMPLOYEE
INSTRUCTIONS:--Made out by Foreman and held as record until employee is disposed of.

NAME ____
ADDRESS ____
PHONE ____
WORKING AS A ____
PLANT ____ DEPT. ____

DATE EMPLOYED ____

Fig. 5. Card on which a Foreman records Information about a New Employe

O-1349 Studebaker Number
DISPOSITION OF EMPLOYEE
INSTRUCTIONS:--Made in Original by Dept. Foreman and forwarded to Superintendent of Labor who will complete record.

Plant No. ____ Dept. No ____ Date ____
I am returning Mr. ____
Address ____
Who worked as ____
With the recommendation that he be { Fired / Transferred
Ability { Excellent / Fair / Poor   Conduct { Good / Agitator / Unreliable   Production { Fast / Medium / Slow   Rehire { Yes / No
Cause ____
Dept. Foreman ____
Transferred from Dept No ____ as a ____
To Dept. No. ____ as a ____
Fired ____ Trans ____

Fig. 6. Reverse Side of Card in Fig. 5 on which Characteristics of Employe are noted

in Fig. 7. This form is also made in duplicate, the original being sent to the pay department for the issuance of a new clock number, then to the new foreman, who indicates the starting time thereon, after which it is taken by the representative of the cooperative department to the employment department. The duplicate is sent to the employment department, where it is retained until the receipt of the original, after which the original and duplicate are sent to the time and pay departments, respectively.

One of the most valuable records kept by the employment department is that of undesirable employes who have left or been discharged. This record is kept on small cards, filed by name in the office of the interviewer, and contains such information as the starting and leaving date, the reason for leaving, the department number, the foreman under which the employe worked, the rate of pay received, and whether the employe should be rehired or not. It is through the information on these cards that undesirable men are prevented from entering service a second time. Often a competent man without funds appears for employment, and to enable such a man to obtain immediate room and board, an order slip is given to him at the end of the first day. He signs this slip and turns it over to his boarding-house keeper, who presents it to the pay department and receives the amount of money indicated. This amount is subsequently deducted from the pay of the employe. This method has proved an aid to the acquisition of many a good man.

Examination of Employes

In the examination of an applicant, the greatest aid to the interviewer is the series of tests developed to check the actual ability of the applicant to do the task for which he applies. These tests were found necessary because of the costly mistakes made with the former method of briefly questioning an applicant, and they proved successful far beyond expectations. It is, of course, impossible to secure absolute perfection in work of this nature, yet the results have been most satisfactory. A test was made up for every class of work in the plant.

Owing to the labor shortage, it was necessary to determine with the greatest possible degree of accuracy, what each applicant was capable of doing, and to place him somewhere, even if he could not be used on the job for which he made application. To this end the tests were first made out to determine what an applicant was capable of doing. As these were used, revisions and additions were made until the tests served a fourfold purpose. First, they determined what the "floater" type was capable of doing or what he was interested in, so that he could be placed where his abilities, both natural and acquired, would be of the greatest value to himself and the firm. Second, they reduced the labor turnover, through a more careful placing of each applicant. Third, they placed an inexperienced applicant where he would find his natural abilities serving him to the greatest advantage. Fourth, they developed more responsible men.

The tests consisted of asking an applicant questions as to the operation of the type of machine he claimed to have had experience on, the manner in which various attachments are used, the way the machine should be set up for certain operations, the function of the different parts of the machine, and the names of some of the more important parts and units, as well as questions involving general mechanical knowledge in their answer. Photographs of the various types of machines were kept in the office of the interviewer for use in this connection. On some machines photographs were taken of disassembled units and parts for the same purpose. A set of qualifications was prepared for journeymen, to gage whether applicants were really proficient in their respective trades. Another list of questions dealt with the characteristics of the applicant, whether he spent any of his leisure time in studying to improve his abilities, and if not, how he did spend his evenings, etc.

These tests took a great deal of time to make out, verify, and revise, but as it was possible to pass upon at least double the number of applicants in the same time as before, and with greater accuracy, it proved to be an efficient means of employing men. No competent man has ever objected to such a test. On the other hand, he is eager to have the test made, feeling that he has a fair chance to prove his ability. It is the inexperienced man, realizing that he cannot convince the interviewer that he has the ability he claims to have, who objects to the examination.

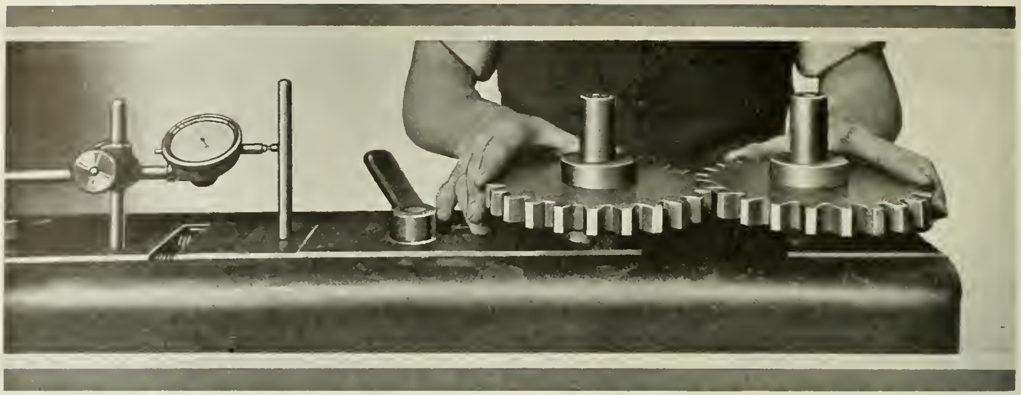
W630 Studebakar
NOTICE OF EMPLOYEE'S TRANSFER
INSTRUCTIONS:—Made in duplicate by Co-operative Department upon the transfer of an employee from one department to another. Original accompanies employee to Paymaster for new clock number and Three Day Pass and to Department Foremen as notice of transfer. Foreman indicates starting time hereon and hands to Co-operative Department representative who forwards to Employment Department. Employment Department retains duplicate until return of original from foremen, then copies starting time thereon and sends original to Time Department and duplicate to Paymaster.

Plant No. ____
Old Clock No. ____
New Clock No. ____

TO TIME OFFICE ____ 19__
We have transferred ____
Dept. No. ____ Equip. No. ____ As a ____ FROM
" " ____ " " ____ " " ____ TO
Signed ____ Employment Dept.

This employee started work in this Dept.
At ____ A. M. / P. M. ____ 192__
Rate ____ Charge Acc't ____
Signed ____ Foremen

Fig. 7. Transfer Notice made out by the Cooperative Department



Inspection of Involute Gear Hobs

Methods Used in Examining the Test Gears—Second of Two Articles

By CARL G. OLSON, Chief Engineer, Illinois Tool Works, Chicago, Ill.

TO transmit uniform rotary motion by gearing, the tooth curves of the gears must have definite theoretical forms, and in practice they must be made very nearly true to these forms. As the involute gear tooth system is the most flexible and the most convenient, it is being universally adopted; and hence we will limit our attention to the inspection of gears having involute teeth. The construction of the involute is well known, but to make this article complete, a reference to the theory will make the principle on which the testing machine operates clearer.

The Involute Test

The tooth curve as shown in Fig. 2 is traced by a point in a string unwinding from a cylinder; and in Fig. 3 an equal line is traced by a point in a tangent rolling on a cylinder without slipping. The fixture shown diagrammatically in Fig. 1, and in Figs. 4 and 5, is constructed on the foregoing theory. The base circle is here represented by a disk, and the tangent by one edge of a flat block on which is mounted an indicator terminating in a contactor point located in the plane of the tangent.

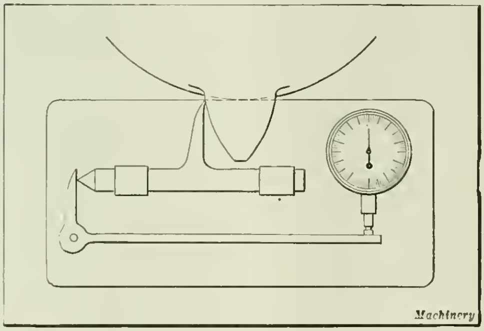


Fig. 1. Involute Testing Machine

The base disks must be of accurate diameters, and these are governed by the number of teeth, and by the pitch and the pressure angle of the gears. A formula for figuring these diameters is given in connection with the accompanying tables of base disk diameters for common sizes and pitches of gears. A groove in the center of the face of the disks is made to accommodate a wire, and it should be of a depth equal to one-half of the diameter of the wire that is used. The edge of the indicator block has a corresponding groove of the same depth as the groove in

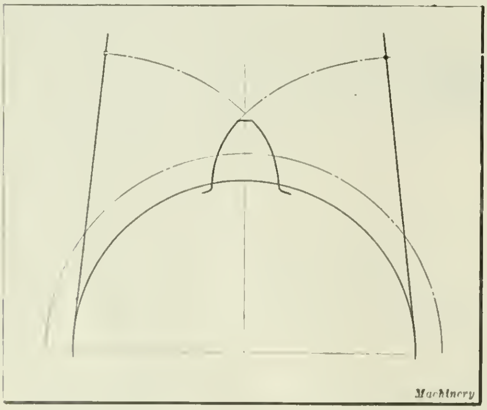


Fig 2. Involute Curve traced by a Point in a String while unwinding from a Cylinder

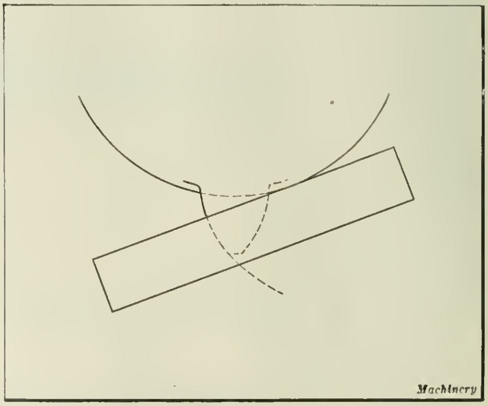


Fig. 3. Involute Curve traced by a Point in a Tangent rolling on a Cylinder

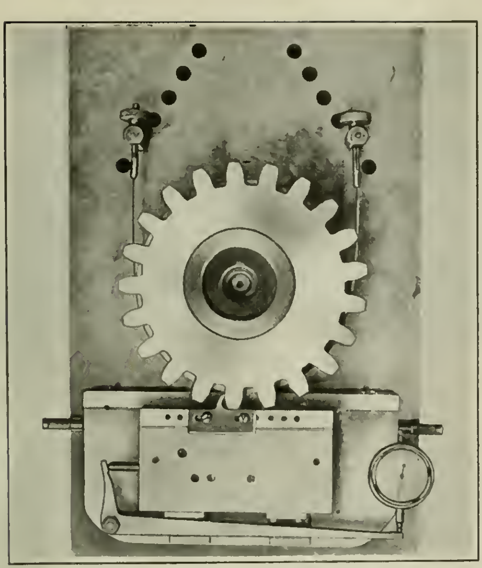


Fig. 4. Testing the Involute Tooth Form of a Spur Gear

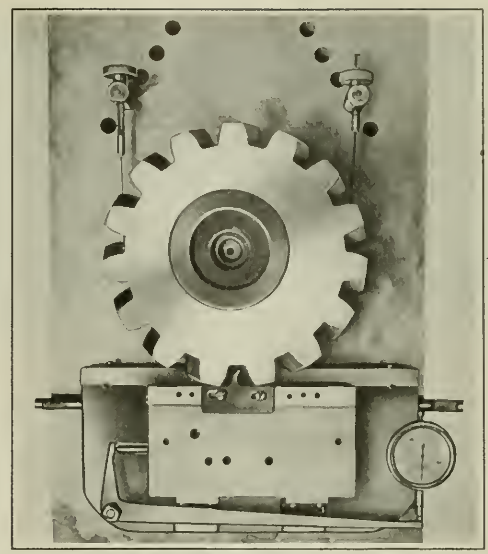


Fig. 5. Testing the Involute Tooth Form of a Helical Gear

the disks. This allows the tangent to roll directly on the base disk, and by having one half the wire in each member, no slipping takes place from the bending of the wire.

To make a test of a gear, the correct base disk is selected and placed on the stud in the table of the machine, after which a spacing collar and the gear to be tested are put in place. The wire bands are then adjusted and tightened. The gear is turned until the face of one tooth acts on the contactor, turning the indicator pointer about one half revolution, when the gear and base disk are locked together with a hand-nut on the stud. The block is rocked on the base disk, allowing the contactor to follow the involute tooth face, while the deflection of the indicator is noted.

If the involute is perfectly true, there will be no deflection of the indicator pointer, but such perfection is hard to obtain. In practice, it has been found that a variation of a fraction of a thousandth inch is not noticeable in the running of the gears.

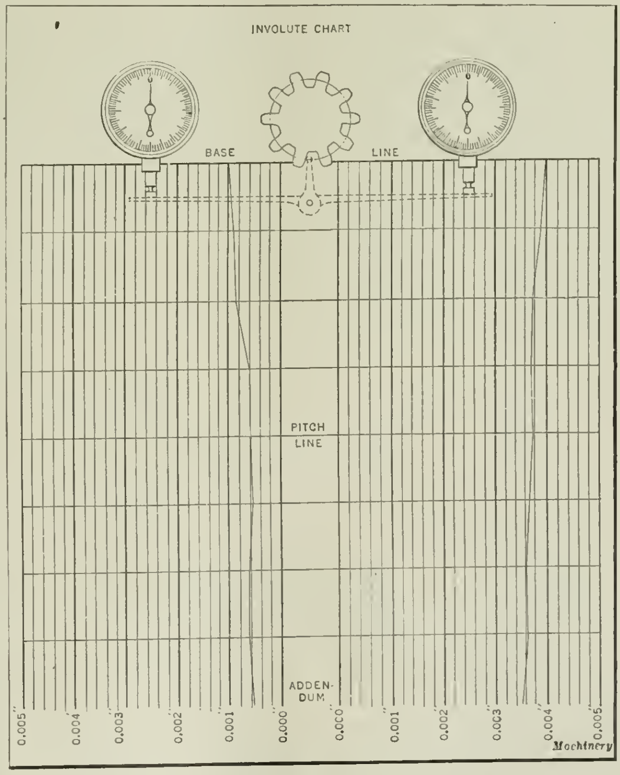


Fig. 6. Chart for recording Results of Involute Gear Tests made on Machine shown in Figs. 4 and 5

The deflection may be recorded in a diagram of the form shown in Fig. 6. The main divisions formed by the vertical lines indicate 0.001 inch, and the horizontal spacing divides the tooth face into eight main divisions headed by the base line, from which the curve is started downward to the pitch line and the addendum line. The base line and the pitch line should be indicated on the gear, but the other lines may be approximated for all practical purposes.

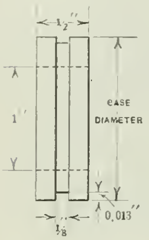
The Jump Test

One of the commercial methods of testing gears is the so-called "jump test," which consists of placing the gears on a gear-testing machine, provided with suitable studs, one of which is mounted in a sliding part acted upon by a spring that tends to force the gears together. An indicator is affixed to the machine in such a manner that it will show the movement of the sliding part and stud when the gears are gently rolled by hand, measuring the "jump" as each pair of teeth meshes. This apparatus is shown in the heading illustration. The maximum tolerance of jump in commercial gears should not exceed 0.010 inch divided by the diametral pitch of the gears.

Dependence cannot be placed upon the jump test for gears that have backlash, because the thin teeth will not roll tightly at the proper center distance, and a closer center distance will not generally show the true condition. To detect the run-out or the eccentricity of the pitch lines, the gears are turned through a complete revolution, but this test does not refer to the correctness of the hob with which the teeth were cut. However, it shows if the gears were

TABLE 1. BASE CIRCLE DISK DIAMETERS

For Testing the Involute Curve on the Testing Machine



The base diameter is equal to the pitch diameter multiplied by the cosine of the pressure angle.

Formula: $BD = PD \times \cos PA$

The depth of the groove is equal to one half of the diameter of the band or wire used on the testing machine.

No. of Teeth	20-degree Pressure Angle					
	Diametral Pitch					
	4–5	5–7	6–8	8–10	10–12	12–14
12	2.819	2.255	1.879	1.410	1.128	0.940
13	3.054	2.443	2.036	1.527	1.222	1.018
14	3.289	2.631	2.193	1.645	1.316	1.096
15	3.524	2.819	2.349	1.762	1.410	1.175
16	3.759	3.007	2.506	1.879	1.504	1.253
17	3.994	3.195	2.662	1.997	1.598	1.321
18	4.229	3.383	2.819	2.114	1.691	1.420
19	4.464	3.571	2.976	2.232	1.785	1.488
20	4.698	3.759	3.132	2.349	1.879	1.566
21	4.933	3.945	3.289	2.467	1.973	1.644
22	5.168	4.135	3.445	2.584	2.067	1.723
24	5.638	4.511	3.759	2.819	2.255	1.879
26	6.108	4.886	4.072	3.054	2.443	2.035
28	6.578	5.262	4.385	3.289	2.631	2.193
30	7.048	5.638	4.698	3.524	2.819	2.349
32	7.518	6.014	5.012	3.759	3.007	2.506
36	8.457	6.766	5.638	4.229	3.383	2.819
38	8.927	7.142	5.931	4.464	3.571	2.976
40	9.397	7.518	6.265	4.698	3.759	3.132
42	9.867	7.893	6.578	4.933	3.947	3.289
44	10.337	8.269	6.891	5.168	4.135	3.446
46	10.809	8.645	7.204	5.403	4.323	3.602
48	11.276	9.021	7.518	5.638	4.511	3.759
50	11.746	9.397	7.831	5.873	4.698	3.915
52	12.216	9.773	8.144	6.108	4.886	4.072
56	13.156	10.523	8.770	6.578	5.262	4.385
60	14.095	11.276	9.397	7.038	5.638	4.698

Machinery

carefully hobbed. The gear-testing machine should be provided with means for accurately measuring the center distance of the gears and means for locking the studs while making roll tests and when checking the backlash.

The Roll Test

When placed on the studs of this machine and adjusted to the proper center distance, the gears should roll without interference and without any noticeable interruption when passing from tooth to tooth, when they are gently rolled by hand with the tooth faces pressed together while rolling. The bearing or rolling contact is carefully noted. To make the bearing show up plainly, the surfaces of the gear teeth may be coated with a thin film of red lead and oil.

The ideal bearing is uniform over the greater part of the face of the teeth, blending gradually out at a point slightly inside the addendum circle. This blending is called the "approach curve" and should be very slight in the case of gears that are not to be heat-treated after hobbing; but in gears that will be subjected to a process of heat-treatment, and, therefore, to a possible slight distortion, this curve should be greater to allow more flexibility in the assembling of gear trains. It has been found that by making liberal approach curves in the tooth profiles of heat-treated gears, rejections due to noisy running have been greatly reduced.

TABLE 2. BASE CIRCLE DISK DIAMETERS

For Testing the Involute Curve on the Testing Machine

No. of Teeth	14½-degree Pressure Angle						
	Diametral Pitch						
	1	2	2½	3	4	5	6
12	11.618	5.809	4.647	3.873	2.905	2.324	1.936
13	12.586	6.293	5.134	4.195	3.147	2.517	2.098
14	13.554	6.777	5.422	4.518	3.389	2.711	2.259
15	14.523	7.261	5.809	4.841	3.631	2.904	2.420
16	15.490	7.745	6.196	5.163	3.873	3.098	2.582
17	16.459	8.229	6.583	5.486	4.115	3.292	2.743
18	17.427	8.713	6.971	5.809	4.357	3.485	2.905
19	18.395	9.197	7.358	6.132	4.599	3.679	3.066
20	19.363	9.682	7.745	6.454	4.841	3.873	3.227
21	20.331	10.166	8.132	6.777	5.083	4.066	3.389
22	21.299	10.650	8.519	7.100	5.325	4.260	3.550
24	23.236	11.618	9.294	7.745	5.809	4.647	3.873
26	25.172	12.586	10.069	8.391	6.293	5.034	4.195
28	27.108	13.554	10.843	9.036	6.777	5.422	4.518
30	29.045	14.523	11.618	9.681	7.261	5.809	4.841
32	30.981	15.490	12.392	10.327	7.745	6.196	5.163
36	34.853	17.427	13.941	11.618	8.713	6.971	5.809
38	36.790	18.395	14.716	12.263	9.197	7.358	6.132
40	38.726	19.363	15.490	12.909	9.682	7.745	6.454
42	40.662	20.331	16.265	13.554	10.166	8.133	6.777
44	......	21.299	17.039	14.199	10.650	8.520	7.100
46	......	22.267	17.814	14.845	11.134	8.906	7.423
48	......	23.236	18.588	15.490	11.618	9.294	7.745
50	......	24.204	19.363	16.136	12.102	9.682	8.068
52	......	25.172	20.138	16.781	12.586	10.069	8.391
56	......	27.108	21.687	18.072	13.554	10.843	9.036
60	......	29.045	23.236	19.363	14.522	11.618	9.681

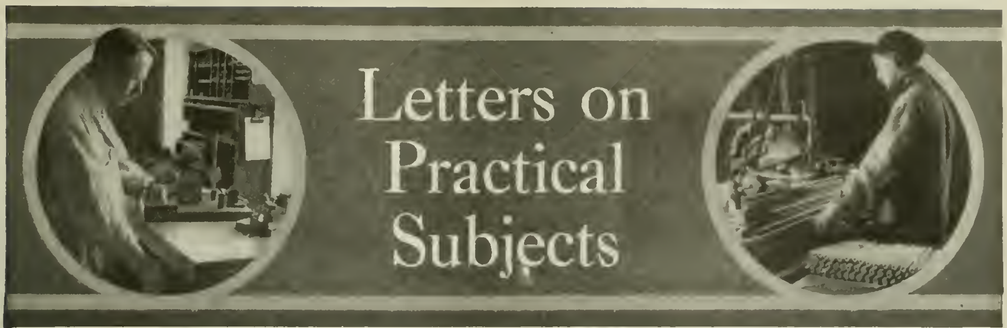
Machinery

TABLE 3. BASE CIRCLE DISK DIAMETERS

For Testing the Involute Curve on the Testing Machine

No. of Teeth	14½-degree Pressure Angle						
	Diametral Pitch						
	7	8	9	10	12	14	16
12	1.660	1.452	1.291	1.162	0.968	0.830	0.726
13	1.798	1.573	1.398	1.259	1.049	0.899	0.787
14	1.936	1.695	1.506	1.355	1.130	0.968	0.847
15	2.075	1.815	1.614	1.452	1.210	1.037	0.908
16	2.213	1.936	1.721	1.549	1.291	1.106	0.968
17	2.351	2.057	1.829	1.646	1.372	1.176	1.029
18	2.490	2.178	1.936	1.743	1.452	1.245	1.089
19	2.628	2.299	2.044	1.840	1.533	1.314	1.150
20	2.766	2.420	2.151	1.936	1.614	1.383	1.210
21	2.904	2.541	2.259	2.033	1.694	1.452	1.271
22	3.043	2.662	2.367	2.130	1.775	1.521	1.331
24	3.319	2.905	2.582	2.324	1.936	1.660	1.452
26	3.596	3.147	2.797	2.517	2.098	1.798	1.573
28	3.873	3.389	3.012	2.711	2.259	1.936	1.694
30	4.149	3.631	3.227	2.905	2.420	2.075	1.815
32	4.426	3.873	3.442	3.098	2.582	2.213	1.936
36	4.979	4.357	3.873	3.485	2.905	2.490	2.178
38	5.256	4.599	4.088	3.679	3.066	2.628	2.299
40	5.532	4.841	4.303	3.873	3.227	2.766	2.420
42	5.809	5.083	4.518	4.066	3.389	2.904	2.541
44	6.086	5.325	4.733	4.260	3.550	3.043	2.662
46	6.362	5.567	4.948	4.454	3.711	3.181	2.783
48	6.639	5.809	5.163	4.647	3.873	3.319	2.905
50	6.915	6.051	5.379	4.841	4.034	3.458	3.026
52	7.192	6.293	5.594	5.034	4.195	3.596	3.147
56	7.745	6.777	6.024	5.422	4.518	3.873	3.389
60	8.298	7.261	6.454	5.809	4.841	4.149	3.631

Machinery



DRESSING WHEELS FOR CONCAVE AND CONVEX GRINDING

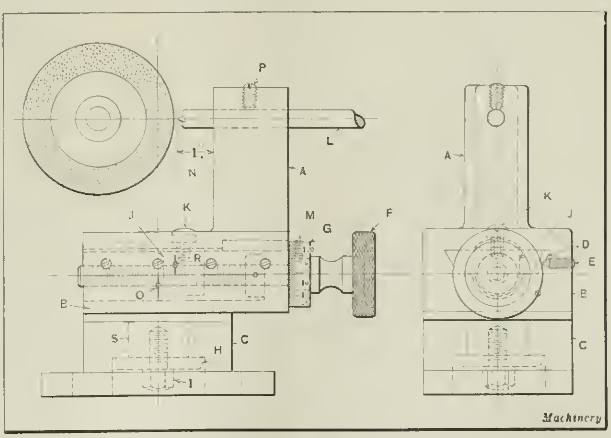
The attachment shown in the accompanying illustration was designed by the writer for use on a universal grinding machine. With it the periphery of the grinding wheel can be given either a concave or a convex form, of any radius within the range of the attachment. This device eliminates the necessity of dressing the wheels with a hand-dresser to conform to a radius gage. The principal parts of the attachment are the diamond-point wheel-dresser holder *A*, which is held to the angular dovetail of saddle *B* by means of gib *D* and screws *E*. Saddle *B* is, in turn, attached to base *C* by means of cap-screw *I* located in the shank *S* of part *B*. Shank *S* acts as a pivot around which part *B* swivels.

Holder *A* can be adjusted on saddle *B* by means of a knurled-head screw *F*, which fits into nut *J* attached to *B* by cap-screw *K*. Screw *F* has an 8-pitch thread, and is provided with a dial *G* having 125 division lines, each representing a movement of the holder *A* of 0.001 inch. Dial *G* is a loose fit on screw *F*, but can be held firmly to it by tightening screw *M*. This attachment has a range for truing wheels up to 6 inches in diameter, and can be used to give the periphery of a wheel either a concave or a convex surface of any radius up to $1\frac{3}{4}$ inches. The device has been tried out in practice, and has given satisfactory results.

In dressing a grinding wheel to a given radius, the device is mounted on the grinding machine table and a diamond-point wheel-dresser inserted in holder *A*. This holder is advanced through the hole until the diamond point projects one inch from the face of the holder, as indicated by the dimension at *N*. Screw *P* is next tightened and dimension *N* checked with a gage. The knee of the grinding machine is then raised until the diamond point is in line with the center of the grinding wheel spindle. The knurled-head screw *F* is then turned until line *R* on the holder *A* coincides with line *O* on the saddle *B*.

This adjustment brings the diamond point directly over the center lines of pivot *S*. Dial *G* is then adjusted until the two zero lines coincide, after which screw *M* is tightened to hold the dial in place. Adjusting screw *F* is then turned until the reading of the dial shows that the device is properly set to true the wheel to the required radius. The wheel is trued by swinging the holder *A* about pivot *S*, the machine being adjusted, of course, to bring the diamond truing point into proper contact with the periphery of the wheel.

Conneaut, Ohio F. A. Gross



Attachment for dressing Concave and Convex Form-grinding Wheels

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FASTENING PAPER TO DRAWING-BOARD

In making large lay-out drawings that require considerable time to finish, the use of thumb-tacks for fastening the paper to the board is unsatisfactory, especially if the lay-out is to be traced, because the paper is sure to stretch and form ridges between the tacks. A good way to keep the paper flat and avoid the annoyance caused by the triangles or drafting machine coming in contact with the thumb-tacks, is to mount the paper on the board in the following manner: Cut the paper, either a heavy grade of detail paper or "Whatman's Hot Pressed" about 4 inches longer each way than the finished tracing, and use a drawing-board the same size or a little larger than the lay-out paper. After the paper is cut, turn up the four sides about 2 inches from the edge without cutting the corners, and remove any dirt or grease that may have accumulated on the part of the board which is to be covered by this 2-inch margin.

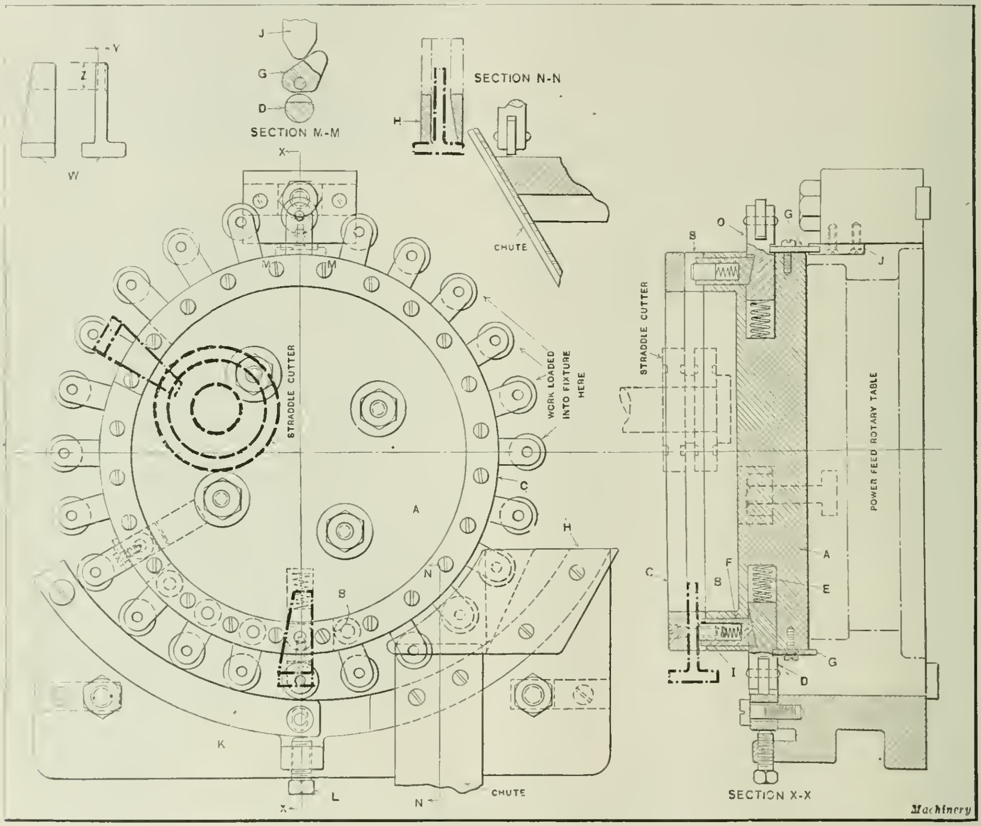
On the inside of this turned-up portion apply a coating of some good library or photographic paste, thinned out with water to about the consistency of liquid glue. Wet the side of the paper on which the paste has been applied with a sponge inside the border of paste. Then place the wet side of the paper on the board and press the upper edge down. Then gently pull the paper out as flat as possible and press the other three edges down smooth. When the paste has taken a good hold on the board, wet the upper face of the paper. The water should not be applied to the portion of the paper directly over the pasted margin; the ridge formed by turning up the edge of the paper for pasting will serve as a guide. Now press down the edges several times with some hard, smooth object, such as the back of a pocket knife, to remove any air bubbles which may be left in the pasted surface.

If the surface of the paper begins to dry in spots, wet the portions that are drying too rapidly so that the entire surface will become dry about the same time. When the paper is thoroughly dry, it will be flat and ready for use. If it is necessary to preserve the lay-out after it has been taken from the board, the drawing should not extend over the pasted border. The writer has found it advisable to stretch the paper down before the end of the day's work so that no time will be lost waiting for the paper to dry. After the lay-out has been traced, cut the paper inside the pasted margin and remove the paper left on the board by rubbing with emery cloth or sandpaper.

Philadelphia, Pa. WALTER A. TEGLER

There are a number of holes drilled radially in base *A*, to receive springs *E* and plungers *D*. Clamp *F*, riding on a bevel on plunger *D*, clamps the work against ring *C* by the pressure of spring *E*. The spring in clamp *F* releases it from the work when the plunger *D* is forced in. Stop *G*, engaging in a slot in the under side of plunger *D*, holds spring *E* in check, keeping clamp *F* released as shown.

Unloading is accomplished by the ejector *H*. As the fixture is revolved, the head of the work hooks into the ejector, which draws it out until it is entirely clear of the clamp, whereupon it overbalances and falls into a chute, which delivers it to a receptacle provided for that purpose. In manipulating this fixture, the operator loads the work into the fixture as the parts are ejected. The auxiliary spring-actuated plunger *I* holds the work in position until clamped. As the fixture rotates, trip-pin *J* trips stop *G* and releases



Milling Fixture with Automatic Clamping and Ejecting Devices

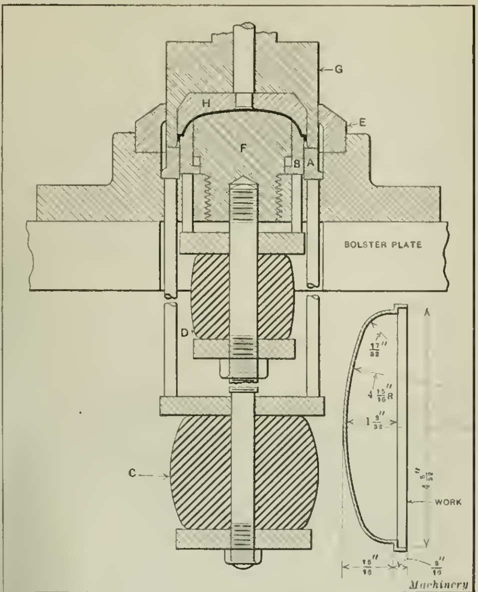
MILLING FIXTURE FOR CONTINUOUS CIRCULAR MILLING

A continuous circular milling fixture for use on a vertical milling machine is shown in the accompanying illustration. This fixture was designed for straddle-milling the ends of aluminum castings such as shown at *W*. The end of the work was required to be machined to a thickness *Y*. As a large number of these parts are used, the fixture was designed for rapid production. The whole fixture comprises the fixture proper, the clamping and releasing members, and the work-ejecting device. The fixture proper is bolted to a standard power-feed rotary milling table. To base *A*, is screwed and doweled the steel ring *C* and spacing blocks *B*. The latter serve also as gage-blocks to locate the work on the tapered side.

plunger *D* which clamps the work while it is carried past the cutter. In unclamping, plungers *D* (which have rollers mounted on them to minimize friction) are forced in by cam *K* until the slots on the bottoms of the plungers allow stops *G* to return to their normal positions, thus holding the plungers in check after they have cleared the cam.

The clamping pressure can be regulated by using a small or a large bevel on plunger *D*. The set-screw *L* is used for adjusting cam *K* after the fixture has been set up. The cutter should be set in a fixed position, a little beyond the point at which trip *J* releases plunger *D*. The dimension *Z* on the work was not required to be held to close limits of accuracy in this particular case, but when necessary, special provision can be made for locating the work radially with greater accuracy.

Brooklyn, N. Y. LESTER FERENCI



Punch and Die Construction permitting the Completion in One Operation of Parts generally produced by Two Dies

DIE WITH TWO DRAWING RINGS

Two distinct drawing operations on power presses are commonly employed in the production of parts which can be just as satisfactorily drawn in one operation by means of a punch and die construction similar to that shown in the accompanying illustration. This punch and die is used for drawing oil-can breasts to the shape and dimensions shown in the lower right-hand corner. The development of a die for producing this part in one operation was difficult because of the shoulder near the open end and the thinness of the metal from which the part is drawn, this metal being cold-rolled stock, 0.024 inch in thickness. The blank diameter is 5 3/32 inches. The special feature of this die is the provision of two drawing rings, one inside the other, against which upward pressures are exerted by means of two separate rubber buffers.

The illustration shows the relation between the punch and the moving members of the die at the completion of a downward stroke of the press ram. Prior to a descent of the punch, drawing rings *A* and *B* are in raised positions due to the pressure exerted by rubber buffers *C* and *D*, respectively. The pressure of each buffer is transmitted to the bottom of its respective drawing ring through the medium of a plate and two round rods. When ring *A* is in the raised position, its upper surface coincides with that of the blanking ring *E*. The raised position of ring *B* is such that the top of the ring does not project beyond the highest point of center plug *F*.

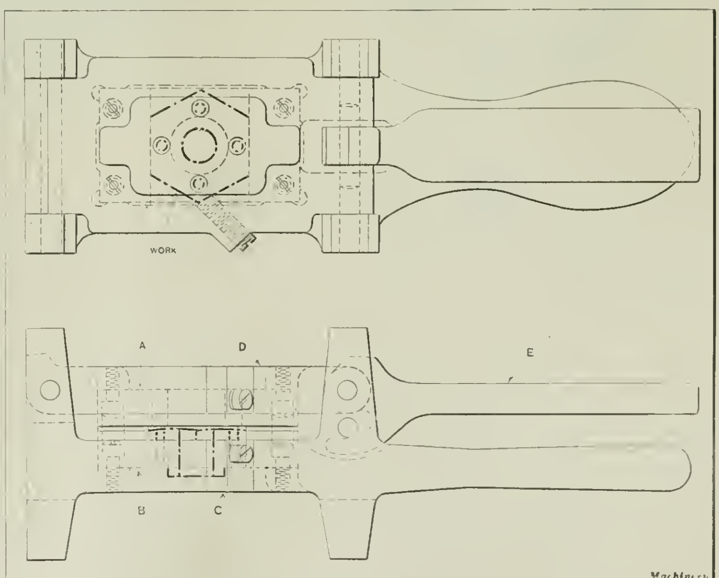
The strip of metal from which a part is to be drawn is laid on the upper edge of ring *E*, and blanked to size as punch *G* enters this ring, pressure being exerted against the blank by drawing ring *A* in the manner previously described. The blank and ring *A* are pushed into the die as the punch continues to descend, while ring *B* remains stationary for a moment due to the pressure of buffer *D*. The result is that the edge of the blank is turned down around ring *B*. This ring is pushed downward after section *H* of the punch comes in contact with the blank, the latter being stretched on plug *F* and ring *B*, and the shoulder being formed. By stretching the metal in this manner all wrinkles are eliminated on the drawn part, so that subsequent spinning or restriking is unnecessary.

The completed part is forced from the die on the upward stroke of the press ram by rings *A* and *B* as they resume their normal positions. In case the part adheres to the ascending punch it is ejected from this member by section *H* which, in addition to its function of shaping the shell, also serves as a knock-out pad. If the die for making this part was of the common design, drawing ring *B* would be integral with plug *F* and so it would be practically impossible to draw a shell without wrinkles. The top edge of ring *B* is rounded, so that the blank is not cut through when it is forced upon the ring.

Toledo, Ohio — J. Bingham

INTERCHANGEABLE-PLATE JIG FOR SMALL PARTS

In shops where a large variety of small parts must be drilled and a jig used for the operation in each case, obviously a considerable investment is involved for the jigs alone, and if it were possible to employ the same jig in a number of cases by simply substituting one or two members to suit the work, drill jig costs might be greatly reduced. With this end in view, the jig shown in the accompanying illustrations was designed. This jig has an upper plate *A* and a lower plate *B*, each of which is replaceable to suit a



Drill Jig designed to accommodate a Large Variety of Work, being provided with Interchangeable Plates to suit Each Part large number of parts of different shapes. In the illustration the plates are those employed in drilling and tapping four holes through the hexagonal head of a small part, the work being located by means of a recess in the lower plate.

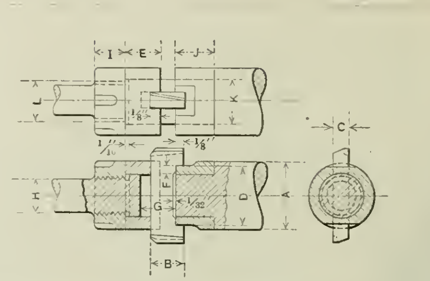
Both plates may be provided with bushings so that operations can be performed from both sides of the work. In many cases, the holes are drilled from one side, and then tapped, countersunk, or counterbored from the other. Bushings may often be eliminated by hardening the plates. The latter are located along one side and one end by accurately machined surfaces on the jig body *C* and leaf *D*, against which the plates are forced by means of two screws. With this arrangement, it is unnecessary to fit the plates in the jig. It will be seen that the plates are attached to the leaf and body, respectively, by means of four fillister-head machine screws. The holes for these screws are located from a jig so that the plates for the various pieces of work will be interchangeable. The body and leaf are steel castings, and the work is clamped in the plates by means of cam-lever *E*. This jig may be made in a number of sizes.

Cleveland, Ohio A. J. Cayouette

BORING-BARS FOR DOUBLE-END CUTTERS

The two types of boring-bars here shown were designed as a result of the demand for boring-bars which would hold double-end cutters, and give the maximum length of service when used with a milling or boring machine or in connection with boring fixtures, for the production of duplicate machine parts requiring a high degree of accuracy. The writer has found these boring-bars to be superior to those frequently used, which have a machine steel or soft tool steel bar for holding the hardened cutter. With boring-bars of the latter type it is often found that, after a very few cuts and changes of cutters have been made, the driving of the taper wedge—usually employed to hold the cutters in place—as well as the thrust on the cutters due to the cutting action tends to peen the bars under the angular or flat centering shoulders, thus making the cutters loose in the bar and impairing the accuracy of the tool to such an extent that new bars or cutters are required.

TABLE 2. DIMENSIONS FOR BORING-BAR HEADS



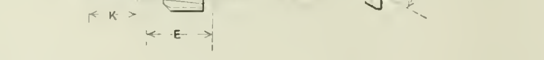
All dimensions in inches

A	B	C	D	E	F	G	H	I	J	K	L
1 1/4	3/4	3/16	1 3/16	9/16	1/8	13/16	5/8	11/16	9/16	13/16	3/4
1 1/2	7/8	1/4	1 7/16	5/8	5/32	15/16	7/8	3/4	5/8	1	1
1 3/4	1 3/16	5/16	1 11/16	11/16	5/32	1 1/4	15/16	13/16	11/16	1 3/16	1 1/8
2	1 3/16	5/16	1 15/16	3/4	5/32	1 1/4	1 3/16	15/16	3/4	1 3/8	1 3/8
2 1/4	1 1/4	5/16	2 3/16	13/16	3/16	1 5/16	1 3/8	1	13/16	1 5/8	1 5/8
2 1/2	1 1/2	3/8	2 7/16	7/8	3/16	1 9/16	1 1/2	1 1/16	15/16	1 13/16	1 3/4
2 3/4	1 1/2	7/16	2 11/16	15/16	1/4	1 9/16	1 3/4	1 3/16	1	2	2
3	1 1/2	7/16	2 15/16	1	1/4	1 9/16	1 7/8	1 1/4	1 1/16	2 1/8	2 1/8
3 1/4	1 1/2	7/16	3 5/32	1 1/16	1/4	1 9/16	2 1/8	1 3/8	1 1/8	2 3/8	2 3/8
3 1/2	1 1/2	1/2	3 13/32	1 1/8	5/16	1 9/16	2 3/16	1 1/2	1 3/16	2 9/16	2 1/2
4	1 1/2	1/2	3 29/32	1 1/4	3/8	1 9/16	2 5/8	1 5/8	1 3/8	3	3
4 1/2	1 11/16	5/8	4 3/8	1 3/8	1/2	1 3/4	3	1 13/16	1 1/2	3 3/8	3 3/8
5	1 11/16	5/8	4 7/8	1 1/2	1/2	1 3/4	3 5/16	2	1 5/8	3 3/4	3 3/4

Machinery

Boring-bars of improved construction, such as shown in Table 1, are intended for boring blind holes, where the bar is supported by a follow-up bushing behind the cutter. The cutter is made with a centering shoulder on each side. These shoulders are turned on centers so that they will fit the inside bores of the two hardened and ground collars. The collar on the inner side is made a tight fit on the bar, and the outer collar is made a good slip fit to facilitate the changing of cutters. The combination of cutter and collars is clamped tight by means of the nut on the threaded end. The outside diameter of the cutter can be ground to size when held on centers or while in position in the bar.

TABLE 1. DIMENSIONS FOR BORING-BAR HEADS



All dimensions in inches

A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	5/8	5/32	5/8	1 1/16	9/16	9/16	5/8	5/32	9/16	11/16	2 7/16	7/8	31/32
1 1/4	3/4	3/16	13/16	1 3/16	5/8	5/8	11/16	5/32	3/4	7/8	2 13/16	1 1/16	1 3/16
1 1/2	7/8	1/4	1	1 5/16	7/8	11/16	3/4	5/32	7/8	1	3 1/4	1 1/4	1 7/16
1 3/4	7/8	1/4	1 3/16	1 5/16	1	3/4	7/8	5/32	1 1/16	1 3/16	3 5/8	1 1/2	1 11/16
2	1 3/16	5/16	1 3/8	1 5/8	1 1/4	13/16	1 5/16	5/32	1 3/16	1 5/16	4 3/16	1 3/4	1 15/16
2 1/4	1 1/4	5/16	1 5/8	1 3/4	1 1/2	7/8	1	3/16	1 5/16	1 7/16	4 1/2	1 7/8	2 3/16
2 1/2	1 1/2	3/8	1 13/16	2	1 5/8	1	1 1/8	3/16	1 1/2	1 11/16	5 1/4	2 1/8	2 7/16
2 3/4	1 1/2	7/16	2	2	1 3/4	1 1/16	1 3/16	3/16	1 5/8	1 13/16	5 1/2	2 3/8	2 11/16
3	1 1/2	7/16	2 3/16	2	1 7/8	1 1/8	1 1/4	3/16	1 13/16	2	5 13/16	2 5/8	2 15/16
3 1/4	1 1/2	7/16	2 3/8	2	2 1/8	1 3/16	1 5/16	3/16	1 15/16	2 1/16	6 1/4	2 3/4	3 3/16
3 1/2	1 1/2	1/2	2 9/16	2	2 1/4	1 1/4	1 7/16	3/16	2 1/8	2 5/16	6 7/16	3	3 7/16
4	1 1/2	1/2	2 15/16	2	2 1/2	1 3/8	1 9/16	3/16	2 3/8	2 9/16	6 13/16	3 3/8	3 15/16
4 1/2	1 11/16	5/8	3 3/8	2 3/16	2 3/4	1 1/2	1 3/4	3/16	2 11/16	2 7/8	7 3/4	3 7/8	4 7/16
5	1 11/16	5/8	3 3/4	2 3/16	3	1 5/8	1 7/8	3/16	3	3 3/16	8 5/16	4 1/4	4 7/8

Machinery

In a boring-bar of the construction indicated in the illustration shown in connection with Table 2, where the bar is supported on both sides of the cutter in a fixture and driven by a universal joint arrangement, it is desirable that the diameter *H* be made as large as is consistent with good practice. In this construction two hardened and ground collars are used and the cutter is centralized by the usual flat shoulder supported on the flats of the inside collar which is tight on the bar. The cutter diameter is ground to size in a suitable fixture or while in position in the bar. Boring-bars that are made in accordance with the dimensions given in the accompanying tables have been found very satisfactory, their additional first cost being more than compensated for by their greater accuracy, dependability, and length of life.

Waterbury, Conn. Albert H. Gaess

HARDINGE OIL BURNER FOR INDUSTRIAL PLANTS

Hardinge Bros., Inc., Berteau and Ravenswood Aves., Chicago, Ill., have developed a new type of oil burner known as the Hardinge oil burning machine. This equipment is constructed to burn all kinds of fuel oil, from the heavy low-grade Mexican product to the better grade of kerosene. Some of the important features incorporated in this oil burning machine are the provision of an atomizer and agitator, which treat the oil before burning; a revolving needle in the oil-feed valve which feeds the oil in small regular quantities; a pressure chamber which eliminates air and water bubbles; an air regulator which regulates the air mixture; an automatic stop which stops the machine and prevents flooding if the fire accidentally goes out; a convenient method of cleaning the burner; and an oiling system for the atomizer spindle. These features make it possible to burn ordinary fuel oil economically without objectionable noise, odor, or dirt.

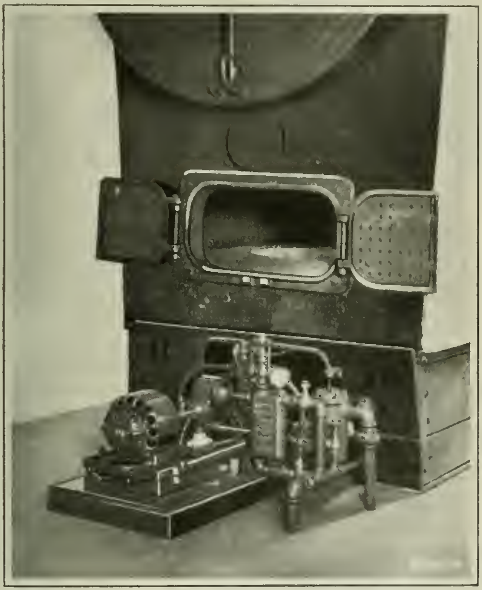


Fig. 1. Hardinge Oil Burner applied to Boiler

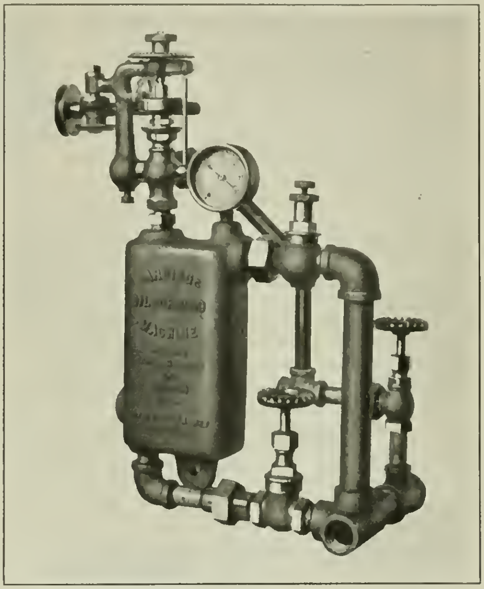


Fig. 2. Valve Control Unit of Hardinge Oil Burner

The machine can be adapted to heating systems of small residences as well as to the heating of boilers in large industrial plants, and is equally applicable whether the problem is one of heating or of generating steam for motive power. The burner is always under control and has a wide range of adjustment. For instance, in the case of an installation in the heating system of a small residence, it is possible to turn the flame down so low that only one half a gallon of fuel oil will be consumed per hour. A good idea of the relative size and location of the oil burning machine as applied to the heating of a boiler may be obtained by referring to Fig. 1. In Fig. 2 is shown a close-up view of the control unit by means of which the fire is controlled.

Operation of Burner

The oil is drawn from the supply tank (which is usually placed under the floor) up through the strainer by a pump driven by an electric motor, as shown in Fig. 1, which also serves to drive the rotating members of the burners. From the pump the oil is forced into a chamber where it is kept under pressure by the pump. It next passes upward through a revolving needle valve seat which regulates the quantity of oil to be burned. From this point it follows the pipe line up to the openings of a short standpipe. It then flows downward through the bottom of the revolving cup of an atomizer where it is thrown off through the oil-tube by centrifugal force. This rotating oil-pipe is held in a bearing located under the burner. An agitator at the bottom of the cup keeps the oil constantly emulsified.

Dirt, water, and other substances are separated from the oil during its passage upward through the cup, according to their specific gravities. The oil next passes over the atomizer into the firebox. The dirt, water, and other substances that are heavier than the oil constantly pass off under the oil and are consumed. This constant treatment of the oil eliminates all possibility of dirt accumulating in the pipe system.

The only place where any dirt can collect is on the convex curve of the atomizer bell, and this is cleaned by the simple process of drawing a small steel poker over the bell surface while the machine is in operation. A small size burner need not be cleaned oftener than once in two weeks, while a commercial burner may require cleaning once a week. The cleaning operation can be done in less than a minute while the fire is burning. As the oil leaves the bell-shaped atomizer it is thrown by centrifugal force into the firebox.

* * *

ELECTRIC ARC WELDING WITH CARBON ELECTRODES

In the first paragraph of the article on electric arc welding, appearing on page 1051, July MACHINERY, it is stated that the weld obtained by ordinary electric arc welding with carbon electrodes is so hard that it cannot be machined. This statement is erroneous. Carbon arc welding has been done in many steel foundries with a great degree of success, and, if the welding is properly done, little or no difficulty is encountered from the hardness of the weld.

* * *

Of the machine tools exported from Germany in 1920, 20 per cent went to Holland, 15 per cent to Switzerland, and 15 per cent to France.

The Metal-working Industries

THERE has been little change in conditions in the metal-working industries, but what has developed has been for the better. A greater demand for small tools, accessories, and grinding wheels is reported; the pig iron output shows an increase after nine months of steady decline—a rather certain and accurate indication of improving business in the metal-working field. The railroads are reporting decidedly better net earnings than in the past, and there is a tone of confidence in business in general that should not be overlooked. The credit situation has improved, and bankers, business men, and manufacturers alike agree that the lowest point of the depression has been passed and that improvements have taken place in many directions.

The Machine Tool and Small Tool Industry

In the machine tool field this improvement has as yet been but little felt, because there will be no appreciable buying of machine tools until the industries are working at greater capacity; but that many of the plants in the machine shop field have started to work is indicated by the demand for taps, reamers, milling cutters and drills, which has increased considerably during the past month. Some of the small tool plants are doing a business equivalent to from 25 to 35 per cent of capacity, and one shop reports doing a monthly business equal to the average monthly business for 1916. The manufacturers of grinding wheels report a similar condition—the demand having improved—and while orders are still small they are numerous. Business in hacksaws is reported to be quite satisfactory. In the machine tool field also, somewhat better conditions are reported by several dealers. The buying in general is done by small shops taking the cheaper types of machine tools. Sales of machinery for repair shops and garages have been unusually good, considering conditions. The second-hand market is quite active, particularly in the New England states. The foreign market for machine tools shows little or no improvement, although there has been a greater number of inquiries during recent weeks.

The most serious aspect of the situation is doubtless the large stocks on hand in the machine tool and the small tool fields. It will take considerable time to reduce these stocks to normal, and in many instances the stock manufactured from high-priced raw materials and with labor at peak rates will have to be sold at considerable reductions, in some cases involving distinct losses.

According to the monthly review of the Federal Reserve Bank, the situation in the molding machine line, foundry supplies and hoisting machinery shows improvement, even though slight. The lowest point of the depression in these lines appears to have been passed.

Prices of Materials

Pig iron, being the basic raw material, represents, both as regards production and price, an index to the situation in the entire machine shop field. The price of pig iron seems now to have been stabilized at from $19 to $21 per ton, at base points, for different grades. A year ago these prices were from $46.50 to $50 a ton. The pre-war price was from $14 to $15 a ton. Steel billets previous to the war averaged about $25 a ton, and are now $29 a ton. Prices of structural steel and bar steel have been reduced in the past year and now compare with pre-war prices the same as pig iron and steel billets. But tool steel is still quoted at only 15 per cent below the peak price, and manufacturers of small tools are complaining about this, as it makes it impossible for them to reduce the prices of their products in proportion to the reductions taking place in other fields. The railroads also suffer from high prices of steel rails. Previous to the war the price was $28 per ton, but it is now $47, notwithstanding the fact that steel billets are only 16 per cent above the pre-war price. Lower rail prices aid the railways, and anything that aids the railways would aid, directly or indirectly, all the industries of the country.

The Automobile Industry

The production of the Ford factories broke all previous records during the month of August with a total output of 117,696 cars and trucks. The automobile industry continues to hold its own in spite of the prophecies to the contrary earlier in the year. The Studebakers production for August was also a record for that concern—8642 cars. The business of the Reo Co. for the same month has been surpassed only three times since the company's organization. All the automobile companies cannot report as favorable conditions, but on the whole the situation is much better than was expected during the earlier months of the year.

Reports from the automobile truck industry vary. One prominent manufacturer states that his orders for the month of July showed an increase over the corresponding month last year, which is the most encouraging report in this field since the beginning of the depression; but another manufacturer finds the truck business practically stagnant. Some of the 75,000 trucks which the Government sold last year in foreign countries were bought by speculators and have been returned to this country for marketing. This has increased the difficulties of both manufacturers and dealers.

The rubber industry has shown a steady improvement during the last few months, and many plants have almost reached capacity production. The industry in general is estimated to be running at approximately 80 per cent capacity, the peak having been reached about August 1, with a slight falling off since then.

The tractor and agricultural machinery business is still suffering from a severe depression, as farmers are repairing old rather than buying new equipment. The farm implement business is estimated at between 50 and 60 per cent of the business a year ago with large stocks on hand. Prices have not been materially reduced.

General Business Conditions

There are many indications of increasing industrial activity. The demand for coal is better, and there is an increase in the inquiries for iron and steel. Copper, after a serious decline in price, has advanced somewhat, and building materials are in greater demand. Bradstreet's reports are distinctly encouraging, showing an expansion of the jobbing trade and a great improvement in textiles, as compared with the earlier months of the year. The woolen industry, which in January was running at only 30 per cent capacity, averaged 80 to 90 per cent on July 1, with still further improvement reported since then. Some of the New England woolen mills are reporting day and night shifts. The improvement in the railroad situation is perhaps the most noteworthy. The deficit from which the roads suffered earlier in the year has been turned into a substantial surplus, so much so that the net revenue now almost equals the average for the three years ending June 30, 1917, which is considered the most prosperous period in American railroad history. This showing is all the more remarkable as the high freight rates have diverted much transcontinental traffic to the Panama Canal route.

NEW MACHINERY AND TOOLS

THE COMPLETE MONTHLY RECORD OF NEW AMERICAN METAL-WORKING MACHINERY

The New Tool descriptions in MACHINERY are restricted to the special field the journal covers machine tools and accessories and other machine shop equipment. The editorial policy is to describe the machine or accessory so as to give the technical reader a definite idea of the design, construction, and function of the machine, of the mechanical principles involved, and of its application.

Lees-Bradner Gear-tooth Grinding Machine

For use in the production of hardened gears to insure accuracy of profile and spacing of teeth and an equal degree of precision as regards the concentricity of the bore with the pitch circle, the Lees-Bradner Co., Cleveland, Ohio, has developed a No. 10 gear-tooth grinding machine. In using this equipment, it is unnecessary to exercise special care in cutting the teeth or boring the hole. After the blank has been turned and bored and the teeth cut, the gears are hardened. Then the bore is rough- and finish-ground and the preliminary and final grinding operations are performed on the teeth. Owing to the fact that the bore is ground first, all grinding operations on the teeth are controlled from the bore and the teeth are thus ground true and concentric with the bore. Before entering into the details of the construction, attention is directed to Fig. 1 which shows the machine from the front, and to Fig. 2 which illustrates one end. The machine is adapted for grinding involute-tooth spur gears having pressure angles of from 14½ to 24 degrees, of any diametral pitch from 12 to 3, and of any pitch diameter from 2 to 12 inches. A 30-inch grinding wheel is employed, the wheel being mounted on a stationary column, and the work traversed past it by a slide having a reciprocating action. The work is given combined rotary and sliding motions in order to obtain the desired tooth profile as ground by the wheel

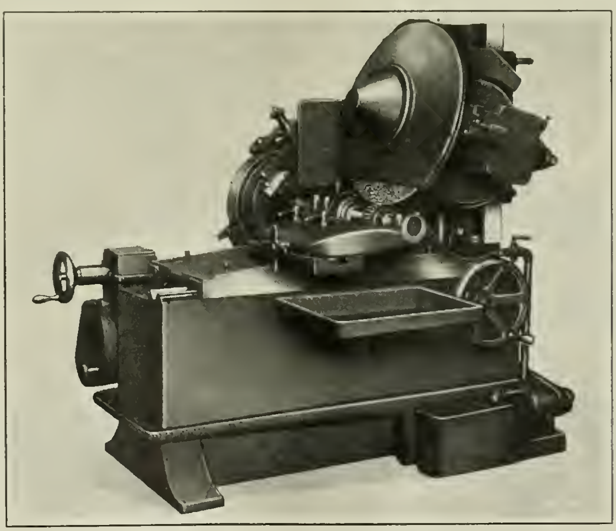


Fig. 1. Gear-tooth Grinding Machine developed by the Lees-Bradner Co.

face. A circular segment is used in conjunction with steel tapes or bands to obtain this combined sliding and rolling action. The segment can be modified in various ways to obtain any desired change in the tooth profile.

Truing and Driving the Grinding Wheel

A diamond which is lever and screw-controlled is used to true the face of the grinding wheel. The diamond is mounted in a ball socket container which can be swiveled to any angle, thereby permitting the diamond face to be used on all its edges. This container is locked into the arm, which is both power- and hand-controlled so that either a fast spiral cut or a slow continuous cut may be taken on the wheel face. The dresser is carried by the main swivel-head casting, which always locates the diamond point in one plane, and the adjustment is made endwise of the wheel when taking a dressing cut. The truing device is used in conjunction with the wheel-spindle micrometer feed.

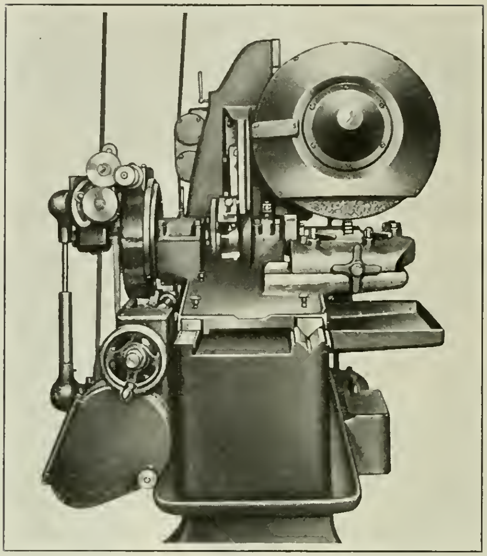


Fig. 2. End View of Gear-tooth Grinding Machine

An endless belt drives the wheel-spindle, this belt being guided by two idler pulleys at the rear of the machine and carried in a bracket having a sliding adjustment on the column to suit any diameter of gear being ground. The machine is driven by a single belt from a lineshaft, but a motor drive may be substituted when desired. Indexing of the work is accomplished by means of hardened and ground plates secured to the work-spindle and completely enclosed. These plates are made by the Warner & Swasey Co. who has a very accurate machine for work of this kind. The indexing is automatic and takes place at one end of the slide reciprocation. The wheel is set to the proper angle by means of a worm and segment on the swivel-head. A pump and connections supply coolant to the point of contact between the grinding wheel and the work. The latter can be held between centers or on a mandrel having a tapered shank to fit the work-spindle and supported at the outer end by the tailstock as shown in Fig. 3. In this illustration *D* indicates the mandrel, and *E* the work.

Means of Obtaining Generating Motion

On this machine power is not applied directly to the work-slide, but to a sleeve in which the work-spindle rotates while indexing. When the machine is grinding, the sleeve and spindle rotate together as one unit. The sleeve carries the segment to which one end of each tape is fastened. The other end is secured to a bracket on the column; accordingly, when the sleeve is rotated first in one direction and then in the reverse direction, the tapes wind and unwind on the segment, and, through their pulling action on the bracket, cause the work-slide to reciprocate. This arrangement is shown in Fig. 4. A uniform torque load is transmitted to the work-spindle by a worm and worm-wheel, the primary function of which is to rotate the sleeve in the reverse directions. There is also a uniform load on the tapes, due to the fact that the frictional resistance of the work-slide on the ways is kept constant by gravity alone. The relation of the grinding wheel face to a gear tooth is illustrated in Fig. 5. The plane face of the grinding wheel has a continuity of action with the gear tooth being ground.

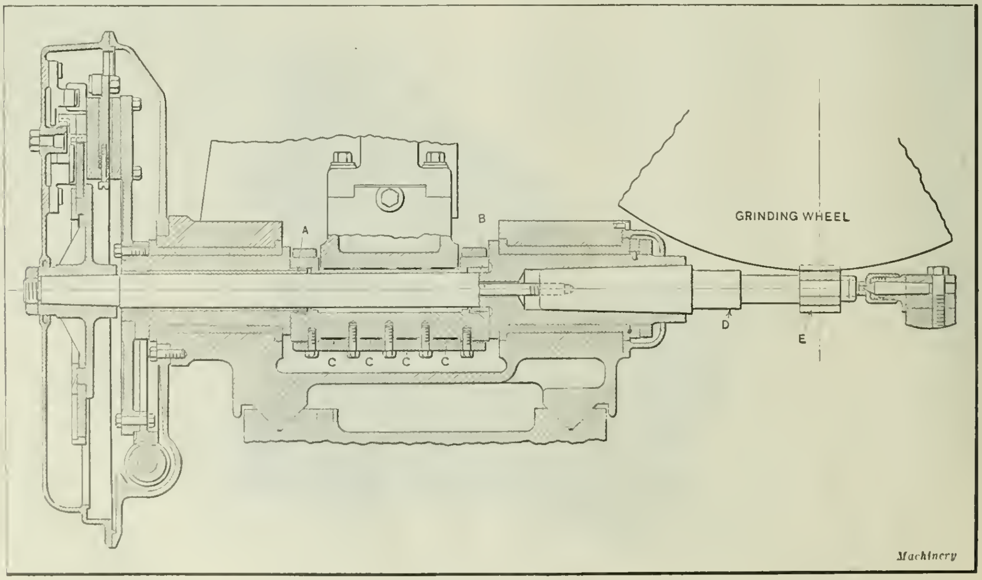


Fig. 3. Longitudinal Sectional View of Work-spindle

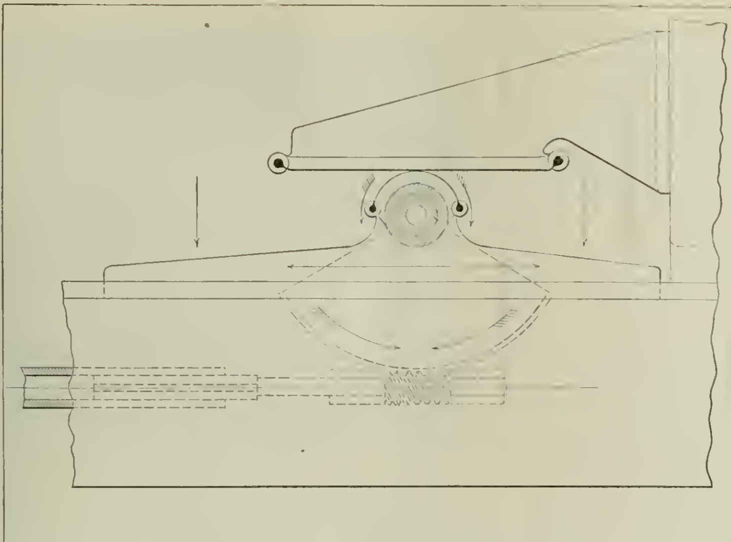


Fig. 4. Segment and Tape Principle of operating Work-slide

Fig. 5. Position of Wheel

How the Tapes and Segment are Mounted

The flat surface *A*, Fig. 3, of the grinding sleeve is utilized not only to drive the segment, but also to locate it in the correct relation to the spindle axis. There is also a support for the other end of the segment. This support is mounted so that it can rotate on the work-spindle, and has a flat locating surface *B*. Surfaces *A* and *B* are used as initial locating points for the radii of the segments, and should any modification of a radius be required, it is made by inserting or taking out metal shims at these points. The tapes are indicated by the letters *C*. They are all the same length and are placed in position loosely, both on the tape-bar and the segment. At the time of tightening up, an independent end adjustment of the tape-bar is used to move the tapes endwise, and in this way rotate the segment to its vertical position for the original set-up. A zero mark is placed on the bar and on the sleeve to facilitate obtaining this position.

The tight and loose pulley drive is so located that the driving belt can be used at any angle without interfering with the operation of the machine. The main shaft drives the gearing in a reverse feed-box in which speed-change gears are used to obtain the number of strokes per minute required of the work-slide. The length of the slide travel is regulated by a trip-dog located inside the gear-case. A starting and stopping lever controls the slide travel, and this is operated from the front of the machine. Hand adjustment of the slide is secured by means of a handwheel. A belt-shift lever is provided for the tight and loose pulleys, for starting and stopping the machine.

A section through the wheel-spindle is shown in Fig. 6, in which *F* indicates the spindle, and *G* the grinding wheel. Pulley *H* at the center of the spindle furnishes the drive. A micrometer adjustment is obtained by means of the worm and worm-wheel mechanism *J* which actuates a screw fastened to the sleeve in which the spindle is mounted. It will be seen that the spindle is mounted in ball and bronze bearings. End thrust of the spindle is taken by a raised shoulder *K* on the spindle, this shoulder being interposed between two ball bearings that are adjusted by cap-screws on the outer side of the flanged end cap The taking up of the end thrust bearing at this point eliminates any displacement through heat acting on a long bearing and creating either play or tightness.

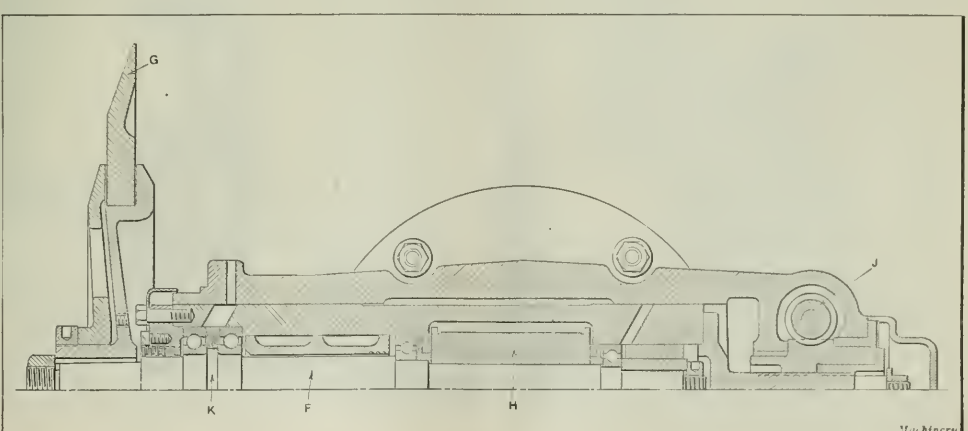


Fig. 6. Longitudinal Sectional View of Grinding Wheel Spindle

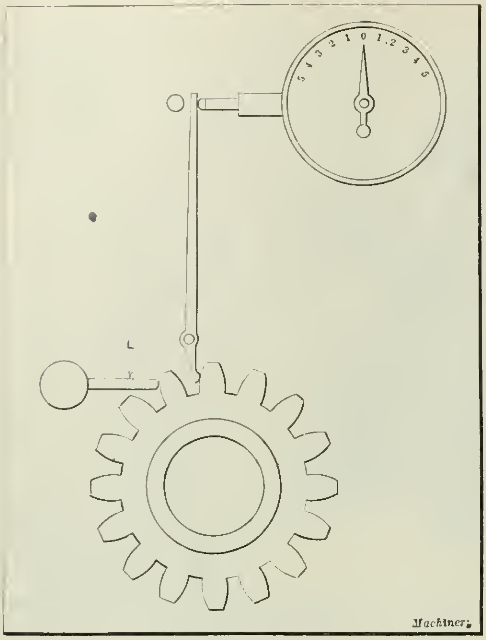


Fig. 7. Device used in testing Spacing of Gear Teeth

Operating the Machine

In operating the machine, the procedure is as follows: A segment corresponding to the pitch diameter of the gear to be ground is located on the work-spindle. The grinding wheel is set to the pressure angle of the tooth to be ground, and the wheel-head is raised to the proper height for the wheel to cover the working depth of the tooth. The wheel is then dressed. Two positive stop-pins located in a circular T-slot are used in conjunction with a positive stop to locate the wheel in the starting and finishing positions, and an intermediate spring stop is used in taking the roughing cut. The starting stop is usually set for the grinding of 0.004 inch from the gear teeth. The work is then locked on the arbor with a tooth in contact with the wheel. When the machine is started, the roughing cut is first taken, the grinding wheel being located by the spring stop to cut 0.003 inch from each tooth. Then the micrometer adjustment feeds 0.001 inch to the finishing stop, in this way removing the 0.004 inch allowed on the teeth for grinding. This movement brings the wheel back into the generating plane and into the position in which it was dressed. The wheel is generally redressed after the grinding of every two gears, and about 0.0004 inch is removed from its face. The dressing is accomplished by an independent feed to the micrometer, so that the starting and finishing stops need not be disturbed.

Modifying the Ground Tooth Form and Testing the Spacing of Gear Teeth

Thus far it has been assumed that perfect tooth profiles are required, but it is a matter of general knowledge that gears are not always used in machines having perfect alignment and accurate center distances, and which are free from other inaccuracies. Consequently the gears may need to be modified, or in other words, the profile changed to suit conditions. As previously explained, the modification of the profile is made by raising the segments by means of shims.

The method of measuring gear teeth for indexing is done by means of the device illustrated in Fig. 7 in which the gear is placed on a stud and a tooth turned against a positive stop *L*. The indicator is set to zero, after which the gear is indicated tooth by tooth, and if the reading remains at zero each time, the gear is perfect. Angular errors are recorded plus or minus by the indicator in increments of 0.0001 inch.

PAWLING & HARNISCHFEGER BORING, DRILLING AND MILLING MACHINES

A new line of horizontal boring, drilling and milling machines, of which the No. 4-F machine shown in Fig. 1 is the smallest size, has been developed by the Pawling & Harnischfeger Co., 38th and National Aves., Milwaukee, Wis. These machines are especially designed for heavy milling and large boring operations, and can be used either as single-purpose machines or for general machine shop work. Among the features of the design are narrow guiding surfaces, take-up for all sliding parts, centralized control, and interchangeability of externally and internally driven faceplates. The back-gears are close to the spindle, and all driving shafts run at a high speed. Automatic stops are provided for the saddle and column of electrically driven machines. The column may be moved transversely on guides on the base by means of a screw. It may be traversed either forward or backward, by hand, power-feed or rapid traverse. The motor for driving the machine is located at the left-hand side of the column. The runway for the column is of a deep box section and is heavily ribbed.

The spindle saddle contains the drive for the spindle, the feeding mechanism, and the feed distributing mechanism. The main spindle sleeve bushing is made of phosphor-bronze, and is scraped to a slight taper so that wear of the sleeve may be readily compensated for. The saddle is guided on the column by a narrow guide located at the front. The feed-screw is located at the center of this guide. The saddle is counterbalanced by a weight inside the column, and is raised or lowered by a worm-wheel nut actuated by a screw. The raising or lowering of the saddle may be accomplished by hand, power-feed, or quick traverse.

The spindle is made from a high-carbon hammered alloy steel forging, and is ground to a sliding fit in the driving sleeve. Power is applied at the front end of the spindle while it is fed from the rear end through a rack and pinion.

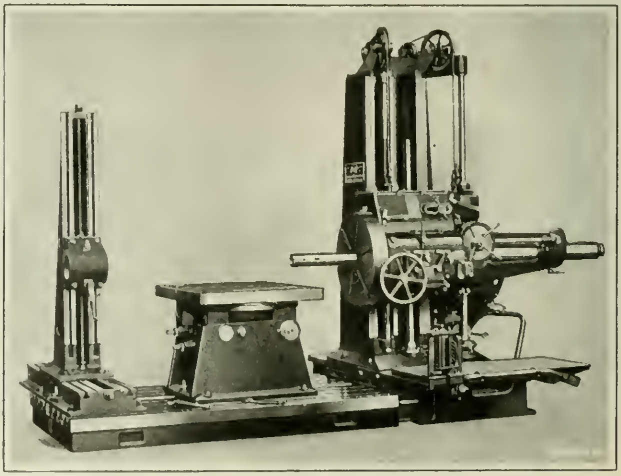


Fig. 1. Boring, Drilling, and Milling Machine built by the Pawling & Harnischfeger Co.

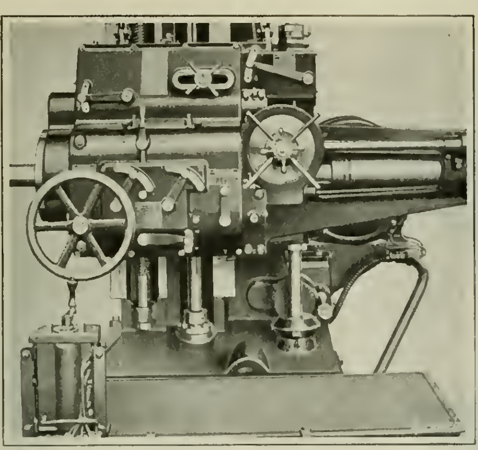


Fig. 2. Close-up View showing the Operating Levers arranged on the Saddle within a 42-inch Circle

The front end has a No. 6 Morse taper socket, and contains the necessary slots for driving milling cutters and boring-bars. The drive is transmitted to the spindle either through a small faceplate with a wide-face, coarse-pitch gear or a larger faceplate with an internal gear of coarse pitch and wide face. These faceplates have slots and tapped holes to provide for the attachment of milling cutters and facing heads. The feed of the spindle on this machine is 36 inches; the minimum height of the spindle from a 9-inch bedplate, 25½ inches; and the maximum height, 73½ inches.

The machine may be driven by a 10-horsepower constant- or variable-speed motor or by belt. The machine is double-back-geared and, through the operation of three levers, eighteen reversible spindle speeds in geometrical progression, ranging from 5½ to 200 revolutions per minute, can be secured. The boring and drilling feeds to the spindle are eight in number, reversible, and range from 0.0076 to 0.45 inch per revolution of the spindle. There are also eight reversible milling feeds to the column and the saddle, ranging from 0.009 to 0.54 inch per revolution of the spindle. The saddle and column have a rapid power traverse of 60 inches per minute.

All operating levers and handwheels are within easy reach of the operator and are conveniently arranged for the various operations. All levers are interlocking so that the engagement of two conflicting speeds or feeds at the same time is impossible. The work bed is provided with planed T-slots running parallel to the direction in which the spindle traverses. A planed squaring strip for aligning work is provided on three sides of the bed. The latter can be made to any desired size. The outer support, unless otherwise specified, has vertical and transverse movements of 48 inches. Graduated verniers reading to 0.001 inch are furnished for the main column and saddle and the outer support and saddle. A screw chasing attachment for cutting threads varying from 2 to 16 per inch and to any length within the capacity of the machine, can be furnished. A universal tilting and revolving table or a plain revolving table with movement by hand or power can also be furnished. The No. 4-F machine without bedplate, outer support, tables or electrical equipment, weighs about 17,000 pounds.

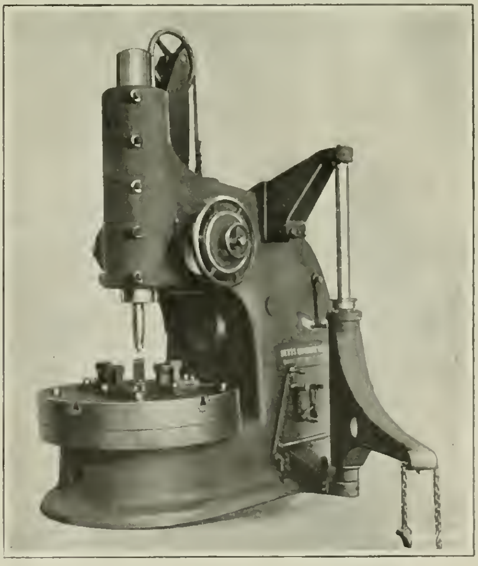
POLLARD WORK-BENCH

A small work-bench designed for use in garages and by mechanics at home is now being placed on the market by Pollard Bros., 4034-4036 N. Tripp Ave., Chicago, Ill. The top is made of selected heavy Norway pine. The legs are constructed of 1¼-inch angle-irons, each pair of legs being joined by three cross-braces welded together The legs are punched for fastening to the floor. Two 3-inch flat steel bars bolted to the legs act as stringers, and eliminate any side or end sway. A large drawer, independent of the top and sliding on angle cross-braces welded to the legs, is furnished. A semi-steel machinist's vise with 3-inch tool-steel jaws having a 4-inch opening, is mounted on the bench. The bench top is 33 inches above the floor, 44 inches long, and 16 inches wide. The drawer is 23½ inches wide, 15½ inches from front to back, and 5 inches deep. A recess at the rear of the top will hold tools, nuts, bolts, etc. The weight of the bench complete, equipped with a vise, is 65 pounds. The wooden portions are shellacked, and all metal parts are painted black.

BETTS CAR-WHEEL BORING MACHINE

A 52-inch car-wheel boring and facing machine has been added to the line of heavy railway machines manufactured by the Betts Machine Co., 400 Blossom Road, Rochester, N. Y. This machine is intended to cover the requirements of both manufacturing and repair shops. The bed and frame are one massive casting, and the entire machine is designed to withstand high stresses. Special attention has been given to simplicity of operation. The machine may be driven by a single pulley or by being direct-connected to a constant- or variable-speed motor. The necessary speed changes to given faceplate revolutions of 10.2, 13.9, 20.4 and 30.7 per minute are obtained by means of hardened sliding steel gears running in oil. The two short levers seen on the frame in the accompanying illustration are used for obtaining the four speed changes. These levers are interlocked so that no two sets of gears can be placed in mesh at the same time.

The table revolves on a wide bearing and has a large spindle running in a bronze-bushed bearing. This spindle is provided with a locking collar at the lower end to prevent it from lifting. The table is equipped with a five-jaw chuck that is both universal and independent, and is readily adjustable for wheels of any size within the range of the machine. Five stations are provided for operating this chuck so that one of them will be convenient to the operator, regardless of where the table is stopped. The long lever seen



Railway Car-wheel Boring Machine built by the Betts Machine Co.

just to the right of the table is used for operating a friction clutch and brake, whereby the machine may be started and stopped instantly.

Six automatic boring and facing feeds are obtained by means of a two-step cone pulley and sliding steel gears so arranged that the feeds can be changed instantly from roughing to finishing. The boring ram has an easy hand adjustment that is facilitated by a counterweight within the machine. When so desired, the machine can be equipped with a facing ram on which the facing head is supported close to the cut. This ram is of such construction that it can be slid out of the way when chucking wheels of large diameter. The machine is regularly equipped with a quick-acting air-operated crane for loading and unloading the car-wheels. This crane can also be arranged to be driven by an individual motor or by belt. All control levers and the hand adjustment of the boring ram are within easy reach of the operator from one position.

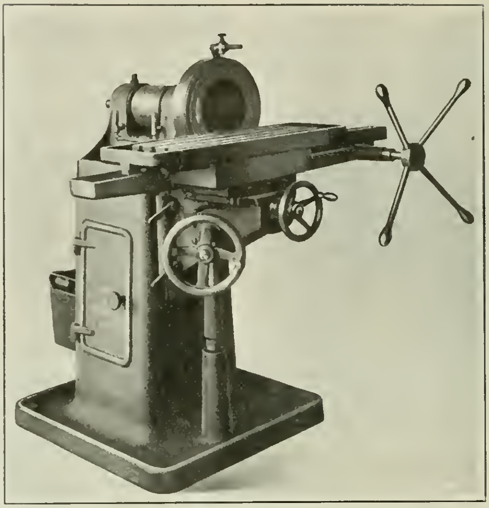


Fig. 1. Knee-type Ring-wheel Grinding Machine brought out by the Graham Mfg. Co.

GRAHAM RING-WHEEL GRINDING MACHINE

The knee-type ring-wheel grinding machine illustrated in Fig. 1 was recently developed by the Graham Mfg. Co., 71 Willard Ave., Providence, R. I. The abrasive wheel has an outside diameter of 12 inches and a hole 7 inches in diameter, so that the face is 2½ inches wide. The thickness of the wheel when new is 3 inches, and it can be worn to a thickness of about ½ inch. The wheel is held in place by a pressed-steel holder, manufactured by the same concern, which was described in May, 1909, MACHINERY. The construction of this holder can be seen by reference to Fig. 2, which shows a sectional view of the wheel-head. The ring-wheel is clamped in this holder by means of a cone-shaped ring that is drawn into an internal tapered surface in the body. An adjustable flange which screws on the hub of the holder is employed to advance the wheel as the latter becomes worn, and it is an easy matter to remove a worn ring.

After the wheel is in place it can be easily trued up and the cutting face reduced to any desired width. A holder for commercial truing devices is supplied, which is fastened to the table. The machine may be driven by a belt from a countershaft as provided for on the machine illustrated, or it may be driven by a motor, mounted on a bracket at the back of the machine and attached to the rear end of the wheel-spindle by means of a flexible coupling. The machine may also be driven by belt from a motor mounted on a bracket on the right-hand side of the column, or one placed inside the column and belted upward. A fifth driving method is by means of a motor built into the head.

The column has cast ledges on the inside to provide for shelves; however, the space may be used for a starting box. Water is supplied to the work by means of a No. 2 B. & S. centrifugal pump, fastened to a tank at the rear of the machine, the water being applied to the work through a nozzle fastened to universal pipe joints. The head is cast separately and is provided with bushings for holding the outer races of the Timken roller bearings with which the spindle is equipped. In order to reduce end play to a minimum, the rear bushing is a close sliding fit in the head and is pushed by means of a coil spring, in the proper direction to automatically take up all end motion and wear. Further adjustment is attained by means of a castellated nut and cotter-pin. The spindle is made of tool steel and is provided at the front end with a collar shrunk on and machined to

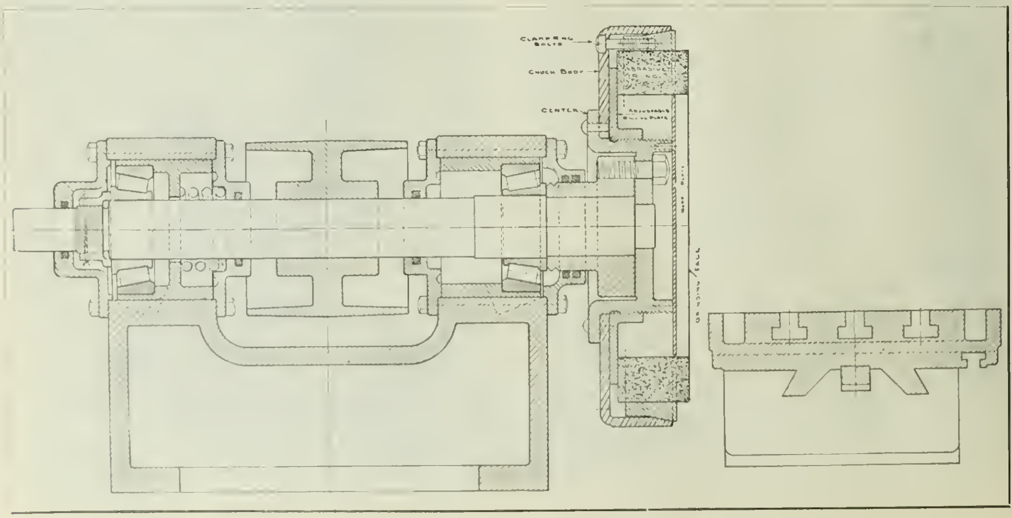


Fig. 2. Sectional View through Wheel-head of Ring-wheel Grinding Machine

accommodate the ring-wheel holder. Felt-packed dust collars protect all running parts on the head, and glass oilers indicate the amount of lubricant in the bearings.

The knee is of box construction, and is adjusted by an elevating handwheel set at an angle. A water trough is machined and fitted to the knee. The table block rests on the knee and is gibbed. It is fitted with an adjustable nut for the cross-feed shaft. This nut may be indexed in increments of 0.001 inch and serves to regulate the depth of cut. The table is fed past the wheel by means of a pinion and rack operated by the spider wheel at the right end. The top surface of the table has standard T-slots in it. Sufficient water guards are furnished to prevent the operator from becoming splashed. These guards were removed at the time the photograph reproduced in Fig. 1 was taken, in order that the construction of the machine could be more readily observed. Some of the specifications of this grinding machine are as follows: Height from floor to center of spindle, 42 inches; working surface of table, 24 by 10 inches; maximum travel of table, 16 inches; vertical movement of table, 7 inches; speed of machine, when driven by standard motor, 1780 revolutions per minute; and weight of machine, approximately 2000 pounds.

MONARCH SMALL-SIZE ENGINE LATHES

A line of engine lathes of 9- and 11-inch swing, made in bed lengths of from 2½ to 5 feet, has been brought out by the Monarch Machine Tool Co., 209 Oak St., Sidney, Ohio. These machines are sold under the trade name of "Monarch Junior." A 9-inch lathe provided with bench legs is shown in Fig. 1, while Fig. 2 illustrates an 11-inch machine equipped with a chip pan and floor legs. The headstock of these machines is of the solid full-webbed bowl type, and the spindle is made from crucible steel, accurately ground and having a 1 1/16-inch hole running through its entire length. The spindle is driven through a three-step cone pulley and single back-gears. The latter are locked in and out of position by a ball and spring plunger.

The base of the tailstock is graduated to enable accurate settings for taper-turning, and is so arranged that it can be considerably overhung on the bed to give greater distances between centers. Either a full-quick or semi-quick change-gear box can be furnished. With the former, fifty-four changes of threads and feeds are obtainable. The feed and lead-screw reverses are secured through a lever on the headstock. Reversing is done instantly, while the lathe is running. The countershaft is equipped with Edgemont friction clutches and cast-iron hangers provided with ring-oiled bearings.

The compound rest is gibbed throughout, and has large bearing surfaces. The toolpost is provided with a "Mac-It" non-breakable screw. The lead-screw is tested on a Hartness screw-thread comparator. The carriage is drilled and tapped to receive a taper attachment, chasing dial, or chasing stop. The upper knurled handwheel on the apron has three positions; when thrown to the left-hand position, the longitudinal feed is engaged, when placed in the right-hand position, the cross-feed is engaged, and when placed in the neutral position, the half-nut is engaged. The lower knurled handwheel controls the mechanism that operates both the power cross-feed and the longitudinal feed. The regular equipment furnished includes a double-friction countershaft, faceplate, dog plate, center-rest, follow-rest, centers, compound rest, and wrenches. A taper attachment, draw-in attachment, and other accessories can be applied by a customer without any machine work or fitting.

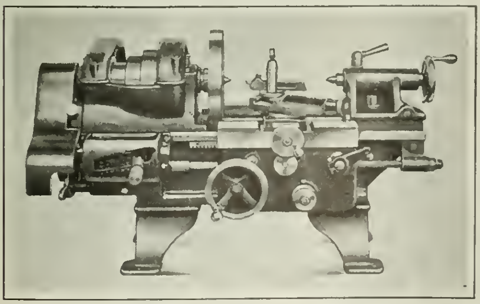


Fig. 1. Small Engine Lathe built by the Monarch Machine Tool Co.

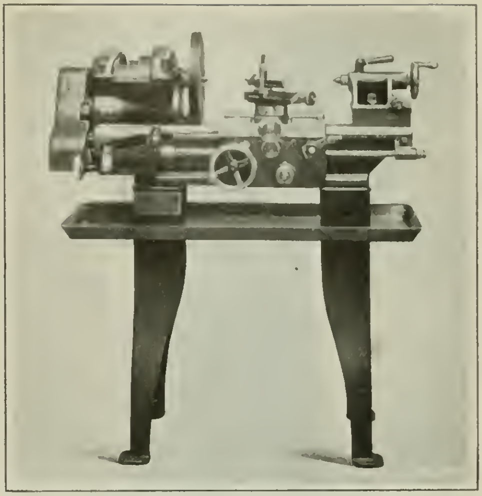


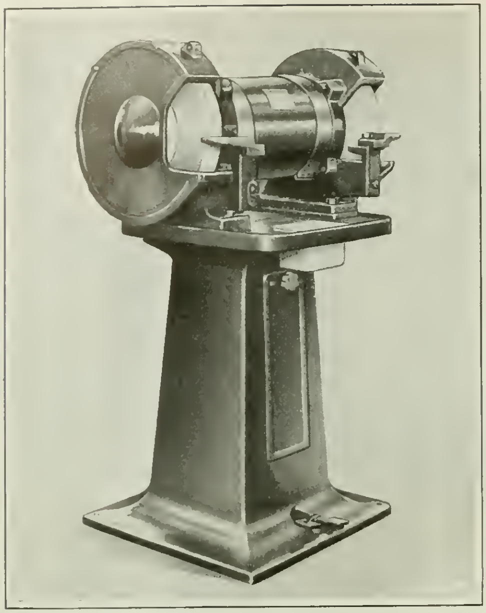
Fig. 2. "Monarch Junior" Lathe provided with Floor Legs and Chip Pan

VAN DORN HEAVY-DUTY GRINDING MACHINE

The heavy-duty ball-bearing grinding machine here illustrated has just been introduced to the trade by the Van Dorn Electric Tool Co., Cleveland, Ohio. It is equipped with two grinding wheels, 14 inches in diameter, and 2½ inches face width. These wheels are mounted directly on the ends of a 1¼-inch motor shaft, and they are quickly changed by removing four bolts and the end flanges. Provision is made on the wheel guards for connection with exhaust ducts when desired, and a lug on each guard permits an eye-shield to be attached. The tool-rest can be conveniently located by horizontal and vertical adjustments. An aluminum water pot is located in the proper position to be reached by a short movement of the arm. This pot may be readily lifted out of place.

The motor was designed especially for this machine, and its rating is 4 horsepower for normal continuous operation, and 7 horsepower for a momentary overload. The standard motors operate on three-phase, 60-cycle alternating current with either 220 or 440 volts, but special windings such as two-phase 60-cycles, or three-phase 50-cycles, with either of the given voltages, are made to special order. The speed of the 60-cycle motors is 1200 revolutions per minute, and that of the 50-cycle motor, 1500 revolutions per minute. The motor is completely enclosed by a dustproof housing which is smaller in diameter than the grinding wheels, so that there is ample space for the operator's hands to move without coming in contact with the machine. Interference when grinding long pieces is also obviated.

Ventilation under all normal conditions is furnished by a fan within the motor, but under conditions of excessive dust a supply of fresh air may be piped to the intake of the housing. The motor shaft is set in large ball bearings rigidly

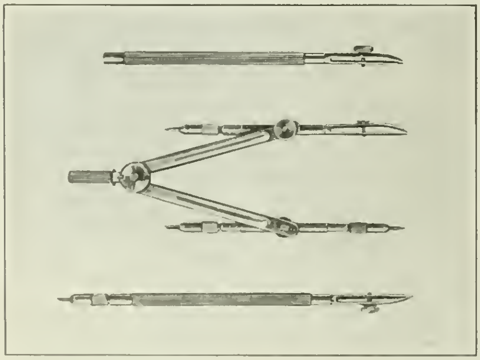


Heavy-duty Ball-bearing Grinding Machine built by the Van Dorn Electric Tool Co.

supported by the housing. Lubrication is accomplished by inserting a grease-gun nozzle in grease ports located directly above the bearings. The pedestal serves as a cabinet for the switch, fuses and connections. The cable conduit enters through a hole at the back, and no wires or electrical appliances are exposed anywhere on the machine. The machine is started and stopped by a pedal switch located at the base of the pedestal. The spindle center is 39 inches above the floor, and the grinding wheels are set 25 inches apart. The machine weighs approximately 700 pounds.

"CYMA" DRAWING INSTRUMENTS

The drawing instruments illustrated are being sold by Edgar Bourquin, 1347 Main St., Waltham, Mass., under the trade name of "Cyma." The ruling pen at the top of the illustration is of the standard type, while that at the bottom is provided with a lead end. The instrument at the center is a combination divider and pen and lead compasses. Either the pen, lead, or divider points may be brought into position for use by swinging the lower legs of the instrument which are pivoted at the center. The legs are clamped in position by tightening a nut at the fulcrum. The divider points may be used for scribing on metal. This combination compass and divider is intended for use as a pocket instrument by draftsmen, machinists, patternmakers, etc.

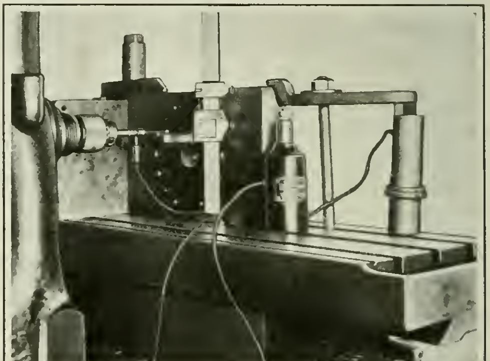


"Cyma" Drawing Instruments

HANSEN "ELECTROCATOR"

An instrument known as the "Electrocator," intended for use in ascertaining the alignment of machine members and in the locating of surfaces or centers for the accurate machining of parts, has been developed by the S. M. Hansen Co., 601 Washington St., Lynn, Mass. The Bely Sales Co. of the same address is the sales agent. When this instrument is used, the previous lay-out of centers is unnecessary, and the use of plugs and buttons is entirely dispensed with. The illustration shows the "Electrocator" being used for locating the center of a hole to be machined in a part mounted on the table of a milling machine.

The ball pointer is held in a chuck inserted in the spindle of the machine, and a vernier height gage is set to the distance that the center of the hole is to be located above the table, allowance, of course, being made for one-half the diameter of the ball end on the pointer. This pointer is connected to an electric light on the member of the instrument shown on the table, which, in turn, is connected to a light socket. When the gaging surface of the vernier gage is constantly in contact with the ball point as the spindle revolves, the light remains lit.

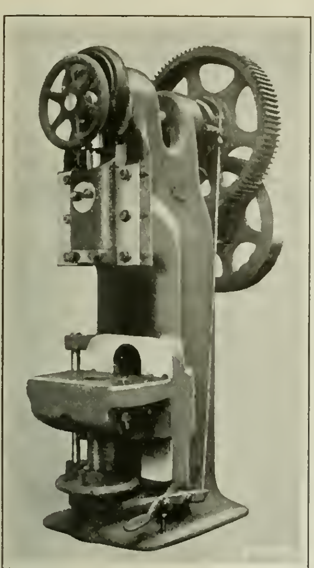


"Electrocator" made by the S. M. Hansen Co., being used on a Milling Machine

The concentricity of round pieces can be readily determined, as the light will go on and off according to the amount that a piece is out of round. The instrument may also be used for testing the alignment of the tables and knees of machine tools and the alignment of a lathe bed with its spindle. The ball pointer can be held in a chuck or clamped to the side of an arbor or boring-bar.

FERRACUTE ADJUSTABLE-BED PUNCHING PRESS

A punching press designed for work requiring a long stroke and an unusual height between the bed and the ram is shown in the accompanying illustration. This machine is built by the Ferracute Machine Co., Bridgeton, N. J., and is equipped with a bed that is adjustable vertically. As the bed and frame are separate castings, it is essential that their connection be strong and rigid, and this condition is obtained by attaching the bed to the frame by heavy steel bolts, and supporting the bed on a steel adjusting screw 4 inches in diameter.

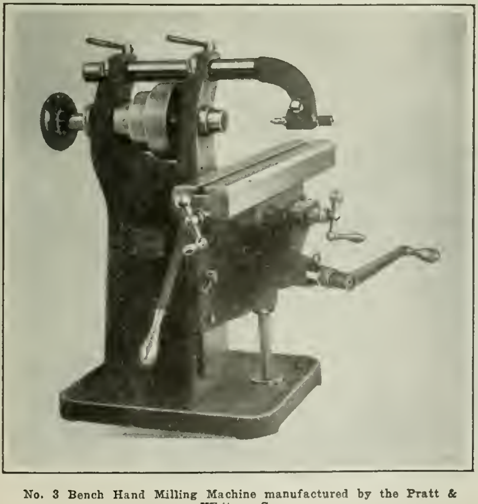


Adjustable-bed Punching Press built by the Ferracute Machine Co.

A projection at the back of the bed fits a planed vertical guide in the frame, and keeps the top of the bed parallel with the bottom surface of the ram at all times. The press may also be used for horning operations by inserting a horn in a 9½-inch hole in the frame. The bed is hinged on a vertical rod at the left-hand side of the machine which enables it to be swung out of the way when the machine is used for horning. The ram has a maximum adjustment of 3 inches, and the bed 9 inches. The distance between the bed and the ram, when the former is adjusted to its lower position and the ram is at the top of its stroke and its highest adjustment, is 30 inches. The ram stroke is 8 inches. The press exerts a pressure of 70 tons, and weighs approximately 13,200 pounds.

PRATT & WHITNEY BENCH HAND MILLING MACHINE

An addition to the line of machine tools built by the Pratt & Whitney Co., Hartford, Conn., is the No. 3 bench hand milling machine here illustrated. The spindle and draw-back on this machine is identical to that provided on the No. 3 bench lathe manufactured by the same concern, and therefore all the spindle attachments of the bench lathe interchange on the milling machine. The table of the latter is of a design suitable for the mounting of attachments and it accommodates the headstock and tailstock of the bench lathe. All screws on the machine are equipped with micrometer dials graduated to 0.001 inch.

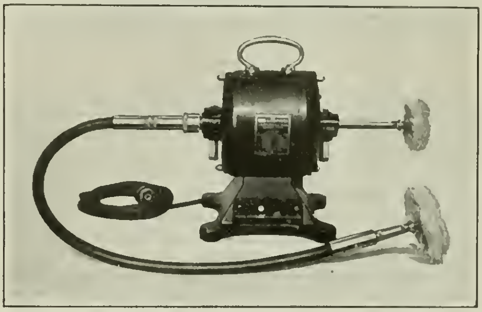


No. 3 Bench Hand Milling Machine manufactured by the Pratt & Whitney Co.

The spindle is made of tool steel, is hardened and ground, and has a conical front end. The front spindle bearing has a double taper, and is also made of tool steel and hardened and ground. A "Non-Gran" bronze bearing is provided at the rear of the spindle. Both bearings are adjustable for wear. The spindle is driven through a three-step cone pulley, which provides speeds ranging from 153 to 1510 revolutions per minute. The special equipment which can be furnished for this machine includes a swivel vise graduated in degrees, an index quill center, a tailstock, arbors for saws, a right-angle adapter, and a vertical milling attachment. The latter is mounted over the spindle nose and is driven by a plug placed in a draw-in collet.

JANETTE PORTABLE BUFFING MACHINE

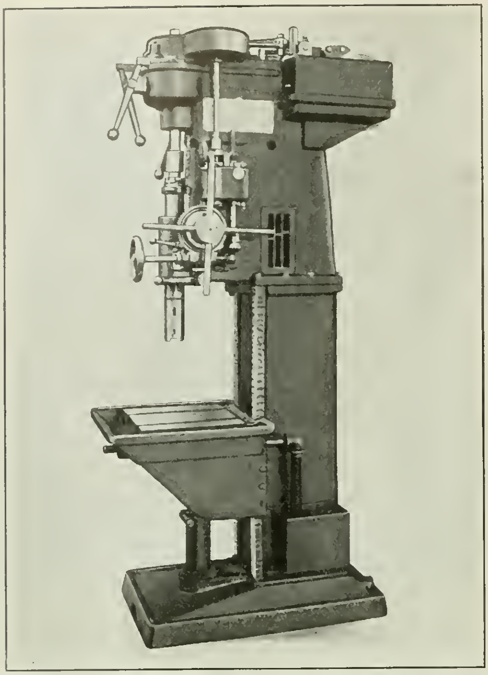
For use in the performance of buffing operations in cases where it is most convenient to take the machine to the work, the Janette Mfg. Co., 556 W. Monroe St., Chicago, Ill., has developed the portable equipment shown in the accompanying illustration. It will be seen that this machine is furnished with two wheels. One of these is mounted at the end of an extension of the armature spindle, and the other is driven by a flexible shaft. This combination assures maximum convenience in handling a wide range of work. The motor is furnished with a 10-foot connection and plug to screw into a lamp socket. The motor develops ¼ horsepower at 3500 revolutions per minute, has a push-button control, and may be supplied for alternating or direct current. With suitable modifications this machine could be adapted for other operations besides buffing.



Two-wheel Portable Buffing Machine introduced by the Janette Mfg. Co.

BAKER DRILLING MACHINES

Baker Bros., Toledo, Ohio, have added the No. 121 single-purpose and the No. 121 quick-change drilling machines to their line of products. These machines are adapted for driving drills ranging from ⅜ to 1½ inches in diameter, and in the general lines of construction are somewhat similar to the No. 217 single-purpose and the No. 314 flexible machines manufactured by the same concern. There are, however, a number of changes and improvements of design, the more important of which will be mentioned in the subsequent description. The No. 121 quick-change machine is shown in the accompanying illustration. The single-purpose machine is similar to this, but the feed-box is provided minus the feed-change gears, shafts, etc. A single-purpose machine can be converted into a quick-change type by the provision of the necessary shafts and gears, which are interchangeable so that they can be assembled without fitting.



No. 121 Quick-change Drilling Machine built by Baker Bros.

Slip change-gears are furnished in addition to the sliding gears to increase the range of speeds, so as to assure the efficient operation of all sizes of drills. This provision also facilitates the efficient use of different sizes of taps. It will be seen that a cabinet is provided in the column to receive these slip change-gears. The introduction of slip change-gears also provides different feeds from those formerly supplied, and so a different dial is provided to correspond with each set of slip change-gears. Attention is called to the convenient arrangement of all operating levers, which are not only centralized, but also located to enable the hands of the operator to move continuously from the highest position downward in shifting levers manipulated with either his right or left hand.

Another feature of the improved design is the casting of the bearing brackets for the tight and loose pulleys integral with the machine column, the pulleys being located directly behind the column. This arrangement is important when it is desired to set machines in gangs, as it brings the control levers on all machines within easy reach of the operator and saves floor space. Simultaneously with the throwing of the belt on the loose pulley, a cam-actuated brake is applied to the tight pulley to bring the machine to a stop quickly. A piston on the spindle rises into a cylinder as the counterbalanced spindle rises rapidly to the starting point after the feed has been tripped. By this means the spindle is quickly returned without occasioning any shock as it reaches the top of its upward movement.

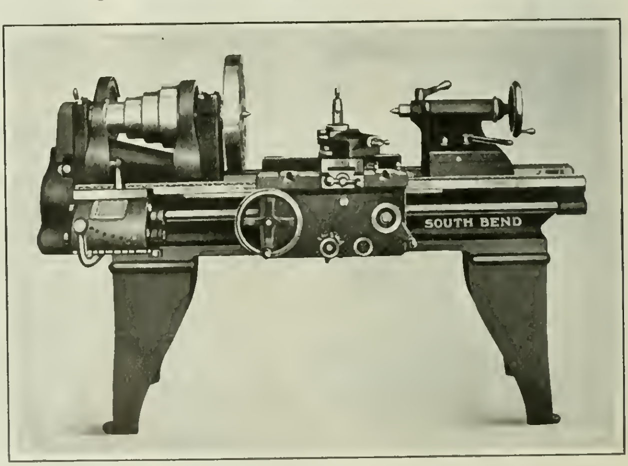
Included in the table-elevating mechanism is a sleeve nut that slides in an auxiliary column. In adjusting the position of the table, the bolt which clamps this sleeve is loosened; then by clamping the table to the main column of the machine and turning the table-elevating crank, the sleeve may be raised or lowered. By tightening the sleeve-clamping bolts and loosening the table-clamping screws, the table is ready to be moved to any desired height. Attention is finally called to the fact that the speed change-gear box is made as a unit which may be readily removed from the column. Ball and roller bearings are provided for the shafts in the speed-box.

ALCORN-BLOCKOUSE HEAT-TREATING FURNACE

An automatic continuous heat-treating furnace of a conveyor type, which is equipped with a combination conveyor for such articles as crankshafts, camshafts, and rear axle shafts, and for miscellaneous small pieces, such as gears, has been produced by Alcorn, Blockouse & Co., 1418 Walnut St., Philadelphia, Pa. The motion of the conveyor is always vertical, so that there is no longitudinal motion in the furnace. The important advantages are a uniform heating of the pieces being treated and the elimination of skilled labor. An increase in fuel efficiency and a decrease in repair and upkeep costs are also claimed. The uniformity of treatment and the reduction in fuel costs are due to the fact that the pieces are suspended above the furnace hearth and, except with flat pieces, are continuously revolved or turned over during the entire treatment. This eliminates spots due to contact with the hearth. The length of treatment is automatically controlled by a variable-speed motor, and the temperature is controlled by Leeds & Northrup control instruments having a temperature recorder. The furnace can be heated by electricity, gas, oil, coal, or any other kind of fuel which will produce the necessary heat.

SOUTH BEND QUICK-CHANGE-GEAR LATHE

The quick-change-gear lathe shown in the accompanying illustration has recently been added to the line of lathes manufactured by the South Bend Lathe Works, 420 Madison St., South Bend, Ind. It is made in eight sizes ranging from 9 to 24 inches swing, and may be provided with either a straight or gap bed. The quick-change gear-box is the same as that provided on Flather lathes, and has forty-eight changes of feeds and threads. These changes are also available for the cross-feed. All gears in the gear-box are made of steel forgings. The index-plate shows the holes in which to insert the plunger for the different changes, and the crank-lever above the box operates an inside clutch.



Quick-change-gear Lathe built by the South Bend Lathe Works

The bed has three vees and one flat way for guiding the headstock, tailstock, and carriage. The headstock is equipped with an improved reverse and a hollow spindle made of special steel and accurately ground. The tailstock is offset to allow the compound rest to be swiveled parallel to the bed, and is provided with a set-over to enable the turning of tapered parts. The tailstock center is self-ejecting. The carriage is provided with T-slots for clamping work to be milled or bored. Both the automatic cross-feed and the automatic longitudinal feed of the carriage are operated from the front of the apron, and but one feed can be engaged at a time. Both feeds are driven by a splined screw and worm so that it is only necessary to use the lead-screw thread when thread cutting.

The compound rest is graduated to 180 degrees, and the cross-feed screw has a micrometer graduated collar reading to 0.001 inch. The regular equipment includes large and small faceplates, graduated compound rest, follow-rest (not included on 9- and 11-inch lathes), adjustable stop for thread cutting, semi-machined chuck-back, gear guards, wrenches, and double-friction countershaft.

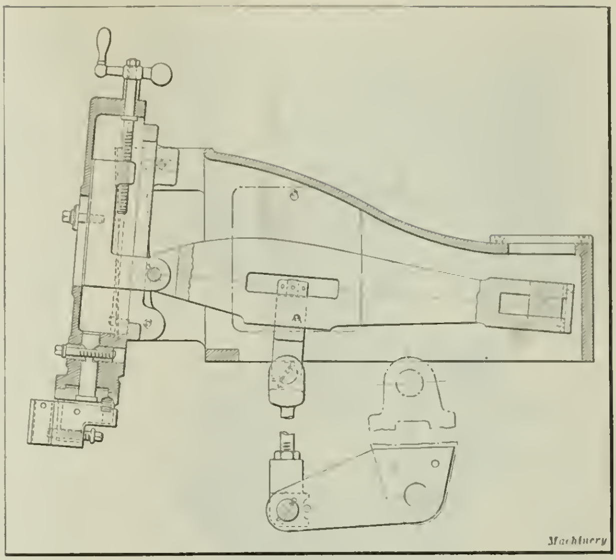


Fig. 2. Details of Vertical Shaper Attachment developed by L. E. Rhodes

RHODES VERTICAL SHAPER ATTACHMENT

To enable operations usually performed on shapers of the vertical type to be done on horizontal shapers, L. E. Rhodes, 51 Oak St., Hartford, Conn., has developed a vertical attachment that can be quickly applied to any of the standard types of crank shapers. This attachment is shown in the accompanying illustrations. The housing which contains the vertical ram and its necessary mechanical parts is made to fit in the ways occupied by the regular horizontal ram. This housing can be adjusted to the desired position with reference to the work, and held in that position by the regular gibs.

The installation of the attachment is a simple matter; practically all that is necessary is to remove the driving arm and attach two steel leg plates which remain on the machine permanently, screw in a connecting-rod, and insert a pin. This attachment is also provided with a rotary work-table equipped with standard index-plates.

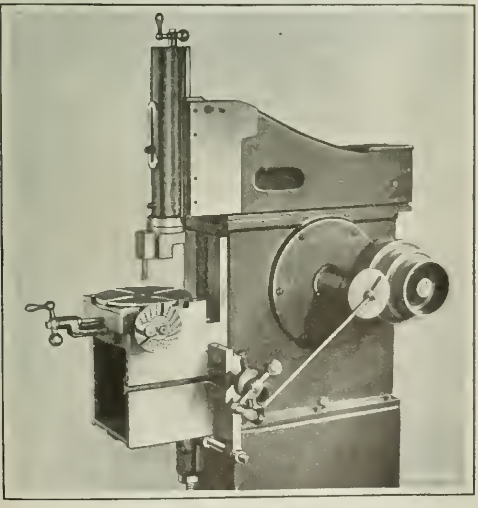


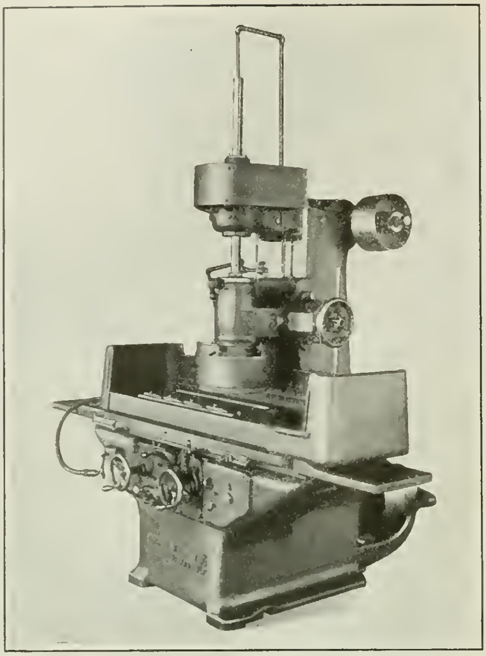
Fig. 1. Shaper equipped with Rhodes Vertical Attachment

PRATT & WHITNEY VERTICAL SURFACE GRINDING MACHINE

The 14-inch vertical surface grinding machine of the movable platen type built by the Pratt & Whitney Co., Hartford, Conn., has had a number of new features incorporated in its design. The ball bearing mounting of the spindle has been completely redesigned, the weight of the wheel unit now being carried on springs set against the upper bearings. This arrangement provides an automatic compensation for wear. The upper section of the mounting is lubricated by oil dripping from regulation oilers through the bearing, and falling into whirling cups which throw it back into the bearing by centrifugal force. In the lower section oil is poured into a large reservoir from which it flows into the upper bearing and runs along the spindle to the lower bearing. The grinding wheel faceplate acts as a retainer, and ribs in this plate continually throw the oil up into the bearing.

The table drive has been strengthened by the use of hardened shafts, gears, and clutches, and is amply lubricated from sight-feed oilers on the front of the case. The entire drive-shaft unit is easily removed through the provision of split bearings. Hand operation of the table has been simplified by the use of a sliding gear on the handwheel shaft in place of a clutch. Smoother reversing of the table is accomplished by means of a dwell in the pinion drive which permits the table to come to a stop before reversal takes place. This eliminates shock and protects the clutch mechanism. The idlers over which the main driving belt runs have been equipped with roller bearings which are lubricated by large grease cups in the ends of the stationary shaft, and the spindle driving pulley is surrounded by a heavy sheet-metal guard.

A series of baffle plates are cast integral with the tank, and these plates are provided with openings alternately at the top and bottom. The solution flows over and under these plates in such a manner that a clean solution is obtained in the last compartment from which it is drawn off by the pump. The motor drive has been improved by mak-

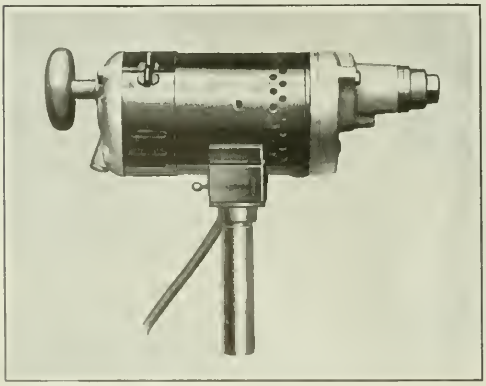


Improved 14-inch Vertical Surface Grinding Machine built by the Pratt & Whitney Co.

ing the motor base adjustable so that the driving belt may be correctly adjusted relative to the steps of the driving cone. The drive for the rotary tilting chuck is now equipped with a flexible coupling, which facilitates the mounting of the unit and the aligning of the driving shaft.

PORTABLE ELECTRIC DRILL

The Electro-Magnetic Tool Co., 2902 Carroll Ave., Chicago, Ill., has recently placed on the market a ½-inch portable electric drill. This tool has been designed to fill the requirements of garages, service stations, small machine shops, etc. A simple inexpensive stand is also made to convert the tool into a small drilling machine and so increase its usefulness. The gears are made of a high-grade steel and are hardened and ground. The spindle shaft is equipped with ball thrust bearings. The tool is controlled by a positive switch. All electrical connections are made in the switch box, the cover of which is removable to permit the reconnecting or changing of lead cords without opening the tool. The commutator may be inspected and the brushes removed by taking off a cover plate.

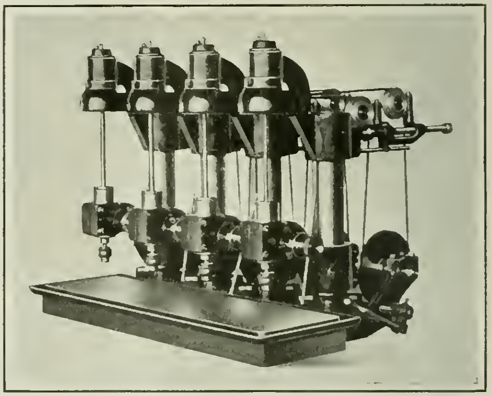


Portable Electric Drill made by the Electro-Magnetic Tool Co.

HENRY & WRIGHT BENCH MULTIPLE-SPINDLE DRILLING MACHINE

A recent development of the Henry & Wright Mfg. Co., 760 Windsor St., Hartford, Conn., is the No. 0 bench multiple-spindle drilling machine illustrated. This machine is equipped with ball bearings and has a two-step pulley in each spindle drive and on the rear driving shaft. These pulleys give four speeds, of which the maximum is 12,000 revolutions per minute, and drive a 13/64-inch drill to the full capacity. The tension on the belt driving each spindle is governed by a spring that can be quickly adjusted to give the proper tension for the size of drill being used.

The lower arm has a vertical adjustment on the column of 6¾ inches, and this, together with a feed of 2½ inches, gives a maximum height of 7⅞ inches from the table to the nose of the chuck. A quick return of each spindle is secured by means of an adjustable flat coil spring connected to the pinion which operates the rack. This spring also prevents the tool breaking when the drilling of a part is completed. The machine is equipped with tight and loose pulleys and a belt shifter. Special attention is given to the alignment of all parts so that high speeds can be maintained. Each spindle is ⅜ inch in diameter, and is provided with a chuck having a capacity up to 13/64 inch. The center distance of the spindles is 7 inches and the distance from the center of each spindle to the edge of its corresponding column is 5¼ inches. The machine occupies a floor space of 26¼ by 33 inches, has a height of 22¾ inches, and weighs about 345 pounds.



No. 0 Bench Multiple-spindle Drilling Machine manufactured by the Henry & Wright Mfg. Co.

WESTINGHOUSE SAFETY MOTOR-STARTING SWITCHES

Motor-starting switches Types WK-30 and WK-55 have been added to the line of electrical equipment manufactured by the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. These switches are of the quick make-and-break knife type, and are completely enclosed, being operated by an exterior handle. The WK-30 switch protects the motor from overloads, both when starting and when running, because it is equipped with thermal cut-outs that open the circuit on dangerous sustained overloads but do not operate under harmless momentary overloads. The cut-outs resemble cartridge fuses, but are not interchangeable with fuses, so that the latter cannot be substituted by error. They operate by fusing a special washer which can be quickly replaced at a negligible cost.

On both switches all parts are enclosed so an operator cannot touch live contacts. The door to the cut-outs or fuses is interlocked with a switch that cannot be opened unless the switch is in the "off" position, when all accessible current-carrying parts are dead. If desired, the door can be padlocked to prevent access by unauthorized persons. It is also possible to lock the handle in the "off" position by three separate padlocks for the protection of those working on machinery controlled by the switch.

MELDRUM-GABRIELSON ADJUSTABLE LIMIT SNAP GAGES

Improved type "Syracuse" adjustable limit snap gages are now being manufactured by the Meldrum-Gabrielson Corporation, Syracuse, N. Y. Style A is shown in Figs. 1 and 2. The measuring pins on these gages may be adjusted to suit conditions, and then sealed over with wax to prevent tampering. The adjusting of the pins to the desired limits is a simple operation. The locking screw *A*, Fig. 2, is first loosened, and the measuring pin set by moving the split adjusting screw *B* either in or out as necessary. By then tightening the locking screw, the split adjusting screw is locked securely in place due to the action of the tapered head of the locking screw. The screw head is then covered over with sealing wax.

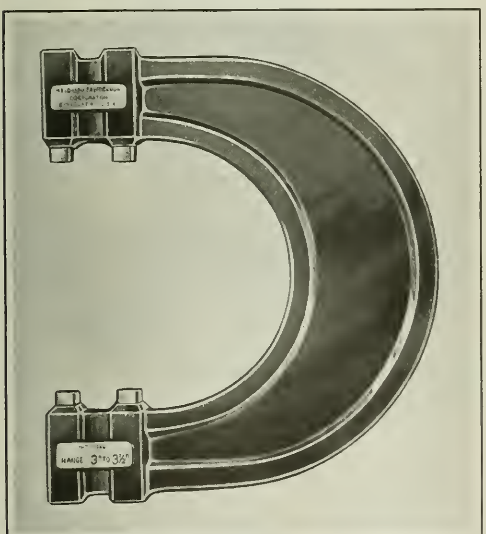


Fig. 1. Style A Adjustable Limit Snap Gage made by the Meldrum-Gabrielson Corporation

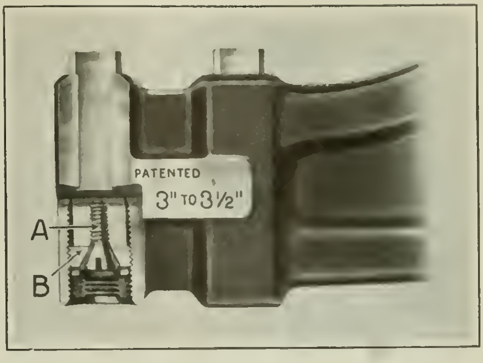


Fig. 2. View showing Arrangement for adjusting and locking Measuring Pins

The gage is provided with square pins, and patents are held on all other styles except round. The pins are made of tool steel, and are hardened and accurately ground to a tight fit. One advantage of a square pin is that it obviates any possibility of a pin turning in its hole. This shape also presents a straight edge to the work. The amount of adjustment possible is sufficient to permit several regrindings and lappings. The frame is made of gray iron, and is reheated to relieve all strains and to season the metal. It is finished in black enamel, baked on.

A gage similar to the one described, but which is provided with rectangular pins for measuring against shoulders is also manufactured. This type is known as Style B. It eliminates the danger of work passing inspection which has an enlarged diameter adjacent to a shoulder. A third type, provided with three pins and intended for use in the closer inspection of parts, is known as Style C. The outer pins of this gage are set to the "Go" dimension, the middle ones to the nominal size, and the inner ones to the "Not Go" dimension. These gages are made in twenty-four sizes, of which the smallest has a capacity of from 0 to ¼ inch, and the largest from 11 to 12 inches.

MARQUETTE EVEN-PRESSURE SPRING CUSHION

In drawing metal shells in dies, it is desirable to have an unvarying pressure during the entire stroke of the press, and in order to produce this uniform pressure, the Marquette Tool & Mfg. Co., 319-331 W. Ohio St., Chicago, Ill., has developed the spring cushion illustrated in Figs. 1 and 2. It is stated that with this device sufficient pressure is obtained at the beginning of the draw to eliminate the wrinkling of the metal and unnecessary wear on the dies. This pressure is maintained evenly at every point of the drawing operation, which avoids the straining of the metal to the breaking point toward the end of the stroke. By eliminating increased pressure at the bottom of the stroke, backlash of the press is avoided.

The cushion is attached to the press by means of a single bolt, which screws into the bolster plate or the die in the same manner that rubber bumpers or coil springs are fastened. No special drilling of the press or bolster is required, and the cushion will fit any ordinary drawing die. When the punch descends on the blank, die pins resting on a plate which, in turn, rests on spring housing *A*, Fig. 2.

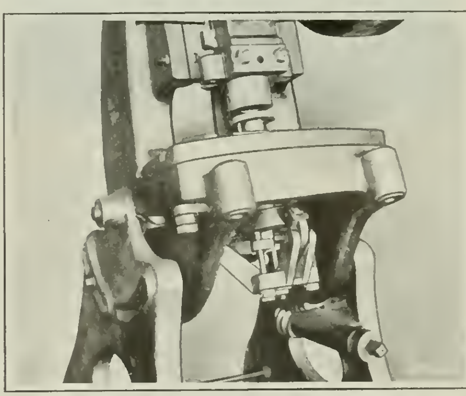


Fig. 1. Even-pressure Spring Cushion made by the Marquette Tool & Mfg. Co.

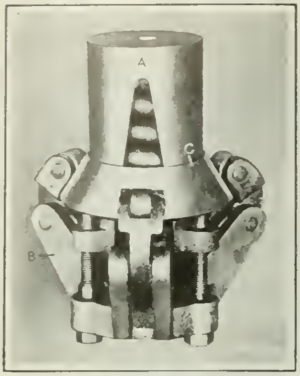


Fig. 2. Detail View of Spring Cushion

force the latter down, compressing the spring against a washer. This washer is carried by the lower ends of equalizing levers *B*. As the spring housing descends, it carries with it adjusting screws which allow the equalizing cam *C* to descend by yielding to the pressure of the rollers at the upper end of the equalizing levers. The angular surface of the cam permits the equalizing levers to swivel about their journals and the spring washer to descend, thereby causing, on a long drawing operation, only a slight compression of the spring. On a 1½-inch draw the compression amounts to only ⅝ inch. The angular surface of the equalizing cam, together with the change in the leverage of the equalizing levers as they swing about their journals during the down stroke of the press, compensates for the increase in the spring pressure made by its slight compression. During the return stroke the same movements take place in reversed order.

NORTON PISTON-GRINDING ATTACHMENT

The Nortou Co., Worcester, Mass., has recently brought out a universal piston-grinding attachment which is to be supplied as regular equipment with this company's auto-part regrinding machine. This attachment facilitates the setting up of a machine for pistons of different makes. It can be used on pistons from 2¾ inches in diameter up to tractor pistons 7½ inches in diameter. The fixture can be set up in less than two minutes.

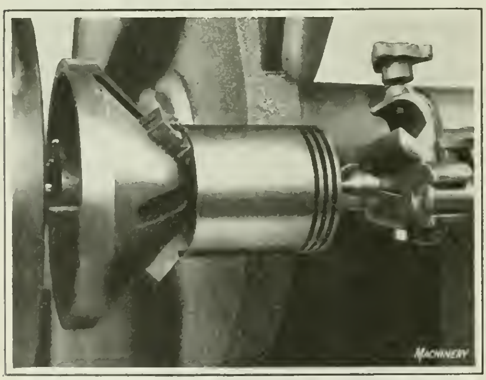


Fig. 1. Piston-grinding Attachment developed by the Norton Co.

In Fig. 1 the fixture is shown in place on a machine. From this illustration it will be seen that it consists essentially of a dead center upon which revolves a cone-shaped member in which three dovetail slots are cut. In each of these slots is mounted a slidable member of hardened tool steel, the upper surface of which is ground to a conical shape. This surface is parallel to the bottom of the slot in the cone, so that the movement of the jaw is along an element of the cone. In each of these jaws is turned a transverse groove, as shown in Fig. 2, which permits the corner of the wheel to travel beyond the end of the piston without interference. The jaws are also slotted longitudinally and locked in place by a taper-pointed screw.

As the surfaces upon which the piston rests are elements of the cone, an accurate setting of the jaws is unnecessary. They are merely set by eye to bring the clearance grooves into their proper positions. The cast-iron cone revolves upon the end of the dead center on a conical bearing, and is driven by the regular drive pin extending from the faceplate of the machine into a cored slot. The piston, in turn, is driven by means of a spline made of a small piece of sheet steel screwed to the side of one of the jaws, as shown in Fig. 2. A shallow slot is filed in the skirt of the piston to engage this spline. In case the maker of a piston does not recommend slotting the skirt, a special driver can be furnished which is adjustable for all sizes of pistons.

The bearing of the cone on the dead center is tapered, and wear is taken up by adjusting a split threaded collar, immediately in back of the cast-iron piece. The slidable jaws can be readily dressed in case of wear by setting the fixture in the adjustable center-grinding attachment which is furnished with the grinding machine. Ample oiling facilities are provided by means of drilled holes leading from the back of the center to the inside of the bearing. The attachment is known as Style No. 509.

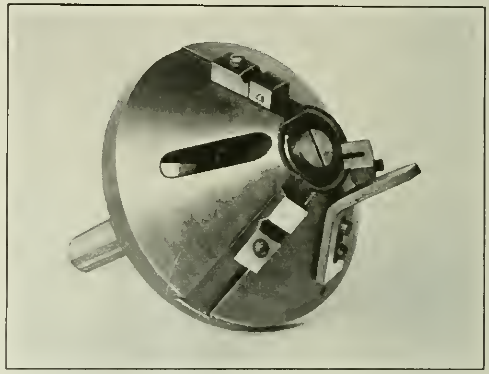
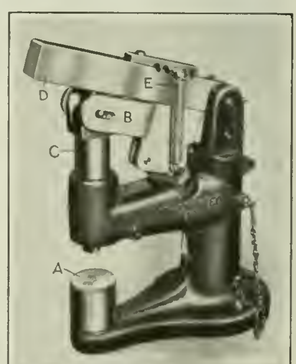


Fig. 2. Close View of Norton Piston-grinding Attachment

GILES TRIP-HAMMER STAKING MACHINE

A machine designed for staking or riveting cupped or drilled rivets, studs, screws, pins, etc., in the assembly of small parts, is now being manufactured by the H. C. Giles Corporation, 303 Cox Bldg., Rochester, N. Y. The machine is particularly adapted for jobs where uniformity of the product is required and where distortion of the work is not permissible. It is operated by foot through a treadle-rod that extends through the bench on which the machine is mounted. This rod is not shown in the illustration.

After placing the rivet or stud, and the parts to be assembled, on the staking block *A*, spindle arm *B*, and consequently spindle *C*, is brought down-



Staking Machine built by the H. C. Giles Corporation ward by operating the treadle, until a certain tension is obtained on a spring pad within the spindle and projecting from the lower end of the latter. When this tension has been secured, a latch in hammer *D*, which has been previously engaged with a stationary dog in arm *B* in such a manner that the hammer and arm are separated, is released. As this occurs, the hammer is pulled downward by two springs *E* which connect the hammer and arm *B*, and strikes a blow upon a pin projecting slightly from the top of the spindle. This pin, in turn, drives the staking set at the lower end of the spindle. A spring in the base of the machine raises the spindle after each blow.

JACKSON VERTICAL-SPINDLE MILLING MACHINES

The accompanying illustrations show improved types of vertical-spindle milling machines built by the Jackson Machine Tool Co., Jackson, Mich., for manufacturing and die-sinking purposes. The machine shown in Fig. 1 is known as the No. 6-A, and has power feeds. A machine known as the No. 5-A is similar to the No. 6-A machine except that the feeds are by hand, the table surface is smaller, and some of the traverses are less. The machines are very much the same as the Nos. 5 and 6 Jackson die-sinkers, but they are not equipped with a cherrying attachment.

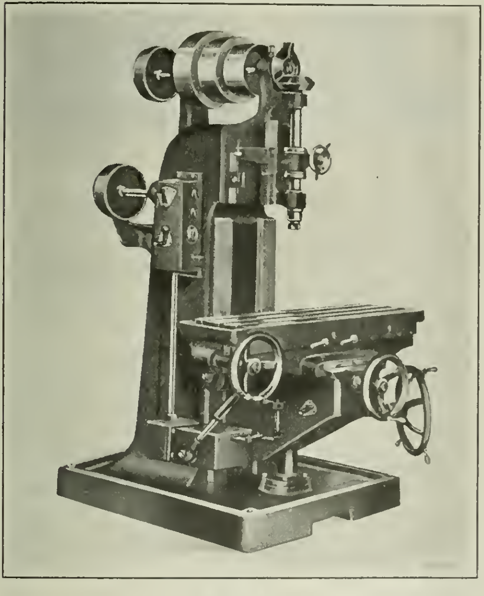


Fig. 1. No. 6-A Vertical Milling Machine built by the Jackson Machine Tool Co.

To facilitate operation, the spindle has a vertical movement, manipulated by hand through a mechanism permitting both hand feed and rapid traverse. Near the lower end of the spindle is a vertical sliding housing, which carries both the lower main spindle bearing and the thrust bearing and is operated for a slow feed by the handwheel shown at the right. The rapid traverse is obtained through a four-spoke pilot wheel located near the handwheel. The slow feed is quickly engaged or disengaged by a slight turn of a small knurled handwheel, and when the slow feed is disengaged, the rapid traverse is free to operate. The spindle and housing are counterbalanced by a weight inside the column, which is slightly greater than the weight of the spindle and attached parts, in order that all lost motion between the cutting tool and the handwheel may be taken up. A micrometer stop is provided for determining the depth of cut and the vertical position of the spindle. The spindle housing may be clamped in position for a longitudinal or a transverse cut when the proper depth is once obtained.

Fig. 2 shows the No. 10-A milling machine. Another machine known as the No. 10-B is similar to the No. 10-A, except that the latter has a table and cross-rail feed ranging from 0.001 to 0.015 inch per revolution of the spindle while the No. 10-B machine has a range of feeds from 5/16 inch to 16 inches per minute, regardless of the spindle speed. These milling machines are practically the same as the No. 10 die-sinker, the only difference being that they are provided with a head containing a heavy vertical milling spindle, whereas the die-sinker is equipped with a head containing a vertical spindle and a cherrying mechanism. Inside the milling machine head is a back-gear arrangement, whereby thirteen changes of spindle speeds ranging from 8½ to 310 revolutions per minute are obtained. A pull-pin lever on the head provides means for quickly shifting from direct to back-gear. All other speeds are secured through the change-gear box on the left-hand side of the base near the driving pulley.

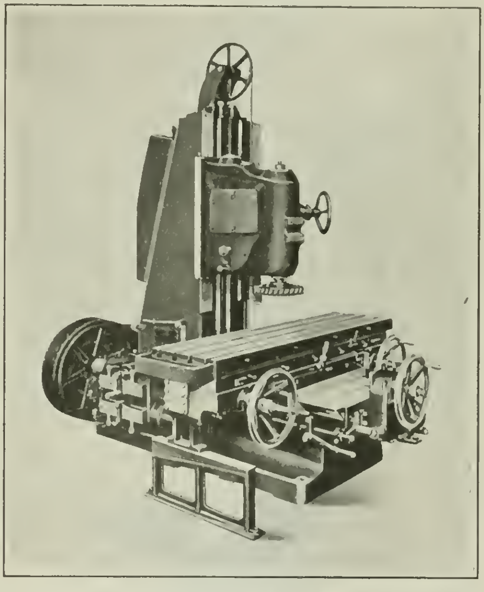


Fig. 2. No. 10-A Jackson Vertical Milling Machine designed for Production and Die-sinking

The lower end of the spindle has an integral flange 6½ inches in diameter and having a ¾-inch keyway running across the face and two holes for securing and driving large cutter-heads. It also has a hole 13/16 inch in diameter running its entire length for a draw-in bolt, and a No. 13 Brown & Sharpe taper hole at the bottom. All feed changes are controlled at the feed-change box on the right-hand side of the base near the rear end. A circular table 36 inches in diameter may be provided for circular and continuous milling. This table may be used as an attachment on the milling machine table, so that it may be removed when not in use, or it may have its bearing on a specially designed cross-rail. Standard sizes of cutters are made for these machines, the cutters being 4, 6, 8, 10, 12 and 14 inches in diameter. All cutters are made from standard stock and may be used with any cutter-head. The larger heads have backing rings for more securely holding the cutters.

PRATT & WHITNEY DIE-SINKING MACHINES

Several new points in design have been incorporated in the die-sinking machines made by the Pratt & Whitney Company of Hartford, Conn., to make their operation more convenient and their maintenance easier. The driving spindle has been provided with a positive pin lock in four positions, so that the chuck or collet can be tightened without holding the driving belt. The spindle pulley has a new system of oil-grooving opposite to the direction of rotation, so that oil is continually carried upward, thus insuring complete lubrication. A floating babbitt washer takes the thrust on the spindle. The main driving cone has been fitted with a hollow spindle having communicating oil-holes that deliver oil to a series of felt-packed grooves which conserve the lubricant and guarantee an ample supply.

Leather wipers held in cast-iron caps attached to the knee protect the ways from chips and dirt. The vise capacity has been increased to accommodate larger work, and the vise has been strengthened in proportion to its greater capacity. A telescopic elevating screw is furnished in place of the old type of straight screw. The elevating wheel shaft is equipped with a thrust bearing for ease of operation. The outboard bearings for the knee and vise slides have been strengthened, and the slides are grooved and protected with covered oilers.

A cherrying attachment recently developed for use on the die-sinking machines is illustrated in Fig. 2. This attachment is pivoted in a bracket attached to the side of the column. When in the working position, the swinging arm of the attachment is doweled and clamped to a boss at the lower machine-spindle bearing. The application of the cherrying attachment does not interfere with the regular functions of the machine. When in the working position, the regular feeds are available for governing the cut, and in the non-working position the spindle is released for ordinary operations. The adjustment to either position can be readily made.

The backs of the cutter teeth are utilized for driving the cutters. These are made in the form of gear teeth and mesh with a spur pinion. Two pinions of different pitch are furnished to permit a variation in tooth space on small and large cutters. Bevel gears transmit power to the cutter pinion, and the end of the machine spindle is threaded to receive the driving gear. The mating driven gear is held on the pinion-shaft by a friction which may be readily adjusted to suit conditions. This friction acts as a safety to prevent injury to cutters which might result from excessive feed or faulty manipulation.

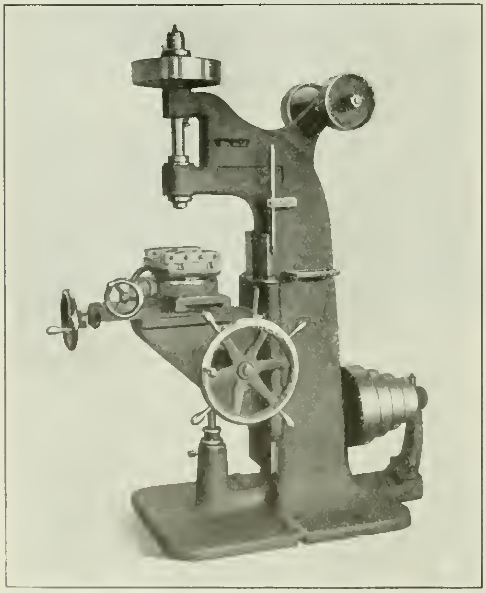


Fig. 1. Improved Die-sinking Machine brought out by the Pratt & Whitney Co.

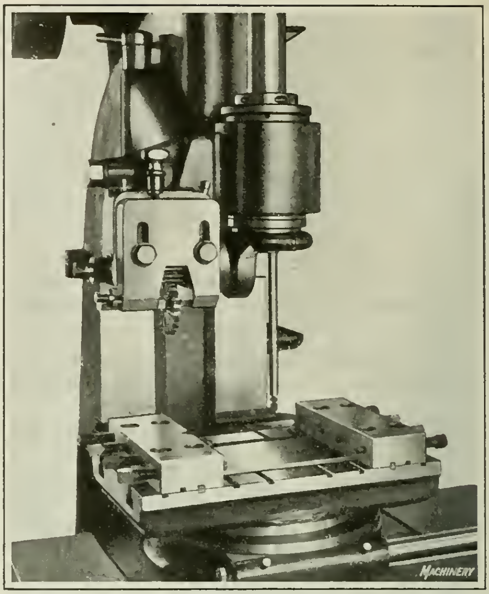


Fig. 2. Cherrying Attachment developed for Use on Die-sinking Machines

Cutters from 1 to 6 inches in diameter can be accommodated, the cutter-slide being provided with an adjustment to compensate for the various sizes. The smaller size cutters are mounted on conical centers, while the larger sizes are provided with a comparatively small hole for which cylindrical centers are utilized. The method of mounting the cutters on centers is such that half the cutter diameter can be used. This cherrying attachment is intended for finishing operations only, and before its use the impression should be roughed approximately to shape. Stock cutters have a 7-degree angle plus a shrinkage allowance of 3/16 inch per foot. The cutters are made from carbon and high-speed steels.

BICKFORD-SWITZER TAP GRINDER

A self-contained tap grinder, equipped with a 1/4-horsepower motor, for either direct or alternating current, has recently been developed by the Bickford-Switzer Co., 50 Norwood St., Greenfield, Mass. This machine is mounted on a column and weighs about 300 pounds. A good idea of its general construction may be obtained by reference to Fig. 1, while the diagram Fig. 2 shows the difference between a tap sharpened by ordinary methods and one sharpened by the new machine. The full lines show the shape of the thread after sharpening in the regular way, while the curved dotted line shows where the point of the tooth at *A* is removed when the tap is ground on the new tap grinder. In many respects the machine is similar to the drill grinder described in March MACHINERY. It is designed to sharpen any style of tap having any number of lands or flutes from two to six, inclusive, by grinding an eccentric relief on the top of the cutting lands. The machine is made to handle hand taps up to 1½ inches in diameter, tapper or machine

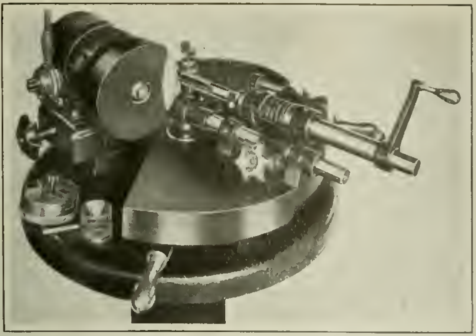


Fig. 1. Tap Grinder developed by the Bickford-Switzer Co.

nut taps up to $1\frac{1}{4}$ inches in diameter, and pipe taps up to 2 inches in diameter.

A feature of the machine is that it grinds the different lands of the tap separately and in consecutive order. A cam on the work-carrying spindle rides against a positive shoe, and causes the tap to approach, and recede from the wheel as it is revolved on its own centers. The squared end of the tap is driven by a bell center of the ordinary type, while the point end is supported by a male or female center as required. These two centers are mounted on a plate which can be revolved, or swung away from the grinding wheel to give sufficient space for inserting the shank of any long tap that it may be necessary to hold in the chuck.

The different cams employed to actuate the relief mechanism are machined on a single shell, mounted on the work-spindle in such a way that the cams do not revolve when the spindle is turned in a backward direction, but will start forward from any position when the spindle is turned forward. This arrangement facilitates the work of setting the tap so that its cutting lands will be in the proper position relative to the cam. In order to do this, it is only necessary to turn the tap backward until the contact point of the wheel is in a position between two lands of the tap and then turn the tap forward. The head which carries the main spindle can be clamped in the desired position on the rocker shaft. A flat spring which acts on the head serves to keep the particular cam in use in contact with its shoe, and a small cam-shaped collar is provided for the purpose of forcing the shoe in contact with the cam.

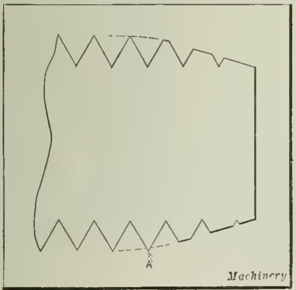
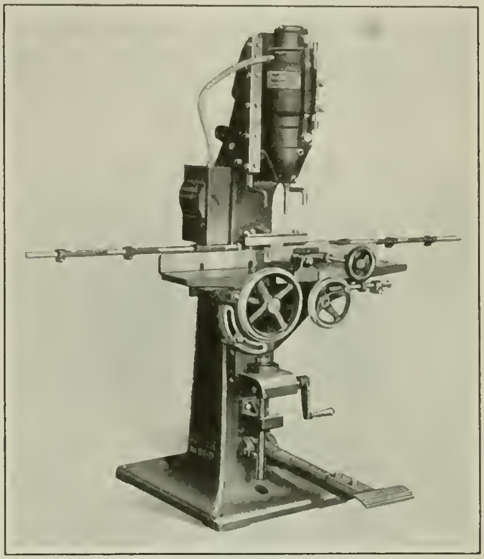


Fig. 2. Outline of Ground Tap

The machine can be used to sharpen countersinks and chucking reamers as well as taps, if they do not have more than six flutes. A lever located at the left is employed to feed the work forward into a position opposite the wheel, at which point another lever at the right of the first is used to set the work to the desired angle. The wheel is fed in as the work is revolved by means of a crank. A special feature incorporated in the machine provides for changing the angle of the work as it passes the wheel, so that a rounded contour is produced where the angle of the bevel near the end of the tap approaches the parallel sides. This feature prolongs the life of a tap and eliminates the necessity of using a hone to take off the sharp corners left on chucking reamers when the latter are ground by the usual methods.

OLIVER VERTICAL HOLLOW-CHISEL MORTISER

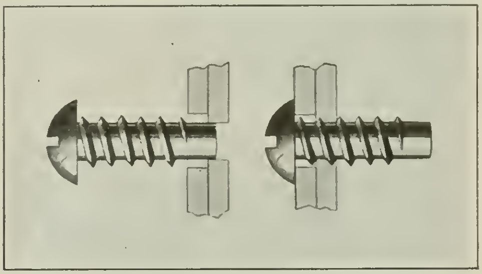
The illustration shows a vertical hollow-chisel mortiser on which the driving motor is built into the mortising head or ram. The motor operates on either two- or three-phase, 60-cycle current and at a speed of 3600 revolutions per minute. The machine is a product of the Oliver Machinery Co., Grand Rapids, Mich. The housing for the motor and head is in one piece, and the rotor of the motor is mounted directly on the machine spindle, which runs in high-grade ball bearings. The motor is connected by means of a flexible Greenfield conduit to a safety enclosed starting switch with fuses. This construction eliminates a countershaft, pulleys, and belts, and so saves floor space. The machine is equipped with a compound table having a handwheel rack- and pinion-feed and a clamp for the work. It is provided with the usual bushings, wrenches, etc.



Motor-driven Hollow-chisel Mortiser built by the Oliver Machinery Co.

PARKER SELF-TAPPING SCREW

A novel design of screw which requires no tapping of the hole in which it is inserted is shown in the accompanying illustration. This screw is manufactured by the Parker Supply Co., Inc., 785 E. 135th St., New York City, and will cut its own thread in die- or sand-cast parts of gray iron and softer metals, without the thread being injured. The screw has a V-thread of fairly coarse pitch and a cylindrical

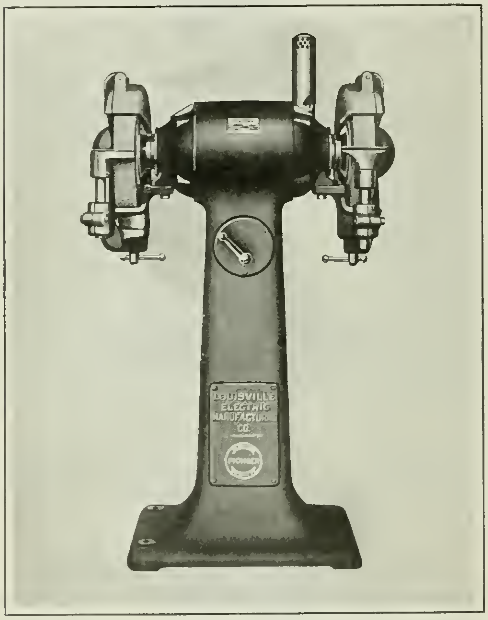


Self-tapping Screw made by the Parker Supply Co., Inc.

pilot which steadies the thread while it seats itself in the metal. In using this screw, a hole is first drilled in the piece which would ordinarily be tapped, a few thousandths of an inch larger than the pilot, and the piece to be assembled is drilled sufficiently large to provide clearance for the threads of the screw. The pilot is inserted in the hole, and with a few turns of a screwdriver, the screw is driven in place. The entire screw is hardened and heat-treated so that the thread cuts into metal similarly to a tap.

LOUISVILLE ELECTRIC GRINDING MACHINE

The Louisville Electric Mfg. Co., Louisville, Ky., has recently placed on the market the two-horsepower electric grinding machine here illustrated. It has improved ventilation, with an air intake so located that clean air is drawn through the motor. The machine can be operated continuously without exceeding temperature limits, and for intermittent duty the motor will operate safely with the air intake closed. The machine is provided with ball bearings,

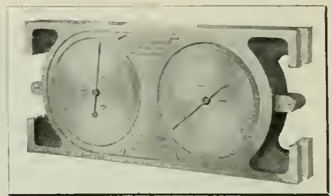


Electric Floor Grinding Machine brought out by the Louisville Electric Mfg. Co.

completely enclosed in housings. The safety hoods are made of steel and have a hinged side wall to enable wheels to be readily changed. The rests are adjustable. The motor-starting switch is enclosed in the column, and a water pot is attached to the latter. The machine is intended to be driven by either direct or alternating current. The height from the floor to the center of the spindle is 38 inches, and the wheels are 12 by 2 by 1 inch. The weight of the machine is approximately 400 pounds.

YOUNG-FISCHER "INCLINOMETER"

An instrument known as the "Inclinometer," which is intended to take the place of a plumb, level, sine-bar, and protractor in mechanical laboratories, machine shops, etc., has been developed by the Young-Fischer Inclinometer Co., Milwaukee, Wis., and is shown in the illustration accompanying this description. The instrument may be used on vertical, horizontal, and angular surfaces. It consists of an accurately machined metal case having two dials on the front face, one of which indicates angles in degrees and the other in minutes. The hand on the degree dial is fixed to the end of a small shaft on which is also attached a heavy pendulum, the result being that the hand indicates directly the number of degrees that the base of the instrument is off a true level. The minute hand is moved by a gear train that multiplies the motion of the pendulum so as to move the minute hand sixty places around the dial while the degree hand moves a distance representing one degree on its dial. A complete revolution of the minute hand represents an angular variation of 10 degrees.

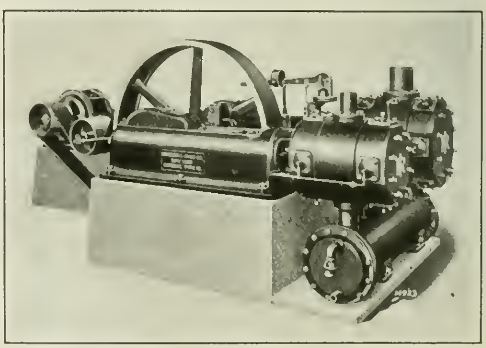


"Inclinometer" made by the Young-Fischer Inclinometer Co.

Inaccuracies due to bearing friction are overcome by mounting the bearings in rings which are concentric with the shafts and which are connected with arms or levers extending outside the case. The levers are provided with knurled handles, and in using the instrument the operator moves these handles up and down a few times, allowing the levers to strike against the ends of slotted holes in the case. The combination of the hammer effect and the oscillating movement of the bearings around the shaft eliminates retardation due to bearing friction.

INGERSOLL-RAND BELT-DRIVEN AIR COMPRESSORS

The Ingersoll-Rand Co., 11 Broadway, New York City, has announced a new line of belt-driven air compressors known as the "Imperial" Type XCB. These compressors are provided with Ingersoll-Rand plate valves for both the air intake and the discharge, and a five-step clearance control for regulating the output of the compressor. The plate valves are kept in alignment throughout their operation without wearing guides. The clearance control has been used with success on the larger direct-connected electric motor-driven compressors of this company's manufacture. This control provides a method of securing efficient operation at partial loads, as it automatically loads or unloads the compressor in five successive steps, as governed by the reduction or addition of clearance space in the air cylinders, which, of course, affects the volume of air taken in and compressed. The compressor will operate at full, three-quarter, one-half, one-quarter, and no load. At any one step the reduction in



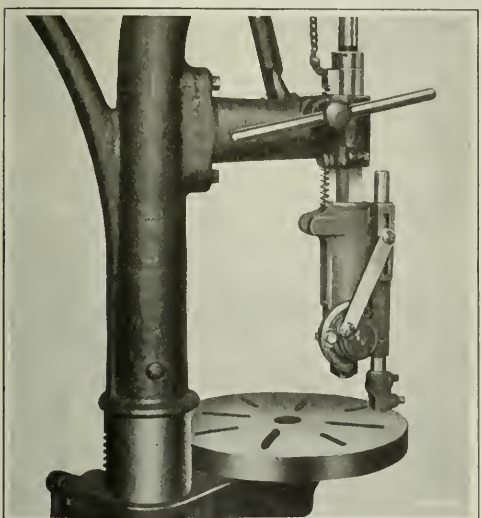
"Imperial" Type XCB Air Compressor developed by the Ingersoll-Rand Co.

input power required is in proportion to the reduction in the output capacity.

The compressors can be furnished in a single-stage style for low pressures and a two-stage style for higher discharge pressures. On a two-stage compressor clearance space in the proper proportion is added simultaneously for both the high and low cylinders, thus giving a constant rate of compression. An added feature of the control is the provision of a stop which will prevent the compressor from being operated at a load higher than desired. The piston displacement capacity for a 100-pound discharge pressure ranges from 610 to 1505 cubic feet of free air per minute. A short-belt driving attachment with a floating idler can be furnished for driving the compressor. This method of drive saves floor space and length of belt, and permits a greater arc of belt contact.

UTILITY FILING ATTACHMENT

A filing attachment designed to be employed with any make of drilling machine has been developed by the Utility Tool & Mfg. Co., 2717 Lafayette Ave., St. Louis, Mo., and is shown in the accompanying illustration. This device is

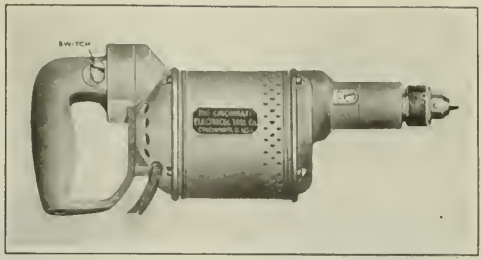


Filing Attachment for Drilling Machines, which is made by the Utility Tool & Mfg. Co.

suitable for either heavy-duty or small die work, and will accommodate any shape of file and any length up to 16 inches. The table of the drilling machine may be moved to any position, and the filing machine can be readily adjusted to any degree from 1 to 90. All gears are made of steel and are hardened and ground. In case of overstrain, a small cold-rolled pin in the shank becomes sheared, which stops the operation of the device. This pin can be easily replaced.

CINCINNATI PORTABLE DRILL

A light-weight portable electric drill of 3/16-inch capacity, provided with a pistol grip, is the latest addition to the line of tools manufactured by the Cincinnati Electrical Tool Co., 1501-1505 Freeman Ave., Cincinnati, Ohio. This drill is suitable for drilling steel, brass, aluminum, and sheet metal. and is especially intended for use in the manufacture of automobile bodies, window frames, etc. The drill is equipped with a universal motor for use on direct or alternating current of the same voltage. The motor housing, end caps,



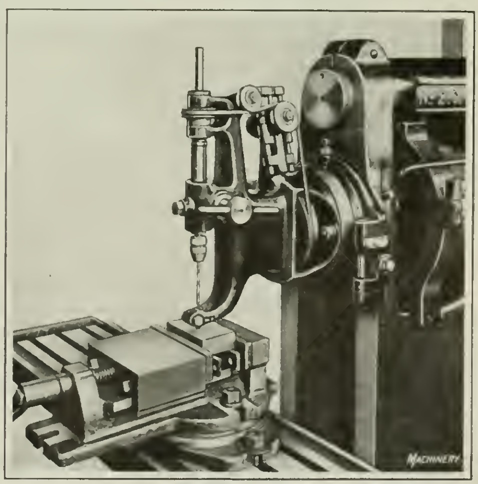
Portable Electric Drill brought out by the Cincinnati Electrical Tool Co.

and handle are made of aluminum, and the armature and gear studs are mounted on ball bearings. The switch is of the Cincinnati special quick make-and-break type, with an overload allowance of 50 per cent. It is entirely enclosed in the handle, and operated by a trigger conveniently located in that member.

KRAG SPOTTING AND ROUTING ATTACHMENT

A spotting and routing attachment designed to be mounted on milling machines for use in the accurate lay-out and drilling of holes up to and including 3/16 inch in diameter in dies, jigs, templets, master plates, etc., is here illustrated. This attachment is distributed under the trade name of "K-N" by E. L. Krag & Co., 50 W. Randolph St., Chicago, Ill. It is manufactured by Franz K. Krag, Chicago, Ill. The locating of holes by means of buttons is entirely unnecessary when this attachment is used. The attachment is securely mounted on a milling machine by means of a swinging clamp, requiring only one locking screw. It is placed in alignment permanently by means of a locating screw in the base, which is locked in place after having been adjusted.

The driving arbor for the attachment is inserted in the spindle of the milling machine, and is provided with a spring dog that engages automatically when the machine is started. The spindle of the attachment is driven by means of a round belt that is always kept at a uniform tension through the provision of a compensating spring idler, mounted in such a manner that the belt is always in alignment. The speeds of the attachment spindle and the machine spindle are in the ratio of 7 to 1. The spindle housing and the bracket which holds the guide bushings are cast



Krag Spotting and Routing Attachment

in one piece to assure alignment at all times. The spindle sleeve can be locked firmly in any desired position when using the attachment for routing by means of a friction plug. Five guide bushings, 1/16, 3/32, 1/8, 5/32, and 3/16 inch in diameter, are supplied, and these are made of a high-grade tool steel. The attachment is graduated to 360 degrees, and may be quickly adjusted to any desired angle. It is supplied for all standard makes of milling machines.

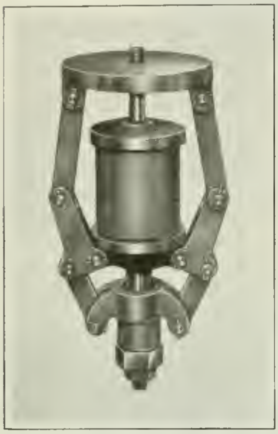


Fig. 1. Press Attachment made by the E. W. Bliss Co.

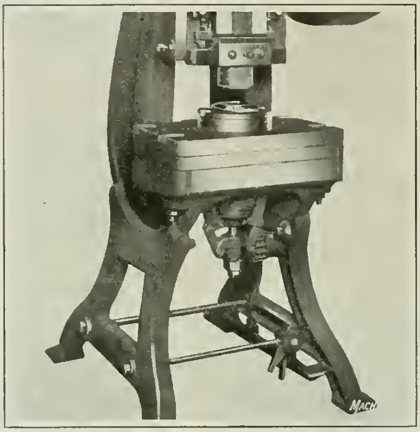


Fig. 2. Press equipped with Spring-pressure Attachment shown in Fig. 1

BLISS PRESS ATTACHMENT

The toggle-joint spring-pressure attachment here shown has been developed for use with combination dies, particularly when lithographed metal is being handled. This attachment is a product of the E. W. Bliss Co., Brooklyn, N. Y., and is intended for use with machines built by this concern. The attachment insures a uniform drawing pressure on the blank, and so increases the efficiency of the dies by minimizing the strain on the metal and reducing wrinkles and the breakage and wear of dies. The application of the toggle mechanism reduces the total rubber or spring compression. The reduced compression enables the economical manufacture of deep shells and a reduction in the number of operations required in cases where reducing operations follow the first blanking and drawing operation.

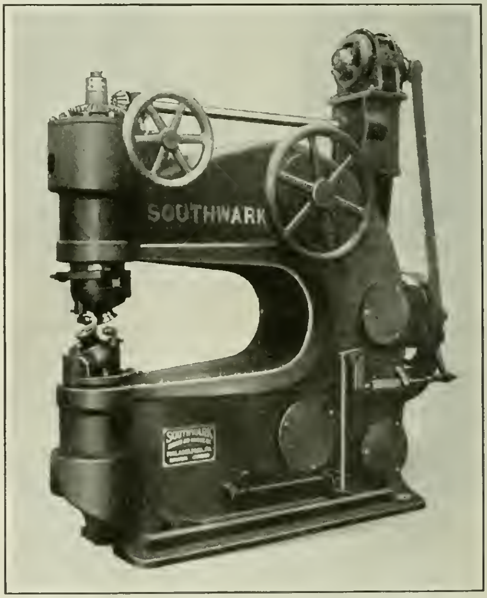
Some of the classes of work usually performed by double-action dies can be accomplished with combination and reducing dies when the presses are equipped with this attachment. The attachment is regularly built in four sizes and the depth of draw obtainable on the various sizes is as follows: No. 18 press, 1 1/4 inches; No. 19 press, 1 1/2 inches; No. 20 press, 2 inches; and No. 21 press, 2 1/2 inches. In order to have the maximum draws given, presses must have the same stroke and die space necessary with the old-style attachment. No change in the press equipment is necessary for the installation of this device.

SOUTHWARK-GRAY TURRET ROTARY SHEAR

A product of the Southwark Foundry & Machine Co., Philadelphia, Pa., known as Gray's turret rotary shear was described in MACHINERY for June, 1920. The principles of design and operation embodied in this machine have been incorporated in three new sizes of rotary shears recently developed by this company. These machines are adapted for cutting any shape of opening in sheet metal without cutting in from the edge and without turning the sheet, this method of cutting sheets and plates being made possible by mounting the rotary cutter on a turret which can be moved to any angle through a full circle while the cutting action is in process.

On the new No. 0 shear, which is the smallest of the four sizes, only the lower cutter is driven. This machine is designed primarily as a hand-driven machine, although power can be applied. On all sizes larger than the No. 0 machine both cutters are power-driven. The special feature of the largest or No. 3 machine, which is here illustrated, is the mounting of both the upper and lower cutters on adjustable turrets. This machine has a capacity for cutting any thickness of plate up to 3/8 inch. Both the upper and lower cutters are set at an angle, and they keep the same relative positions at any degree of the circle to which they may be turned. Handwheels for revolving the turrets are provided on both sides of the machine, so that the operator can control the machine from either side. The cutting speed of this machine is 10 feet per minute, and the throat depth 36 inches. Only 3 horsepower is required for driving.

The No. 2 machine has a capacity for cutting sheet metal of any thickness up to No. 8 gage, with a cutting speed of 10 feet per minute. The throat depth of this machine is 30 inches. The No. 1 machine will cut sheet metal up to No. 14 gage, and has a throat depth of 30 inches. The smallest or No. 0 machine will cut up to No. 16 gage, and has a throat depth of 18 inches. Special machines of larger sizes can be built to shear plates up to 1 inch in thickness. The lighter models of the turret rotary shear are employed

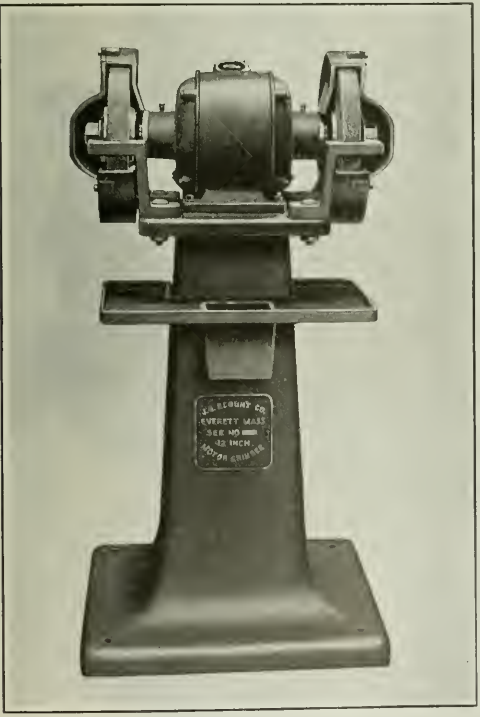


No. 3 Double-turret Rotary Shear built by the Southwark Foundry & Machine Co.

to cut such parts for automobiles as aprons, pans, tanks, mud guards, flanges, fenders, radiators, etc. In general sheet-metal work they are employed to cut elbows, tees, hoods, oil-pans, parts for ventilator systems, etc. The heavier models are employed to shear plates used in building ships, locomotives, boilers, etc., and in structural and ornamental iron work.

BLOUNT MOTOR-DRIVEN GRINDING MACHINES

A new line of grinding machines driven by alternating-current motors has recently been brought out by the J. G. Blount Co., Everett, Mass. The machines are built in ½-, 1- and 2-horsepower sizes. The ½-horsepower machine has 8- by 1-inch grinding wheels; the 1-horsepower machine, 10- by 1½-inch wheels; and the 2-horsepower, 12- by 1½-inch wheels. The illustration shows the 2-horsepower machine. These grinding machines are equipped with S K F ball bearings contained in dustproof mountings. The bearings are a light drive fit on the shaft, and are secured by lock-nuts. The spindles are made of a high-carbon steel, and are ground to size. The wheel flanges are machined all over, and the inner flanges are pressed to the shoulder of the spindle. The tool tray and water pot are bolted to the collar. They are separate and detachable. The tool-rests are in one piece and adjustable. Each machine is equipped with one coarse and one fine grinding wheel unless otherwise specified. The machines are driven by Westinghouse motors equipped with starting switches of the textile snap type.

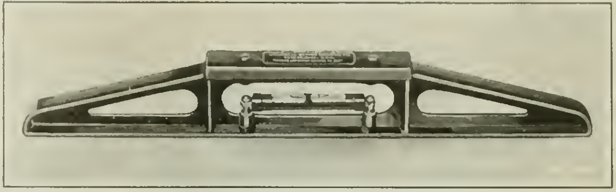


Two-horsepower Motor-driven Grinding Machine brought out by the J. G. Blount Co.

UNIVERSAL MACHINE-ALIGNING LEVEL

The Universal Boring Machine Co., Hudson, Mass., has just placed on the market a precision machine-aligning level. The frame is an iron casting of truss construction, and is of sufficient strength to eliminate strains. The leveling surface is 27 inches long. The vial is made of the best Jena glass, specially ground. It is set in a brass japanned case mounted on two lacquered brass studs which enable adjustments to be made. After being adjusted, the vial is locked in position by two nuts working against each other. The bubble in the vial has a guaranteed sensitiveness of 5 seconds of arc per graduation, this being equivalent to twenty-nine hundred-thousandths inch per foot. The manner of mounting the vial insures protection from breakage.

The level casting is insulated from the palm of the hand by means of a handle of non-conductive material and so distortion from this source is eliminated. In its manufacture, the casting is planed and drilled and then thoroughly seasoned. Subsequently, the base is hand-scraped and tested, after which it is allowed to rest for another period and is again tested. The vial is finally adjusted. The instrument is supplied in a felt-lined mahogany case, equipped with a brass handle to enable it to be conveniently carried from place to place. The level is 27 inches long and weighs about 9¾ pounds.



Machine-aligning Level placed on the Market by the Universal Boring Machine Co.

NEW MACHINERY AND TOOLS NOTES

Connecting-rod Machine: Sawyer-Weber Tool Mfg. Co., Los Angeles, Cal. A machine, the bed of which consists of a faceplate on which may be located clamps, V-blocks, boring tools, and other equipment such as required in babbitting connecting-rod bearings, straightening the rod, and boring the bearing to size.

Spring Tool-holder: Willard Tool Co., Inc., 105 E. Main St., Stratford, Conn. A spring tool-holder of the gooseneck type made of drop-forged steel and hardened to a spring temper. This holder is made in several styles and sizes, and is so designed that the tool will yield or recede in a practically straight line from the work, without causing chatter marks or breakage when taking a heavy cut.

Pneumatic Grinder: Onsrud Machine Works, Inc., 3908 Palmer St., Chicago, Ill. A high-speed grinder operated by compressed air at a pressure of 70 to 100 pounds per square inch. The complete unit weighs only 5½ pounds and is intended for small grinding wheels. Provision is made for attaching the unit to standard machine tools, but it can also be held in the hand and operated as a portable grinder.

Hardness Testing Machine: Riehle Bros. Testing Machine Co., 1424 N. 9th St., Philadelphia, Pa. A combination Brinell and scleroscope hardness-testing machine, designed primarily for the use of the Association of Manufacturers of Chilled Car Wheels in making a study of the hardness and comparative wearing and breaking qualities of chilled wheels. With this machine it is possible to employ both the Brinell and scleroscope tests on the same spot.

Electric Grinder: Forbes & Myers, 178 Union St., Worcester, Mass. A small grinder adapted for repair shop and garage work, whuch is supplied in either the bench or stand type. Model No. 42 is driven by a ¼-horsepower motor and is equipped with two 6- by ½-inch wheels. Model No. 62 is driven by a ½-horsepower motor and is equipped with two 6- by 1-inch wheels. The grinding wheels are mounted at each end of the motor housing. Straight-, round- or bevel-faced wheels can be supplied as desired.

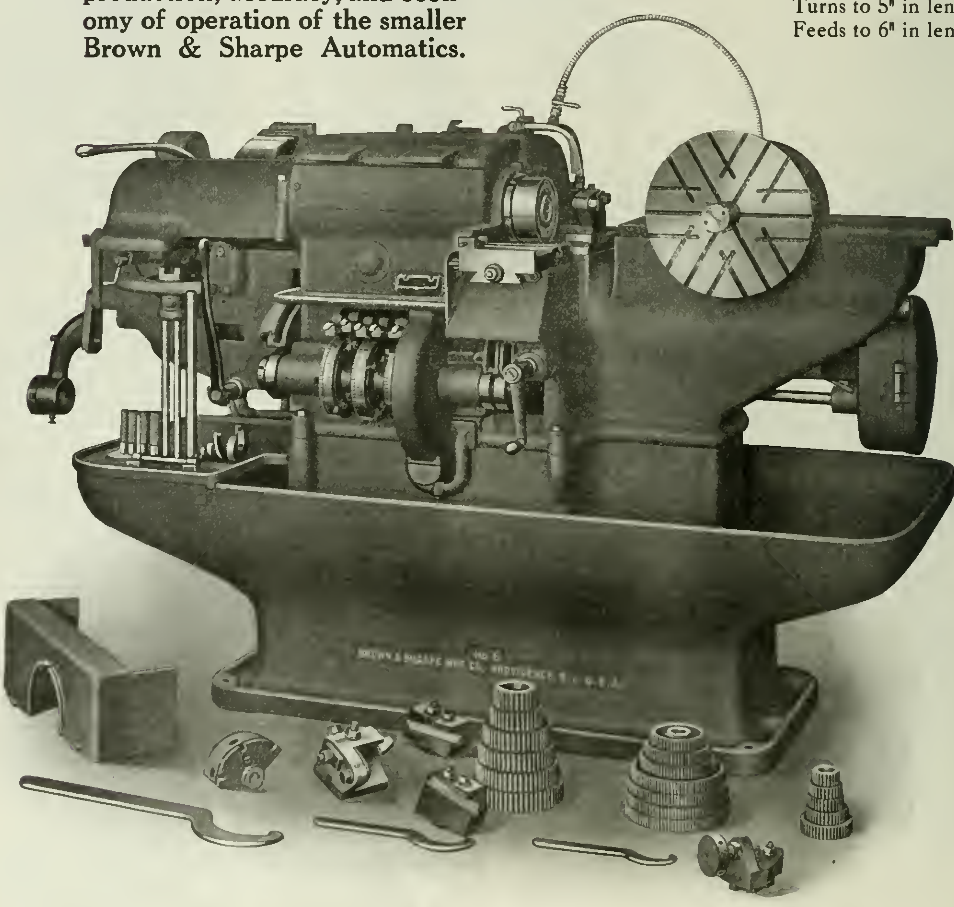
for heavy work—

BROWN &

No. 6 AUTOMATIC

With the characteristic high production, accuracy, and economy of operation of the smaller Brown & Sharpe Automatics.

Takes work to 2" dia.
(light work to 2⅜" dia.)
Turns to 5" in length
Feeds to 6" in length



PARKER-HOLLADAY POSTER SERVICE

An art poster service, for use in manufacturing plants, has been developed by the Parker-Holladay Co., 230 E. Ohio St., Chicago, Ill., which is intended to assist business men in educating their employes to think and act along constructive lines and to aid them in their advancement to more responsible positions. The service consists primarily of a series of posters, 28 by 42 inches in size, which are put up in frames and changed every week. Each poster deals with some common cause of failure for men to advance in their work and suggests methods of overcoming the trouble. The posters are printed in four colors to give them the maximum "attention value."

There are fifty-eight posters in the complete series. An oak frame is furnished for the set, which is hinged in the front, and the posters are perforated to slip over pins in the frame. An important feature of this arrangement is that the posters can be quickly put up and changed, and the same set can be used several times. In conjunction with the posters a leather-covered loose-leaf binder containing complete instructions for the application of this system is delivered to the man in charge of such work in the factory.

Pages are provided for what are known as "result charts" on which there are spaces for entering, in condensed form, the substance of reports sent in by the various foremen, indicating the results obtained by the posters in their departments. Such information is of definite value in using the posters a second time. For instance, suppose it is found that the labor turnover in a factory is excessive. If poster No. 17, entitled "Who's the Loser?" (reproduced in Fig. 1) had been used several months previously, and showed definite results in correcting this difficulty, the management would be justified in using this poster again with the expectation that it would overcome the trouble a second time.

For the use of foremen in making out their reports on the results obtained from successive posters put up in the factory, a special form of result chart is furnished, with spaces for entering the name of the poster, whether employes were interested, what comments were overheard, etc. The notations from these weekly result charts are summarized and entered on the permanent record sheets.

In using these posters, it is believed to be of the utmost importance to display the right poster at the right time. For instance, a poster pertaining to industrial accidents is likely to prove more effective if displayed when the thought of an accident is fresh in the minds of the workers in a factory. To obtain maximum results, it is essential for the foremen, superintendent, and other officials to show personal interest in each poster. By so doing, they will draw out remarks and discussions from the workers which will help in maintaining an accurate record of results. Illustrations are used, so that even though there may be many employes who do not read English, the subject matter of the posters will still be understood by the illustrations.

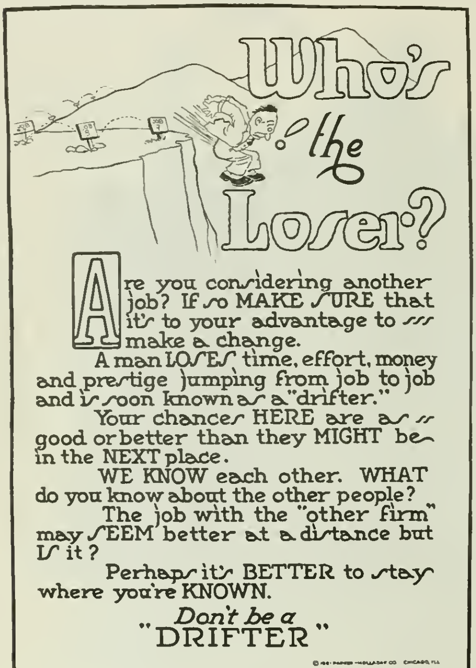


Fig. 1. Poster intended for Display in Manufacturing Plants in Cases where the Labor Turnover is Excessive

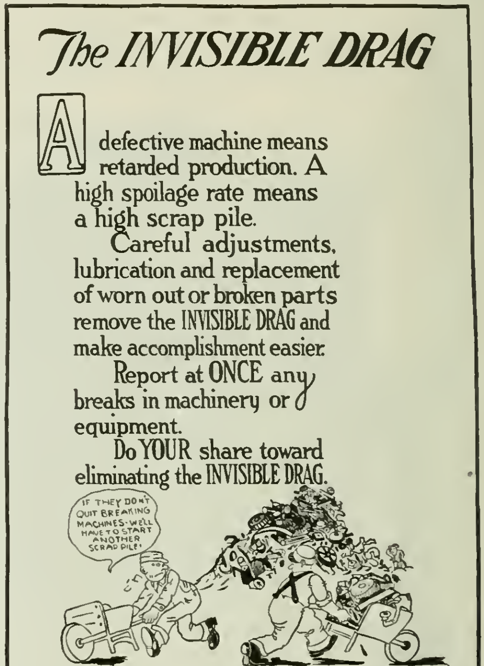


Fig. 2. Poster emphasizing the Need of Careful Adjustments, Lubrication and Replacement of Worn Parts of Machines

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ENGINEERING EMPLOYMENT SERVICE

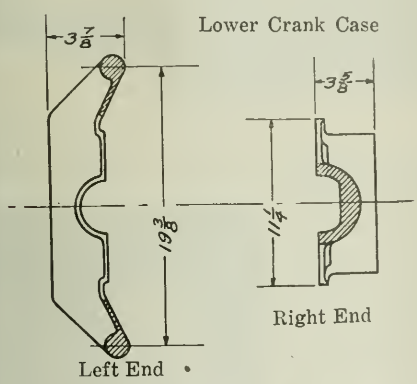
In recognition of the need of a clearing house of engineering services from which engineers of specific qualifications may be obtained, the Federated American Engineering Societies, representing a combined membership of about 50,000 professional engineers, has established at their headquarters, 29 W. 39th St., New York City, an employment bureau for engineers of every kind of training and experience. Applicants must be members and must submit a complete educational and professional record, carefully classified, so that as the special requirements of any position are received, the records of men of suitable qualifications can be submitted. The services of the bureau are free, and negotiations will be treated as confidential if desired.

Milling two parallel surfaces at one pass on the Cincinnati 48-in. Automatic Duplex Miller

Time per piece, 75 seconds. Average on a day's run, 40 pieces per hour.

The operator loads one end of the Indexing Fixture while the other end is milling.

The photograph below shows how we modified the 48 inch wide bed Duplex Miller to meet special needs.



Our Engineering Service Department modified our 48 in. Automatic Duplex to suit this job. We designed and made the fixtures and built the equipment complete ready for maximum production the minute the belt was on. These parts are cast-iron crank cases. Two surfaces at one end and one at the other are milled at one pass. The clamping arrangement is simple and the fixture inclines slightly toward the center to help in chucking. About 1/8 in. metal is removed. The thin metal section makes a relatively slow feed rate necessary. But the production is high, because—

The fixture is handy.

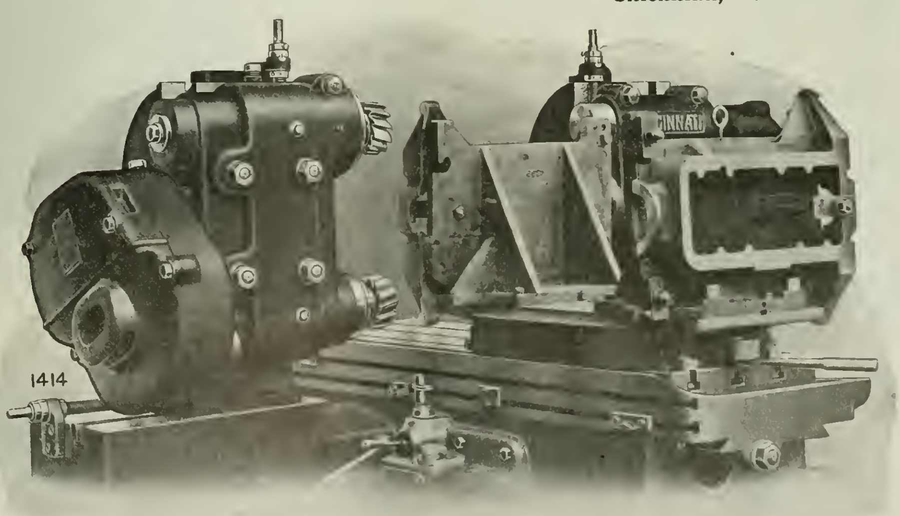
The Index Base allows the operator to chuck one piece while the machine is milling the other.

The fixture being loaded is always at the point nearest the operator.

The machine is automatic, and the operator has nothing to do but chuck and handle pieces.

All this can be applied to your work. If it requires special equipment, our Service Department will modify our Automatics to suit. Let us see your blueprints.

The Cincinnati Milling Machine Company
Cincinnati, O.



PERSONALS

George O. Gridley has resigned as manager of the Windsor plant of the National Acme Co. His outside interests have become of such volume and importance that he has decided to devote his entire time to banking, development work, and other affairs. Mr. Gridley's work in the building up of the manufacturing organization of the Windsor plant from its small beginning to its present proportions covers a period of a quarter of a century, during which time he brought into play his ability as an inventor, a business organizer, and a financier.

Mr. Gridley was born in Harwinton, Conn., in 1869. In industrial work he was first employed by the Waterbury Button Co., and then went to Springfield, Vt., to learn the machinist's trade. He studied stenography during his leisure hours evenings, and was employed for a few months with the Jones & Lamson Co. as stenographer and office-man, also spending some time on the road as salesman. From there he went to Indian Orchard, Mass., where he started the Indian Orchard Screw Co., making bicycle parts, and later he went to Windsor, Vt., as superintendent of the Windsor Machine Co. In 1902 the Gridley single-spindle automatic was developed; later, the idea of the multiple-spindle machine was gradually evolved, until the first machine was built in 1908. From that time on the business grew rapidly.

In 1915, when the National Acme Co. took over the Windsor Machine Co., Mr. Gridley was appointed manager of the Windsor plant. Previous to that he had been vice-president and general manager of the Windsor Machine Co., and he was also vice-president of the firm of Potter, Johnson & Gridley, Ltd., of England, which built a large factory in Birmingham. This factory was taken over by the British Government at the outbreak of the war. Mr. Gridley was a charter member of the Society of Automotive Engineers. From 1917 to 1919 he served as a member of the Vermont House of Representatives. He is president of the State National Bank of Windsor.

C. B. Cole has opened a consulting engineer's office at 546 W. Washington Blvd., Chicago, Ill. He will specialize in tools, gages, interchangeable manufacture, and inspection systems.

John D. Hurley, president of the Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago, Ill., manufacturer of "Thor" air and electric tools, returned on September 9 from a six weeks' trip abroad, during which he visited all the principal points of continental Europe.

Ogden R. Adams, machinery merchant, of Rochester, N. Y., has been elected president and general manager of the Seneca Falls Mfg. Co., Seneca Falls, N. Y., manufacturer of "Star" and "Short-cut" lathes. Mr. Adams still remains at the head of, and actively identified with, his Rochester business, which will not be interrupted in any way by his new connection.

Robert L. Crane, for twenty-three years western New York manager of Henry Prentiss & Co., Inc., Buffalo, N. Y., and well known throughout the United States as a machine tool salesman, has terminated his connections with that company and will continue in the same line of business under the name of Crane Machinery Co., with offices at 501 D. S. Morgan Bldg., Buffalo, N. Y. Mr. Crane is now establishing selling connections with a view to opening branch offices in the near future in Rochester, Syracuse, and Albany.

W. La Coste Neilson has been appointed general sales manager of the Norton Co., Worcester, Mass., succeeding Carl F. Dietz, who has left the Norton Co. to become president and general manager of the Bridgeport Brass Co., Bridgeport, Conn. Mr. Neilson has been with the Norton Co. for fourteen years. For a few years he was assistant sales manager, and later was placed in charge of all foreign business, including the sales and management of the two foreign plants of the Norton Co. at Wesseling, Germany, and La Courneuve, France, his office being located in London, England. He was made a vice-president of the Norton Co. two years ago. Mr. Neilson returned to Worcester last month, and took charge of the general sales October 1. He will, in addition, continue to look after the company's foreign interests.

Carl F. Dietz has resigned as vice-president and general sales manager of the Norton Co., Worcester, Mass., to become president and general manager of the Bridgeport Brass Co., Bridgeport, Conn., his new duties being assumed October 1. Mr. Dietz has been connected with the Norton Co. for ten years, first as plant engineer, then as assistant sales manager, and later as sales manager of the wheel division. Two years ago, when the Norton Co. and the Norton Grinding Co. were consolidated, he became vice-president and general sales manager of the entire business, including both wheels and machines. Mr. Dietz graduated from Stevens Institute of Technology in 1901, and subsequently took post-graduate courses in Berlin, Germany, in metallurgy and mining. He has been employed by the U. S. Steel Corporation, and has designed and built modern ore milling plants for the American Glue Co., the Grasselli Chemical Co., and the Ozark Smelting & Mining Co. In 1908 he became consulting engineer for the Minerals Separation, Ltd., London, and in the interest of this company developed treatment methods for iron ore deposits in Norway, and studied ore treatment methods for properties in Russia, South America, Australia, and Africa.

* * *

OBITUARIES

P. M. Fowl, president and general manager of the Cadillac Tool Co., Detroit, Mich., died August 24, following an operation for appendicitis, at the Harper Hospital of Detroit. Mr. Fowl was born in 1883 at Elyria, Ohio. He started work in several of the plants in the vicinity of Elyria, and in 1907 went to Detroit, where he was connected for a short time with the Ford Motor Co., and the Burroughs Adding Machine Co. He became associated with the sales force of the Strong, Carlisle & Hammond Co. in 1909, and from that time on became well known throughout the machine tool industry. From 1914 to 1917 he was the Detroit manager of the Strong, Carlisle & Hammond Co., and upon leaving that concern became president and general manager of the Cadillac Tool Co. He was also president of the Detroit Garage Equipment Co. His wife and one daughter survive him.

Louis J. Goldman, president of the Cincinnati Electrical Tool Co., Cincinnati, Ohio, died in that city August 22. Mr. Goldman was born in New York City in 1850. When he was two years old his father died, at which time the family moved to Cincinnati, and Mr. Goldman has lived there ever since. At the age of fourteen, he started to work and later engaged in the wholesale clothing business. In 1910 he bought the Cincinnati Electrical Tool Co., and remained its president up to the time of his death. His son, J. Albert Goldman, is treasurer of the company.

COMING EVENTS

October 3-4—Regional meeting of the American Society of Mechanical Engineers in Cleveland, Ohio; headquarters, Hotel Winton.

October 5-6—Twelfth annual convention of the American Manufacturers' Export Association in New York City; headquarters, Waldorf-Astoria Hotel. Secretary, A. W. Willmann, 160 Broadway, New York City.

October 5-7—Fifth annual convention of the Society of Industrial Engineers in Springfield, Mass.; headquarters, Hotel Kimball. Office of the society, 327 S. La Salle St., Chicago, Ill.

October 17-22—Twenty-fourth annual convention of the American Mining Congress in the Coliseum, Chicago, Ill. In conjunction with the convention there will also be a national exposition of mines and mining equipment.

October 17-22—Twenty-seventh annual convention of the National Hardware Association of the United States in Atlantic City, N. J.; headquarters, Marlborough-Blenheim Hotel. Secretary, T. James Fernley, 120 High St., Boston, Mass.

October 17-22—National exposition of mines and mining equipment in Chicago, Ill., under the auspices of the American Mining Congress, Washington, D. C.

October 18-20 — Annual convention of the National Machine Tool Builders' Association in New York City; headquarters, Hotel Astor. General Manager, Ernest F. DuBrul, 817 Provident Bank Bldg., Cincinnati, Ohio.

November 1-4—Annual convention of the Industrial Relations Association of America in New York City; headquarters, Waldorf-Astoria Hotel. Acting executive secretary, E. A. Shay, 671 Broad St., Newark, N. J.

November 2-4—Fall conference of Industrial Cost Association in Pittsburg, Pa. Headquarters of the association, 2828 Smallman St., Pittsburg.

November 4-5—Regional meeting of the American Society of Mechanical Engineers in Kansas City, Mo.

December 1-3—Fall meeting of the Taylor Society in New York City. Secretary, Harlow S. Pearson, 29 W. 39th St., New York City.

December 6-9—Annual convention of the American Society of Mechanical Engineers in the Engineering Societies' Building, 29 W. 39th St., New York City.

May 8-11, 1922—Spring meeting of the American Society of Mechanical Engineers in Atlanta, Ga. Assistant Secretary (Meetings), C. E. Davies, 29 W. 39th St., New York City.

NEW BOOKS AND PAMPHLETS

Welding and Cutting. By Fred E. Rogers. 95 pages, 6 by 9 inches. Published by the Davis-Bournonville Co., Jersey City, N. J. Price, $1.

This is an instruction book on oxy-acetylene welding and cutting and is intended for operators who have mature judgment and some knowledge of metal-working practice. The book is intended to supplement personal instruction and refresh the memory on points of practice not in daily use. It contains eight parts, treating of the setting up of welding and cutting equipment; instructions in welding, including handling of the torch, preparing work for welding, size of tip and flame, etc.; general welding practice; boiler and tank welding; welding machines; oxygen cutting; mechanically operated cutting torches; and the generation of gases.

NEW CATALOGUES AND CIRCULARS

Sterling Grinding Wheel Co., Tiffin, Ohio. Circular containing grading tables, price lists, and speeds for Sterling grinding wheels from 1 to 60 inches in diameter and from ¼ to 4 inches in thickness.

Electric Controller & Mfg. Co., Cleveland, Ohio. Bulletin 1002-A, containing information on the application, design, and advantages of Dinkey ventilated controllers for alternating-current, slip-ring motors.

Michigan Stamping Co., Detroit, Mich. Bulletin 10, illustrating and describing wiring fittings, including outlet boxes, stamped steel fixture studs, covers for outlet boxes, sectional switch boxes, and panel surface cabinets.

General Electric Co., Schenectady, N. Y. Bulletin 46041, descriptive of the Type H2 alternating-current temperature indicator for transformer windings, the purpose of which is to safeguard transformer units from deterioration due to over-heating.

Ingersoll Milling Machine Co., Rockford, Ill. Circular illustrating an Ingersoll 42-inch continuous rotary continuous milling machine machining the sides of both ends of connecting-rod forgings, a production of forty-seven connecting-rods an hour being attained with the equipment shown.

E. J. Kruce & Co., 960 Harper Ave., Detroit, Mich. Circular illustrating and describing the Kruce spiral expansion reamer, which is equipped with an improved expanding device giving a greater range and insuring concentric expansion. These reamers are carried in sizes from ½ to 2½ inches in diameter, and the circular gives prices for the various sizes.

Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. Leaflet 1888-A, describing the applications of storage battery mine locomotives, and illustrating the Baldwin-Westinghouse type of apparatus. Leaflet 1610-C, describing in detail the features of Type A auto-starters, including the auto-transformer, switching mechanism, contacts, overload relays, etc.

Hart Roller Bearing Co., Orange, N. J. Booklet entitled "Prepare for a Boom," containing an article showing the need of installing improved equipment in readiness for renewed business activity. The circular also contains illustrations of Hart staggered roller bearings, and a description of the design, material, workmanship, and application in different classes of machines.

Taft-Peirce Mfg. Co., Woonsocket, R. I. Bulletin 110, containing a detailed description and illustrations of many interesting applications of this company's entire line of production and inspection tools, including sine bars, sine bar fixtures, taper test gages, V-blocks, equalizing jaws, parallels, toolmakers' adjustable knees, universal right-angle irons, measuring irons, bench plates, universal squares, etc.

Norton Co., Worcester, Mass. Calendar for the year August 1921 to August 1922. On the twelve sheets of the calendar are listed the various products of the company, including multi-purpose grinding machines; alundum and crystolon wheels; refractories and laboratory ware; floor stands; grinding wheel dressers; machines for grinding cams, crankshafts, and crankpins; automobile part regrinding machine for repair shops, etc.

Mattingly Automatic Valve Co., Inc., 201 Chouteau Trust Bldg., St. Louis, Mo. Pamphlet containing a description of the construction and operation of Mattingly automatic valves for water gages on steam boilers, ammonia pipes, steam pipes, hose lines, etc. These valves have been designed especially to provide for the safe operation of steam boilers and conducting of fluids under pressure, by preventing false registration of the fluid in the gage glass.

Binghamton Electric Truck Co., Inc., Binghamton, N. Y. Circular containing description and specifications of the "Ideal" industrial trucks and tractors, the main features of which are as follows: A complete power unit mounted on trunnions and interchangeable in all models; a hill-climbing device making possible normal ampere construction on steep grades; an electrically welded frame; ball bearings for all the working parts; and a uniform over-all width for all types of 34 inches.

Edison Lamp Works of General Electric Co., Harrison, N. J. Bulletin entitled "Railway System Lighting Buildings and Yards," containing an article on modern lighting practice in railway shops, terminals, yards, etc., and equipment needed. Pamphlet entitled "Reflectors for Incandescent Lamps," containing a general discussion, classification of reflectors, and illustrations and data covering different types for a wide range of applications, including industrial plants, commercial lighting, etc.

Heald Machine Co., 16 New Bond St., Worcester, Mass. Circular treating of common automobile engine troubles, and describing how they can be corrected by regrinding. The advantages of the grinding process for machining worn or scored cylinders and for finishing new cylinders are pointed out, and a list is given of some of the automobile engines in this country and Europe whose cylinder bores are finished by grinding. The circular illustrates Heald regrinding machines in use in several plants, and describes the process of regrinding.

Flexible Steel Lacing Co., 4622 Lexington St., Chicago, Ill. Book entitled, "Short Cuts to Power Transmission," which is intended to answer many questions relative to the successful operation of belt-driven machinery. The book describes all types of belting and lacing, and contains belting problems and simple calculations. It also gives information on direction to run splices, belt dressings and preservatives, care of beltings, determining horsepower, figuring the size belt to use, margin of safety, etc. Copies will be sent free upon request.

W. S. Rockwell Co., 50 Church St., New York City. Bulletin 232, entitled "The Variety of Furnace Design." This pamphlet is the third of a series dealing with the fundamentals that influence the quality and cost of heated products. It discusses the relation of type and arrangement of heating equipment to cost of production, and the many factors that must be considered in adapting such equipment to individual manufacturing conditions. It contains fourteen pages of illustrations of different types of furnaces designed to meet industrial heating requirements. The section dealing with the relation of type and arrangement of furnaces to cost of production should be of particular interest at this time.

TRADE NOTES

V. Lowsner, 114 Liberty St., New York City, requests manufacturers of looms for fence wire weaving to communicate with him.

C. N. Cady Co., Canastota, N. Y., manufacturer of one- and two-cylinder two-cycle engines and four-cylinder four-cycle engines, announces that an addition to the factory has recently been completed, and that it is intended to employ an additional number of men in the new building. The company has at the present time from eight to ten months work ahead.

Link-Belt Co., 910 S. Michigan Ave., Chicago, Ill., reports that it has recently received a large contract for supplying the elevating and conveying machinery for two locomotive coaling stations for the New York Central Railroad Co., to be located at Solvay and Wayneport, N. Y. The equipment includes gravity-discharge elevator-conveyors, apron conveyors, track hoppers, etc.

Heller Bros. Co., Newark, N. J., announces that the Rex File Co. and the Vixen Tool Co. have become consolidated with Heller Bros. Co. It is believed that this consolidation will result in better service to both dealers and consumers. Walter D. Craft, who has been secretary-treasurer of the Vixen Tool Co. for some time, will act as domestic sales manager of the consolidated companies.

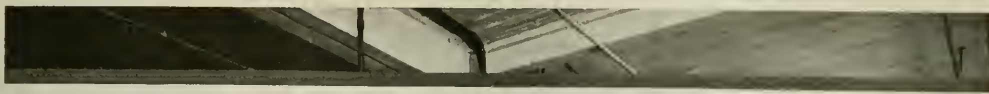
Lumen Bearing Co., Buffalo, N. Y., manufacturer of "Machinebronze" brass and bronze castings and bearings, solders, and babbitts, has found it necessary owing to the increase in its activities, to locate a branch office in Chicago at 15 N. Jefferson St., which will handle the western business of the company. H. S. Huncke is western sales manager, and Henry Waters, associate salesman.

Alexander Milburn Co., Baltimore, Md., announces that it has received two large contracts for oxy-acetylene welding and cutting equipment from the Baltimore and Ohio Railroad, and the Western Maryland Railroad. The contracts call for a number of Milburn "Cut-Weld" combination cutting and welding torches. These torches can be transformed instantly from the cutting to the welding type by merely changing the tip.

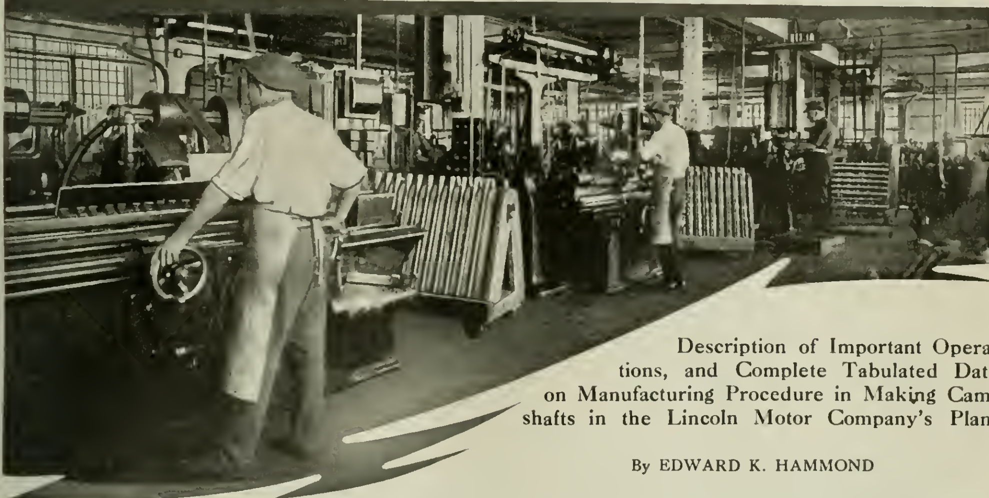
Surface Combustion Co., Inc., 366 Gerard Ave., Bronx, New York City, announces that it is now represented in all the principal European countries, and many large industrial furnace installations have been made. The Compagnie Generale de Construction de Fours, 32-34 Rue de la Grange-aux-Belles, Paris, France, is the sole licensee and manufacturer for the Surface Combustion Co.'s apparatus in France and its colonies, Belgium, Holland, Switzerland, Italy, Spain, and Portugal. British Furnaces, Ltd., Millbank House, 2 Wood St., London, S. W. 1, England, was organized in July for the purpose of manufacturing and selling the Surface Combustion Co.'s apparatus in the British Empire.

Firth-Sterling Steel Co., 312 Hudson St., New York City, announces that the agency arrangement for the sale of sheet-steel that heretofore existed between Thomas Firth & Sons, of Sheffield, an associated company, and Wheelock Lovejoy & Co., of New York and Cambridge, has been terminated, and Horace C. Hides, of Hartford, Conn., who for the last twenty years has represented William Jessop & Sons, has been appointed general sales manager of Thomas Firth & Sons for the United States. A stock of Firth Sheffield sheet steel will be carried in the New York warehouse of the Firth-Sterling Steel Co. Thomas Firth & Sons and the Firth-Sterling Steel Co. are also opening a joint office in Hartford, Conn., where Mr. Hides will have his headquarters and where Henry I. Moore will represent the Firth-Sterling Steel Co.

Henry & Wright Mfg. Co., Hartford, Conn., has been reorganized. The new president of the company is Charles J. Sorrells, senior partner of C. S. Sorrells & Co., New York City; and the vice-president is Jonas O. Hoover, lawyer and business man of Chicago, Ill. Mr. Hoover will also act as attorney, and as chairman of the executive committee, and expects to reside in Hartford after January 1. T. B. Owens, president and owner of T. B. Owens & Co. of New York City, is treasurer, and Mrs. Daniel M. Wright, secretary. Frank M. Rogers, formerly of Chicago, is general manager and assistant treasurer, having assumed his duties on August 1. All the stock of the company is held by the officers mentioned. William G. Allen of Hartford, Conn., the inventor of the Allen screw machine, will be superintendent and factory manager. When business returns to normal, the company proposes to build a factory equal in size to its present building for the development of the Wright dieing machine, invented by the late Daniel M. Wright and later redesigned and standardized by Mr. Allen.



Manufacture of Accurate Camshafts



Description of Important Operations, and Complete Tabulated Data on Manufacturing Procedure in Making Camshafts in the Lincoln Motor Company's Plant

By EDWARD K. HAMMOND

A COMPARISON of methods used in machining corresponding parts of the engine for a high priced automobile, and for one that sells for a lower figure, will frequently reveal the fact that these methods are fundamentally the same in both cases, but that various supplementary operations are interspersed into the schedule of operations followed on the high-priced work. These intermediate steps in the process of manufacture may not appear necessary, but it is the refinements attained through the performance of these additional operations that are responsible for giving to the engine of a high-priced machine its freedom from noise and vibration under normal working conditions. A study of the accompanying table of operations on the camshaft for automobile engines built by the Lincoln Motor Co., in Detroit, Mich., will at once make it apparent that there is considerable duplication in the number of turning, grinding, straightening, and other operations that are performed. However, if an attempt were made to lower the cost of manufacture by reducing the number of turning and grinding operations, etc., there is no doubt that it would be impossible to make camshafts and other parts to the high standards that characterize the work of the Lincoln factory.

A careful study of manufacturing costs is necessary in striving for accuracy in quantity production. The manufacture of high-grade automobiles presents excellent examples of work of this kind. Accuracy and quality are prime necessities; but quantity production at a reasonable cost is also a commercial requisite, and the best production engineering service, the selection of the best types of machine tools, and the working out of the most suitable methods are of the greatest importance in order that the three factors—accuracy, quantity, and cost—may each receive its proper share of attention. In the manufacture of high-grade automobiles, economical manufacturing methods are just as important as in the making of cheaper cars, because the total number of cars built is less, and the great care used, in conjunction with the additional operations performed, would increase the cost beyond the commercial limits permissible, if the best machines and methods for reducing expenses were not employed.

Drilling an Axial Hole through the Shaft

It is the practice of the Lincoln plant to use bar steel for camshafts, and to turn the cams and bearings from the solid metal. The blanks used for this purpose come to the camshaft department cut off to a specified length and annealed, so that the steel is in a condition which is favorable for machining. In the accompanying schedule of operations it will be seen that the fifth step in the process of manufacture is to drill an axial hole through the work, 17/32 inch in diameter for a part of the way and 13/16 inch for the remainder of the distance. In connection with the schedule of operations, reference should be made to Fig. 1, which shows a detailed view of the camshaft, the various surfaces to be machined being indicated by reference letters. Fig. 2 illustrates a duplex rifle barrel drilling machine, built by the Diamond Machine Co., Providence, R. I., which is used for these two drilling operations.

During the war period when a number of American plants were engaged in making rifles, MACHINERY

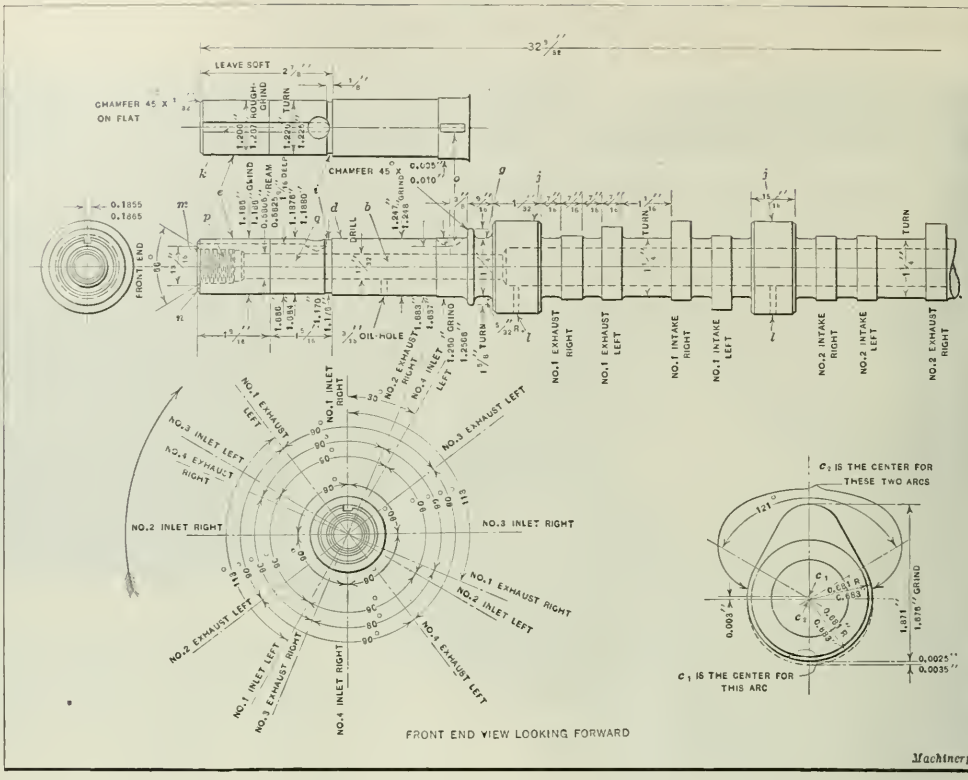


Fig. 1. Detailed View of Camshaft for Automobile Engines made by the Lincoln Motor Co. In Connection with this Illustration Reference

published a complete description of the method of using one of these deep-hole drilling machines. (See MACHINERY, March, 1916.) The drills *A* are of the oil-tube type, and carry oil at high pressure directly to the cutting point, so that the chips are washed out of the deep hole in the work *B* and fall through shields *C* into the pan beneath the machine. On account of the high pressure required to clear the chips from these deep holes, it is necessary to use shields of the kind furnished on this machine, to direct the oil down into the pan, so that it will not spatter over the operator and on the floor.

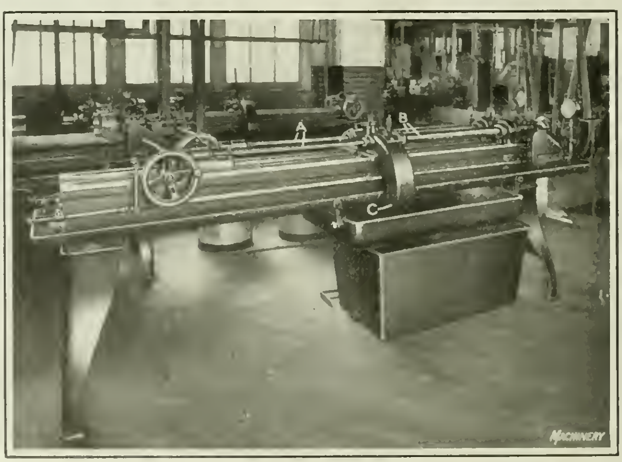


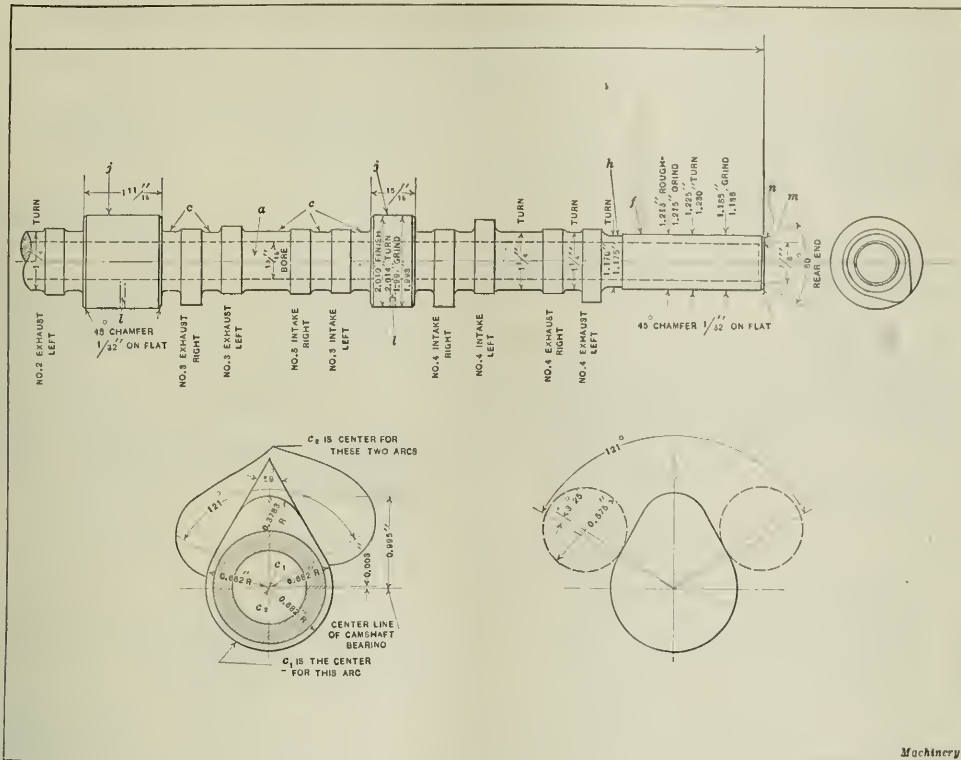
Fig. 2. Duplex Rifle-barrel Drilling Machine used for drilling an Axial Hole through the Rough Steel Bars

Turning Spaces between Cams

As will be seen by referring to the detailed view of the Lincoln camshaft, in the illustration Fig. 1, there are five spaces to be turned in machining between each group of four cams. For these operations, a Lo-swing lathe built by the Fitchburg Machine Works, Fitchburg, Mass., is employed, and this machine is equipped with a tool-block that carries five cutter bits, so that the tools may be fed inward to finish all of these surfaces at a single cut. Fig. 4 illustrates one of these machines in operation, and clearly shows the tool-block *A*, the camshaft *B* on which the turning operations are being performed in the spaces between the cams, and the five cutter bits *C* which simultaneously perform these turning operations. Little time is required to position the tool-block and the tools for taking successive cuts. Four settings of the tool-block are required to clean up the areas adjacent to the sixteen cams and the line bearings; and stops are provided on the lathe to facilitate this part of the work.

Milling the Cams to Form

As the camshafts leave the Lo-swing lathe illustrated in Fig. 4, the cam blanks have been roughed out in so far as the width is concerned, but they are still concentric with the camshaft. Next in the process of manufacture comes the milling of the cams to the required form. On the Lincoln camshafts the cams are concen-



should be made to the Sequence of Operations and Equipment used for machining these Camshafts, as given in the Accompanying Table

tric for 239 degrees, and the rise and fall occur during the remaining 121 degrees; it is obvious that the rise on each cam has to be properly located so that the firing order of successive cylinders will be correct.

Provision has been made for obtaining the required results on a No. 2 plain milling machine built by the Cincinnati Milling Machine Co., which is equipped with a set of 10-inch index-centers made by the Brown & Sharpe Mfg. Co. The machine is shown in operation in Fig. 3. An end milling cutter *A* is mounted in the horizontal spindle of the machine, and in milling each cam *B* to form, the method of procedure is as follows: In the index-plate of the centers are holes for determining the four points at which each successive cam on the shaft must change its form, so that this equipment not only provides for milling all the cams to the proper shape, but also gives them the correct relationship to obtain the proper firing order for the engine. A brief description of the way one cam is milled will make the procedure clear.

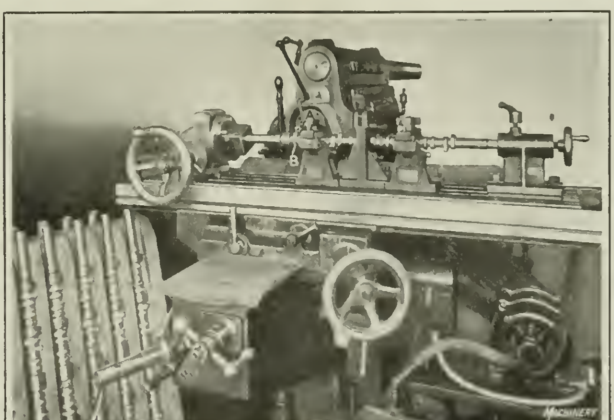


Fig. 3. Plain Milling Machine equipped with Indexing Centers for milling the Cams to the Required Form

It has already been mentioned that the cam is concentric with the shaft through an angle of 239 degrees (see Fig. 1), and for milling this arc, it is merely necessary to rotate the camshaft with the milling cutter in contact with the work. The index-plate on the dividing head determines the starting and stopping points of this concentric portion. Next comes a straight rise on the cam, and to provide for milling this part of the work to shape, rotation of the camshaft is stopped when the index-pin reaches the limiting point, and a vertical feed movement is substituted, so that the work may be fed straight past the cutter. On the milling machine knee, limit stops are furnished to make it a simple matter for the operator to ascertain when he has fed the work the required distance past the cutter in a vertical direction; and upon reaching the second stop, a rotary feed movement of the work is substituted for the straight vertical movement. This rotary movement produces the round top surface of the cam, which is concentric with the shaft.

SEQUENCE OF OPERATIONS AND EQUIPMENT USED FOR MACHINING LINCOLN CAMSHAFTS

Oper. No.	Name of Operation	Type of Machine and Special Tools	Type of Standard Tools
1.	Cut off stock 32⅝ inches long	Newton cold saw	Circular saw blade
2.	Heat-treat	American gas furnace	Bristol pyrometer
3.	Straighten	No. 3A Geier straightening press and roller support for testing trueness	Indicator bracket and No. 5 Ames indicator
4.	Turn both ends to 2 inches diameter by 2.0025 maximum, 1.9975 min., long; face ends to a length of 32 15/32 ins.	Reed 16-inch lathe, steadyrest, and over-all length gage	Cushman three-jaw chuck and Johansson snap gage for 2 ± 0.0025 inch
5.	Drill 13/16 hole a and 17/32 hole b through work (see Fig. 1)	Diamond duplex rifle drilling machine	13/16- and 17/32-inch gun-barrel drills
6.	Center both ends with pilot center	21-inch Cincinnati Bickford upright drilling machine and vertical work-holding fixture	Wiard chuck, 60-degree center drill and 13/16- and 17/32-inch pilot for the center drill
7.	Rough-turn balance of shaft to 2 3/64 inches diameter	3½-inch Lo-swing lathe and roller rest	Driving dog and tool-holder
8.	Straighten	No. 3A Geier straightening press	Indicator bracket and No. 5 Ames indicator
9.	Grind turned diameter 2.045 min., 2.050 max.	Norton 10- by 36-inch cylindrical grinding machine	Johansson snap gage, and driving dog
10.	Rough spaces c between cams and adjacent to bearings, leaving 1/32 inch of stock	8-inch Lo-swing lathe, steadyrest, tool-block, and tool spacing gage	Driving dog and snap gage
11.	Straighten	No. 3A Geier straightening press	Indicator bracket and No. 5 Ames indicator
12.	Finish-turn spaces c between cams	8-inch Lo-swing lathe, tool-block holding five necking tools, tool spacing gage	Snap gages for diameter, width, and spacing of cam blanks
13.	Straighten	No. 3A Geier straightening press	Indicator bracket and No. 5 Ames indicator
14.	Rough-turn front end diameters d and e to 1 11/16 and 1⅝; also rough-turn rear end diameter f to 1 5/16 inch	18-inch Reed engine lathe	Armstrong tool-holder, snap gages, and driving dog
15.	Turn recess g to 1¼ diameter by 5/32 inch radius, and recess h to 1.170 min., 1.175 max., diameter	3½-inch Lo-swing lathe	Gages, driving dog, and turning tools
16.	Turn front end e to 1.225 max., 1.220 min., and recess i to 1.175 max., 1.170 min., by ⅛ inch wide	Leland-Gifford 15-inch lathe	Snap gages and Armstrong tool-holders
17.	Turn rear end f to 1.230 max., 1.225 min., diameter by 3 5/16 inches long	Reed 18-inch lathe	Driving dog, Armstrong tool-holder, Johansson snap gages
18.	Straighten	No. 3A Geier straightening press	Indicator bracket and No. 5 Ames dial indicator
19.	Rough-grind line bearings j to 2.030 min., 2.032 max.; front end diameter e to 1.206 min., 1.207 maximum; diameter d to 1.285 min., 1.287 max.; and rear end diameter f to 1.213 min., 1.215 max.	10- by 36-inch Norton cylindrical grinding machine	Johansson limit snap gages and driving dog
20.	Rough-mill keyway k to 0.170 max., 0.165 min., in width, and burr	Pratt & Whitney spline milling machine, keyway milling fixture, tool setting gage	Two-lipped fish-tail cutter and gages
21.	Mill cams to form	No. 2 Cincinnati milling machine	Brown & Sharpe 10-inch plain index-head and center, Johansson snap gages and end milling cutter
22.	Chamfer bearings and burr all over	Reed engine lathe	Flat files, driving dog and steadyrest
23.	Inspect		Gages for all dimensions
24.	Copperplate 0.005 to 0.008 inch thick—Inspect	Electroplating bath and rack for holding in copperplating bath	
25.	Recenter ends		

Machinery

Rotary feed movement is again stopped when the index-pin of the dividing head drops into its next hole in the plate, and a vertical downward movement of the knee is substituted for the rotary feed, until the lower stop is reached, which limits this vertical movement. At this point, the cutter has returned to the position where it started to mill the concentric portion of the cam over an angle of 239 degrees, and this completes the cycle of operations. Then, the work is withdrawn from the milling cutter, and rotated until the index-pin enters the next hole in the plate. This rotates the camshaft into the proper position to start milling the 239-degree concentric portion of the next cam, after the work has been traversed longitudinally to bring the next cam blank opposite the milling cutter. When this has been done, the machine is again set in motion. By repeating this cycle of operations sixteen times, all the cams on the shaft are milled to shape.

Grinding the Cams

After roughing out the cams to the required form by milling, as just described, the work goes to a Norton 10- by 50-inch cam grinding machine for the first grinding operation. The machine is shown in operation in Fig. 7. It is provided with the usual arrangement for rocking the work as it rotates in contact with the grinding wheel, this oscillation being accomplished by means of a master cam which is of the same form as the cams to be ground. Hence, it is a simple matter to perform this cam grinding operation in accordance with standard practice. It will be apparent that for performing this cam grinding operation, the master cam must be an exact duplicate of the cams on the camshaft in the form they have reached after the first grinding operation. This is true both as regards the allowance for metal to be removed by subsequent grinding, and the angular positions of the cams around the shaft, in order to give exactly the proper firing order for the engine cylinders.

Testing Hardness of Cams and Bearings

All cams and bearings of the Lincoln camshaft are hardened, and as the finished shafts go to the inspection department, the first step is to test the hardness of these members with a Shore scleroscope *A*, Fig. 5. This instrument is mounted on a special machine which holds the camshaft on a table *B* that may be moved longitudinally under the scleroscope, so that a minimum amount of time is required to bring successive cams and bearings into position for making the hardness test. This is a typical example of the usefulness of the scleroscope in testing a finished product, as it enables an accurate determination of hardness to be made without damaging the finish of the surface.

SEQUENCE OF OPERATIONS AND EQUIPMENT USED FOR MACHINING LINCOLN CAMSHAFTS

Oper. No.	Name of Operation	Type of Machine and Special Tools	Type of Standard Tools
26.	Grind copper off line bearings j to a diameter of 2.018 min., 2.020 max.; rear bearing f to a diameter of 1.203 min., 1.205 max.; and front bearing d to a diameter of 1.265 min., 1.268 max.	20- by 36-inch Norton cylindrical grinding machine	Johansson snap gages and driving dog
27.	Grind copper off cams to a diameter of 1.378 min., 1.382 max.	Norton 10- by 50-inch cam grinding machine	Norton master cam, grinding wheel and Johansson snap gage
28.	Drill 3/32-inch oil-holes l in bearings j	Leland - Gifford sensitive drilling machine and jig	Jacobs drill chuck, twist drills, and countersinks
29.	Inspect	Over-all length gage	Johansson snap gages
30.	Carburize	Carburizing tubes	
31.	Clean centers m and straighten	No. 3A Geier straightening press	Indicator bracket and No. 5 Ames indicator
32.	Face and chamfer ends n to 32 9/32 inches long. Recenter both ends and turn Woodruff keyseat bearing o to 1.265 min., 1.268 max., diameter	Reed 16-inch lathe	Gages and Armstrong tool-holder
33.	Inspect	Special gaging machine	Johansson snap gage
34.	Sand-blast	Pangborn sand-blasting machine	
35.	Harden	American gas furnace	Bristol pyrometer
36.	Draw temper	Cyanide bath	Bristol pyrometer
37.	Sand-blast outside	Pangborn sand - blasting machine	
38.	Sand-blast hole	Pangborn sand-blasting machine	
39.	Inspect for hardness		File
40.	Straighten	No. 3A Geier straightening press	Indicator bracket and No. 5 Ames dial indicator
41.	Inspect location of cams	Special testing machine	Ames No. 5 dial test indicators
42.	Rough - grind line bearings j, and front and rear bearings d and f	Norton 10- by 36-inch cylindrical grinding machine and back-rest	Johansson snap gages and driving dog
43.	Drill and tap hole p, ream hole q, and counterbore	Cincinnati Bickford drilling machine. Vertical work-holding fixture	Wiard quick - change chuck, drill, tap, reamer, and counterbore
44.	Recenter	Reed 18-inch lathe	Armstrong tool-holder, and driving dog
45.	Finish-mill keyway k to 0.1855 min., 0.1865 max., in width	Pratt & Whitney spline milling machine and keyway milling fixture	Two - lipped fish - tail milling cutter and gages
46.	Mill Woodruff keyseat o	No. 6 Whitney hand milling machine and work-holding fixture	Woodruff keyway cutter and holder, and gages
47.	Grind line bearings j to 1.999 min., 2.000 max., diam.	10- by 36-inch Norton cylindrical grinding machine	Johansson tolerance snap gage and driving dog
48.	Grind cams to 1.367 min., 1.368 max., diameter	Norton 10- by 50-inch cam grinding machine	Johansson tolerance snap gages, Norton master cams and rollers
49.	Finish - grind cams to 1.366 max., 1.3655 min., diam.	Norton 10- by 50-inch cam grinding machine	Norton master cams and rollers. Johansson snap gages
50.	Finish - grind line bearings j to 1.998 max., 1.997 min. diameter; front bearing d to 1.248 max., 1.247 min. diameter; Woodruff keyseat bearing o to 1.2505 max., 1.250 min. diameter; front end e to 1.1880 max., 1.1875 min. diameter for 1 5/16 inches, and to 1.1860 max. 1.1850 min. diameter for balance of length; finish-grind rear bearing f to 1.186 max., 1.185 min. diameter.	Norton 10- by 36-inch cylindrical grinding machine	Tolerance snap gages and driving dog
51.	Stone off sharp corners on cams, and burr	Blount 11-inch speed lathe	Carborundum oilstone and driving dog
52.	Hand tap	Bench fixture	No. 4 Bay State tap wrench and tap and limit thread plug gages
53.	Inspect	Machines for testing opening and closing points of cams, and concentricity and spacing of cams and bearings	Johansson tolerance snap gages
54.	Test hardness	Shore scleroscope	

Machinery

Testing Concentricity and Spacing of Cams and Bearings

For testing the concentricity of the four line bearings, and of the two bearing diameters at the front end of the shaft, use is made of six dial test indicators mounted on the fixture illustrated in Fig. 6. The work is carried on supports which allow it to be rotated with the bearings in contact with the plungers of the dial indicators. If the needles of any of these instruments indicate an error of more than 0.001 inch, the work is sent back to the machine shop for correction or else it is discarded, according to the seriousness of the conditions which are discovered. On this testing fixture, there is also a spacing gage-bar *A* at the opposite side of the work from the dial indicators. This gage has spaces machined in it to receive each of the cams and line bearings, so that if there is any error in the longitudinal spacing of these members, it will be impossible to place the work in the gage.

Ascertaining the Accuracy of the Intake and Exhaust Points on the Cams

In connection with the preceding description of the method used for rough-milling the cams, mention was made of the importance of locating each cam accurately on the shaft, so that the firing order of the engine cylinders would be accurate. Obviously this is a most important point, and great care must be taken in inspecting the finished camshafts to make sure that these points on the cams have all been correctly located. For this purpose, use is made of an inspection fixture which is shown in use in Fig. 8. This consists of a dial test indicator, carried by a bracket *A* which is free to slide along a bar *B* at the rear of the fixture.

In this way, it is an easy matter to bring the plunger of the indicator into successive contact with each cam; after a plug *C* at the front of swinging bracket *A* has been brought down into contact with a corresponding block *D* mounted on the front of the fixture frame, the indicator dial is set to zero, with the plunger in contact with the 239-degree concentric portion of the cam. Then the camshaft is rotated until the indicator plunger comes sufficiently beyond the extreme of this concentric portion to deflect the needle over a 0.001-inch space, after which the inspector observes the position of a fixed index mark on bracket *E* relative to two limit marks scribed on the rim of a wheel *F* that is turned with the camshaft. This wheel is keyed to the camshaft, so that a definite relationship always exists between the position of the opening or closing point on each cam and the corresponding graduations on the rim of the wheel.

There are thirty-two sets of graduations around the wheel *F*, which indicate the limiting positions for the sixteen cams that actuate the opening and the closing of the intake and of the exhaust valves for the eight cylinders. When the dial indicator needle has been deflected over a 0.001-inch space in the manner previously described, the fixed graduation at *E* must lie between the two limit graduations on wheel *F* for that point on the cam. Then the inspector turns the wheel *F* in the opposite direction until the indicator needle is again deflected over a 0.001-inch space, and observes whether the fixed graduation at *E* lies between the two limit graduations on the rim of the wheel. After making this test, the bracket *A* is moved along bar *B* to bring the plug *C* into contact with the next plug *D*, after which the test is repeated for the next cam. This cycle of movements is gone through sixteen times, in order to test the opening and closing points of each of the cams on the shaft. The method is one which enables extremely accurate determinations to be accomplished with a minimum expenditure of time.

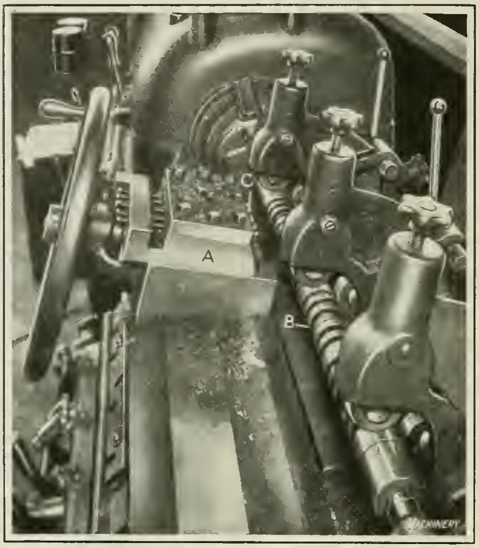


Fig. 4. Spacing the Cams and Line Bearings on a Lo-swing Lathe

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DEMAND FOR LOW-COST GARAGE MACHINERY

By J. ARTHUR GLATTLY

The whole trend in machine tool design has been toward the production of machinery that would perform a large amount of work in a minimum of time. It is the writer's belief that there is now a large potential field for machine tools designed along somewhat different lines. This field includes machines that are low in initial cost, but which nevertheless should have capacity for a wide range of work. Machine tools of this class have received comparatively little consideration. In making this statement the writer has in mind the requirements of small repair shops and garages.

There are about nine million automobiles and trucks in use in the United States today, and every one of these requires more or less maintenance work. Many of these automobiles were built by companies no longer in existence, and it is often difficult and usually requires considerable time to obtain replacement parts for them.

Machines for Regrinding Cylinders

The matter of regrinding cylinders is an important one. It is necessary to regrind the cylinders at least once during the life of the average car if satisfactory operation is to be maintained. Regarding cylinder grinding machinery, there is little to be desired in the way of improvements in the standard machines now on the market, so far as accuracy or production is concerned, but the average price of these machines is somewhat high for small garages or repair shops. What is needed is a machine that will handle a large variety of cylinders the first cost of which will be within the reach of the man who owns a small garage and who has a limited amount of this work to do, but who cannot afford to make a heavy initial investment for what may be termed a standard machine. A machine to meet these requirements need not be capable of high production rates. There are many devices for reboring cylinders, but reboring does not give the desired finish. The writer believes that a regrinding machine that would cost, say, about $500 to $800 would have a vast potential market.

Milling Machine Developments

In regard to milling machines the same condition obtains as in the case of grinding machines. No heavy initial expenditure in tool equipment, however, need be made if fly cutters are used in place of milling cutters. There is no reason why some of the lighter types of hand milling machines could not be equipped with table feeds at no great

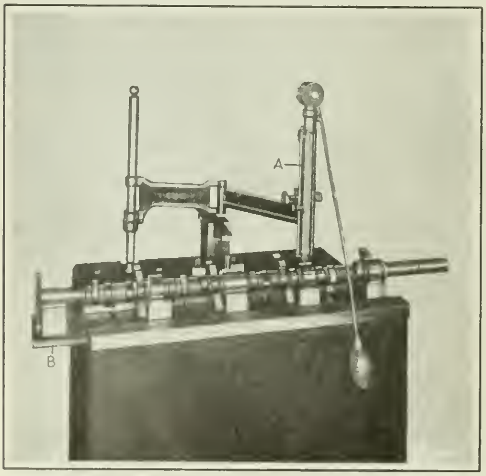


Fig. 5. Testing the Hardness of the Ground Cams and Bearings with a Scleroscope

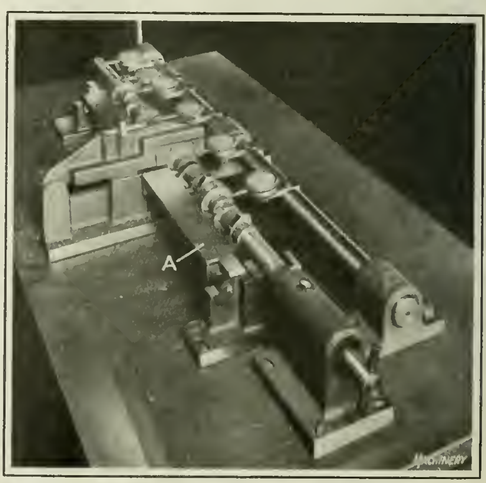


Fig. 6. Testing Spacing of Cams and Bearings, and Concentricity of Bearings

additional cost. By the use of fly cutters, machines so equipped would be capable of handling a wide range of work. In fact, the writer believes that the possibilities of the fly cutter are overlooked to a great extent at the present time in our large shops and tool-rooms. For the small shop, however, the possibilities of the fly cutter are almost limitless.

With the development of the electric furnace and electrical temperature recording instruments, the problem of heat-treating small quantities of gears has become a simple matter. The time is not far distant when there will be many shops throughout the country which will be equipped to replace gears for automobiles made by companies no longer in business.

Improvements in Drilling Machines

In regard to drilling machines the writer believes that there is room for development, notwithstanding what has already been accomplished along these lines. For a small shop there is need of a drilling machine that has a wide range of speeds and feeds and one which has simple provision for taking up the lost motion in the spindle bearing. A taper roller bearing would, the writer believes, make adequate provision for spindle bearing adjustment.

The small shop owner cannot afford several drilling machines, and it is therefore necessary that he have a machine which will be capable of handling all sizes of drills, from the small "numbered" drills up to the large sizes having taper shanks. It should be borne in mind that a drilling machine in a small shop can be used to good advantage on many boring jobs, but at the same time it must be remembered that the cost should be kept as low as possible and the machine made as simple as is consistent with the work it is intended for. In regard to lathes and external grinding machinery, the writer believes that the possibilities of design, as far as the needs of the small shop are concerned, have been well covered.

A well-equipped machine shop will become more and more a necessary adjunct to every first-class garage. This shop will be successful in handling its work just as soon as machine tool builders develop and produce a line of machinery which is adapted especially to the peculiar needs of the garage and the small repair shop.

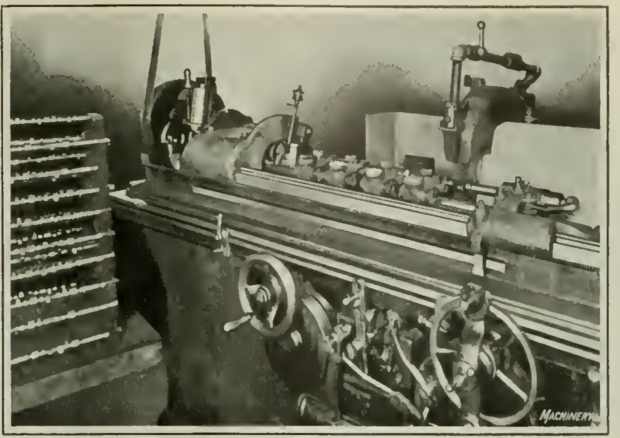


Fig. 7. Camshaft Grinding Machine

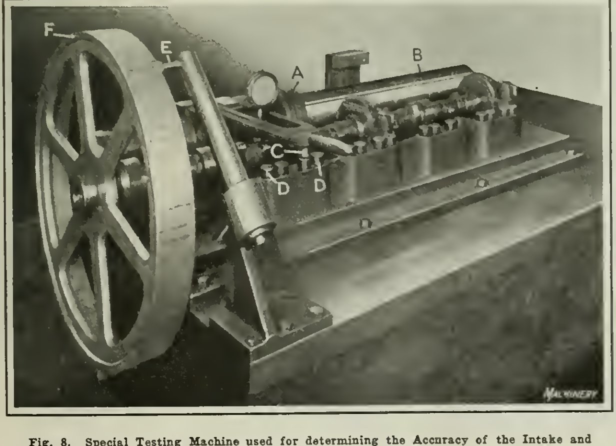


Fig. 8. Special Testing Machine used for determining the Accuracy of the Intake and Exhaust Points on all Cams on the Shaft

COURSE IN INDUSTRIAL PUBLISHING

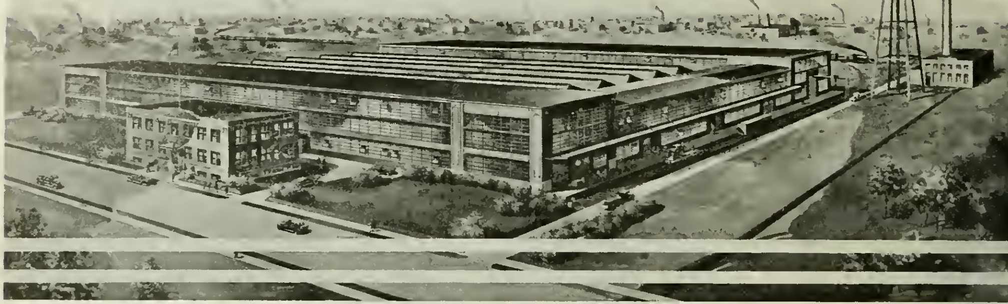
At its September meeting, the New York Business Publishers Association announced the establishment of a course in industrial publishing. The course has been organized and will be conducted under the direction of the educational committee of the association by the Business Training Corporation, which has been retained for that purpose. It will include lectures, conferences, text-books, problems, and a personal commenting service. Classes are now being organized in New York and will soon be organized in other publishing centers. The course will also be conducted by correspondence for people who are unable to attend classes. Although designed primarily for the benefit of members of the editorial and business staffs of trade and technical periodicals, it will be open to all who are interested in the field. It is intended not only to give instruction, but to develop the business as a whole by setting up higher standards of editorial and business service and showing how these standards can be attained.

The following topics will be covered: Distinctive features of industrial publishing; its code of ethics; personal qualities required for success; determining editorial policies; getting the right kind of articles; securing accurate reports and data; writing for industrial papers; building up circulation; creating advertising; departmental management; service to the industry; service to advertisers; and basic policies and tendencies. "We look upon this undertaking," said H. M. Swetland, president of the United Publishers Corporation and chairman of the educational committee, "as one of the most important steps ever taken toward making industrial papers even more valuable to their readers and advertisers. Our own prosperity will grow in direct proportion to our growth in ability to render useful service." Those interested can obtain further information regarding the course and the classes by communicating with the secretary of the course in industrial publishing, 185 Madison Ave., New York City.

* * *

It is estimated that at the current rate of construction, the output of American shipyards for the present fiscal year will be about 2,250,000 gross tons, as compared with 3,735,000 gross tons, constructed during the year 1920.

Factory Lay-out as an Aid in Reducing Costs



A Description of the New Plant of the Colburn Machine Tool Co., Cleveland, Ohio, which has been Laid out with a View to Economy in Manufacturing

THE new plant of the Colburn Machine Tool Co., on Ivanhoe Road, Cleveland, Ohio, presents an example of how a well thought-out factory lay-out may aid in reducing production costs. A description of this plant will point to many desirable features in modern plant construction. A general view is shown in the heading illustration, the office building being located in front, but directly connected with the factory by a passageway.

The buildings are practically fireproof, being constructed of steel, brick, and cement, with steel window sashing and frames, and provided with a complete sprinkler system. The shop building, which is 310 by 280 feet, is designed with a front and rear flat-roof bay or head-house extending the full length of the building, these bays being connected on the north end of the structure by a third bay; the remainder of the space is covered with a saw-toothed roof, and is divided into five bays. The three high-roof bays are provided with traveling cranes, and serve as an assembling floor and receiving, shipping, and stock rooms, while the five bays in the center are devoted mainly to machining operations.

The office building contains, in addition to the executive offices, the engineering and advertising departments, which are located on the second floor. From the office a covered passageway leads into the shop, which is unusually well lighted and ventilated. The important factor of good lighting has been carefully considered in its effect upon production. All girders and steel framework are painted light gray, and the roof and window sash are white.

The front and rear bays, extending the full length of the building, are each 50 feet wide. From a point about midway of the front bay a main central traffic aisle extends to the rear, dividing the machine shop area and leading into the high bay at the rear. The main aisle and several side aisles, which lead into it, as shown in Fig. 2, are laid out by painting white boundary lines on the floor, which is paved with creosoted wood blocks set on a bed of solid concrete, 6 inches thick. The aisles are kept free and clear to facilitate transportation of materials, which is done either by means of a flat car, such as shown on the narrow-gage track extending through the shop to the yard at the rear, or by industrial motor trucks. The boundary lines are laid out and painted on the floor in the bays as well as in all aisles, the advantage of this traffic regulation being obvious.

There is a 15-ton Cleveland traveling crane, with a 5-ton auxiliary hoist, in the front head-house, with crane tracks extending the entire length of the bay. This crane travels on tracks placed high in the bay—about 8 feet higher than another crane of like capacity and design which is provided in the side bay that runs along the north side of the building. The tracks for this crane extend out into the front and rear head-houses, the object being to permit material to pass directly from one to the other by running the lower crane under the upper one. This arrangement, which is identical in both head-houses, is shown in the background of Fig. 1.

The north bay is another clear passageway, 50 feet wide, extending the full depth of the building between the front and rear head-

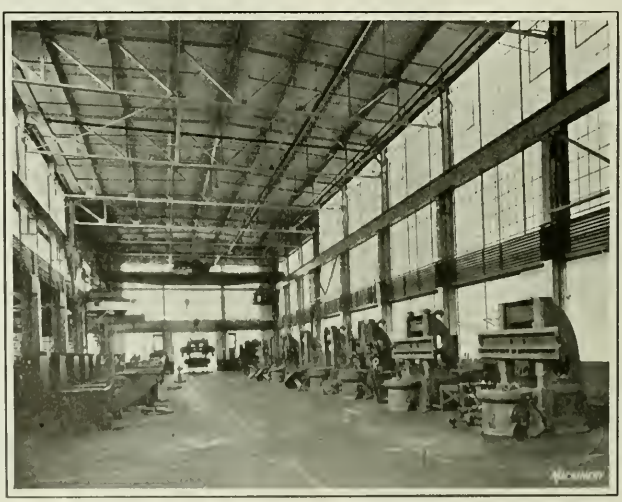


Fig. 1. View in Front Head-house used as Erecting Floor

Fig. 2. Central Traffic Aisle, which runs entirely through the Shop, from Front to Rear Bay

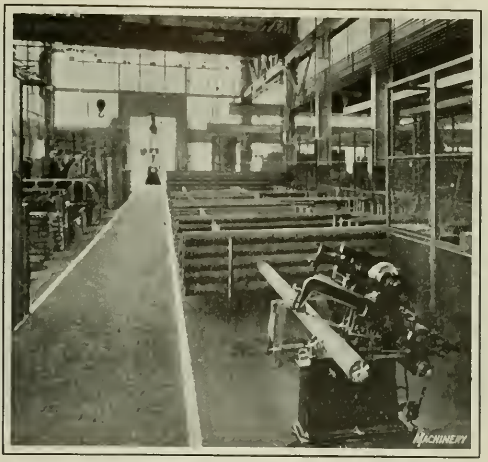


Fig. 3. Transportation Facilities provided from Receiving Platform to Storage Space

houses. Six double doors in the north wall lead to the receiving and shipping platform which also extends the full depth of the building. Running parallel with this platform is a concrete roadway for the accommodation of express trucks, etc., and between the platform and the roadway there is a spur track of the Nickel Plate Railroad. The convenience of this lay-out for handling material going to and coming from the cars will be apparent from an inspection of Fig. 5. The floor of the platform is made of concrete, and it is equipped with labor-saving facilities for loading and unloading freight cars. Two wire cable winches are installed under this platform so that heavy machines may be easily moved, or when locomotive power is not available, freight cars may be towed in from the main tracks, which are 1600 feet distant from the platform.

Cemented into the platform floor at both sides of the last door (which leads into the rear head-house) are two snatch-block hooks, provided so that tackle may be used to facilitate the unloading of material from the cars. From the platform it is picked up by a monorail traveling hoist, the overhead rail of which extends through the doorway out beyond the tracks of the railroad siding. This enables material to be delivered directly to the floor of the rear head-house. Fig. 3 is a view looking toward this doorway from the interior of this head-house, and shows, in addition to the hoist, the overhead crane installation, which is similar to that in the front head-house, previously described.

Arrangements for Storing Material

The rear head-house is used mainly as a storage room for property and stock, and is separated from the rest of the factory by sheet-metal and wire-mesh partitions. In this connection, it may be mentioned that all receptacles, desks, benches, racks, etc., as well as all partitions in the building are made of steel, and there are no wooden closets or shelves where inflammable material may accumulate and increase the fire hazard. All sheet-metal factory accessories used in the shop were furnished by the Hausermau Co., of Cleveland. Attention is directed to the appearance of the farther left-hand corner of this bay, in Fig. 3, where the larger castings are neatly arranged. The large bar stock is supported by sections of I-beam, laid in orderly fashion on the floor, and the smaller bar stock is stored on floor stands. This illustration also shows in the right foreground the metal-partitioned stock-room office, which is equipped with metal files for recording stock, and also the power cut-off saws.

The opposite, or south end of this bay contains metal bins which are used for storing jigs and fixtures and for such small parts as bolts, nuts, screws, gears, bushings, shafts, small castings, and similar parts; the electric power room in which the current converter and main switchboard are installed; the portable oil-tanks, industrial motor trucks, and certain millwright equipment such as rope and cables, tackle-blocks, ladders, etc. The storage room does not occupy the entire length of the rear head-house, but is partitioned off to provide space for the heat-treating department in the southwest corner of the factory. The end of the stock-room used for storing small parts is shown in Fig. 4.

Fig. 4. Stock-room, showing Bins used for storing Small Parts

Wash-room and Coat Room

The wash-room, which can be partially seen at the left in Fig. 2, is located near the left-hand corner of the main aisle and front head-house. Enamelware wash basins, hot and cold water, and complete sanitary equipment for the men are provided. An all-steel tool-crib is located at the rear of the wash-room and almost in the exact center of the shop, so it is convenient to all departments.

Fig. 5. North Side of the Factory, showing Facilities for loading Machines on Flat Cars

The workmen's entrance is on the south side of the building adjacent to the front head-house and leads into a well-arranged coat room constructed entirely of sheet-metal and wire-mesh. Metal hangers are suspended from an overhead framework, each of which is suitable for the accommodation of ten or a dozen men's clothing. Above the hooks for the clothing there is a shelf on which such things as lunches, towels, and other personal belongings may be placed, and they are protected from dust by a hood, or roof, which extends over the shelf. Ample space is left between these hangers for the men to pass without interfering with each other. Here again, the provisions for prevention of fire hazards and accumulation of dust and dirt are in evidence. During working hours a sliding door between the manufacturing floor and the coat room is kept closed.

There are no benches extending along or near the walls of the shop. Instead, individual portable metal benches are provided. There are many advantages to be derived from this departure from the usual shop arrangement, some of which are the elimination of a hiding place for debris and combustibles, better light, and more available working space.

Machine Installation and Arrangement

The machines in the manufacturing departments are arranged in rows with a spacious aisle between, each leading to the main aisle and its narrow-gage car track. All machine equipment is driven by individual motors which, in some cases, necessitated a rather complete change-over from the original drive of the machine. Fig. 6 shows a battery of Cleveland automatics on each side of the aisle, and also illustrates the mounting of individual motors and the method of connecting them with the machines. Operators are not permitted to tamper with the panel boxes from which the various motors receive their current. These boxes are attached to a post near each machine, out of the men's reach. The arrangement is well illustrated in both Figs. 6 and 7; the latter illustration shows one such box open, exposing to view the four switches which it contains. Each machine is provided with a start-and-stop push-button switch for switching the power on or off.

In reference to the installation of such equipment as automatic screw machines, attention is called to a provision for confining the dripping oil to the vicinity of the machine so that it will not be tracked into the aisles and all around the shop. The machines are each surrounded by a strip of angle-iron, forming a shallow drip-pan, 1 inch high, under the machine, which is filled with dry sawdust, the supply being replenished as occasion demands. This precaution keeps the passageway between the machines in a neat condition, and eliminates the danger of slipping on oily floors.

All machines are grouped in such a manner that the flow of work during the process of manufacture is always in the general direction of the front head-house, where the erecting of Colburn heavy-duty drilling machines and vertical boring and turning mills is done. Another group of machine tool equipment which shows the uniformity of arrangement is illustrated in Fig. 7, this being a line of multiple- and single-spindle drilling machines of this company's manufacture.

The heat-treating department, shown in Fig. 8, is situated in the southwest corner of the plant. Special care has been taken to provide for the removal of fumes, heat, and smoke by covering the furnaces with an overhead hood, which has flues that deliver impurities out of doors.

Electric Wiring System and Facilities

It has been mentioned that all machine tools have individual motor drive, and in this connection reference has been made to Figs. 6 and 7. The advantages gained by thus eliminating all overhead pulleys and belting are well known. The electric wiring is carried in wrought-iron pipe conduits with suitable switch panels and distribution stations located conveniently throughout the factory. By arranging all pipe lines, including sprinkler systems and feed pipes for the heating coils, so that they may be suspended near the roof, the entire space above the machines is left open.

The main electric current is furnished by a converter installed in the power room in the rear head-house. From the converter the current is delivered to six distribution panels located at various points throughout the shop. Two of the panels are for lighting purposes and four for furnishing power to the machines. These six panels are mounted high up in the sawtooth roof space, one panel being shown in Fig. 6 attached to the upper framework of the building. Between the distribution panel which serves any particular group and each machine in that group, there is a switch panel to which reference has previously been made. The

Fig. 6. Aisle in the Automatic Screw Machine Department, showing Individual Motor Drive

only person who has access to the switch panels is the regular shop electrician, who systematically examines the switches, blows out the dirt from the motors, and gives all the electric equipment general attention. It requires one week for him to make the complete rounds, giving each motor and switch the necessary attention, so that all equipment is visited at least once in that period of time.

One interesting feature of especial note in connection with the electrical equipment is the provision of testing machines on the erecting floor. The entire row of columns between the front head-house where the erecting is performed and the adjacent parallel bay in which the assembling department is situated is equipped with special switch boxes. The switch boxes are arranged so that not only the motor for driving the machine may be plugged in, but small electric tools may also be connected up by the use of sockets, as, for example, portable drills, which are often required in the final finishing of a machine before shipment. This enables a drilling machine or boring mill to be tested wherever it is located, without moving it. Much time is thus saved, and the result is a considerable and direct reduction in the cost of performing this necessary work. This factor in the lessening of production costs should always be taken into account by the manufacturer, especially if the product is heavy, as is usually the case with machine tools.

Fig. 8. Heat-treating Department—Note Provision of Overhead Hood for carrying off Fumes and Smoke

A complete auto call and intercommunicating telephone system is provided, and also a Stromberg time recorder. Horns located in various parts of the shop which announce starting and stopping time operate automatically and are synchronized with the time system.

Relation of Systematic Lay-out to Production

The incoming raw material when it arrives on the receiving platform can readily be transported by means of the crane system and other equipment, either to the storage space and thence to the machine shop, or direct to the manufacturing department. The lay-out of the cranes and traffic aisles is the result of careful planning, and the arrangement finally evolved is such as to offer the least resistance to the steady flow of the product being machined. If the material is in the form of bar stock, it is cut to length on a power saw in the stock-room and then routed to the first-operation machine. The lay-out is such that the material always moves in the same general direction, arriving in the front head-house for erecting without unnecessary handling.

Upon arrival of the finished product in the erecting department, it is subjected to the usual fitting, scraping, and testing, and is then picked up by the crane in the front head-house and delivered to the auxiliary side-bay crane, and thence to the shipping room which occupies a section of the side bay adjacent to the shipping and receiving platform. Here there is installed suitable woodworking machinery for crating machines.

* * *

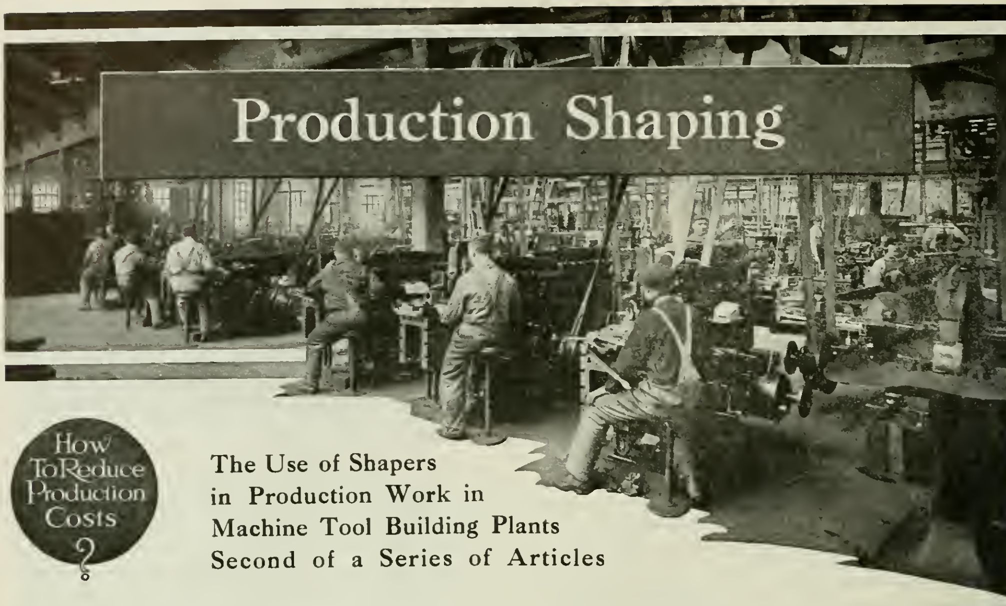
WELDING BROKEN ARMATURE SHAFTS

Large armature shafts occasionally break at the junction of the journal and the pulley end. While recognizing the adaptability of the thermit welding process to the welding of large steel shafts, operators sometimes, in this case, decide to scrap the old shaft, fearing that the heat of the steel produced by the thermit reaction might injure the armature coils and produce short circuits. However, it has been the experience of the Metal & Thermit Corporation, of New York City, that when the armature coils can be separated from the fracture by a few inches of molding sand (at least about 4 inches in the case of a 3-inch diameter shaft) a repair by this method is entirely feasible without injuring them, if the following simple precautions are observed. There is no danger of damaging the armature windings through the effect of direct heat, as the fracture is completely surrounded by molding sand and all preheating is confined within this molding sand. The heat which is conducted along the shaft is readily taken care of either by directing an air blast on the shaft or, where necessary, by using a specially constructed water-cooler box with a packing box on the shaft to prevent the possibility of any water coming in contact with the windings. The windings themselves are further protected by being totally encased in an oil-cloth and burlap bag.

In case the keyway of the pulley end of an armature shaft becomes badly worn, this end can be removed and a new over-size extension welded on and machined down. A large number of such extensions have been thermit-welded satisfactorily. As an example of costs, an extension to a 3½-inch shaft can he thermit-welded for about $35.

Fig. 7. View in Another Machining Department, showing Excellent Lighting

Production Shaping



How To Reduce Production Costs ?

The Use of Shapers in Production Work in Machine Tool Building Plants
Second of a Series of Articles

In the first installment of this series of articles dealing with the use of shapers on production work, attention was called to the various advantageous features of machines of this type. In shops engaged in the building of shapers, it will be obvious that it is desirable for the manufacturer to have such machines in operation in his plant, which are then available for exhibition purposes. This can be done to peculiar advantage because in the manufacture of shapers there are many parts of small or medium size, for the planing of which the shaper is especially well adapted. Typical examples of such work are illustrated and described in this article; in addition to showing the range and flexibility of the shaper, the methods are of general application, so that they could be applied with equal success on many other lines of work, for reducing costs and increasing production.

Planing Steptoe Shaper Column Castings on the Shaper

On shapers built by the John Steptoe Co., the ends of the column castings are planed, and this work was formerly done on a shaper. Little thought will be required to make it apparent that work of this kind is too large to be advantageously handled on this type of machine; but the present example clearly shows the capacity of a shaper in an emergency. Fig. 1 shows this job set up on an old-style triple-geared Steptoe shaper.

A fixture *A* is hung on the shaper cross-rail in place of the apron, which provides for feeding the work transversely or for adjusting its vertical position; the fixture is also provided with a graduated swivel, so that the work may be adjusted for planing different surfaces. This is the means of effecting a substantial saving of time in setting up these castings, because after the end of the shaper column has been planed, as shown in the illustration, it may be swiveled through 90 degrees for planing the ends of the bearing bosses that carry the transverse shafts. Then the work can again be swiveled through 90 degrees to bring the opposite end of the casting under the tool for planing the bearings for the cross-rail, after which a third swiveling of the work brings the opposite side into position for planing.

Thus it will be apparent that all four sides of the work can be planed at a single setting, and even though the shaper may be a little slower than the planer, the possibility of completing all the machine work at a single setting would offset the difference in speed, so far as the total production is concerned. Notches are cut in the flange of the rotary fixture, one notch being shown at *B*, so that the column can be properly located in successive positions for performing the planing operations.

Planing Shaper Table Support

At the plant of the John Steptoe Co. a shaper of this firm's manufacture is employed for planing the table support for Steptoe shapers. These would be rather difficult pieces to hold on any other type of machine, and it has been this company's experience that the work can be done to the best advantage on a shaper. In Fig. 2, which illustrates a Steptoe shaper equipped for this operation, it will be seen that the shaper table has been removed, and that holes have been drilled and tapped in the apron to receive two bolts *A* which hold each casting in place while the operation is in progress.

A method of this kind constitutes a simple means of attaching the work to the machine, but obviously there would be too much overhang if some adequate form of outboard support were not provided. For this purpose, two jacks *B* are utilized, one end of which is entered into T-slots in the apron, the opposite ends engaging a flange in the outer extreme of the work. The planing operation is not unusual, use being made of a round-nosed tool for taking a roughing cut on the area surrounding the slot *C* in the table support, and a square-

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It might be expected that builders of shapers would have machines of this type operating in their plants under the most advantageous conditions, and the visitor who has an opportunity to see the work done in some of these plants will find this to be true. Shaper builders have developed the use of their machines to a high standard of efficiency, and the results they obtain in everyday practice give ample evidence of the possibilities of the shaper in regular production work. In selecting material for this series of articles, the operations have been chosen with a view to showing what the shaper is capable of accomplishing when employed on manufacturing jobs.

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nosed tool for performing the finishing operation.

Planing a Hendey Shaper Ram

In the illustration Fig. 4 is shown a 20-inch crank shaper built by the Hendey Machine Co., which is equipped for performing a planing operation on the top of the ram for a shaper of this company's manufacture. The point of special interest in this connection is the application of an extension table *A* for handling long pieces of work. This table extension is a substantial casting of triangular outline. The top or working surface is of uniform thickness and has T-slots corresponding with the top surface of the regular table. The side supporting walls of the extensions are under-cut, to save metal. The dividing line between the main table and the extension is shown by the termination of the T-slots on the side. The extension is fastened to the front end of the table by means of five bolts and two tapered dowel-pins, so it can be readily taken off when desired, and replaced in perfect alignment.

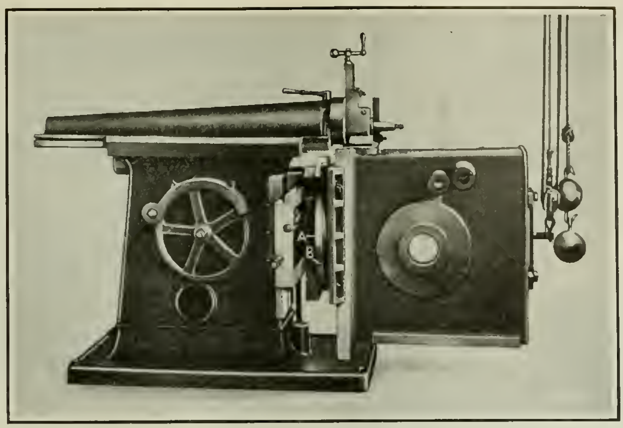

Fig. 1. Fixture used in holding Column Casting of a Shaper for planing Four Sides of the Work at a Single Setting

The shaper ram *B* has had the dovetailed bearing planed on its under side before being set up on the shaper for performing the operation here illustrated. The casting is set on two parallel blocks *C*, and held down by bolts entering the table T-slots and straps *D* extending over the top of the work. The planing operation consists merely of taking roughing and finishing cuts over the flat surface surrounding the slot at the top of the ram.

Planing Rocker Arms for Springfield Shapers

On the so-called "stroke" or rocker arm for the single-geared shapers built by the Springfield Machine Tool Co., there is a cylindrical member *A*, Fig. 3, at the top, which is machined to the required form on a Springfield shaper equipped as shown. The machine is furnished with a special rotary fixture that provides for revolving the work as the tool reciprocates back and forth across it, thus generating a cylindrical shaped pivot *A* of the required form. This is the method employed for machining rocker arms for 12- and 15-inch single-geared Springfield crank shapers.

The fixture is so arranged that it is only necessary to set the casting in position and locate the cylindrical pivot that is to be planed from a round disk on the fixture. This disk is directly behind the work, and serves the double purpose of locating the casting, and of providing a reference point from which the tool is set in order to plane the work to the required size. It will be noticed that the circular feed is taken from an auxiliary ratchet *B* connected to the feed mechanism of the shaper, and transmitted through a worm on shaft *C* that meshes with worm-wheel *D* on the fixture. The operation is performed at a single cut, with a very fine feed, and it requires about forty minutes to set up the casting and finish it to the required form.

Shaping Operations on a Queen City Shaper Rocker Arm

In machining rocker-arms that transmit motion from the crank to the ram on shapers built by the Queen City Machine Tool Co., it is required to face off the bearing bosses on the inside of a yoke at one end of these castings. The operation, as performed on a 24-inch shaper of this company's manufacture, is shown in Fig. 5. The side of the rocker arm that rests against the table, and the wide slot for the crankpin sliding block, are machined previously. The work is drawn squarely against the side of the table by the two bolts *A*, and the thrust of the cut is taken by

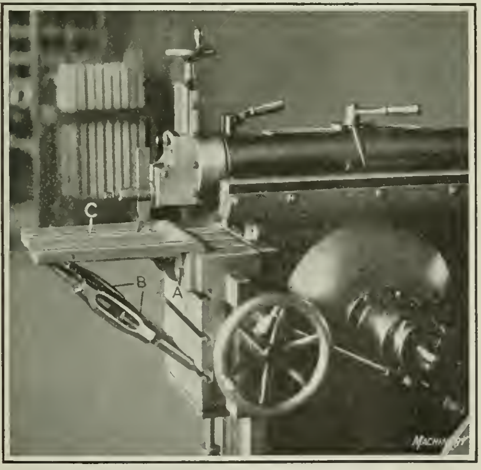

Fig. 2. Method of setting up Shaper Table Support for performing a Short Planing Operation on the Shaper

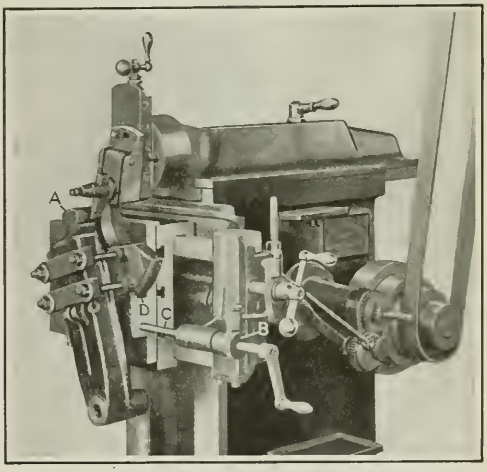

Fig. 3. Use of Rotary Fixture for holding Shaper Rocker Arm to guide Work for shaping Bearing A

a long block fitted to the slot in the rocker arm and bolted and tongued to a vertical T-slot on the side of the table.

After the work has once been set up, the table remains in this position, the operation of facing down the two opposite bosses being performed with a tool-holder carrying two cutter bits that machine the faces of the bosses simultaneously. A roughing and a finishing tool are employed, and a tool-setting gage is used to insure the correct relation between the tool and the finished face on the side of the arm. The simplicity of the holding devices, as well as the adaptability of the shaper for this job, enables an average production time per piece of only six minutes to be attained.

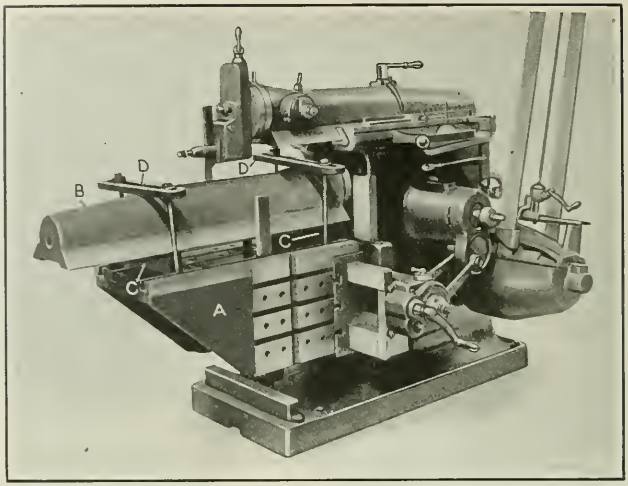

Fig. 4. Use of a Table Extension to afford Outboard Support for a Shaper Ram while performing a Short Planing Operation

Planing the Slot in a Smith & Mills Shaper Rocker Arm

For machining the rocker arms used in shapers built by the Smith & Mills Co., use is made of one of this company's 28-inch back-geared, single-pulley drive machines for finishing the slot in the arm that receives the sliding crank block. Fig. 6 illustrates this operation, and it will be seen that a tool-holder with two cutter bits is used for simultaneously machining the two sides of this slot in order that they may be finished parallel with each other and with exactly the required spacing between the sides. This is a regular production job, and the special work-holding fixture shown in the illustration is used for holding the work.

Mention has previously been made of the three-point principle for obtaining a preliminary support for rough castings, in order to compensate for slight inequalities in their size, and to insure obtaining a firm foundation for the work. This fixture has three screws by means of which the casting is leveled up, the correct setting being determined with a surface gage; and after this part of the setting has been accomplished, the work is lined up in the fixture by the adjustment of four screws *A*, which also tend to hold the work against sidewise movement. Tests for accuracy of alignment are made from the edge of the table to the work with a surface gage. Final clamping is accomplished by means of straps *B* that hold the work down on the fixture. After the casting has been leveled up and brought into alignment with the line of travel of the shaper tool, the tool is centered over the work by the regular adjustment of the saddle on the shaper cross-rail.

Both the roughing and the finishing tools are of the double-point type shown in Fig. 6, but the finishing tool is required to bring the width of the slot to exactly the desired dimension, and in order to compensate for wear that occurs in sharpening, there is a wedge *C* that is forced down between the two cutter bits *D* by means of an adjusting screw *E*, so that the tools may be adjusted to plane the slot to exactly the required width. For both the roughing and finishing operations, the feed is 0.032 inch, and the

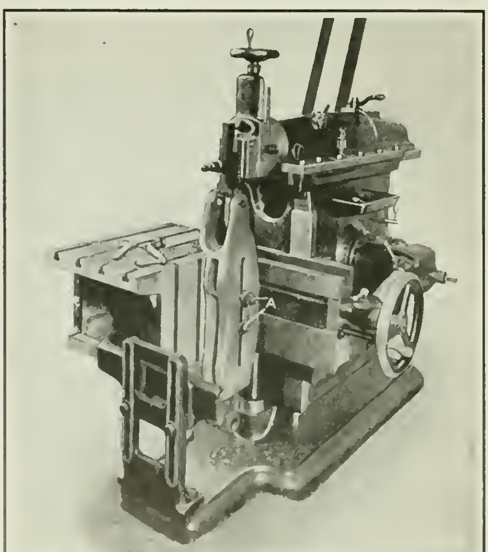

Fig. 5. Application of a Duplex Tool for simultaneously planing Inside Faces of Yoke Bosses on a Shaper Arm

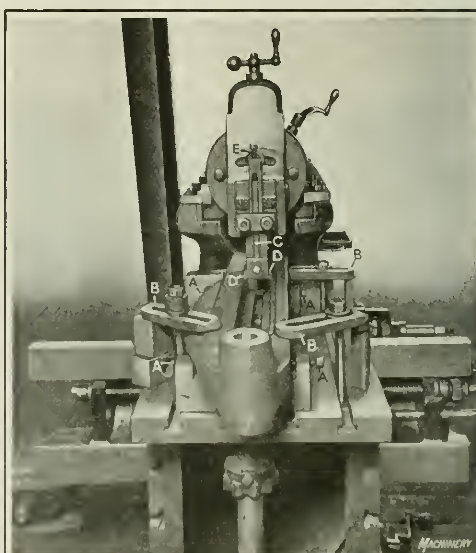

Fig. 6. Crank Shaper equipped for simultaneously planing Sides of Slot in Rocker Arm for a Shaper

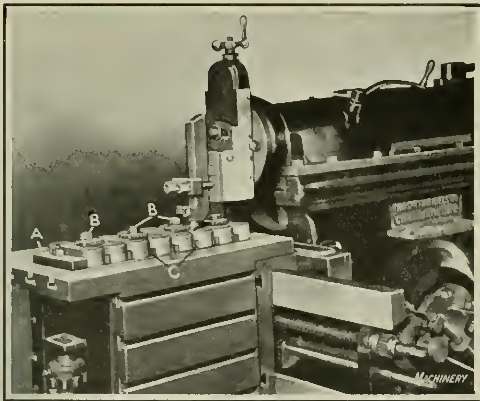

Fig. 7. Crank Shaper equipped for planing the Bosses on a String of Eight Shaper Pendulum Links

cutting speed 35 feet per minute. The time required for this operation is one hour and a half, which includes the time necessary for planing the horizontal top face of the rim which surrounds the slot.

Performance of String Planing Operation on a Shaper

In many plants where there are limited numbers of small and medium sized parts on which it is required to plane the faces of bosses and to perform similar operations, it will be found that a shaper is well adapted to the requirements of such work. Fig. 7 illustrates a Smith & Mills 28-inch back-geared shaper with single-pulley drive, which is used

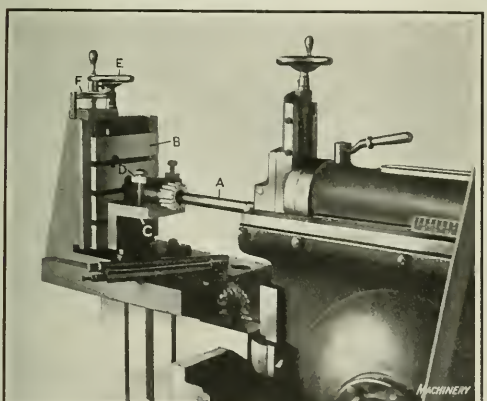

Fig. 8. Use of a Keyseating Fixture for machining the Keyway in Bronze Sleeve Gears for Shapers

in this company's shop for planing both sides of bosses at opposite ends of short links of the form shown clamped to the table of the machine. It will be seen that eight of these pieces are set up at a time, and there are four faces to be finished on each link.

The operation is quite simple, consisting of taking a roughing cut with a round-nosed tool and a finishing cut with a square-nosed tool. The method of setting up the work is also simple, and is well shown in the illustration. A bar A is utilized as an end-stop, and this serves the double purpose of squaring up the work with the line of travel of the ram, and of supporting the end thrust of the tool. It will be seen that straps and bolts B are placed between each pair of castings to hold them down on the table, and small blocks C are put between the ends of each pair of links, because these pieces of work are larger at the center than at the ends, and if some precaution of this kind were not taken there would be a tendency for the thrust of the tool to swing them about their central points. For taking a roughing and a finishing cut on both sides of both ends of eight of these links, that is to say, planing thirty-two faces, the production time is about one hour and twenty-five minutes.

Application of the Shaper for Keyseating Bronze Sleeve Gears for Steptoe Shapers

Another application of a shaper in the John Steptoe Co.'s plant is shown in Fig. 8. This is a keyseating operation in the bronze sleeve gear for machines of this company's manufacture. In this illustration one of the gears is shown lying on the table, and a second gear will be seen in place in a keyseating attachment that is supplied as an auxiliary equipment for use in shops that have an occasional keyseating operation to perform. It does not find wide application, but in repair shops where there would not be sufficient

Fig. 9. Using an Indexing Shaper Fixture for planing Gear-boxes

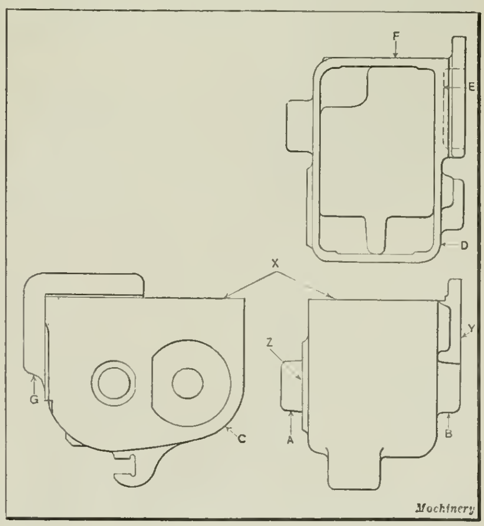

Fig. 10. Outline of Gear-box planed in Fixture shown in Fig. 9

work to justify purchasing a keyseater, this fixture is often found useful.

The tool-holder *A*, mounted in the shaper ram, is made of sufficient length so that it can be reciprocated back and forth through the axial hole in the gear and its shank. The attachment is provided with a vertical table *B* having T-slots planed in it for attaching various work-holding fixtures. In the present instance the fixture consists of a block *C*, bolted to the table and provided with two clamping bolts and a strap *D* for holding the work down. The position of the vertical table *B* is adjusted by a screw having a handwheel *E* on the end. A stop-screw that is positioned by a graduated dial *F* enables the depth of the keyseat to be accurately controlled.

Indexing Shaper Fixture for Planing Gear-boxes

In the plant of Gould & Eberhardt, shapers of this concern's manufacture are used for short planing operations on gear-boxes. One of these machines is shown in operation in Fig. 9, where it will be seen that the gear-box casting *A* is set up in a box-type work-holding fixture pivoted at *B*. An index-pin provides for locating the fixture in successive positions, so that planing operations may be performed on three sides of the work without requiring the casting to be reset. This is the means of effecting a substantial saving of time in the performance of planing operations.

Fig. 10 shows an outline drawing of the gear-box casting. It rests on the trunnion fixture on fixed supports which make contact with the casting at points *A*, *B*, *C*, *D*, *E*, and *F*. Point *G* rests on a support which is adjustable to compensate for variations in the casting. The latter is clamped in place in the fixture by set-screws located directly opposite the supporting points to eliminate distortion. The first operation on the part consists of roughing and finishing the top surface *X*; the second operation consists of roughing and finishing the back surface *Y*; and the third and final operation consists of roughing and finishing front surface *Z*. Means are provided on the fixture for accurately and quickly setting the tool so that the three finished surfaces are machined in the correct relation to the rough casting.

* * *

CREDIT SERVICE FOR SHOP EQUIPMENT

The Black & Decker Mfg. Co., Baltimore, Md., manufacturer of portable electric drills, grinders, and electric air compressors, has recently put into effect a unique credit service. The company sells its products entirely through jobbers, and the new credit service enables users of Black & Decker equipment to buy through their regular jobber by paying 23 per cent of the price in cash and the balance in six equal monthly payments. Nothing is added to the standard price for the long-term credit, and no interest is charged. A conditional sales agreement is made, whereby the product sold becomes the security for the sum to be paid until entirely paid for. The Black & Decker Mfg. Co. shares the responsibility equally with the jobber for the fulfillment of the sales agreement. The purpose of this service is to enable the user to put cost-reducing equipment into his shop without a heavy investment, and to make it possible for the equipment to practically earn its own cost while it is being paid for. It is generally acknowledged that the principal obstacle in the path of normal sales today is a financial one, and the purpose of this plan is to overcome this difficulty as far as possible.

ESTIMATING THE WEIGHT OF BAR STEEL

By HYMAN LEVINE

Tables giving the weights of bar steel per running inch and per running foot may be found in nearly all engineering handbooks; and by the use of these one can easily calculate the weight of steel bars of almost any length and section. It frequently happens, however, that inspectors, salesmen, draftsmen, designers, and shop executives require a rough estimate of the weight of bar steel when a handbook is not available.

The formulas given in the accompanying table will be found particularly useful in such instances, as they provide a means of calculating the approximate weights of various sections and lengths of steel. The formulas are so simple that they may be readily memorized, and the results obtained are sufficiently accurate to warrant their use for many practical purposes. It is possible, of course, to rearrange these formulas so as to avoid the necessity of making any additions or subtractions; thus for round steel the weight per inch of running length would equal $\frac{2\frac{1}{4}D^2}{10}$, approximately, and for square steel $\frac{2\frac{7}{8}D^2}{10}$, approximately.

FORMULAS FOR ESTIMATING WEIGHT OF BAR STEEL

Section	Pounds per Inch of Running Length	Error	Pounds per Foot of Running Length	Error
Round (D = diameter)	$\frac{2D^2}{10} + \frac{1}{10}\left(\frac{2D^2}{10}\right)$	1 per cent low	$2.5D^2 + \frac{1}{10}(2.5D^2)$	3 per cent high
Hexagon (D = width across flats)	$\frac{2.5D^2}{10}$	2 per cent high	$3D^2$	2 per cent high
Square (D = side of square)	$\frac{3D^2}{10} - \frac{1}{20}\left(\frac{3D^2}{10}\right)$	1 per cent high	$3.5D^2 - \frac{1}{20}(3.5D^2)$	1 per cent low

Machinery

Experience has shown that it is easier mentally to multiply by 2 and then increase this result by 10 per cent or 1/10 than to multiply by 2¼. It is likewise less difficult to multiply by 3 and subtract 5 per cent or 1/20 than to multiply by 2⅞. In some instances sufficiently accurate results may be obtained by disregarding the amount to be added or subtracted.

In using the formulas, dimension *D* must be given in inches. Thus a bar of 3-inch round steel, 10 inches long, would be estimated to weigh

$$\left[\frac{2 \times 3^2}{10} + \frac{1}{10}\left(\frac{2 \times 3^2}{10}\right)\right] \times 10 = 19.8 \text{ pounds}$$

or approximately 20 pounds. The actual weight of this bar is 20.03 pounds. A bar of 1-inch hexagon steel, 5 feet long, will be estimated to weigh $(3 \times 1^2) \times 5 = 15$ pounds; while the actual weight is 14.65 pounds. A bar of ½-inch square steel, 8 inches long, would be estimated to weigh

$$\left[\frac{3 \times (\frac{1}{2})^2}{10} - \frac{1}{20}\left(\frac{3 \times (\frac{1}{2})^2}{10}\right)\right] \times 8 = 0.570 \text{ pound}$$

The actual weight is 0.566 pound. Where the size of the steel cannot be easily calculated mentally, a handbook may be used.

* * *

The Pittsburg chapter of the American Society for Steel Treating plans a number of activities for the coming season. Many prominent speakers have been secured for coming meetings, which will be held on the first Tuesday of each month. At the meeting held in September, Prof. MacIntosh of the Carnegie Institute of Technology, Pittsburg, spoke on the metallurgy of iron and steel. The October meeting was addressed by Mr. Carpenter, president of the E. F. Houghton Co., Philadelphia, Pa., his subject being "Individualism versus Socialism." This month, Professor Sauveur of Harvard will speak on the heat-treatment of steel, and in December Professor H. F. Moore of the University of Illinois will discuss fatigue testing and resistance of materials. In January, the subject will be alloy steels. For further information address E. C. Cooke, 108 Smithfield St., Pittsburg, Pa.

Machine Tool Markets in Asia*

By W. H. RASTALL, Chief of Industrial Machinery Division, U. S. Department of Commerce, Washington, D. C.

THE largest proportion of the foreign market for machine tools has always been in Europe. In 1910, 81 per cent of the foreign shipments went to Europe; in 1913, 76 per cent; in 1915, 89 per cent; in 1918, 74 per cent; in 1919, 69 per cent; and in 1920, 57 per cent. Because of this large market in Europe there has been a temptation to overlook other machine tool markets of the world. Asia has never been considered a very good market—at least it was not so considered previous to the war, but there have been great changes since. Asia is developing in a way that few understand unless they have given this subject close attention.

Past Machine Tool Exports to Asia

In 1910, all the countries of Asia bought only $156,000 worth of American metal-working machinery. In 1913, this export grew to $200,000, and in 1915 to $500,000. A tremendous change in this market took place about 1918. In that year, metal-working machinery to a value of $5,900,000 was exported to the Asiatic countries, the exports in 1919 being $8,800,000, and in 1920, $7,400,000.

In spite of the tremendous expansion industrially that has taken place in Europe, the ratio of industrial expansion in Asia has been even more rapid in the last few years, and has been practically sustained during recent months. The indications are that the exports of metal-working machinery to Asia for 1921 will be valued at about $6,000,000. In other words, the 1921 market in Asia will probably show an even better result than in 1918.

Comparison of Asiatic and Other Foreign Markets

If we compare the Asiatic market with that of other non-European markets, we find that whereas Asia took $7,400,000 worth of metal-working machinery in 1920, Australia absorbed not much more than $1,000,000, and South and Central America, $4,000,000. The significance of this tremendous development in the absorption of metal-working machinery by Asia should be duly recognized. Asia has absorbed more metal-working machinery from America in the last three years than she would have absorbed in an entire century at the rate at which metal-working machinery was imported previous to the war.

Whatever has wrought the change, the fact remains that during the war there was a great industrial agitation in Asia, which has continued since. The Japanese market is comparatively well known, because Japan has absorbed important quantities of machinery for several years. However, it has been felt that Japan was a little different from the rest of the Asiatic continent. Speaking in round numbers, Japan has absorbed 50 per cent of the machinery shipped from the United States to Asia during recent years. China, on the other hand, in spite of her large area, tremendous population, and resources, has absorbed but 15 per cent.

Both the Chinese and Japanese markets are comparatively well known to the American manufacturer, but the markets of British India and the markets of the Dutch East Indies are not so well known. It is therefore of importance that American machine tool builders recognize the great change that has taken place and the relative importance of the markets of all the Asiatic countries. Of all the metal-working machinery shipped abroad from the United States, Asia absorbed in 1913 only 1 per cent, and in 1915 only 2 per cent. But in 1918 Asia took 11 per cent; in 1919, 15 per cent; in 1920, 17 per cent; and the indications are that in 1921 Asia will absorb 25 per cent of the machine tool exports. These figures should be carefully considered.

When the conditions as they exist in Asia today are contrasted with those in the Latin American countries and in Europe, the most startling differences will be found. Latin America, comparatively speaking, is unpopulated; Asia is densely populated. The resources of Latin America possibly are unexplored, but at any rate, so far as they are known and accessible, they are comparatively limited. The natural wealth of Asia is enormous, the mineral wealth alone being equal to or greater than that of any other continent. Asia is now developing rapidly in an industrial way, and probably the most rapid development is taking place in British India.

British India as a Machine Tool Market

Before the war it appears that it was British policy to keep India as a producer of raw materials and to take these to Europe, manufacturing them into finished materials in the United Kingdom. This policy has been changed, and now the government of India, native and British financial interests, and everybody concerned with controlling the destinies of the Indian Empire appear to have decided upon the policy that India shall be industrialized. That statement should be brought home to American manufacturers with all the emphasis that it is possible to put into it, because a definite step is being made to establish, in a methodical way, industries throughout the Indian Empire. The natural resources of the country are being studied. It has been stated that it is possible to produce pig iron in India and lay it down in San Francisco at the competitive price. One large steel plant has been developed, mostly under the guidance of American engineers, and there are now several other large enterprises in the metal-working field being planned—foundries, railway car shops, rolling mills for both rails and structural steel, and machine-building shops.

It is impossible to say how much and how rapidly this development will grow, but it may be stated with certainty that India is being industrialized as rapidly and as effectively as British and Indian interests can accomplish it. The figures of exports of American metal-working machinery to India will illustrate this point. In 1910 the exports were valued at $45,000; in 1913, at $43,000; and in 1915, at $23,000. A great change took place between 1915 and 1918, when we find the exports amounting to $1,250,000. In 1919 they amounted to $900,000, and in 1920 to $1,375,000, this last figure representing nearly 20 per cent of the entire metal-working machinery export to Asia.

Selling Machinery in Asia

One of the first questions that will be asked is, "How should one sell machinery in Asia?" Fortunately, it is easy to give a definite answer. One hundred per cent of the machinery sold in Asia is sold through the import merchant there. This import merchant corresponds more or less to the export merchant as he is known in the United States. The only practical way to sell machinery is through these merchants. The Department of Commerce at Washington is now doing everything it can to assist machine builders in developing their foreign business. The department has reasonably complete lists of machinery dealers in every important city in the world, and this information can be obtained either by correspondence or by a personal call at the Bureau of Domestic and Foreign Commerce.

*Abstract of address made before the National Machine Tool Builders' Association's convention in New York City, October 20.

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REDUCING PRODUCTION COSTS

The articles in October MACHINERY describing some of the modern machines, tools, and other interesting devices and methods for reducing manufacturing costs, have received a great deal of attention, and MACHINERY acknowledges the receipt of many favorable comments, but especially appreciates the active cooperation of the manufacturers in this serious effort to spread useful information on the greatest need of our time in industry.

Material along the same definite lines will be found in the present number of MACHINERY, and in December and January there will be substantial additions to it. In this number, specific examples of cost reduction will be found in the articles on "How Factory Investigations Reduce Costs"; "Production Work in the Locomotive Shop"; "Machining Hudson Super-six Pistons"; "Drawing Dies for Manufacturing a Carburetor Bowl"; "Production Shaping"; and others. All of these articles give practical suggestions indicating how machine tools and accessories may be used to best advantage in different lines of manufacture.

It is no longer wise to say that prices *will be* reduced, that competition *will be* keen; prices *have been* reduced, competition *is* keen, and the way to meet this changed situation successfully is to adopt machines and methods which produce with the lowest relative operating outlay.

A great many manufacturers have wisely used the time this period of slackness has forced upon them to investigate new machines and improvements for getting results and cutting costs. Those who utilize the dull present to make a thorough study of the machines, shop methods and varied equipment and materials now available in a buyer's market for giving better results at lower costs are laying up solid foundations upon which to build the business they must work harder to get and hold than ever before.

* * *

A DEVELOPMENT IN GRINDING

The extensive use of the automobile has developed a new kind of repair shop, of which hundreds have been started all over the country, for the purpose of regrinding automobile cylinders. These shops are usually independent enterprises, soliciting their work both from the garages in the vicinity and from individual automobile and truck owners. Grinding machines have been developed especially to meet the mechanical needs of these shops, and the demand for them has created an additional outlet for the product of some grinding machine manufacturers which has helped to keep their shops running during the present depression.

Many machinists who were out of employment have started small shops of their own in the regrinding business, often taking on a general line of repair work in addition. In some instances these shops undoubtedly will expand into larger enterprises.

The regrinding of automobile engine cylinders, when carefully and accurately done, may add years to the life of a car and make it possible to maintain or even improve the running qualities of the engine. It is likely that within the next few years many developments will be made in appliances for repairing and maintaining automobiles, and some machine tool manufacturers will doubtless specialize in providing equipment for shops engaged on this kind of work and in repair work in general.

SPECIAL AND STANDARD MACHINES

The demand, created largely by the automobile industry, for machine tools intended for a few special operations—sometimes for one operation only—has greatly stimulated the production of such tools. In the near future, with keen competition and reduced prices, quantity production will be an important factor in lowering costs, and the demand for special machines to perform a single operation or series of operations will undoubtedly increase. There is a definite indication of this in the inquiries that have been received by the builders of special types of machine tools, especially in the milling, drilling, and multiple-spindle automatic machine fields.

On the other hand, what are generally known as standard machine tools—the engine lathe, turret lathe, milling machine, upright and radial drilling machine, planer, shaper and slotter, grinding machines of various standard types and a number of other machine tools in the same category, will always be in demand, because only a comparatively small portion of the entire machine shop work of the world can be done on the quantity production basis. Steam turbines and engines, large gas and oil engines, heavy mining machinery, large units of electrical machinery and many other types of machines and appliances cannot be built in quantities; and there are many machines that, while they will be built in fair-sized lots, will never be produced in such quantities as sewing machines, typewriters, cash registers or automobiles. Machine tools themselves are examples of this class. The special machine for producing in quantities, so effective in the automobile plant, would seldom be of service in a shop that produced machine tools only.

Both types of machines meet definite requirements, and while the present demand for special types appears to be better than for the standard machines, this does not indicate that the former are likely to replace the latter. Neither type really encroaches on the field of usefulness of the other.

* * *

ELECTRICAL DRILL STANDARDIZATION

Recent correspondence with a well-known manufacturer of machine shop accessories emphasizes the need for standardizing electric drilling equipment. It would be a decided advantage to all users of such equipment if manufacturers employed the same size and kind of fittings for attaching chucks of the same capacity. Instead of there being a standard means for doing this, some manufacturers use a taper arbor, while others employ a threaded spindle. A further advantage would be gained if drill chuck manufacturers would establish standards so that all drill chucks of the same capacity would have the same size recess to receive an arbor. This would relieve dealers from the necessity of carrying a large variety of arbors in stock and enable manufacturers to produce them in such quantities that they could be sold at lower prices. The user would gain added convenience from the interchangeability of different drill chucks, and the cost of the equipment would be less.

At this time, when production problems are not pressing, such changes involving a saving in time or money might well be considered by manufacturers. Their satisfactory solution would help the machine building industry and add another step toward the standardization of machine shop equipment.

National Machine Tool Builders' Convention

THE twentieth annual convention of the National Machine Tool Builders' Association, held in New York City October 18, 19, and 20, was unusually well attended, and a great deal of interest was displayed at all the sessions. The address by the president, August H. Tuechter, at the opening session covered many of the important questions now facing the machine tool industry. It reviewed the past history of the association and the business in the machine tool field, and contained much sound advice for the future.

The President's Address

In welcoming the members to the convention, Mr. Tuechter pointed out that he was called upon to preside at the most important annual meeting the association has ever held, because of the period of dullness through which the industry is passing. "We had four years of false prosperity," said Mr. Tuechter, "due to the war, when our industry was called on to increase its capacity and output far more than we ever dreamt possible. How well it met the call is a record to which we can point with pride. After the armistice, we had a slackening in business, which we rather expected, but to our surprise another period of false prosperity began in 1919. However, this did not last long, because new orders fell off from January, 1920, and kept slipping down until July, 1921."

In order to compare present conditions with those that the industry has passed through since the association was formed, extracts from the addresses of former presidents of the association at various conventions were read, dating back to 1904. From these extracts it was evident that during this period the machine tool industry has passed through a number of successive cycles of prosperity and depression in business. Seven slumps have been experienced in twenty-one years, and Mr. Tuechter expressed the hope that the mistakes made in the past in times of depression will not be repeated again, especially when the association now has in Mr. DuBrul, its general manager, an able advisor and competent observer who can give warning of shoals ahead and of clear sailing, and of the rise and fall of the business barometer. In this connection it was stated that the most promising and the most necessary activity in which the association is now engaged is the organization of the statistical service for each group of machine tools for which it is possible to render such service.

Waste in Industry

Mr. Tuechter referred to the Committee on Waste appointed by the Federated American Engineering Societies, the work of which has been to call public attention to the sources of waste in industry, and to arouse industrial leaders to the necessity and profit of eliminating waste. During the past year the association has assisted Fred J. Miller, formerly president of the American Society of Mechanical Engineers, in making studies of the machine-building industry. "This investigation," said Mr. Tuechter "seemed to show a probable waste of about 40 to 45 per cent. The report of the committee is very interesting, and it shows that in the machinery industry not a large proportion of this waste can be chargeable directly to labor restrictions; therefore, the responsibility for elimination of waste in the machinery business rests largely on the shoulders of management. There is a large excess of facilities that are not used to the fullest extent. There is badly planned management. Efficient planning and guidance of production is the duty of management; better employment service and policies lie within the power of management and not of the employes." The old proverb says that a dollar saved is a dollar earned, and Mr. Tuechter recommended to the members that they investigate every opportunity to save waste in their own shops, waste of every kind—in equipment, in time, in material, and in organization.

Uniform Cost Accounting

Another work carried on by the association during the past year is that relating to uniform cost accounting. It was advocated that this work be continued until the members all have some system of figuring the proper elements of cost. Unless this is done, there will be a false basis upon which false prices are founded. The man who does not charge enough into his costs is prone to make mistakes in his prices, although his cost system should automatically provide for the proper charges. Especial emphasis was placed on the point that a uniform plan should be used for calculating a normal burden, and that cash reserves should be put away in boom times to carry over depressions. If this had been done, the industry would be in a better condition than it now seems to be. The cost-accounting work, therefore, is one of the important phases of the association's activities.

Statistical Service

The statistical service recently organized was referred to in detail. A chart was shown, exhibiting the great irregularity to which the whole industry has been subjected, with an excessively high peak indicating the war activity; this peak showed that the number of machines manufactured at that time were something like 150 per cent in excess of the number manufactured at the most prosperous period previous to the war. It was pointed out how impossible it is to judge the wisest course from mere individual experience, and how much more accurately the future may be predicted if the information of manufacturers in regard to past business cycles is pooled in a statistical service. Other trade associations, it was said, have found this to be the most valuable service they can render their members, and Mr. Tuechter pointed out that the whole world gains much from the monthly reports of output that the iron industry has published for many years. All industry is closely related, and by proper study and interpretation of conditions it would be possible to better stabilize industry and to have ready for the consumer all the goods that he needs at any given time, at the same time avoiding an excess of goods when the consumer is not likely to need them. The individual manufacturer, confronted with a business situation such as the one through which we are now passing, is groping blindly, when guided only by his own knowledge and experience. He is much more subject to losses than if he had full information as to the total current output and sales of his particular product throughout the country, together with reliable information as to finished stock on hand, the amount in process, and the rate at which this stock is moving.

The statistical service of the association has already compiled figures of shipments of certain groups of machine tools for the last twenty years. The figures thus obtained make it possible to form quite a fair conclusion as to the pre-war trend, and in the light of that information an intelligent plan can be laid down for future policies. When complete monthly reports and charts are made out for each group, the actual flow of business can be easily seen, whether it is improving or falling off. Such statistics can be made of great value to the country at large, because it is evident that the slump in machine tools in any period of depression precedes the decline in general business by several months and perhaps a year.

Standardization

Mr. Tuechter referred to the standardization work of the association in the following words: "For many years this association has talked about the possibilities of standardization. The time has now come to stop talking and go to work. The American Society of Mechanical Engineers has taken up a number of subjects that directly concern the machine tool builder, and we shall have to be represented on committees on these subjects. A recent letter from Mr. Einstein, chief engineer of the Cincinnati Milling Machine Co., who is now in Germany, says that the German machine tool builders are very busy with standardization work. Each committee should seriously and promptly formulate opinions as to what things can be standardized, and then go into the work of standardization.

"A general plan would be to have a general committee of the association which could make recommendations to the Engineering Standards Committee. Each machine group should have a special committee on standardization which would report its findings to the general committee. This is the practice of other organizations. We should take our proper position in these matters. If we do not do this work ourselves as affecting our own interests, we will have no just cause for complaint if others attempt to do it for us and do it badly, because of lack of understanding of our problems.

"We should not let the matter lie as we have heretofore, but we should make this a vital and active part of our association program. It will finally be a very profitable undertaking, as has been demonstrated by standardization work in other fields."

Report of the General Manager

The general manager of the association, Ernest F. DuBrul, presented a comprehensive report referring mainly to the statistical work that is being carried out by the association under his leadership. He emphasized the value of cooperation between the members, and between the members and the association's office. He outlined the methods used in distributing information and the value to the members of exchanging ideas. The bulletins sent out by the association to its members were referred to, and the value of the bulletins emphasized.

The main part of Mr. DuBrul's report, however, was devoted to the statistical work done by the general manager's office. In referring to this work, Mr. DuBrul reiterated the statements made by the president in his address. "It is well demonstrated," said Mr. DuBrul, "by many trade associations, that the most valuable service that can be rendered is to gather and distribute statistics of production, shipments, stocks, and sales. Without information of this sort, each manufacturer must simply grope blindly in the dark, making the wildest kind of guesses as to conditions that he must anticipate in the future. The poorer his information of a general situation, the worse his guess is likely to be.

"The first thing a man wants to know is whether he is getting his share of the business at any time. He can tell this if he knows the total number of machines in his line being sold in a month, and the total capacity of his group. If he knows that the present state of demand is only fifty machines a month, and that he is getting his share of that limited demand, he will not be tempted to do things that will compel his competitors to fight him, to his own detriment. But if he is ignorant of the facts, he is pretty sure to do something that will work against his own pocketbook. In no other way can he know, except by joining with his competitors in a composite report of conditions. When he has that report he can then compare his own conditions with those of the group as a whole.

"It is for the purpose of developing that sort of information for each group that we are organizing monthly statistical services of orders, concellations, production, shipments, factory stocks, and dealers' stocks for various groups. The groups who have already put this service into operation are the shaper, radial drilling machine and upright drilling machine groups.

"To give some groups a picture of their past, so that they can have a guide for the future, we have gathered statistics of shipments for the last twenty years. These are far from complete, but are fairly typical. The group charts show the situation not only for the group as a whole, but for the different sizes of machines made by the groups reporting."

The subject of how to provide a reliable and simple barometer of the machine tool industry that will indicate at all times with a fair degree of accuracy the conditions not only in the entire industry but in certain groups was dealt with in detail. Every industry should have such a barometer, and suggestions have been made both by Mr. DuBrul and by Mr. Charles Oesterlein, with a view to solving the problem in the machine tool building field.

Addresses Made at the Meeting

Charles L. Underhill, member of Congress from Massachusetts, made an able address on the subject "How Present Political Policies Affect Business," in which he pointed out the importance of business men and manufacturers taking an active interest in political matters, and informing their employes of business conditions and of the effect on their particular business of any political action. An address on "Business Cycles" was made by Professor David F. Jordan, which was followed by a discussion led by C. L. Cameron of Gould & Eberhardt, Newark, N. J., and by E. F. DuBrul. This discussion covered the questions: "What things should machine tool builders do?" and "What should they avoid at various stages of the business cycle?"

An address containing much information of value to machine tool builders was delivered by W. H. Rastall, chief of the Industrial Machinery Division of the Department of Commerce, Washington, D. C., on "The Orient as a Machine Tool Market." J. H. Drury, treasurer of the Union Twist Drill Co., Athol, Mass., spoke on "Conditions in Europe," giving his impressions from a recent business trip in several European countries.

At the meeting of the Executive Committee held Thursday morning, October 20, three questions were raised for general discussion, as follows: "What can be made in idle machine tool plants during times of slack demand for regular product?" introduced by H. L. Flather, treasurer of Flather & Co., Inc., Nashua, N. H.; "What reductions in prime costs may be expected in the machine tool industry during 1922?" introduced by P. M. Brotherhood, vice-president of Manning, Maxwell & Moore, Inc., New York City; and "Can sane methods be devised to grant long terms with proper credit guarantees or insurance in foreign trade?" introduced by J. E. Andress, secretary of the Barnes Drill Co., Rockford, Ill.

Officers of the Association for the Coming Year

The officers of the association were re-elected, but as the secretary Carl F. Dietz had resigned, Howard W. Dunbar, Norton Co., Worcester, Mass., was elected to fill his place. The other officers for the coming year are: President, August H. Tuechter, Cincinnati Bickford Tool Co., Cincinnati, Ohio; first vice-president, E. J. Kearney, Kearney & Trecker Corporation, Milwaukee, Wis.; second vice-president, C. Wood Walter, Cincinnati Milling Machine Co., Cincinnati, Ohio; and treasurer, Winslow Blanchard, Blanchard Machine Co., Cambridge, Mass. In addition, the following members were added to the executive committee: J. B. Doan, American Tool Works Co., Cincinnati, Ohio; C. E. Bilton, Bilton Machine Tool Co., Bridgeport, Conn.; and Fred L. Eberhardt, Gould & Eberhardt, Newark, N. J.

The British Machine Tool Industry

From MACHINERY'S Special Correspondent

London, October 12

At the present time industry may be said to be trying to find its feet, a process that is bound to occupy some time, even though it is generally believed that many of the labor difficulties have been permanently relieved. The most serious barrier is the price of coal. The anxiety to start to produce is evidenced by the many inquiries that reach the machine tool makers. Even if some of these inquiries are merely for the purpose of sounding the market, it must still be assumed that there is a great deal of work ahead for the machine tool industries. Many of the machine tool makers are now building for stock, and most of them are of the opinion that the low point of the depression has been passed. Firms who specialize in jigs, fixtures, and tool lay-outs are busier than for months past, and this again must be construed as a hopeful sign, particularly as such orders generally point to a well defined manufacturing program on the part of the customer. Textile machinery manufacturers are becoming increasingly active.

A revival in the shipbuilding industry appears to be imminent, and there are indications that railway and locomotive building shops intend to resume buying. The latter continued to buy long after most of the other branches of the industry had gone out of the market. The main reasons for their withdrawing when they did were the instability of prices and lack of funds.

With regard to the automobile industry, most firms are working steadily, but the trade is seasonal, and an ebb invariably sets in about this time of the year and continues until after the automobile shows. The demand is more particularly for light cars, and various manufacturers, who previously have been exclusively engaged on the heavier and more expensive types, are making rapid progress in their arrangements to produce smaller models.

Another branch of the engineering industry that has maintained its activity is that specializing on marine Diesel engines. There are brisk inquiries for general brass-foundry work, for which Birmingham is world-renowned. The conclusion of the strike of joiners in the shipyards is good news for this industry, and it is hoped that many orders which have been held up by conditions in the shipbuilding trades will now be released.

One or two instances are noted where reductions of approximately 10 per cent have been effected in machine tool prices. While the recent reduction in wages is bound to have an ultimate effect on the price question, it requires some courage to begin cutting list prices, and makers prefer to quote on the conditions ruling at the time of the inquiry.

Overseas Trade in Machine Tools

There is a certain amount of business to be had in railway machine shop equipment for shipment to various European governments. The terms of payment, however, are such as to produce caution in booking orders. For example, the Bulgarian State Railways will pay only 10 per cent of the price on shipment, and the remainder after the machines are erected and satisfactorily at work in the shops. Orders for machine tools of the heavier types are coming more freely from Japanese sources, and India still continues to afford a profitable field to some British manufacturers of machine tools.

For the month of August the exports of machine tools amounted to £183,391, the tonnage being 1144. Although this showed a slight fall from the exports for July, the figures are exceptionally high as compared with imports, which again show a decided drop, reaching only £17,480 in value, for a tonnage of 65. The value per ton of imported machine tools rose from £166 in July to £269 in August, the value per ton of exports remaining fairly constant at about £160. The class of machine tools that represented the greatest export value was lathes, reaching a value of £54,000, spread over 192 machines. Drilling machines were exported in fairly large quantities and reached a value of £29,824, spread over 87 drilling machines. The only machines that in July compared somewhat nearly in value for exports and imports were grinding machines; the value of the imports was £4532 and of the exports £6448.

Developments in the Machine Tool Field

The practice of grinding the teeth of hardened gears is growing quite rapidly; one firm that makes a specialty of this work is the Gear Grinding Co., Ltd., of Birmingham. The method employed by this concern is to grind the wheel teeth with a grinding wheel dressed to the exact form of the tooth faces required. The wheel-dressing diamond is controlled from an enlarged form through a pantographic device. The indexing is by automatic means, and the machine will handle work up to 36 inches in diameter by 8 inches face. By the substitution of formers, teeth of any pitch or pressure angle, in either stub or full-tooth forms, can be ground accurately.

Thomas Shanks & Co., Ltd., Johnstone, Glasgow, have recently completed a very large machine for shipment to Japan. The machine is designed for turning very large gear blanks, and has a center height of from 110 to 123 inches, adjustable by means of packing blocks. The distance between centers is 40 feet, and the bed is 18 feet 6 inches wide. There are four saddles, each weighing 21 tons, and the total weight of the machine is 330 tons. The faceplate is 15 feet in diameter, and is capable of carrying parts weighing 100 tons. The main journal is 27 inches in diameter by 36 inches long.

Some large overhanging type hydraulic forging presses are being built by A. Rice & Co., Leeds, for the Great Indian Peninsula Railway. These presses have both vertical and horizontal rams, each of 200 tons, and the presses, except for the rams which are of cast iron, are built of cast-steel members. Hydraulic wheel presses have also recently been supplied by Messrs. Rice to the Polish Government railways. Two of these presses are for 7-foot wheels and exert a pressure of 300 tons.

A machine which has created a great deal of interest is a crankpin turning machine that has been developed by George Richards & Co., Ltd., Manchester. In this machine, the crankshaft is held rigidly while the tools rotate around the pin to be machined, and are held in a circular carriage that rotates in a housing through which the crankshaft is passed. The tools can be made to turn the full width of the pin at one cut, or narrower tools can be used and a traverse applied to the tool-holder housing. The feed of the tools is arranged in an unusual manner. An internally and externally cut gear ring is rotated differentially with the tool-holding ring, the difference in speed of the two resulting in advancing or withdrawing the tools, suitable gearing being provided to control the differential effect. The machine has been designed with the object of rapidly producing crankshafts with fairly inexpensive labor, but is said to be capable at the same time of machining a crankpin to an accuracy of within one-quarter of a thousandth inch of size.

A grinding machine of considerable interest has been put on the market by Alfred Herbert Ltd. of Coventry. It is for the purpose of grinding cutting tools with a curved lip, so that a comparatively acute cutting angle can be obtained, with sufficient support to prevent crumbling. The machine uses a circular grinding wheel, and the tool is traversed below the wheel, the path of the tool relative to the wheel axis being variable so that the periphery of the wheel presents to the cutting tool anything from a straight line, through the whole range of ellipses, to a full circle. By using the extreme lower edge of the wheel, various forms of curve can be obtained behind the tool cutting edge.

A die-sinking machine built on rather novel lines has been designed by Bryant-Symons & Co., London. The work and a former to an enlarged scale are placed on a horizontal table, and above them are two vertical spindles, one carrying a tracer point and the other an end milling cutter. The spindle carriages are arranged on a horizontal arm, pivoted horizontally and vertically at one end of the machine, and arranged to be moved across the table by means of a rack and pinion, the relative position of the heads being controlled by a pantograph. The arrangement of the machine makes it equally suitable for die-sinking or profiling work, and cuts up to 0.3 inch deep can be taken.

J. Parkinson & Son, Shipley, are building for the market a Sunderland patent double-helical gear generator. These machines produce a continuous double-helical tooth without any finishing or correction by hand. The sizes of machines now in hand are for gears up to 3 inches in diameter by 10 inches face width, and for pitches up to 3 diametral pitch.

Prices of Materials

In the iron and steel trades, current demand shows only an insignificant improvement. Most of the works are getting their raw material from the Continent, some from Belgium, others from France and Luxemburg; and a certain proportion of the half-finished products which British manufacturers are working up comes from Germany. Home prices are approaching closer to foreign, but some materials, like wire rod, can be obtained cheaper from Germany.

Labor Conditions

The number of unemployed in the engineering and allied trades is approximately half a million, about one-third of the total number of unemployed in the country, and until some of the present handicaps to production are removed, it is not to be expected that conditions will improve. The cost of living is still a cause of grave dissatisfaction. Although it is generally admitted that the 12½ per cent war bonus must come off wages, it is the belief among those who should know, that the necessities of life could come down in price—thus offsetting the drop in wages—and still leave a reasonable profit. Retailers and middlemen in particular are blamed for profiteering on articles of food.

British Trade Ship

A project which is now receiving active attention is that of sending a trade ship to the principal ports of the world, carrying an exhibition of British manufactures. The ship will be called *British Industry*. She will have a gross tonnage of 20,000, and there will be eight decks, four of which will be devoted to the exhibition proper. The voyage will last about eighteen months.

PRICES OF BRITISH MACHINE TOOLS

Size	Price, £	Weight, Pounds	Price per Ton, £
Engine Lathes			
Swing, Inches			
12	105	.....	...
12½	160	1,400	256
12½	227	2,580	262
13	170	2,240	170
14	200	2,020	222
15	151	1,790	189
15	341	3,700	206
16½	336	4,700	160
17	295	4,260	155
17	347	5,150	151
17	340	6,160	124
26	400	7,840	114
26	862	14,560	133
29	670	......	...
30½	1010	21,280	106
Milling Machines			
Table Travel, Inches			
28	354	2,570	308
30	705	5,040	313
36	875	6,270	313
42	1036	8,960	258
Turret Lathes			
Swing, Inches			
16	824	5,260	351
20	938	6,380	329
Shapers			
Stroke, Inches			
9	110	1,570	157
16	200	2,460	182
16	383	8,400	102
16	175	3,140	125
16	160	2,800	128

Size	Price, £	Weight, Pounds	Price per Ton, £
Grinding Machines			
Inches			
10 by 24	458	3,250	315
12 by 36	720	6,830	240
12 by 24	462	3,580	290
Upright Drilling Machines			
Inches			
20	90	1,010	200
20	95	780	272
27	180	2,300	176
30	475	8,290	128
Radial Drilling Machines			
Radius, Ft. In.			
3 0	320	2,740	261
3 0	372	3,360	248
3 0	453	4,030	252
3 6	295	4,140	159
4 0	360	6,500	124
6 0	859	15,120	127
6 0	450	5,260	192
6 0	1390	18,480	169
Planers			
Feet			
1⅔ by 1⅔ by 4	258	3,470	167
2 by 2 by 6	250	6,720	83
2 by 2 by 6	370	5,600	148
2 by 2 by 8	450	9,180	110
2½ by 2½ by 6	474	8,400	126
3 by 3 by 8	628	11,540	122
3½ by 3½ by 8	826	17,920	103
4 by 4 by 10	1237	27,440	101
4 by 4 by 12	1100	32,480	76
4 by 4 by 16	1490	38,080	88
5 by 5 by 10	1847	45,360	91
6 by 6 by 10	2276	49,280	104

Machinery

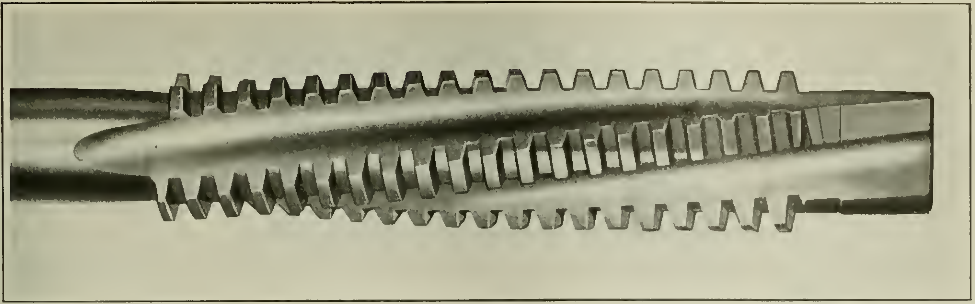


Fig. 1. Acme Double-thread Finishing Tap having Relief, Spiral Flutes, and Taper in the First Threads

Making an Accurate Acme Thread Nut

By B. M. W. HANSON, President, Hanson-Whitney Machine Co., Hartford, Conn.

THE Acme thread, as is well known, especially among machine tool builders, has practically replaced the square thread. It has proved to be the most efficient type of thread for such purposes as lead-screws on lathes and for screws employed for moving and adjusting slides on various kinds of machine tools, because it wears much better and it is more easily produced than other types of threads. If there is any criticism against the Acme thread it is on account of its large tolerance at the top and bottom of the thread, which is probably unnecessary. Half the tolerance would doubtless be sufficient for adjusting screws and slide screws.

Machine tools of the present day invariably have a micrometer dial on the adjusting screws; therefore these screws have in a way become micrometers, and if a machine tool is furnished with a combination adjusting screw and micrometer, it is important to have such a screw accurate and to make sure that it maintains its accuracy. The only practical way of maintaining the accuracy of the screw is to have a large bearing surface, properly lubricated, in the nut. In order to obtain a good wearing surface, it is necessary to make the nut long, and the best practice in modern machine tools is to have the nut as long as two diameters of the screw. In the majority of cases, there is no reason why a nut could not be made four diameters in length, provided the lead of the thread in the nut were the same as the lead of the thread on the screw. If such a nut were well lubricated and well protected from dust and grit, the wear would be reduced to a minimum and the accuracy of the screw would therefore be maintained for a long time.

Difficulty of Obtaining Proper Contact between Screw and Nut

On important work it has been found necessary to chase the thread in the nut, but if the nut is small in diameter in proportion to its length, it is not a very easy task to chase an accurate thread, and the practice in such cases is to finish the nut with a finishing tap. If the tap is not of accurate lead, however, it will not improve the thread in the nut, and although the screw may go through the nut and seemingly fit, it will actually bear on the end threads only and full contact between the screw and the nut will not be obtained until they have worn together, at which time the accuracy of the screw is gone.

If a machine tool were taken apart after having been used for a few months, when the screws were taken out of the nuts, which are usually made of bronze, it would be seen that the oil (if there is any) is yellow in color. The yellow color comes from particles worn away from the bronze nut, and even if the screw has been well lubricated there will be a considerable amount of bronze particles in the oil, mainly because there has not been proper contact between the thread of the screw and the thread in the nut, or because the nut is too short in proportion to the load it is working under. The writer's experience has been that there

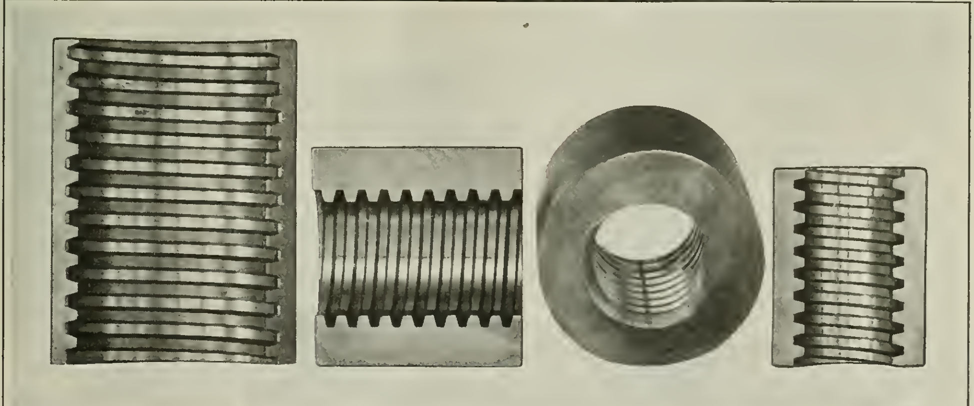


Fig. 2. Tapped Bronze Nuts of Fine Finish and Exceptionally Accurate Lead and Shape

has never been any proper means of producing an accurate nut, and although screws have been made very nearly accurate it has been a difficult matter to make nuts that fit them.

Use of Roughing and Finishing Taps

During the last few years the writer has made a great many experiments in an attempt to produce accurate threads in nuts, and after a comparatively short time was able to make taps of the U. S. standard form and the Whitworth form that are very accurate in lead and size, as described in the article "The Problem of Accurate Thread Cutting" in July MACHINERY. The Acme thread, however, presents other difficulties, as it is very much deeper in proportion and has a much slighter angle than the V-shaped threads have. Also, accuracy is of even greater importance in places where Acme threads are used.

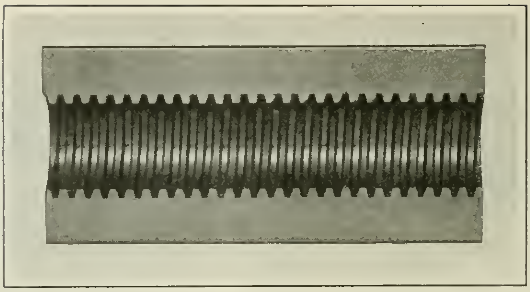


Fig. 3. Tapped Cast-iron Nut, 6 Inches Long, with Thread of very Accurate Lead

After making a good many sets of taps of different forms, clearances, shapes of flutes, and different proportions for removing stock quickly, the following method has finally been adopted: One or more roughing taps are made according to the length of nut and depth of thread. The roughing tap leaves the thread almost the full diameter and too wide, which is the same as making the space between the threads too narrow. Next a finishing tap is made, having the proper clearance and a thread on the end narrow enough to enter the nut. The width of the thread is gradually increased by making the tap gradually larger in diameter in the angle of the thread; the threads are also stepped by proper amounts to give the chips the proper thickness, and the straight part of the tap is not made longer than twice its diameter. This tap is finished to accurate diameter and lead after hardening. By this method it is possible to obtain a finished thread in a nut that will fit an accurately made gage. The thread will have a mirror-like finish.

Experiments have been made in bronze, cast iron, and machine steel, and it is possible to produce a finish in any of these materials that is surprisingly fine, as well as to maintain a lead in which it is very hard to detect any error. Figs. 2 and 3 show nuts that have been cut in half, but one must see the actual work to appreciate fully its fine finish. As a general rule, it is possible to obtain these results with one roughing tap and one finishing tap, but a combination roughing and finishing tap has also been made which gives excellent results. It is merely a matter of economy as to whether one or more taps should be used. One of the finishing taps is shown in Fig. 1.

Lubrication when Tapping

Ideas vary as to the lubricants to use when tapping different materials. For steel it is generally accepted that lard oil or sperm oil is best when using small taps. After several weeks of experimenting with different taps, accurately made, having different clearances and different thicknesses of chips for each tooth, it was found that in tapping cast iron, steel, and bronze, good lard oil gives the best results.

Nuts were tapped in cast iron with taps 1¼ inches in diameter and 6 inches long, using a copious stream of lard oil. The tapping was done in a turret lathe. Excellent results were obtained, and the temperature of the piece being tapped, as well as of the taps, was very little different from what it was before tapping. Hundreds of nuts were tapped in this way out of different materials, and different clearances or reliefs were provided on the taps to see which produced the smoothest work and operated the easiest. Although it is possible to improve the results by varying the clearance on the tap according to the material to be tapped, an average clearance can be provided which will be satisfactory for almost any material. It was found that the thickness of chips that each tooth was taking with a reasonable relief and proper lubrication made a combination that always produces good results.

In making an Acme tap in the old way, that is, by finishing it first and hardening it afterward, no matter how much care has been taken to see that each tooth takes the correct thickness of chip, the chip thickness will vary after the tap has been hardened. It will be found that thick chips and scrapings are produced and that most of the chips are in two flutes, whereas with an accurately made Acme tap that has been finished and corrected after hardening, the chips will be of uniform thickness and shape, and the same amount of chips will be found in each flute. Even in tapping cast iron with an accurately finished tap, the chips will be distinctly curved, about the same as when turning cast iron with a tool that has a certain amount of rake.

Acme screws are often made double-thread or even triple- and quadruple-thread, so the lead angle in such a thread is considerable. Every mechanic knows the difficulty of tapping holes with a thread of this kind, but by properly designing the tap and making the flutes of such a spiral that they will be at right angles to the tap teeth, the tap will work practically as easily as a single-thread tap. With tools of this kind it has been fully demonstrated that not only extremely accurate work can be done, but that the work can also be done with a large saving of time. Nuts such as shown in Figs. 2 and 3 have been produced in a few minutes.

Holding an Acme Tap in a Turret Lathe

A turret lathe is a convenient machine to use in tapping Acme nuts. It generally has the proper holding devices, power, and good facilities for lubrication. In using the roughing tap, unless the operator is very skillful and careful he is likely to ream the hole before the tap takes hold, and this may happen even after the tap takes hold if it is rigidly fastened in the turret, as it is difficult for the operator to follow up with the turret-slide at the same speed as the tap is traveling. If he pushes too hard, he will widen the thread, and the same thing will take place if he retards the motion of the slide; if he does not attempt to follow up with the turret-slide, the tap will have to

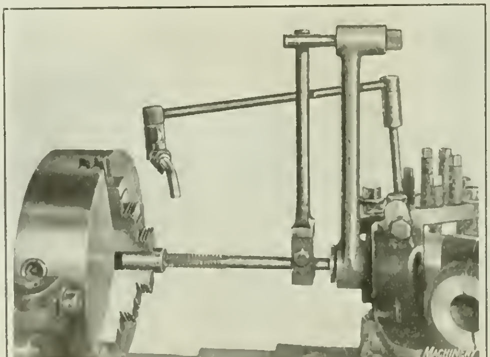


Fig. 4. Floating Tap-holder for Turret Lathe

drag the slide along, and this will also cause the thread to be widened.

It is important that a roughing tap should not cut the thread (or rather the space between the threads) too wide, because in that case there would not be enough metal for the finishing tap to remove. The roughed out thread, as previously stated, should be wider than the finished thread. Fig. 4 shows a floating holder used to hold an Acme tap in a turret lathe. It will be seen that with this device a tap will be allowed to make its own lead without having to drag the turret-slide along or without it being necessary for the operator to try to follow up the lead except roughly.

The shank of the tap in this holder has a free running fit in the bushing, and the wrench-shaped arm which fits the flats of the tap shank rests against a pin in the stationary arm of the holder. This prevents the tap from turning around, but the shank can slide in and out in the bushing, and if the arm is 12 inches long from the contact point of the rod to the center of the shank, the pressure on the outer end of the arm will be approximately one-twelfth of what it would be if the tap were held rigidly by the ordinary square at the end of the shank. Therefore it is possible for the tap to float in and out while sliding on the arm, which has a reduced pressure contact. With this device it is only necessary for the operator to follow up with the turret-slide so that the arm does not slide off the rod, and hence the tap has very little chance of dragging so as to widen the space between the threads.

When the finishing tap is used, the operator proceeds in the same way, except that he turns the finishing tap in by hand until the sides of the thread of the tap are in contact with the walls of the roughed out thread. Acme taps of the type described in the preceding are manufactured by the Hartford Tap & Gauge Co., of Hartford, Conn.

* * *

SOUTH AMERICAN TRADE

Efforts are being made to re-establish American business relations with South America, a thing difficult to do because of conditions developed during the war and the present disadvantage of an unfavorable money exchange which protects the European trade in South America against American exports. The American Trade Bureau, in the interest of which Colonel S. Graae has recently sailed for South America, in order to organize trade connections, states that the real difficulties to be overcome are those due to the lack of harmonious understanding between American representatives in South America and South American business men, the insufficient support given by the banks, and last but not least, the fact that the Latin business men have not always been handled with that diplomacy and tact which is one of the main factors leading to success in doing business in South America. The European countries, according to Colonel Graae, are daily progressing in South America, not only because the exchange rate is in their favor, but because they have thoroughly studied the customs of the Latin race and won their confidence. With the quality of goods that America can offer, the right kind of trade representation would assure success.

Care in relation to certain apparently minor details is often the means of securing the good will of South American concerns, as, for example, in the matter of postage. In this connection attention is called to the recommendation of Commercial Attaché W. L. Schurz, of Rio de Janeiro, that American manufacturers should discontinue sending heavy catalogues to South America by parcel post. Such publications should be sent by express, or by any other means available. A large number of packages sent by parcel post are piled up in the custom-house at Rio de Janeiro, and it requires so much time and expense to get a package out of the parcel-post section of the customs that many persons prefer to leave their packages unclaimed.

INDUSTRIAL CONDITIONS IN FRANCE

By MACHINERY'S Special Correspondent

Paris, October 11

Orders for machine tools are few and, as a result, French builders of machine shop equipment are producing far below their normal capacity. Because of this low production, the costs of machine tools have increased considerably. This market is also flooded with the stocks of importers, and with machines purchased by the various government bureaus for the devastated regions, and machines coming from Germany. The selling season for agricultural machinery which is now being terminated has been rather good, the sales at least equalling, and possibly surpassing, those of the same period in 1920. The market for this class of machines remained firm throughout the whole season, but a certain quantity of left-over agricultural machinery can be obtained at the present time at reduced prices.

Improvements in Various Fields

In the automobile field the situation has improved slightly, although, as yet, there is but a limited activity in most plants. The Peugeot plant produces 700 automobiles and 250 motorcycles a month; it also produces 9000 bicycles. Another automobile manufacturer near Paris produces 200 16-horsepower cars per month and an equal number of smaller cars. The accessory manufacturers state that their business is fair.

During the last few weeks the makers of aviation products have begun producing to a slight extent, a few orders having been received from foreign governments and private sources. Another noteworthy order is that of the War Department for 150,000 sets of special breathing apparatus, which will be filled by Leconge & Willmann. The order amounts to 5,025,000 francs (about $366,000, present exchange).

There has been a slight improvement in the iron and steel field. Buyers have decided to place orders while the market remains firm, because they fear an increase in the cost of raw material which would, of course, cause prices to rise. Conditions, however, are far from what could be considered normal. Good quality scrap iron and iron castings are still in demand, principally for export, a large quantity being bought by Belgian dealers and destined principally for Germany. In northern France and in the vicinity of Paris, the market for scrap iron has also improved.

There has been a decided improvement in the bolt and nut field. Conditions in this field are different from those in other branches of the metal-working industry, as no scale of production is fixed by organized labor, and this leaves the manufacturer free to reduce production costs and quote prices accordingly. Prices have been reduced, and although they do not yet seem stable, further large reductions are not anticipated. It is interesting to note the wide variation in prices of the past week. An offer for 810 metric tons of bolts was accepted at 65.6 francs per 100 kilograms ($2.12 per 100 pounds, present exchange) while another offer for 37 metric tons of bolts at 121.9 francs per 100 kilograms ($4.02 per 100 pounds) was rejected.

Labor Conditions

There is no indication of an ending of the strikes in the textile industry in northern France, as neither side seems willing to modify its viewpoint. It is believed that, due to the instability of prices of raw materials, the owners are not anxious to resume operation. The workers in the iron and steel field have also declared a strike to show their strength, but it is thought that this strike will be of short duration. Labor conditions in the rest of France are quiet, except for some slight disturbances occasioned by reductions in wages. The slight improvement in the manufacturing field has contributed toward decreasing the number of unemployed.

American Gear Manufacturers' Convention

THE fall convention of the American Gear Manufacturers' Association, held in Rochester October 13 to 15, was largely attended, and the program was crowded with important reports on gear standardization. The meeting was opened by a welcome to Rochester by Andrew C. Gleason of the Gleason Works, after which the president of the association, F. W. Sinram, of the Van Dorn & Dutton Co., Cleveland, Ohio, in brief opening remarks gave voice to the conviction that the lowest point had been reached in the industrial depression, and that industry is now on the upgrade. Two new member companies were elected, the Central Products Co., of Detroit, Mich., and the Harris Engineering Co., of Bridgeport, Conn. The association now has 94 member companies, 112 executive members, and 61 associate members. The extent of the industry represented by the association may be estimated from the fact that reports from less than half of the member companies show that they employ together nearly 20,000 men.

Papers Read before the Convention

Several papers of direct interest to the gearing industry were read before the convention. S. O. White, chief engineer of the Warner Gear Co., Muncie, Ind., read a paper on "Gear Tooth Wear," reviewing some valuable experiments that have been made in the laboratory of that company, relating to the wear of gears made from different materials and heat-treated in different ways. This paper also indicated the remarkably high efficiency that may be expected from gearing properly cut and heat-treated—96½ per cent in the case of a train of four spur gears.

A comprehensive paper on "Duralumin as a Material for Worm and Other Gearing" was read by R. W. Daniels of the Baush Machine Tool Co., Springfield, Mass., and one on "Tooth Forms" by E. W. Miller, chief engineer of the Fellows Gear Shaper Co., Springfield, Vt. Abstracts of these papers will appear in a coming number of MACHINERY. An address was also made by E. S. Sawtelle, assistant general manager of the Tool Steel Gear & Pinion Co., Cincinnati, Ohio, entitled "First-hand Impressions of Europe," in which Mr. Sawtelle related some interesting experiences and impressions from his visit to Europe this summer.

The Society's Standardization Work

The most important part of the society's work is that of standardization in the gearing field. The society has already dealt with a number of the important phases of the work met with in the gear-cutting industry, and has made great headway in the direction of standardization, but until recently there has been no comprehensive standardization program that would act as a complete guide for the entire work of the association in this direction. Hence, at a meeting of the members of the General Standardization Committee held last summer, a definite standardization program was adopted with the idea that by having such a program constantly before the association, better aid could be obtained by the committees from the members. As no standardization in gearing has been attempted in this country up to this time, except by the American Gear Manufacturers' Association, the objects of the standardization activities of the association will doubtless be of interest to the entire mechanical engineering industry. The program laid out by the association is therefore partly republished, in order that the cooperation of engineers everywhere may be obtained—a factor essential in any real standardization work in this field. Those who may desire to communicate with the association in connection with the standardization program should address B. F. Waterman, chairman of the General Standardization Committee, American Gear Manufacturers' Association, Brown & Sharpe Mfg. Co., Providence, R. I.

Standardization of Spur Gears

The objects of the Committee for the Standardization of Spur Gears are as follows: (1) Nomenclature and symbols in conjunction with the Nomenclature Committee; (2) preparation of a standard spur gear for general industrial use, by means of a diagrammatic illustration of various types of spur gears, including a spoked wheel, a webbed wheel, and a solid pinion, with proper formulas covering width of face, rim, arm proportions, and hub proportions, in conjunction with the other committees; (3) development of general horsepower formulas with the view of developing tables for horsepowers; (4) investigation of allowable stresses for A. G. M. A. materials in connection with the Metallurgical Committee; (5) arrangement of means for communicating with the general membership regarding gear installations (using standard chart) to determine the proper design of gear sets and gear mountings under various conditions; (6) standardization of automotive spur gears, as to tooth forms, form of blank, horsepower, wear of teeth, method of mounting, stiffness of shafts, clearance, materials, tolerances, lubrication, etc.; (7) cooperation with Committee on Tooth Form to standardize spur gear tooth forms; (8) inspection.

Standardization of Bevel Gearing

This committee will take up the following subjects: (1) Nomenclature, symbols, and formulas in conjunction with the Nomenclature Committee; (2) materials—all kinds to

be considered in conjunction with the Metallurgical Committee; (3) mounting of bevel gears, location of bearings in the surrounding case, or supports and lubrication; (4) bores and their relation to diameter of gear; (5) keyways; (6) radial and thrust loads—method of calculation and their relation to strength and wear; (7) backlash for various conditions of service; (8) bottom clearance; (9) tolerances for blank gear and teeth; (10) length of face and its effect on strength and wear; (11) tooth form and addenda proportions (generated gears, form planed gears); (12) thickness of teeth; (13) strength—rules for horsepower; (14) wear of teeth; (15) heat-treatment in conjunction with the Metallurgical Committee; (16) inspection in conjunction with the Inspection Committee; (17) body proportion (arms, web, and hub) in conjunction with other committees; (18) accumulation of records of successful and unsuccessful bevel gear drives transmitting limiting power, using standard chart for the purpose.

Standardization of Worm-gearing

(1) Nomenclature, definitions, abbreviations, symbols, and formulas in cooperation with the Nomenclature Committee; (2) materials for worm and wheel and heat-treatment in conjunction with the Metallurgical Committee; (3) recommendations for the best sizes of worms for each pitch and style (hole or shaft worms) to reduce the number of sizes to a minimum; (These will cover worms for industrial and automotive use, and tables or lists of the recommended sizes will be compiled.) (4) compromise in a commercial, practical, and scientific manner, the various factors which affect the practical use, manufacture and efficiency of worm-gearing; (5) recommendations for the design of worm-gears for all kinds of service, and their mounting and housing; (6) strength or load-carrying capacity—horsepower rules—method of calculating tooth and bearing pressures; (7) tooth form and proportions for various applications; (8) wear of teeth; (9) design of body of worm-wheel (arms, web, hub) in conjunction with the other committees; (10) accumulation of records of successful and unsuccessful worm-gear drives transmitting limiting loads, using standard chart for the purpose; (11) inspection in conjunction with the Inspection Committee; (12) recommendations as to the design of the worm-wheel to enable the present existing hobs to be used to best advantage. Such items as material, blank proportions, tooth pressures, bearing loads, mounting and lubrication will be considered.

Standardization of Herringbone Gearing

(1) Nomenclature, symbols, and formulas; (2) most suitable spiral angle (of teeth with axis), pressure angle; (3) rules for calculating diameters for various ratios of hobbed gears where corrections are made for under-cut; (4) width and depth of groove in center of face for solid blanks or rims for different methods of hobbing; (5) formulas for strength (horsepower, using safe working stresses of A. G. M. A. materials); (6) recommendations for the use of standard (stock) 14½-degree pressure angle hobs. Method of calculating blank diameters; (7) design of gears and mountings; (8) accumulation of records of successful and unsuccessful installations to determine the proper design of gear sets and mountings, using standard chart for the purpose; (9) inspection.

Standardization of Keyways

(1) Recommendations for suitable sizes of keyways for various shaft sizes; (2) keyway-stock sizes and materials; (3) review of existing splined shaft standards with the object of recommending more suitable limits and tolerances; (4) consideration of keyways now recommended for special purposes; (5) cooperation with committees of other organizations now considering keyways; (6) consideration of key strength; (7) tables showing depth of vertical wall for keyway sizes recommended; (8) methods of inspection.

Standardization of Tooth Forms

(1) Nomenclature, symbols, and definitions, in cooperation with the Nomenclature Committee; (2) recommended standard tooth form (to include pressure angle, addendum, whole depth of tooth, clearance, fillet, and backlash); (3) stub tooth standard; (4) investigation and comparison of the merits of teeth having equal addendum and dedendum with those having a long addendum for the driver; (5) methods of inspecting tooth forms.

Standardization of Inspection Methods

(1) Methods of inspecting gears, testing machines, etc.; (2) inspection of threads, in conjunction with other interested organizations; (3) inspection of raw materials in conjunction with the Metallurgical Committee; (4) inspection of hobs and cutters; (5) investigation of possible methods of determining the degree of gear noise.

Standardization Reports Accepted at the Meeting

The committee on gears and pinions for electric railway service presented a report which was accepted as recommended practice for the members of the association. The Metallurgical Standardization Committee also presented a report covering forged or rolled steels, brass, and bronze, and steel castings, which was accepted as recommended practice. Another report also accepted at the meeting covered sprocket wheels and chains.

Friday afternoon, October 14, the representatives and guests present at the convention were invited to the Gleason Works for luncheon, which was followed by an inspection of the plant. Saturday afternoon the members and guests were again the guests of the Gleason Works at a clambake at Corbetts Glen, a short distance from Rochester.

Reducing Costs by Rotary Milling

Examples of Work Advantageously Handled on Becker Vertical Rotary Milling Machines

METHODS that open the way to higher production, particularly those that employ standard machine tool equipment, are essentially cost-reducing methods. A number of representative examples of parts which have been machined on the Becker rotary type of milling machine at a saving in production time are cited in the following, and data furnished regarding the equipment used and the time consumed.

The first job to which attention is directed is that of milling the interior bearing surfaces of a 48-inch solid truck tire mold, and the set-up used is illustrated in Fig. 1. The steel casting is shown strapped to a special table, which for this job is substituted for the regular machine table. This table is tapped for a number of long tie-rods so that the deep casting, which is 12 inches wide on the tread, may be conveniently held down. A special high-speed end-mill extending the full depth of the casting is used, and it is driven at 45 revolutions per minute, which is equivalent to a cutting speed of 30 feet per minute. The depth of cut is 3/8 inch, and the time required to complete this operation is forty-five minutes—ten minutes of which is required to set up the work. In locating the steel casting centrally, use is made of a stud assembled in the center of the special table. A radial arm is fitted to this stud, the arm being swung about this center to quickly and effectively centralize the casting.

The particular point of interest in the set-up shown in Fig. 2 is the multiple fixture employed. This fixture has eighteen loading stations, in each of which two pieces of work are carried. The stations in the lower and upper parts of the fixture are staggered relative to each other, as a means of relieving the strains set up by the cutters. The parts to be machined are small drop-forged steel yokes, and the clamping element is so devised that a pair of yokes is located by one stop at each station between the two parts, and also each pair of yokes, when thus located, is secured by a single strap and bolt. This makes a very convenient arrangement for loading the fixture, and a quickly operated one. Two special double-staggered inserted-tooth milling cutters, 7 inches in diameter, are used, which work at a cutting speed of approximately 55 feet per minute. It will be seen that the lower end of the cutter-spindle is provided with a bearing, which prevents the spindle from springing out of alignment due to the stress set up by the cutters, thus safeguarding against inaccuracies resulting from this cause. The table feed is 2 inches per minute and the production rate is ninety drop-forgings per hour.

Milling Operations on Rotary Worm-gear for Milling Machines

Figs. 3 to 6, inclusive, show set-ups for the various operations required to machine a rotary worm-gear used on Becker vertical milling machines, prior to cutting the teeth. The first operation, Fig. 3, is the taking of a surfacing cut on one side, this surface being used as a locating surface in later operations. This worm-gear is made of cast iron, and is 28 inches in diameter. The cutter used is an 8-inch high-speed inserted-tooth face mill, which takes a cut 1 1/4 inch deep over a surface of 7 inches wide. The cutter revolves at 30 revolutions per minute, which is equivalent to a cutting speed of about 60 surface feet per minute. The table feed is 6 inches per minute, and the cutting time twelve minutes, exclusive of the six minutes required to set up the work. It will be noted that no special equipment is required to hold the gear blank, ordinary screw-operated clamping jaws being employed for this purpose.

In the second operation, which is set up as shown in Fig. 4, the work is reversed and strapped securely to the table, being located by the previously milled face. The operation illustrated is the milling of a 30-degree beveled surface in two cuts, using a 60-degree high-speed angle cutter. The depth of the roughing cut is 1/8 inch, during which operation the cutter revolves at 40 revolutions per minute, using a table feed of 10 inches per minute. During the finishing cut the same table feed is employed, but the rotative speed of the cutter is increased to 50 revolutions per minute. The setting up time is from six to seven minutes, and the actual cutting time eleven minutes for the roughing cut, and from nine to ten minutes for the finishing cut, making a total time of about twenty-seven minutes per casting. There is no setting up time included in the finishing operation, it being unnecessary, of course, to reset the work.

It is a generally recognized principle in machine shop practice, and particularly in the manufacture of parts in quantity, that any method that permits the cutting tools to operate continuously upon the work while the loading and unloading of jigs and fixtures is done with the machine in operation, adds greatly to the economy with which the machining can be performed. One of the best examples of this principle of manufacturing is found in the application of rotary milling, and advantage is being taken of the savings made possible by this process of machining to an ever-increasing extent. In quantity production, the rotary milling process has been found to be a valuable means of reducing costs.

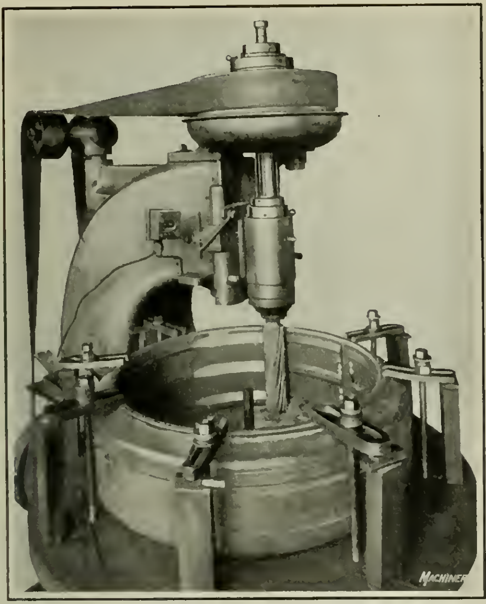


Fig. 1. Vertical Rotary Milling Machine set up for milling Truck Tire Molds

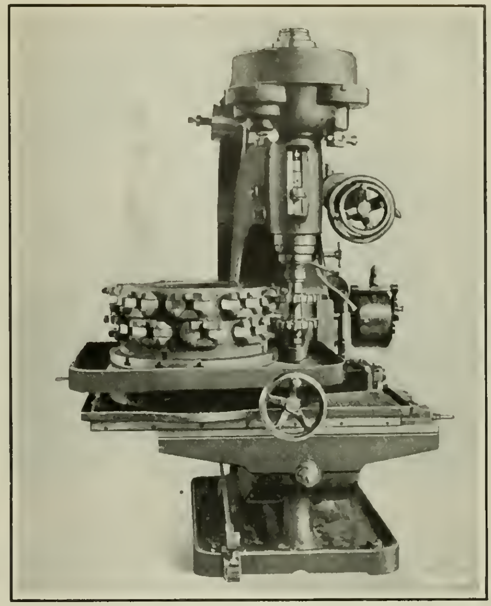


Fig. 2. Straddle-milling Yokes, using a Continuous Rotary Milling Fixture

The third operation on the worm-gear blanks is milling the outside diameter to 18 inches, the work being located in the same position as in the previous operation, as shown in Fig. 5 and the only work required in resetting being simply the changing of the position of the clamps so as not to interfere with the passage of the cutter during the cut. A 2½- by 3-inch high-speed face milling cutter is used and the depth of cut required to finish the castings to the specified outside diameter is 3/16 inch. The cutter revolves at 45 revolutions per minute, or at a cutting speed of about 30 surface feet per minute. The table is fed at the rate of 8 inches per minute, and the approximate time for completing the operation is eleven minutes per casting. It has been estimated that this job would consume about twenty-five minutes if machined by turning in a lathe.

Fig. 6 illustrates the final milling machine set-up required to rough out the blanks, and consists of milling the groove in which the teeth are finally cut. In changing from the third operation to this, it is only necessary to change the cutter and set the table over to give a depth of cut of 7/16 inch, and then proceed without changing the work from the position occupied in the previous operation. A special high-speed steel form cutter is employed which works at 45 revolutions per minute, in conjunction with a table feed of 6 inches per minute. The production time is twelve minutes per casting. The outstanding features of

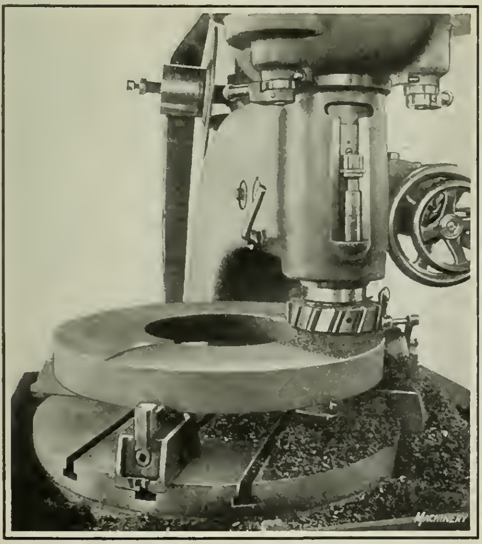


Fig. 3. Surface-milling a Worm-gear Blank

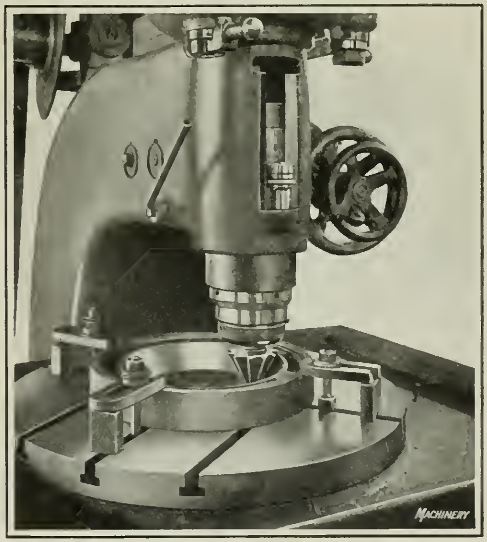


Fig. 4. Milling a 30-degree Bevel on a Gear Blank

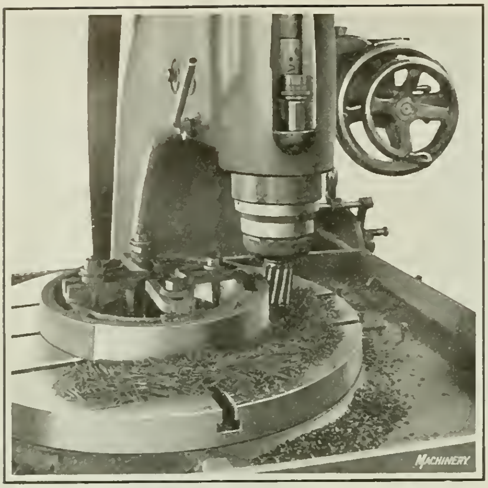


Fig. 5. Milling Outside Diameter of Gear Blank

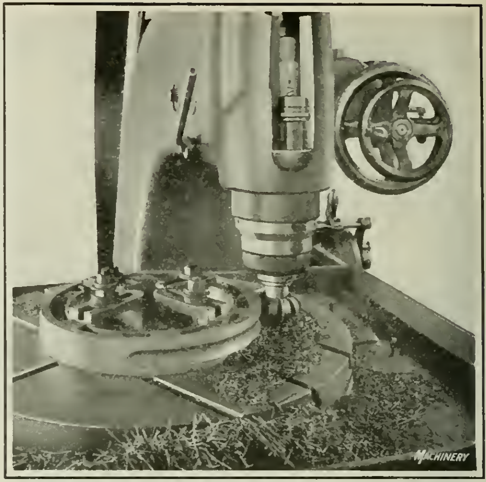


Fig. 6. Milling the Groove for the Gear Teeth

the job just described are the simple and effective means that can be employed for holding work when machined by rotary milling, and the speed with which the several operations may be completed.

Milling Crane Sheaves

Three operations are performed on cable sheaves for hoists and cranes by means of the application of the vertical rotary milling method. These three operations are shown in Figs. 7, 8, and 9. In the first operation, the outside diameter is milled to form the groove where the cable operates, and the rim is straddle-faced. A gang of three milling cutters is employed—a form cutter for the groove and two inserted-tooth face milling cutters for straddle-milling the rim. The sheaves are steel castings, and are machined as described, with the set-up illustrated in Fig. 7, in thirty minutes, exclusive of setting up time.

The work is located on a special fixture attached to the table of the machine, the fixture being provided with elevating blocks for holding the work sufficiently above the base of the fixture to allow operating space for the lower straddle milling cutter. The three blocks by means of which the sheave is thus elevated carry a pair of clamping bolts each, their location being such that a strap may be used over every other arm of the sheave to clamp the work down by means of the bolts. This arrangement is shown in the illustration. The side milling cutters are 8 inches in diameter, and the form cutter 6 inches in diameter. The cutters revolve at 28 revolutions per minute, or at a cutting speed of approximately 44 feet per minute. The rate of table feed is 3 inches per minute.

The second operation on the sheaves consists of boring a 6¾-inch hole in the top of the sheave, as illustrated in Fig. 8. The work is located in the same manner as in the first operation, there being a substantial fly-cutter substituted for the milling cutter. A roughing and a finishing cut are required to machine this hole, in the first of which ¼ inch of stock is removed. The cutter speed is 28 revolutions per minute, and the rate of feed is ¼ inch per minute. It will be understood, of course, that this feed does not apply to the rotation of the milling machine table, as in previous operations, but rather to the vertical feed of the machine spindle. The time required to complete this operation is twenty-four minutes.

The third and last milling operation on these sheaves is illustrated in Fig. 9. The operation consists of straddle-milling the faces of the hub, using two side-milling cutters of 6 inches diameter. The milling machine spindle is fed down by hand until the lower cutter has passed through the bored hole in the hub to a sufficient depth to bring the two cutters into the proper vertical relation with the surfaces to be faced. The table of the machine is then fed over so that the center of the spindle is eccentric relative to the center of the bored hole, thus enabling the cutter to extend beyond the outside diameter of the hub. The spindle speed is 36 revolutions per minute, the table feed is 2 inches per minute, and the depth of cut, ⅜ inch. The time required to straddle-mill a sheave is fifteen minutes.

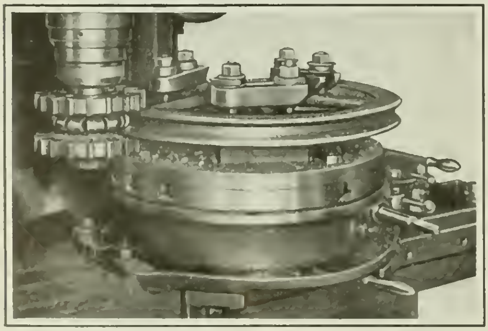


Fig. 7. First of Three Set-ups for machining a Crane Sheave

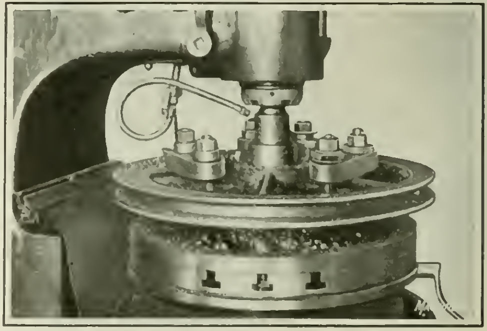


Fig. 8. Boring the Hole in the Hub of a Crane Sheave

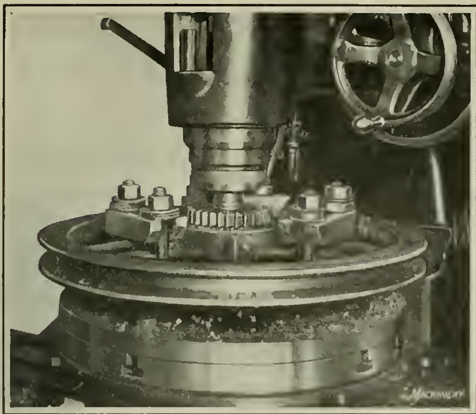


Fig. 9. Straddle-milling the Face of the Huh of a Crene Sheave

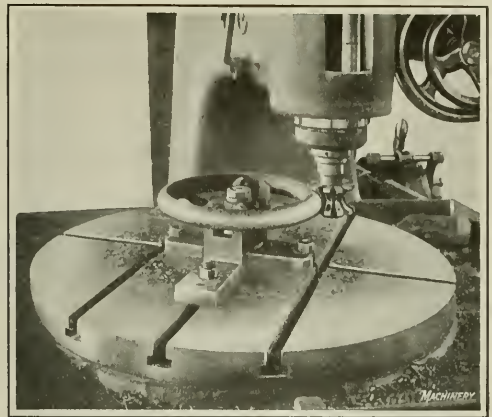


Fig. 10. Set-up for machining Rim of Milling Machine Handwheels

Machining the Rim of Milling Machine Handwheels

Handwheels used on Becker machines are first bored and faced on Gisholt turret lathes, and then finished on the rim by rotary milling and polishing. Fig. 10 shows the set-up used in the milling operation. After being received from the turret lathes, the handwheels are located for machining from the previously bored hole and faced hub, using a central stud and clamping nut to secure them in place. Two driving arms in the form of angle-plates are used, these being machined to straddle opposite arms of the casting. The central locating stud for the handwheel is carried in a base casting which can be quickly and conveniently attached to the machine table as shown. A special high-speed concave milling cutter, operating at a speed of 45 revolutions per minute, is used. The table feed is 7 inches per minute, and from 1/8 to 3/16 inch of metal is removed. The wheel is 10 inches in diameter, and it required approximately four and one-half minutes to complete the work.

After the milling operation, the milled rim is finished by holding it loosely on an arbor, against the workman's leather apron, and spinning it against a felt buffing wheel. This buffing wheel is faced with 60-grain alundum, which is glued to the felt. A final polishing operation is performed with a formed-face felt wheel, using 120-grain alundum.

PLANING STOCK REEL SUPPORTS FOR AUTOMATIC SCREW MACHINES

Figs. 1 and 2 show a 24- by 30-inch planer, built by the Putnam Machine Co., Fitchburg, Mass., engaged in planing the base pads for a stock reel support for an automatic screw machine. This planer is used by the National Acme Co. in its plant at Cleveland, Ohio. The planing operation is quite simple, but the fixture which is employed for supporting the casting during the performance of the operation is somewhat unusual.

The fixture consists of a heavy 90-degree angle-block, strapped down to the table, with provision for carrying the end thrust of the tools. On the casting that is to be planed, there are two lugs *A* that project over the top edge of the fixture and rest on hardened steel supporting pads. The casting is then clamped in this position by tightening a strap *B*.

It will be evident that additional support must be provided to hold this large piece of work back in position against the vertical face of the fixture, and this is furnished by a bolt *C* by means of which a long strap *D* is tightened to hold the work back against the fixture. It will be seen by referring to the illustrations that the planing operation is performed by a single-point tool *E*.

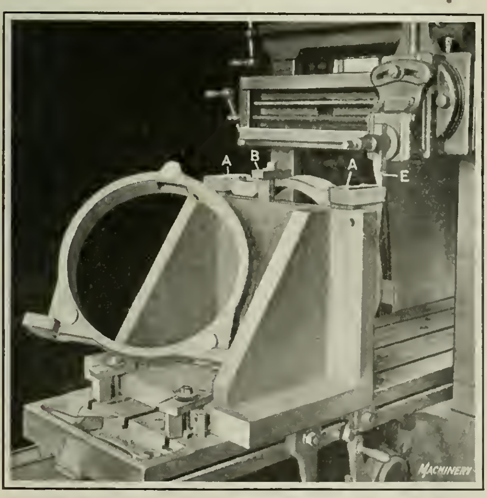


Fig. 1. Planing Base Pads on Stock Reel Support for an Automatic Screw Machine

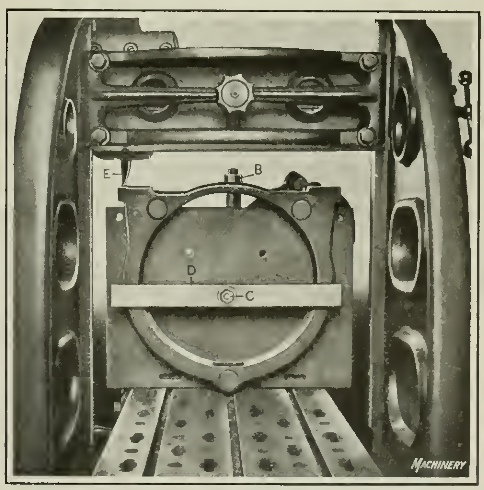


Fig. 2. Opposite Side of the Work and Fixture for planing Stock Reel Supports

Industrial Conditions in Spain

By RAMON CASALS, Manager, Fenwick & Co., Barcelona, Spain

THE metal-working industries of Spain are passing through a critical period. The industrial crisis which the entire world is experiencing is felt here more than in most other countries, due to the abnormal stimulus that the metal-working industries received during the war period, the activity of which cannot be sustained.

During the war and all through 1919 every concern of any importance received a great many orders from the allied nations, and many were also busy on work for the domestic market. During this entire period it was not essential to be a first-class manufacturer, far less to be a specialist, in order to obtain business. Hence, many shops and factories were established employing inferior equipment, material, and workmanship. Those shops that were developed with a view to meeting post-war competition in the world's markets are comparatively few. Hence, as soon as the boom was over, it was easy for Germany, France, and Italy to enter the Spanish market with the result that the imports during the second half of 1920 and the first four months of the present year were very large. This, together with the sudden reduction in prices, was the immediate cause of the crisis which the metal-working industry in Spain is now passing through. As an example of the abnormal conditions, it may be mentioned that some manufacturers, after having developed the design of special machines, have sent the drawings to German manufacturers to have the machines built for about one-half the price at which they could be built in Spain, inclusive of delivery charges. Besides, the Germans have been able to make quicker deliveries.

It is expected that this critical situation will gradually improve, partly because of the increase in import duties that is now in effect, and partly because the manufacturers are beginning to specialize and thereby reduce manufacturing costs. In addition, the industry is hopeful of the passage of an important railway construction bill, now under discussion in the Spanish Parliament. If this bill is passed, it will increase the activity in various metal-working branches.

The Machine Tool Trade

The building of machine tools in Spain, started during the war, has been almost entirely discontinued. During the war some copies were made of American machines. The classes of machines built were lathes, planers, shapers, and simple milling machines and drilling machines. Some of the builders of these machines now have a large stock, and those in particular who were ambitious enough to undertake the building of machines of highly developed designs have been obliged to retire from this business entirely. All firms dealing in machine tools have large stocks on hand, and there are at present very few inquiries. As a matter of fact, scarcely anybody buys anything at the present moment; any orders that may be placed are almost entirely for repair shops, and these small shops want inexpensive machines. They, therefore, rather prefer offers from German makers who quote from 50 to 60 per cent less than the price for American machine tools in Spain, although it is well known and recognized that these inexpensive machines are of rather inferior quality.

American machine tools continue to be highly appreciated in Spain, and more so after some sad experiences which some buyers have had with German machine tools. They believed that they had gained certain advantages in buying some machinery from Germany, but were afterward obliged to return the machines as unsatisfactory, suffering considerable losses. Nevertheless, in spite of experiences like this, there are still firms who prefer to buy inexpensive machinery, but this would not be the case if the difference in price were not as great as it is at present, due partly to the high rate of exchange of the dollar and partly to the actual difference in price.

It is difficult to forecast the future, but there are reasons to believe that manufacturers of standard types of machine tools may expect a fair export trade to Spain when conditions become more stable. It must be borne in mind that there are more than 1500 firms in Spain using machine tools, and 97 per cent of these are so badly equipped that if they do not provide themselves with better machinery, 80 per cent of them will have to close down altogether, because of inability to compete with foreign manufacturers. There are also new industries gradually being developed in Spain. The automobile industry has been rather quiet lately, but it is expected that the increased import duties on automobiles will aid this industry, and that it will show a healthy growth as soon as the commercial and industrial situation becomes more normal.

Spanish Import Duties

In the early summer, a considerable increase in the import duties went into effect. The increase was especially large for machinery of all kinds. A month after the general tariff bill had gone into effect, a further increase in import duties was made affecting machinery imported into Spain from countries with an unfavorable rate of exchange —Germany, France, and Italy. The duties on different classes of machine tools in accordance with these new import duties are given in the following list. On account of the fluctuation in exchange, they are given in pesetas (exchange on October 20, 1 peseta = 13 cents).

Machine tools and parts for machine tools weighing over 501 kilograms (1100 pounds) are assessed at 40 gold pesetas per 100 kilograms gross weight. A gold peseta, of course, is worth the regular normal value (one gold peseta = 19.3 cents) so that when paid in paper pesetas at a lower rate of exchange, the import duty is about 40 per cent higher. For machinery imported from countries with an adverse rate of exchange, as far as Spain is concerned, the import duty is still higher. For instance, if a machine, boxed, weighs 2000 kilograms (4400 pounds) it would pay the following duty:

From the United States	1124.72 pesetas
From France	1416.60 pesetas
From Italy	1597.10 pesetas
From Germany	1814.95 pesetas

In this case the value of the peseta is figured at present exchange, that is 1 peseta = 13 cents.

Machine tools and parts of machine tools weighing less than 500 kilograms (1100 pounds) pay 50 gold pesetas per 100 kilograms gross weight. The custom duties in this case also are increased according to the exchange rate with the country from which the machine is imported, so that a machine weighing 400 kilograms (880 pounds) would pay duty as follows:

From the United States	285.20 pesetas
From France	389.20 pesetas
From Italy	405.00 pesetas
From Germany	560.20 pesetas

The pesetas in this table are figured at present exchange (1 peseta = 13 cents).

Forging hammers pay duty at the rate of 44 gold pesetas per 100 kilograms (220 pounds) plus the addition due to the foreign exchange rate. A forging hammer weighing 5000 kilograms (11,000 pounds) would therefore pay duty at the following rates:

From the United States	3087.50 pesetas
From France	4088.70 pesetas
From Italy	4388.25 pesetas
From Germany	4981.80 pesetas

The foregoing is figured at present exchange (1 peseta = 13 cents).

Small tools pay duty at the rate of 40 gold pesetas per 100 kilograms (220 pounds). Electric motors and other electrical machinery pay very high rates of import duty, as follows:

Up to 100 kilograms (220 pounds)	150 gold pesetas
From 100 to 400 kilograms (220 to 880 pounds)	142 gold pesetas (per 100 kilograms)
Above 400 kilograms (880 pounds)	75 gold pesetas (per 100 kilograms)

When paid in paper pesetas, the rate is 40 per cent higher, and in addition higher rates of duty are paid when the imports are from France, Italy, or Germany or other countries having a low exchange rate.

Important Industrial Plants in Northern Spain

In the metal-working industry, northern Spain presents the most promising field. A number of large companies are located here, of which a few may be mentioned. In Bilbao, we find the Altos Hornos de Vizcaya, an important company owning two factories specializing in the iron and steel field, operating extensive rolling mills for rails and plates, and employing from 4000 to 6000 men; a shipbuilding concern, the Compania Euskalduna, capable of building and repairing ships up to 12,000 tons, and employing from 3500 to 4500 men; and the Vasconia Compania Anonima, which builds aerial tramways and bridges and specializes in many other structural lines, employing from 2500 to 3500 men.

The Sociedad Espanola de Construcciones Babcock & Wilcox in Galindo, province of Vizcaya, has recently been established in Spain for the manufacture of locomotives, both for the Spanish national railways and for export. The shops just erected are very large and imposing, and in addition to the manufacture of locomotives, the company constructs boilers of its own design, manufactures seamless steel tubes, and builds cranes.

An important company devoting itself to the building of ships has three large factories and shipyards located in Sestao (province of Vizcaya), Ferrol, and Cartagena. This company, Sociedad Espanola de Construccion Naval, is partly owned by Spanish capitalists and partly by the well-known firm of Wickers in England. An important factory for general machine shop work, castings, etc., is located in Mondragon, province of Guipuzcoa; this company, La Union Cerrajera, employs over 2000 men. The Compania Auxiliar de Ferrocarriles, Beasain, province of Guipuzcoa, is devoted to the building of railway cars, and is equipped to turn out 2500 cars annually. Besides these factories in northern Spain, there are many others of similar size and importance.

* * *

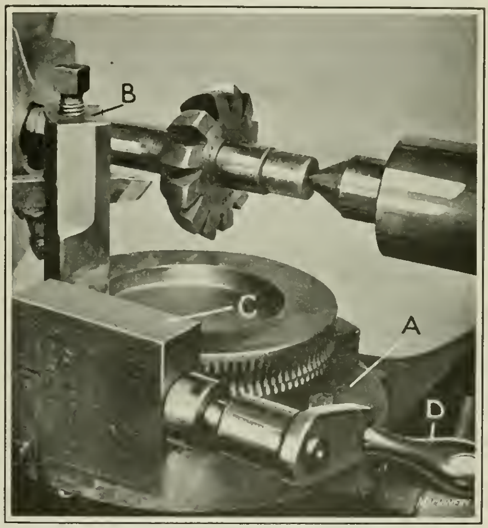
COST OF CHANGING TO THE METRIC SYSTEM

In order to determine the probable cost to manufacturing concerns of the compulsory introduction of the metric system, the American Institute of Weights and Measures, 115 Broadway, New York City, requested a number of manufacturers to study this question and prepare estimates of the cost of changing over to the metric system in each plant. Thirty-one firms located in a number of different states submitted estimates showing that the total cost for changing over in these thirty-one instances would be about $21,500,000. The plants referred to employ about 95,000 men, so that the change would cost over $225 per worker.

RADIUS TURNING FIXTURE FOR TOOL-ROOM

By O. S. MARSHALL

The demand for formed milling cutters and forming tools such as are used on automatic machines, makes it desirable that tool-rooms be provided with some kind of radius-generating device which may be used on an engine lathe for forming the circular part of forming tools. The accompanying illustration shows a simple arrangement designed for this purpose, which can be mounted on the lathe cross-slide in place of the usual compound rest. The base *A* is bolted to the cross-slide, using the bolts employed in securing the compound rest. The toolpost *B* has on the under surface of its base, a hub which extends through the lower baseplate. A nut and collar on the end of the projecting hub serve to hold the toolpost member to the base and provide adjustment for wear. A worm-gear is cut on the base



Radius-turning Lathe Fixture

of the toolpost which is hand-operated by a worm concealed by guard *C*. Handle *D* is used to rotate the toolpost.

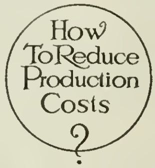
The toolpost member was made from a solid block of steel, the center being bored out and the surplus stock sawed away, leaving a narrow column, as shown, to carry the turning tool. The column is cut down to permit turning through as large an arc as possible when the blank is held on an arbor. This particular fixture will generate inside or outside circular forms such as required on the usual line of forming tools employed in ordinary shop work. The distance from the center of the hub on which the toolpost turns, to the tool point when the tool is drawn back the maximum amount is 2½ inches. For large internal forms the tool may be used with the point extending away from the post. A high degree of accuracy is attainable, and a fine finish is produced on high-speed steel tools.

* * *

Direct government control of the railroads in Great Britain, which has existed for the last seven years, ended in August. The financial results of the operations show that while the income has been doubled during these seven years, the expenditures have been tripled. With the releasing of the control of the railroads from government administration, they will also be deprived of the government support by which the deficit between income and expenditures has been equalized.

How Factory Investigations Reduce Costs

By ALBERT A. DOWD, President, and FRANK W. CURTIS, Chief Engineer, Dowd Engineering Co., New York City



THE factory investigator who produces results is not content with a surface analysis of conditions; he starts at the bottom of things and determines how various parts should be manufactured, estimating the length of time which would be required under first-class manufacturing conditions. After this he looks up the cost records and compares the actual cost with his estimate. If he finds that there is only a small amount of variation in certain parts, he is satisfied that in these instances the loss in production is not heavy. Occasionally a differeuce of 50 per cent or so may be found between his estimate and the actual cost of prodnction; naturally such conditions will require investigation to find out the reason why the costs are higher than they should be.

Effect of Design Upon Cost of Machining

While the engineer is looking through the blueprints of various components of the mechanism which is being manufactured, he considers carefully the design of the parts with respect to their effect upon the cost of machining. Many designers do not consider as carefully as they should the various processes necessary to machine the product, and as a result the tool engineer is frequently forced to design complicated tools in order to machine a certain part, when a few changes in design would make the operations much simpler. The factory investigator looks into these points, at the same time realizing that there is a disinclination on the part of factory executives to permit changes in design unless it can be conclusively shown that specific savings will result. Therefore, before any suggestions of this kind are made, it is always necessary to consider the amount of material which has been purchased for the parts to be machined, especially if the contemplated changes in design make it necessary to use castings, forgings, or bar stock of different sizes from those which may have been ordered for the work. The suggestion may, however, be offered for use in the future, after a certain amount of ordered material has been used.

Under present conditions when a factory is only running part time, there is an excellent opportunity for the manufacturer to call in an expert investigator and seriously consider any suggested changes in design, as these may be the means of saving a great deal of money when he is again ready for production. By preparatory work of this kind and by a careful analysis of design, tools and methods, the manufacturer may be able to reap a future reward in proportion to the pains taken. No manufacturer can afford to neglect the present opportunity to look carefully into his methods of manufacture.

Examples of Savings Realized by a Change in Design

A number of examples can be cited to illustrate the advantages of a design in which manufacturing methods have been carefully considered. Fig. 3 shows an example which illustrates the points mentioned. At the same time the change in design suggested gives a better product and one

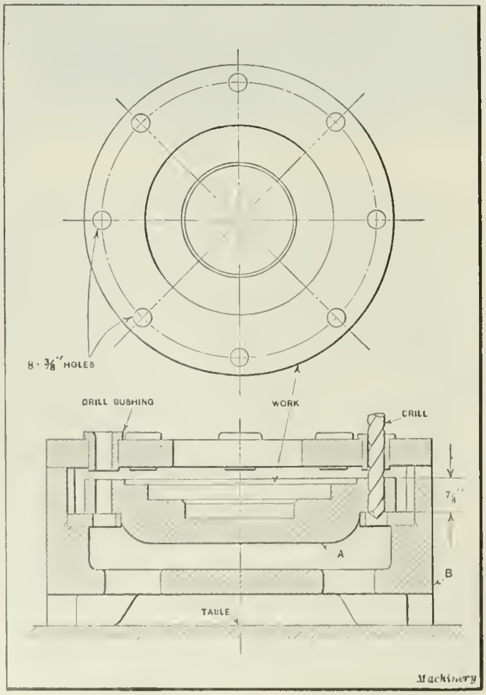


Fig. 1. Jig originally used for drilling Cast-iron Cover

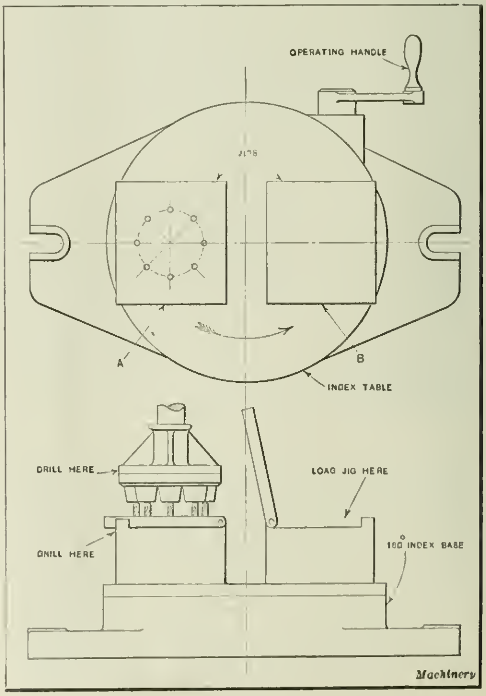


Fig. 2. Use of Standard Index Base for drilling Cast-iron Cover

in which there is less likely to be trouble. The work shown at *A* is a double gear made up of two separate parts *B* and *C*, which are riveted together as indicated. The engineer's attention was drawn to this part on account of the possibility of looseness developing between the two gears after they had been in use for some time. An inquiry developed the fact that trouble occasionally resulted from this cause, but that it had not been serious enough to require any change in the method of manufacture. However, as it would generally be considered better practice to use a single piece in preference to two or more parts riveted together, the investigating engineer suggested making this part as shown at *D* from a solid piece of steel. An analysis of the two methods is given in the following table, and the savings effected can be readily seen.

OLD METHOD

Operation	Time, in Minutes
Operation 1—Blank out both gears complete on automatic screw machine—two machines, one man	2.80
Operation 2—Cut teeth in both gears (twelve pieces per arbor)—two machines, one man	1.10
Operation 3—Drill six rivet holes and countersink both parts	2.60
Operation 4—Assemble rivets and rivet two parts together on riveting fixture—one machine, one man	1.30
Total	7.80

NEW METHOD

Operation	Time, in Minutes
Operation 1—Blank out gear complete on automatic screw machine—two machines, one man	2.50
Operation 2—Cut teeth in large gear on gear-hobber; (two pieces per arbor)—two machines, one man	1.09
Operation 3—Cut teeth in small gear on gear shaper—three machines, one man	1.90
Total	5.49

A comparison of the two methods shows a saving in time effected by the second method of 2.31 minutes. The actual increase in production is approximately 40 per cent, and in addition the new part is much better than the old, as it is a solid piece with no possibility of any change of relation between the positions of the two gears. While there is little clearance between the two gears, the small one can be cut readily on a Fellows gear shaper.

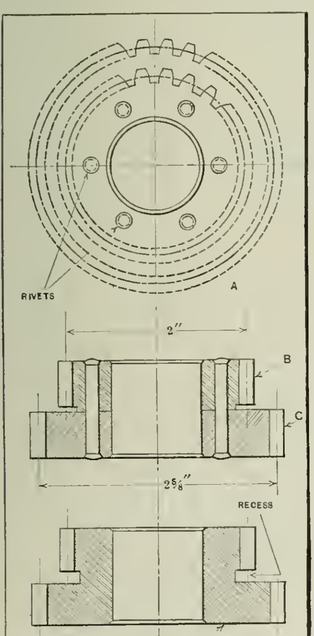


Fig. 3. Change in Design of Gear which lowered Production Costs

On large castings which are designed with brackets applied on angular surfaces, the investigator can often effect large savings by doing away as far as possible with the angular surfaces and making them straight. By so doing awkward and expensive fixtures can be avoided and simple designs used. This point is also of value in connection with the assembling of the completed mechanism, as much less difficulty is experienced in aligning the various members. A good example of this sort is an automobile crankcase having one or more angular pads to which brackets are applied. In machining an angular surface on a large casting, it would be necessary to design a massive fixture on which the work would be set up at an angle, in order to bring the surfaces in the right relation to the milling cutter. The suggested changes in design obviate all this trouble and allow the tool designer to make a simple and inexpensive fixture. Many other cases can be cited to show advantages obtained by improvements in design which assist in making the machining processes easier.

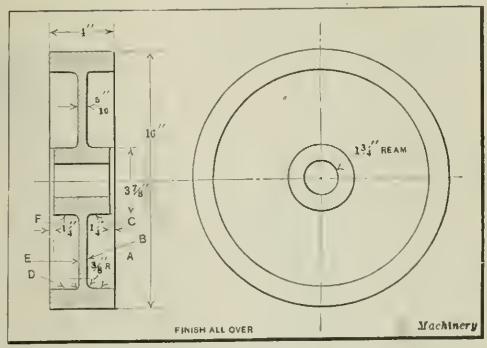


Fig. 4. Flywheel Pulley produced at Lower Cost by Improved Methods

Use of Standardized Equipment

Frequently the equipment of a factory may not be up to date and much time is lost in machining various kinds of work without modern appliances. A number of devices are on the market which are time-savers and which can be installed at a nominal cost. The savings effected will usually pay for such appliances in a short time. The investigating engineer often sees opportunities for using devices which are standardized and may apply them to various operations in the shop with gratifying results. Quick-operating vises, quick-change chucks, quick-acting dogs, index bases and self-centering steadyrests are among the appliances which will be found of great use in saving time and production. Quick-operating vises may be fitted with special jaws to take the place of a milling fixture. Quick-change chucks assist greatly in production by making it possible to change drill sizes rapidly while the machine is still running. Quick-acting dogs save time because they adjust themselves automatically to an arbor on which work is being turned. Self-centering steadyrests are also automatic in their action and save time by the ease with which they adjust themselves to the work. An index base can be applied to many operations in the shop and saves time by allowing two or more fixtures or jigs to be placed on it, so that one can be loaded while the other is in position for machining.

Savings Effected in Drilling

An example which shows the application of a standard index base to a production job and the savings effected thereby is illustrated in Figs. 1 and 2. Fig. 1 shows the work *A* which is being machined in large quantities in a drill jig *B*. There are eight ¾-inch holes in the work, spaced evenly around the flange, and these are drilled by means of a multiple drill head. In order to increase production, the suggestion is made by the investigating engineer that a standard type of index base be purchased, such as shown in Fig. 2. On the table of this mechanism two jigs are fastened at *A* and *B*, in such a position that while the holes are being drilled in *A* jig *B* can be loaded, so that there is very little lost time.

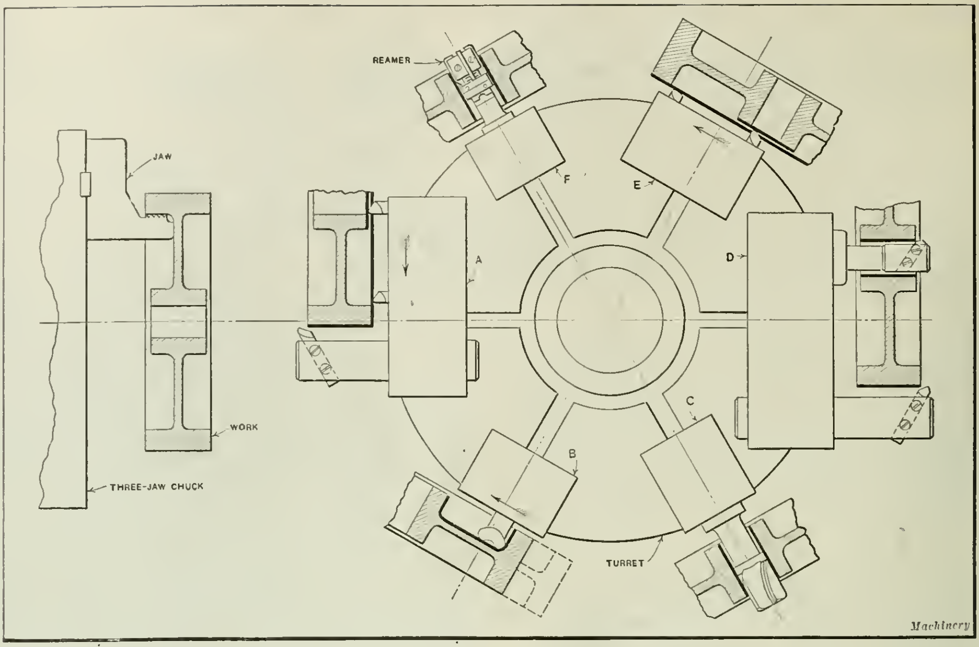


Fig. 5. Standard Tooling Lay-out for Work shown in Fig. 4

A comparison of the two methods is interesting. When using a single jig the work is produced in seventy seconds, or 411 pieces per eight hours. By the new method, using two jigs and an index base as shown in Fig. 2, the work is produced in forty seconds, giving a production of 720 pieces per eight-hour day. The production by this method is increased approximately 75 per cent. The index base and an extra jig represent an investment of approximately $350. The gain in production is such that this outlay is absorbed in about forty-eight days.

Manufacturing a Fly-wheel Pulley

Turret lathe makers furnish a variety of standard tools which are designed so that they can be adapted to various conditions. They are extremely useful for short jobs, and even for certain kinds of high-production work. There are cases, however, when special tool equipment may be found more productive, as it is designed for the particular case in question. Fig. 4 shows a flywheel pulley, 16 inches diameter by 4 inches face, which was finished all over by using standard tool equipment, as indicated in the turret lathe lay-out shown in Fig. 5. The portions *A*, *B*, *C*, *D*, *E*, and *F*, Fig. 4, require rough-machining only, no accuracy being necessary at these points. The work is held by means of the inside chuck jaws as shown in the lay-out. In the first chucking, the outside is turned, and the hub and one side of the flange are faced by means of the standard tool equipment shown at *A*. The turret used is of the cross-sliding type, which allows the tools to be fed as needed for the facing cut. The inside of the flange, the web, and the hub are machined by a double-lip tool in a holder shown at *B*. No further machining is required on this portion, as the roughing cut is all that is necessary. After this operation is completed, a core-drill is used for drilling out the hole in the hub of the pulley as shown in the diagram at *C*. The core-drill is followed by a boring-bar, in combination with a finish-turning tool for the outside diameter. This set-up is shown at *D*. The next operation, shown at *E*, consists of finish-facing the end of the hub and the flange. The final operation is the reaming of the

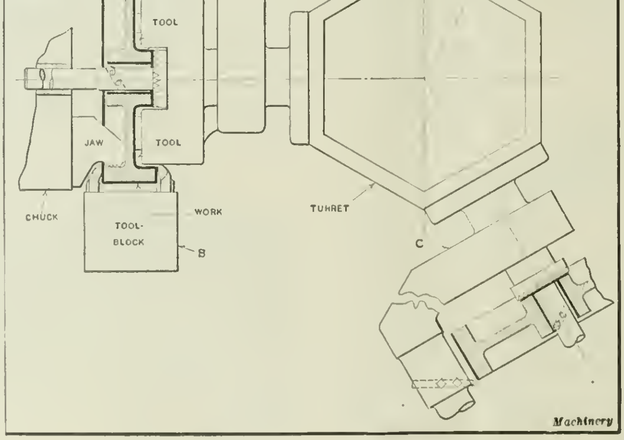


Fig. 6. Special Tooling Lay-out for Work shown in Fig. 4

hole in the hub, which is done by a reamer in a floating holder shown at *F*.

In the second chucking, the work is held by the outside in soft jaws, and some of the same tools are used for turning the inside, and facing the hub and web. The tools not used in the second chucking are the outside turning tools, core-drill, boring-bar, and reamer.

Due to the method of machining, it was found that the hole did not run perfectly true with the outside diameter, and for this reason a lathe operation was found necessary. The work was held on an arbor and a light cut taken over the outside diameter and the two flanges, in order to square them up true with the hole. The total time necessary for machining the flywheel pulley complete in the three chuckings employed with this method was seventy-seven minutes.

The investigator decided, after an inspection of this job, that the work was being turned out much too slowly, and he therefore suggested a revision of the tooling, after finding out that the work was a standard product on which any savings would be much appreciated. The suggested changes in tooling are shown in Fig. 6. In the first chucking, the work is held by the inside of the flange in special jaws in a three-jaw geared scroll chuck, the jaws being cut away so as to permit the facing tools to operate without interference. Two special combination tools were made for turning, facing, and boring, the turning tool being supported in a pilot bracket on the headstock of the machine, as shown at *A*. This means of support allowed heavier cuts to be taken without vibration. In connection with the turning tool, a cutter-head was used with several cutters in it so arranged that they would bore the inside of the flange, face the web and turn the hub at the same time. These tools were staggered so as to break up the chip and make the cutting action easier. A boring-bar was also piloted in a bushing in the chuck, and a face mill used to face the end of the hub. While these operations were in process both sides of the flange were faced by two tools in the cross-slide front tool-block *B*. The cuts mentioned are all roughing cuts, but the finishing operations were performed by similar tools shown at *C*. These consisted of a turning tool in combination with a boring-bar and face mill. While this finishing operation was in process two tools in a special tool-block on the rear of the cross-slide were used to finish-face the sides of the flange. The final operation is the reaming of the hole in the hub. As the boring tools used are of the single-point type, the hole and the outside diameter must necessarily be concentric.

In the second chucking, the work is located on a plug in the center hole, the plug being held in a faceplate and the work clamped by means of straps on the face of the flange. The tools used for this second chucking include only the facing tools used in the first chucking. The turning tools and boring-bars are removed. The reamer also is not used in the second chucking. The total time necessary for both settings by the new method is twenty-four minutes.

A comparison between the old and new methods shows an increase in production of over 230 per cent, as the number of pieces produced by the old method was six per day, while the new method gave twenty per day. The old tool equipment included practically all standard tools, but the new equipment cost $460. The increase in production and decrease in cost of the second method over the first was so great that the new tool cost was absorbed in less than one month from the time when it was put in operation. Savings of this kind are remarkable and considerably more than is generally accomplished. The example given, however, is an actual case, which illustrates conclusively the possibilities of savings which can be effected by a careful investigation of modern practice and up-to-date equipment.

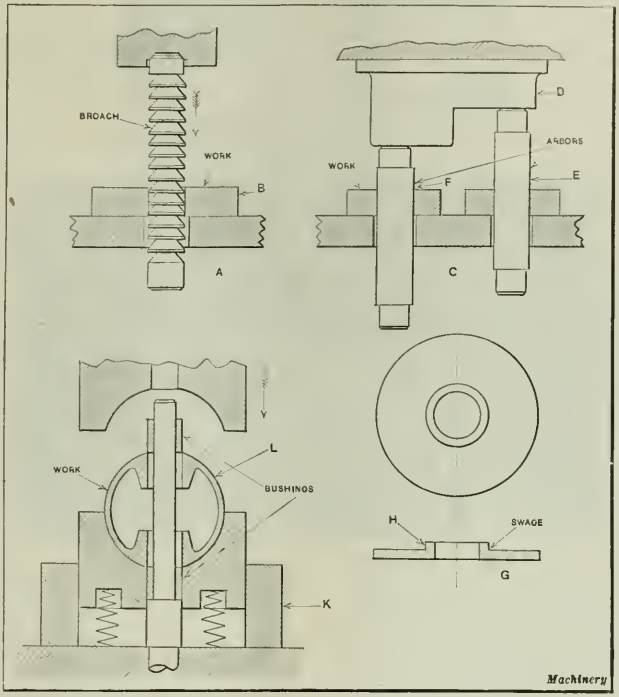


Fig. 7. Various Uses of Punch Press on Production Work

Savings Effected by the Use of the Punch Press

The average manufacturer does not realize the savings possible by using a punch press for various production operations. Shops which do not use sheet-metal work in their product to any extent are not likely to be equipped with punch presses, yet this type of machine is extremely useful for many operations in production work, and as it is comparatively inexpensive such an installation will be found profitable. The factory investigator is often able to suggest applications of a punch press to certain kinds of work not ordinarily done on these machines. For example, a punch press is useful in riveting together two or more parts which are assembled, although it must be remembered that it will not take the place of a riveting machine for all classes of work. However by using a simple fixture several rivets can be headed with one blow of the press, and the results obtained will be found very satisfactory. A little ingenuity on work of this sort will reveal opportunities for economical and productive tools.

Oil-grooves, straight or spiral, can easily be cut either outside or inside of a piece of work by using a punch press and a special fixture. The operation is rapid and the fixture can be of very simple form. Steel or brass work can be centered by means of a punch press instead of using a center-drill. The operation is considerably more rapid, and for certain classes of work fully as satisfactory. For certain kinds of slotting operations, a punch press is very useful and only requires the design of a simple fixture to make it profitable. It can frequently be employed for assembling operations in cases where bushings or pins are required to have press fits.

Fig. 7 illustrates several operations which can be performed on a punch press with a considerable saving over other methods. In the example shown at *A*, the work *B* is to be broached or burnished, and the hole brought to size. A simple broach can be applied to the punch press as shown, and the work accurately sized with very little trouble. The cost of a broach or burnishing tool is naturally dependent upon the shape of the work to be broached, but for sizing operations of irregular or round holes there is often considerable economy in using a method of this kind.

The usual method of placing work on an arbor is by means of an arbor press. This method, however, is rather slow, and a decided improvement on it is shown at *C*, in which a punch press is used for the purpose. The ram is provided with a block, as shown at *D*, and two pieces are set up on the machine at the same time. The arbor *E* is being pressed into the work while that at *F* is being removed. A great saving in time is effected by a method like this.

Parts are occasionally found in production work which require a rather long operation if made on a screw machine. One of these parts is shown at *G*. If the hub *H* is very short, it is easy to swage this on a punch press, so that the piece can be turned out accurately and very rapidly from sheet stock instead of from the bar. When great accuracy is required, a shaving operation can be resorted to for operations which might ordinarily require a profile cut. Many manufacturers think that sharp corners cannot be produced on a punch press, yet it is not particularly difficult under certain conditions.

In the article "Economic Value of Factory Investigations," published in October MACHINERY, two methods of making a small spur gear were compared, and the method of using shaving dies for the finishing cut, thus producing accurate work, was described. This particular operation was mentioned because it really stands in a class by itself, yet it is frequently overlooked by manufacturers who continue to make small gears of certain kinds by the old method. The size of the gear naturally determines whether it can be produced in this way or not, yet slight modifications in design can sometimes be made which will permit the work to be manufactured on a punch press.

An application which illustrates the use of a punch press in connection with a fixture for pressing in bushings in an automobile piston is shown at *K*. The work *L* lies in a nest which is supported on coil springs as indicated. The bushings are placed as shown, and a blow of the press drives them into place very rapidly. There is usually a slight amount of distortion after the operation, but as the piston has not been completely finished at this time, the subsequent operations true it up accurately and bring it to size. Increased production of from 100 to 200 per cent can frequently be obtained by using a method of this sort.

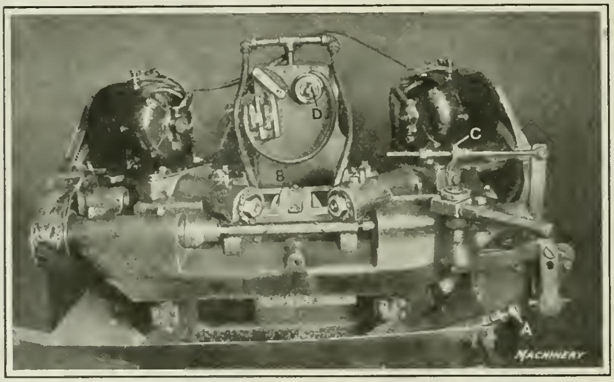
The use of die-castings covers a recognized field, and the savings resulting from this method of producing work are great. The investigator determines whether such work is advisable or economical for any of the parts used in the factory in which he is operating. It is not economical to use die-castings for small lots, as the cost of the die is considerable. For many kinds of work, however, die-castings can be made so that they are complete and do not require further finishing, holes, slots and various surfaces being so carefully made that they are within very close limits of accuracy. The cost of dies on large production work is quickly absorbed by the savings effected.

The examples given in this article are taken from actual practice, and the savings effected are substantial. The fact that the investigator looks at the matter from a different viewpoint from the inside man who knows all the details of the factory, makes it possible for the former to perceive details overlooked by the other man who is too close to the work to see it clearly. There is no better time than the present for the manufacturer to consider his methods of manufacture, and there is probably no better way to obtain results than by a survey of the entire scheme of production.

* * *

OIL-GROOVE MILLING MACHINE OF SPECIAL DESIGN

The accompanying illustration shows an oil-groove milling machine built and used by the De Laval Separator Co., Poughkeepsie, N. Y. This is a single-purpose machine designed to mill two helical oil-grooves which have opposite-hand leads, as indicated by the shaft shown held in the machine. The shaft is driven by a tongue in the chuck which fits into a machined slot *A* in the end of the spindle, the opposite end being supported by a regular lathe center. There are three motors used in operating this machine, one for driving each of the two cutter-arbors, and one for driving the combination right- and left-hand worm screw *B* and the chuck. The motors which drive the cutter-spindles are mounted on carriages, which move in opposite directions simultaneously, being actuated by the right- and left-hand worm screw.



Special-purpose Machine for milling Two Helical Oil-grooves simultaneously

After two grooves have been cut in a shaft, it is not necessary to return the carriages to the starting point, the work simply being removed and replaced. Then, during the cut on the next piece, the feed of the carriages is reversed so that they travel in opposite directions. By this means no time is lost in traversing the carriages when the cutters are not actually at work. The stop which limits the traverse of the carriage in either direction is shown at *C*, it being evident that the connections with the threaded rod operate the reverse motion of the carriages. The motor driving the right- and left-hand carriage feed-screw is hidden behind the board on which switch *D* is located.

* * *

INVESTIGATION OF MOLDING SAND

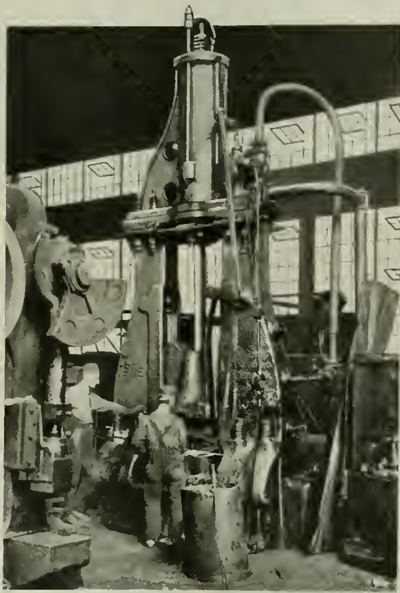
The molding sand investigation carried out by the American Foundrymen's Association in cooperation with the Engineering Division of the National Research Council is well under way. To avoid duplicating investigations already carried out, a summary of the existing literature on natural and artificial sands has been prepared. This summary covers the work of both the American and European countries. A questionnaire has also been sent to members of the American Foundrymen's Association to obtain a knowledge of work done along this line in American foundries. The information collected will be submitted to a committee of representatives from the various branches of the foundry industry and from the interested governmental bodies.

Modern Drop-forging Practice

Comparison of Drop-forgings and Castings, and General Methods of Making Drop-forgings
First of Two Articles

By FRED R. DANIELS

THE development in methods of producing drop-forgings has been due to the increasing demands upon this industry. In its infancy, the industry was confined to small forgings of comparatively plain design, and later, with the advent of the bicycle, to more complicated designs of a small size. With continued use, the inherent advantages of drop-forgings became generally recognized so that, in a great many lines, parts formerly made of malleable or steel castings were made from the stronger and tougher drop-forgings.



Comparison of Castings and Drop-forgings

It was soon recognized that added strength without increase in weight could be obtained by using drop-forgings in place of castings. Thus with the coming of the automobile, a vast field for development in the production of drop-forgings was opened. This also put the metallurgical world to a severe test in evolving special steels, as something better than the previously used steels was required. The development of many different kinds of alloy steels for forgings followed, as well as of steels for die-blocks. Finally came research work to determine the most satisfactory methods of heat-treating.

In comparison with drop-forgings, a casting has a rather coarse open grain, is brittle, and often contains blow-holes beneath its surface. The raw material from which drop-forgings are made, is stronger and tougher than a casting, and is still further improved by working under the drop-hammer. Where quantity is a factor, drop-forgings can often be produced more economically than castings. The advantages of drop-forgings have resulted in their replacing castings in many instances within the last few years. A few examples of parts that are now drop-forged instead of being cast, including mainly motor truck parts, are shown in Fig. 1. Among these are crankshafts, steering arms, axles and engine supports. The gears used in automobile construction are almost invariably machined from drop-forged blanks, and the satisfactory service rendered by gears made in this way has led to the use of drop-forgings for a great many other automobile parts.

The best material to use in making drop-forgings, from the standpoint of workability, is a 0.20 to 0.30 per cent carbon steel made by either the Bessemer or open-hearth process. Comparatively low carbon steels flow readily in the dies and fill up the impressions better than any of the higher carbon or alloy steels. Aside from instances where especially severe service is required, this grade of carbon steel is usually used, being properly heat-treated before being put into service. Greater difficulty is experienced in drop-forging high-carbon and alloy steels, and more caution must be employed in designing the dies so that there will be a minimum of sharp projections and deep impressions. Failure to fill the die impressions fully, which is likely to occur with certain grades of high-carbon and alloy steels, entails subsequent work and additional expense. Such forgings, at times, can be salvaged by building up the defect with the acetylene torch and restriking in the drop-hammer. This involves, besides the extra labor, the trouble of transporting the work to the welding department.

Among the many alloy steels which are commonly used for drop-forgings may be mentioned straight nickel, chrome-nickel and chrome-vanadium. Nickel steels must be carefully watched when being worked and treated. Chrome-nickel steel is probably the most difficult alloy to work under the hammer, and in addition to the special heat-treatment which this steel must receive, there are certain other precautions that must be taken. Steel forgings containing nickel should have large fillets, and should be worked fairly hot and not be permitted to cool rapidly by being thrown on a damp cold floor, or put out of doors where the cold air can quickly chill them. Large fillets reduce the possibility of cracks starting, and check the development of fatigue fractures in the work. Sudden cooling is injurious to the structure of those alloy steels in which nickel is an ingredient, and is also liable to cause distortion.

It is good practice to take a rough cut from forgings made from chrome-nickel steel before the final heat-treatment occurs. This will remove any

The process of drop-forging has been developed to a point where thousands of pieces are practically completed under the drop-hammer and require little or no further machining operations. As a cost-reducing method, drop-forging ranks high among metal-working processes. In the drop-forging plant itself, costs may be reduced by applying certain principles and methods making for economy—by selecting steel of the right quality, and by keeping dies and stock in such a manner that they are readily accessible and the required die and the right size and kind of steel may be easily located. Drop-forgings, when used in quantity, can sometimes be made as cheaply as castings, and are superior in strength. Actual costs are then reduced by employing them, because of the improved quality obtained at an equal price. Furthermore, a saving is usually made in the cost of machining, due to the fact that a drop-forging generally requires less finishing than a casting.

surface seams or laps, and will prevent the development of cracks which otherwise might be developed during the final heating. Generally, alloy steels are more sensitive and require far more care in working and in heating than straight carbon steels, and consequently the output is correspondingly reduced. A detailed account of the method of heat-treating drop-forgings of different analyses will be given in a subsequent article in this series.

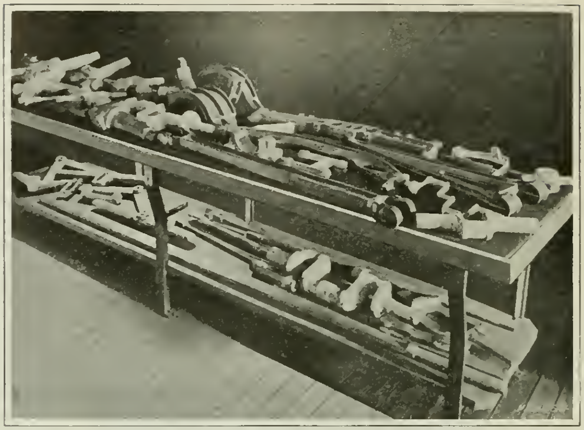


Fig. 1. Examples of Drop-forgings, showing Variety of Size and Design

Tungsten steel may be drop-forged, although a high forging heat is required. Of the non-ferrous materials, copper alloys, such as tobin, naval, and manganese bronze, can be readily forged, and aluminum can also be forged if it is handled with care, but the die impressions must be exceptionally well finished. No success has been met with in drop-forging phosphor-bronze or any composition of brass, although brass forgings can be produced by means of dies and applied pressure, which is a distinctly different process from drop-forging.

Selection of Drop-forging Steel

A great deal of care is usually taken in modern drop-forging plants in purchasing forging steel. The material is ordered from the steel mill in accordance with certain definite standards. Assurance that these have been maintained by the steel manufacturers is obtained by physical and chemical tests in the laboratories of the drop-forging plant, which test the material when received. Some concerns follow the practice of putting an inspector in the steel mill, and he sends a sample of the steel to the laboratory of the drop-forge plant to have its chemical analysis checked before the steel is shipped. After this sample has passed the exhaustive laboratory tests to which it is subjected, the process is repeated on a piece of steel cropped from the end of a bar as soon as the shipment arrives from the mill. When desirable, photomicrographs are made of these two pieces, so that a permanent record may be kept of the exact appearance of their structure. The filing cabinet shown in Fig. 2 is located in the laboratory of a large drop-forging concern and contains fractured test pieces, suitably marked. Record sheets, shown at the left of the cabinet, contain the data obtained by the various tests; and these furnish a permanent record of what each grade of steel is capable of withstanding in the way of tension, compression, impact, bending, wear, etc.

Suitable laboratory equipment for conducting these physical tests may consist of one transverse testing machine, one Brinell hardness testing machine, one impact testing ma-

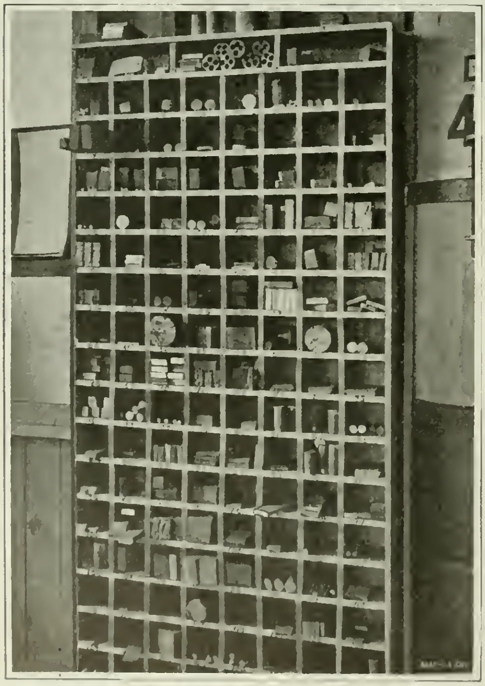


Fig. 2. Fractured Bar Steel Samples which have been tested in the Metallurgical Laboratory

Fig. 3. Aisle in Storage House where Different Sizes of Bar Stock are stored

Fig. 4. Horizontal Storage Rack in which Special Grades of Drop-forging Steel are stored

chine, one tensile testing machine, and the necessary number and types of machine tools for cutting the metal into the sizes and shapes desired for test pieces. The apparatus used for making photomicrographs of the fractured test pieces shown in Fig. 2 is the product of the Bausch & Lomb Optical Co. of Rochester, N. Y., and is standard for this kind of work.

After the steel has been unloaded from the cars, it should be stored in suitable bins or racks and labeled, or marked by the color system. Figs. 3 and 4 show vertical and horizontal storage racks, respectively, which greatly facilitate the handling of stock, and which are in use in one modern drop-forging plant. Various sizes of bars have separate compartments, as shown in Fig. 3, while special grades where the quantities are small are placed horizontally, as in Fig. 4. The largest sizes are stored horizontally on floor stands.

Drop-hammers for Different Classes of Work

In the early development of the process, the size of drop-forgings and the material from which they were made, called for board drop-hammers of not more than 2000 pounds falling weight; in fact, at the present time where concerns are engaged in the manufacture of drop-forgings such as the smaller wrenches, eyebolts, chain ends and similar parts, hammers of this style and capacity are adequate. In the modern commercial drop-forge plant, however, there must be facilities for handling everything from small work up to heavy forgings of 350 to 400 pounds in weight, such as motor truck axles; consequently the range in hammer sizes must necessarily be such as will also conveniently handle this large class of work. The typical drop-forge plant, therefore, should be equipped with a much wider variety of apparatus than was formerly needed, but practice is so varied that standard requirements are very difficult to state. (See "Drop-forge Plant Lay-out and Equipment" in MACHINERY, July, 1921.)

In selecting the drop-hammer to use for producing a particular drop-forging, it does not necessarily follow that the size of the work regulates the size of hammer to use, although, of course, there is a certain relationship between the two. If the metal is hard to work, as for example chrome-nickel, it is always desirable to produce the forging with as few blows as possible; consequently the heavier drop-hammers will give the best results. If the forging is bulky, a hammer should be selected which will have enough falling weight to deliver blows that will penetrate to the center of the forging. As a general rule, it is better to select a drop-hammer which is too large for the job than one that is under weight. The greatest cross-section area of the forging must always be considered when selecting a hammer. The heavier drop-forgings are commonly produced on steam drop-hammers rather than on board hammers, and the inclination is, especially in the automobile industry, toward the use of steam drop-hammers, in a ratio of about two to one.

The depth of impression and the direction and distance the heated metal must be forced to flow in order to fill the die, the forging heat which must be used on the steel, and the intricacy of design, must each be given due consideration in the selection of the hammer. The sizes of hammers most suitable for different types of parts will best be learned by following the practice employed in the actual production of a number of drop-forgings to be described in the next article, which will appear in December MACHINERY.

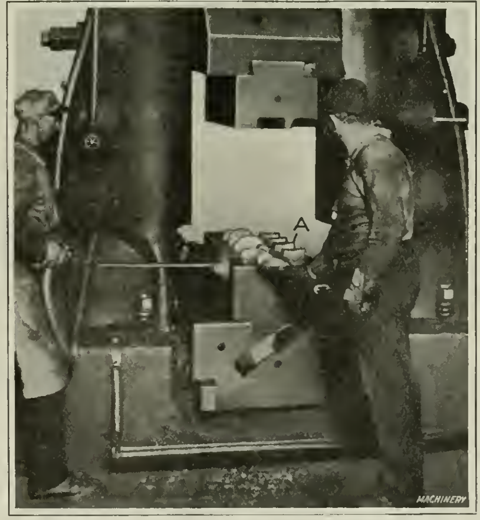


Fig. 5. Forging a Crankshaft

General Procedure

Starting with the smallest sizes of drop-forgings, the usual practice is to work from short bar lengths, rather than to cut the stock up into blanks, continuing this practice as long as it is practicable to do so. These bars are about 3 to 5 feet long, which is a convenient length for handling. They are placed in the furnace, and after being properly heated at one end, transferred to the dies and the forgings produced, this practice being continued until the bar is too short to be handled with tongs. The work is much easier to handle in this way than if individual blanks were used. On the very small sizes it is often possible to produce two drop-forgings with one heating of the bar, provided too many blows are not required to produce each piece. In other words, by working from the bar, full advantage is taken of the heat retained in the bar after one drop-forging has been made, for of course, the bars are heated beyond the length required for the actual production of the drop-forging. The drop-hammers, which for small work are invariably of the board type, range in size from 300 pounds falling weight up to 2500 or 3000 pounds, which is the maximum efficient size for this type.

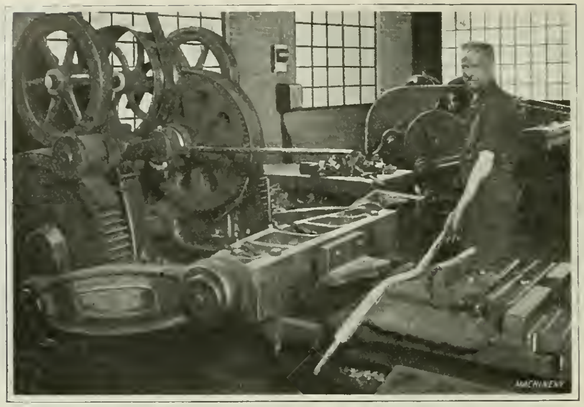


Fig. 6. Using Bulldozer for Preliminary Bending Operations on Large Work

Frequently the forger works with a helper who passes the heated bars to him and receives in return from the hammer man the end of the bar from which the forging has just been made, which he places back in the furnace fire. The hammer man usually works from left to right, first scraping the scale from the heated bar before fullering out his stock (the fuller being located conveniently on the side of the die as described in detail in the article "Design and Manufacture of Drop-forging Dies" published in August MACHINERY), and then transposing the drawn-out metal to the edger which is cut into the dies on the side opposite the fuller, and finally into the die impression. If two die impressions are required—a breakdown and a finishing impression—the breakdown is usually located next to the edger and the finisher between the breakdown and the fuller.

One blow is all that is usually needed to edge the drawn-out stock. For average work only a few blows (perhaps three or four) are required in either the breakdown die or the finisher die. Between each of these blows the hammer man slightly lifts or tilts the partially forged end of the bar so that it will not "freeze" in the impression. This tilting also allows the surface scale to be removed by air or a steam blast. When working from the bar, a cut-off is attached to the smaller hammers on whichever side is most convenient for the operator. For larger work, the cut-off is attached to the press on the hammer side. When the blanks are cold-sheared to the proper forging size before heating, instead of being cut off from the bar during the forging operation, the hammer cut-off is not used—in fact no cut-off is provided on the larger sizes of hammers.

When working from blanks of a predetermined size, the work must be handled with tongs, the dies being so designed that a sprue or "tong-hold" is left for convenience in handling the hot forgings. This practice is always followed in making heavy parts. On this class of work a steam drop-hammer is preferable, because the blow delivered is firmer and drives the greater mass of metal contained in the blank into the impression more completely.

It should be borne in mind that under-cuts and transverse holes which can be produced in castings by means of cores are out of the question when it comes to making parts under the drop-hammer. The movement of the dies is limited to a vertical direction, and attempts to produce intricately shaped cavities by the use of mandrels, although often made, have never been successful. Although the drop-forging process has certain limitations, quite intricate pieces can be produced by the use of properly designed dies and by the application of only vertical blows, as some of the examples to be discussed in the next installment of this article will show.

It has been mentioned that the practice followed in various drop-forging plants conforms to the facilities for handling the work. For example, in breaking down a crankshaft blank, an edger may be used such as shown in Fig. 5 at *A* attached to the die, or, if more convenient, a bulldozer, Fig. 6, equipped with suitable bending dies, may be employed. Probably the best machine for bending a crankshaft blank, however, is a hydraulic press equipped for the

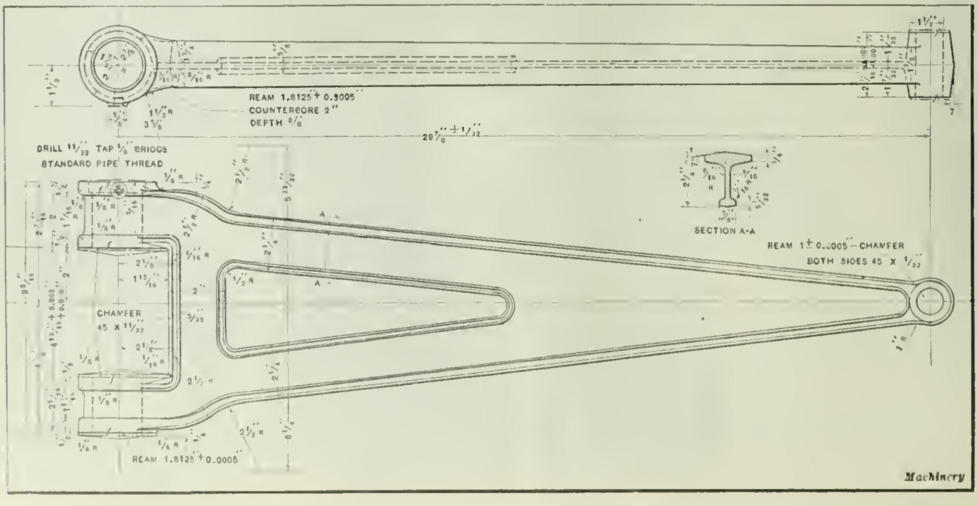


Fig. 7. Rear Axle Torque Arm drop-forged in the Dies shown in Fig. 8

purpose. Particular care must be exercised when using bending dies, to see that the benders are not of a design which is likely to cause rupture of the structure of the steel; for example, they should not be narrow and comparatively sharp.

In connection with the general reference to crankshafts for gasoline engines, it may be mentioned that the drop-forging of these pieces preserves a uniform fiber structure throughout all sections of the crankshaft, whereas if these shafts are hand-forged in the steam hammer the continuous grain structure is not obtained, because in hand-forging the arms and wrist-pins are machined from a solid slab of roughly forged metal. After the arms have been produced by cutting out the metal, the grain of the arms will be seen to extend transversely in relation to that in the drawn-out end bearings, and as a result the strength and the stability of the entire crankshaft are considerably lessened.

Variations in Size of Forgings

Although the die impressions may be accurately laid out, sunk, and carefully finished, as explained in the article "Design and Making of Drop-forging Dies," which was published in August and September MACHINERY, a certain amount of variation from the required sizes is unavoidable in drop-forging practice. The variation is due partly to wear and partly to unevenly distributed shrinkage resulting from peculiarities in design. Wear, of course, depends directly on the hardness of the steel being drop-forged. Tool steel (0.70 per cent carbon and over), must be worked at a lower forging heat than is advisable for an 0.20 to 0.30 per cent carbon mild steel, and this lower forging temperature in combination with the increased hardness of the steel causes au appreciable increase in the rate at which the die deteriorates. The allowance for wear, therefore, for hard, dense steels must be greater than for the low-carbon steels.

An example where the length of a forging is considerably affected due to excessive shrinkage is that of a gasoline engine connecting-rod. The typical connecting-rod design embodies two rather bulky bosses connected by a thin I-beam section. This unequal distribution of metal permits the large amount of flash on both sides of the I-beam section to cool quickly, which tends to draw the ends together, producing greater shrinkage than would otherwise result. On parts such as this, where the metal is unevenly distributed, the total shrinkage will be at least 5/32 inch in a center-to-center distance of 10 inches. Forgings such as these, however, do not shrink equal amounts. On a lot of 10-inch connecting-rods this variation will amount to as much as 1/32 inch, while for longer forgings such as crankshafts the shrinkage allowed when laying out the dies will vary in proportion to the length. For example, in a four-throw crankshaft having an over-all length of 43 inches, a variation of 1/16 inch or more from the intended length will probably occur. Such variation is, of course, unavoidable on parts that cool unevenly.

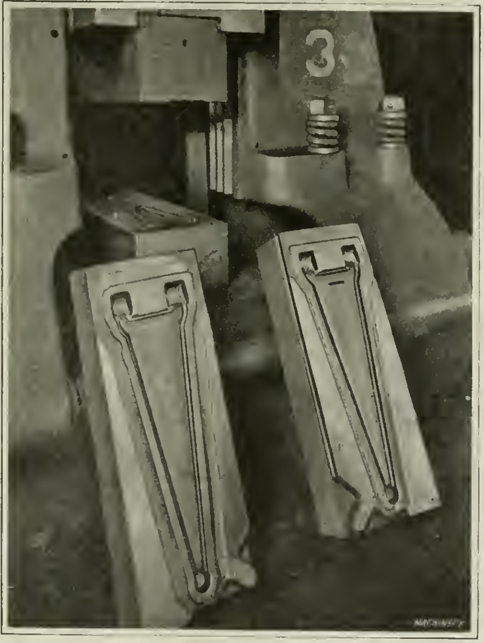


Fig. 8. Steam Drop-hammer and Dies for producing the Torque Arm in Fig. 7

The variation in thickness will depend somewhat on the shape and size of the piece, but will not ordinarily vary more than 1/32 inch and usually less in the smaller forgings. If greater accuracy than this is required, the impressions may be made over size, and the forgings restruck cold to size them after they have been trimmed. Often, no special dies will be needed for this sizing operation, the regular drop-forging dies being suitable. Type-bars for typewriters are usually sized in this manner and may be produced so that there will not be a variation in thickness of more than a few thousandths inch.

Another common cause for variation in size of drop-forgings is due to the metal not being worked fast enough, so that it has a chance to cool before the size of hammer employed can break it down and force the forging to shape. The result is that the dies do not come together as they should, and consequently the thickness or diameter is increased. This will also occur if there has been too great an allowance of metal in shearing the blank. Over-size blanks are also likely to produce cold-shuts by the metal being lapped over on the forging by the first blow or two of the hammer, and then being hammered in on subsequent blows. This trouble may be experienced if the blanks are under size, for in that case there is the probability of laps and seams showing at the parting line where the metal fails to fill the impression.

Bending, Drawing out, and Heading Work

The bulldozer is useful in a forge plant, for bending large work such as motor truck axles, etc. Preliminary bending operations of this kind can be handled on the bulldozer to advantage. The hydraulic press is also a valuable machine in the drop-forge plant, and is used for drawing out long tapered parts, such as the rear axle torque arm for a motor truck shown in Fig. 7. The forging is made from a piece of 0.20 to 0.25 per cent carbon steel, 3 inches thick, 6 inches wide, and 12¾ inches long. It is first drawn out to the approximate length and taper on a hydraulic press, and forged in a 5000-pound steam drop-hammer. The first operation is that of breaking down the drawn out blank and hot-trimming the flash from the outside of the forging. In the second operation the forging is reheated, finished, and the flash removed hot from the outside and from the triangular hole in the web, both the trimming operations being performed simultaneously by the use of a combination trimming die and punch. Fig. 8 shows an Erie 5000-pound steam drop-hammer set up for producing the finished drop-forging. The first-operation dies used in breaking down the drawn out blank are shown resting against the machine. The forging weighs 37 pounds.

The upsetter, variously termed a header and forging machine, is of vital importance for the production of numerous designs of drop-forgings. One of the most common uses for an upsetter is that of heading the end of a crankshaft to produce the flywheel flange. For such work, as well as for bending heavy hooks, the upsetter is commonly used, subsequent to the drop-forging operation.

How To Reduce Production Costs ?

Drawing Dies for Manufacturing a Carburetor Bowl

By N. T. THURSTON, The Acklin Stamping Co., Toledo, Ohio

An interesting series of operations was performed in the manufacture of the carburetor cup or bowl illustrated in Fig. 1. By drawing and forming this part on power presses, a substantial saving was effected over the previous method of casting the part. The later method of manufacture eliminated all cleaning and machining necessary when a casting was used. In addition, tolerances on the various dimensions were actually decreased, because it was possible to secure more accurate work and at a lower cost than when the part was cast. The appearance and dimensions of the part after each of the operations are shown in Fig. 2. One apparent obstacle to the successful drawing and forming of the part was the fact that a metal thickness sufficient to permit the drilling and tapping of a hole for a standard 1/8-inch pipe was required at the bottom of the boss. This difficulty was successfully overcome, however, by filling the inside of the boss with spelter as shown at *H*. All the operations on the part were performed on single-action straight-sided power presses.

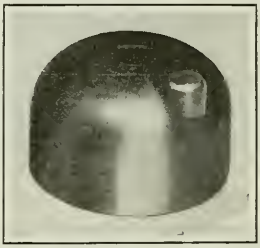


Fig. 1. Carburetor Bowl

The design adopted for dies used for drawing operations may make the difference between a substantial profit and a serious loss in the manufacture of an article. The study of successful die designs is therefore of the greatest value to the designer of press tools. By a slight modification in the design, an extra operation may be saved; and the quality of the product depends greatly upon the right proportioning of the successive operations. A press-tool designer can reduce the cost of manufacture to a great extent, and he is aided in so doing by studying designs that have proved successful elsewhere.

The material used in manufacturing this bowl was 0.050-inch hot-rolled strip steel of a good drawing quality. The strips were purchased from the mill in sizes 5 5/8 inches wide by 60 inches long, and before being used, they were well coated with slushing oil in a machine designed for this purpose. This oiling process was sufficient to permit the work to be put through the first three operations; it was then annealed and dipped in slushing oil prior to the fourth operation. The eight operations required to complete the part, and the dies used are described in the following.

Cutting the Blank and Drawing it to a Varied Depth

The combination die used to blank the part and draw it to the dimensions shown at *A*, Fig. 2, is illustrated in Fig. 3. It will be readily seen that the height of the shell varies around its periphery, the greatest difference being 11/32 inch, at points diametrically opposite. This result was effected by placing the draw-ring *A*, Fig. 3, eccentrically in relation to the die plug *B*, so that dimension *R* in the sectional view *X-Y* is greater than dimension *S*. This difference is not apparent on account of the great reduction necessary in making the illustration. If the draw-ring were concentric with the die plug, a shell of one depth would, of course, have resulted. Although there is a difference of 11/32 inch in the height of the shell, the difference between dimensions *R* and *S* only amounts to 7/32 inch. The extra 1/8 inch of height is produced by the stretching of the metal due to its being held more firmly on the side where the draw-ring is wider, than on the narrower side of the die.

Prior to a descent of the punch, the top of the draw-ring is on a level with the top of die part *D*, and as punch *E* enters the latter, the blank is cut and held firmly against the punch by the draw-ring during the remainder of the operation. Pins *C* are, of course, pushed down on the rubber buffers supporting them, and on the ascent of the punch, these buffers expand, forcing the draw-ring to follow the punch upward and thus stripping the shell from plug *B*. At the end of the upward stroke, the knock-out device *F* forces the shell from the punch, and as the shell falls on

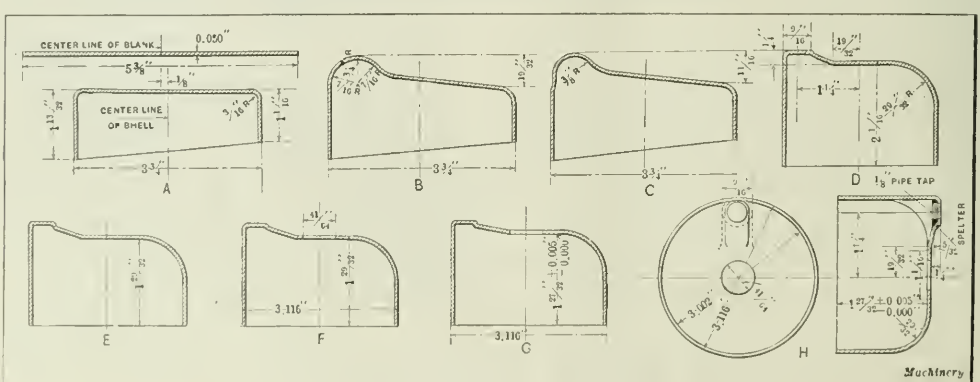


Fig. 2. Appearance and Dimensions of the Shell after Each Successive Operation

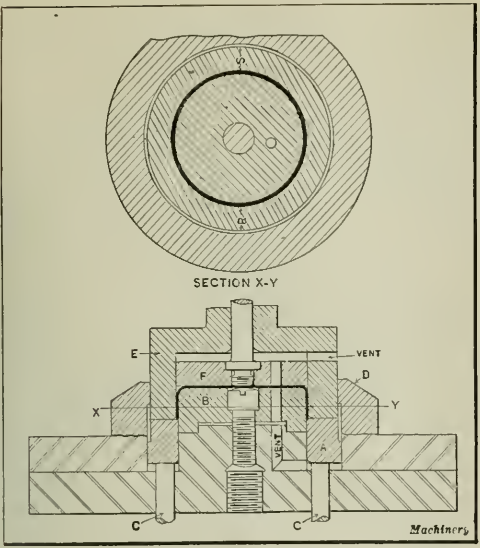


Fig. 3. Combination Die with Eccentric Draw-ring

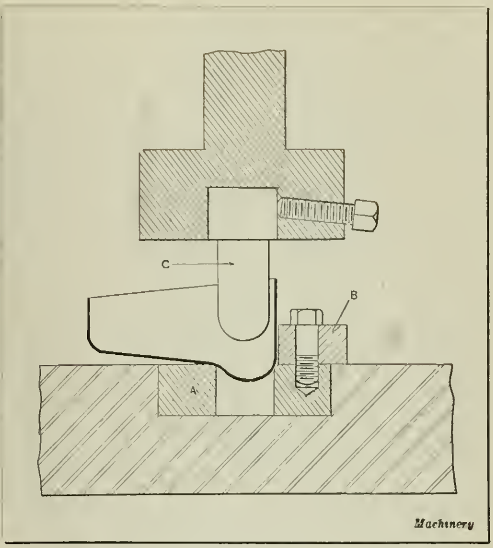


Fig. 4. First Embossing Operation on the Shell

top of the die, it is removed by the operator. Die part *D* consists of a machine steel base on which is forged a ring of tool steel. Punch *E* and plug *B* are also made of tool steel. Vents are provided in the punch and die to allow confined air to escape when the punch descends. A No. 57 Toledo press was used for this operation, and a production of about 4000 pieces per day was maintained.

Forming the Boss on the Shell

The second operation was an embossing one, the boss at the bottom of the bowl being made to the dimensions shown at *B*, Fig. 2. The construction of the die for this operation is shown in Fig. 4. The work is placed over the hole in the tool-steel ring *A* of the die, being located properly by means of stop-gage *B*, which is curved on the inside to correspond with the periphery of the shell. The die ring is mounted in a cast-iron base. The punch-holder is also made of cast iron and is carried in stock. Punch *C* is made of tool steel, so that all parts of the die which actually come in contact with the shell during the forming operation are made of tool steel. The punch is held in the holder by means of a set-screw inclined at an angle of about 2 degrees from the horizontal, which is a simple but satisfactory arrangement for keeping such a member in place. This operation was accomplished on a No. 5 Toledo press, and the production was about 6000 pieces per day.

The die for the next operation is shown in Fig. 5; this die increases the depth of the boss, and forms it to a smaller inside radius, as shown at *C*, Fig. 2. The construction of the die is very similar to the one for the preceding operation, with the exception that a stop-gage is not required. The shell is placed with the boss in the opening of the die ring and the die ring serves as a stop gage. The shell is held in place during this operation by the operator,

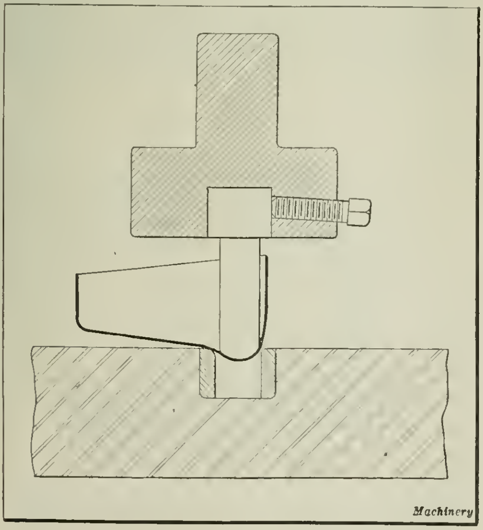


Fig. 5. Second Embossing Operation

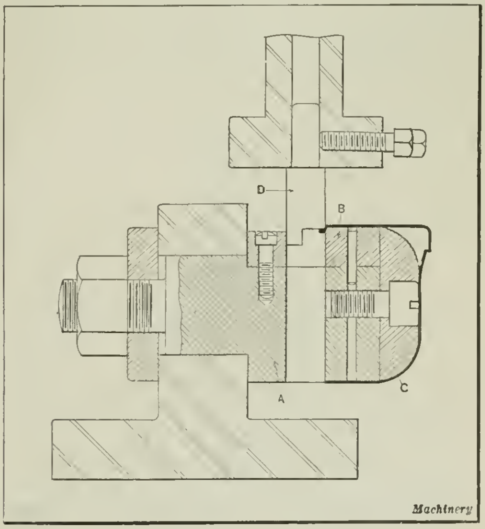


Fig. 6. Rough-trimming the Open End

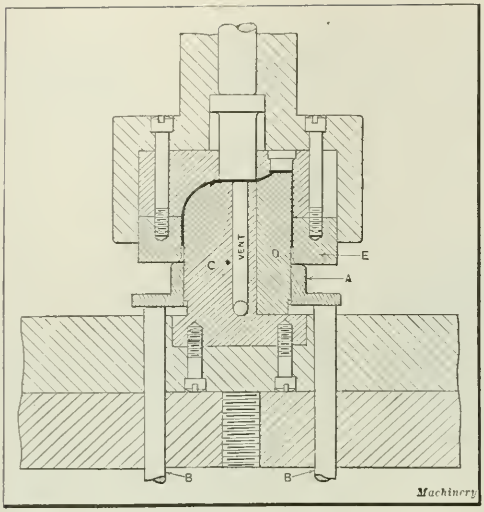


Fig. 7. Die used in drawing the Part to the Final Shape

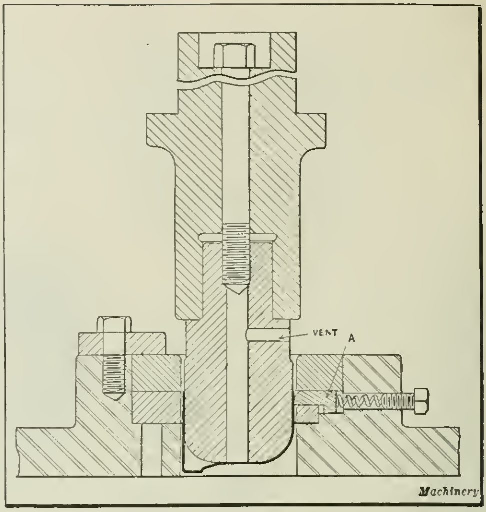


Fig. 8. Push-through Die used in sizing the Open End of the Part

who holds it at a point diametrically opposite the boss. The punch and die ring are made of tool steel, and the die base and punch-holder of cast iron. This die was also mounted on a No. 5 Toledo press, and the production was approximately 6000 pieces per day.

Final Drawing Operation

Prior to the fourth operation, it was necessary to anneal the shell thoroughly. The shell was heated to a cherry red, and the annealing was performed in a gas furnace after the shell had been dipped in a solution of one part of muriatic acid to five parts of water. This solution had no direct effect upon the annealing, but was applied for the purpose of loosening scale formed by the oxidation of the hot steel. When a part is annealed after being wet with such a solution, the scale which invariably forms can easily be removed by tumbling.

In the fourth operation the shell was brought to the final shape shown at *D*, Fig. 2; the die used for this operation is shown in Fig. 7. As in the case of the first die described, the draw-ring *A* is in a raised position before the punch begins to descend, due to the action of the rubber buffers upon which pins *B* rest. The work is then located by slipping it over the draw-ring, and is drawn on plugs *C* and *D* as the punch descends and draws the metal between the draw-ring and face *E* of the punch. The rubber buffers again expand as the punch ascends, causing the draw-ring to follow the punch and strip the shell from plugs *C* and *D*. The knock-out arrangement in the punch ejects the shell when the punch reaches the conclusion of its upward movement, and the work is caught on the end of a wooden paddle by the operator as it drops.

Die plugs *C* and *D* are mounted on a machine steel base, and the punch-holder is made of the same metal. All forming parts of the punch and die are made of hardened tool steel. A vent is provided through plug *C* for the escape of confined air during the operation. It will be noticed that two plugs are placed in the punch; one of these flattens the top of the boss, while the other flattens the closed end of the shell at the center. The view of the completed shell at *H*, Fig. 2, shows that a flat space 1 1/16 inch in diameter is required at this point.

This specification caused some difficulty when the dies for this operation were first tried out, the trouble being that the thickness of the metal at the bottom of the boss became several thousandths of an inch thinner than the thickness

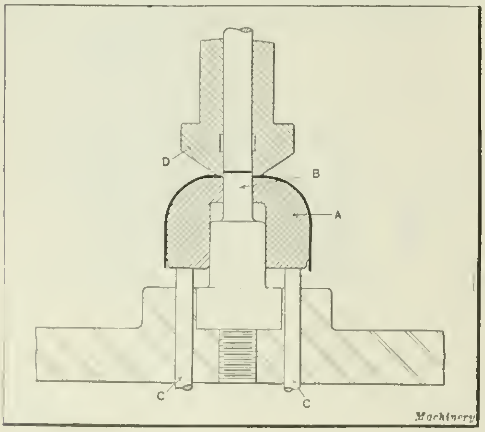


Fig. 9. Piercing a Hole through the Closed End

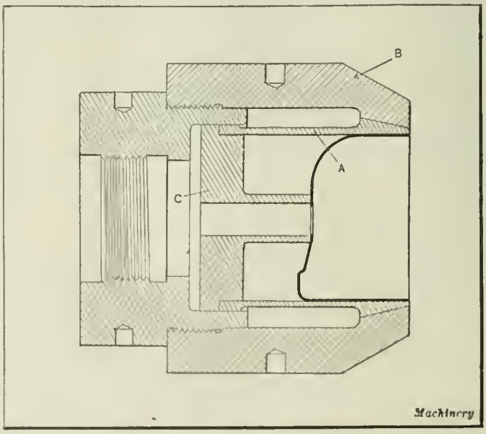


Fig. 10. Chuck used in finish-trimming the Open End

at the center of the closed end. While this condition had been anticipated, the exact thickness at the two points had not been estimated correctly. The result was that the bottom of the boss was not entirely flat. However, the condition was quickly remedied by grinding down the shoulder of the small plug placed in the punch above the boss, and thus lowering the plug several thousandths of an inch. The thickness at the center of the closed end and at the bottom of the boss as the shell was finally produced differed from 0.003 to 0.004 inch, the bottom of the boss being the thinner. The production of this part on a No. 57 Toledo press averaged 5000 pieces per day.

Rough-trimming, Piercing, and Sizing Dies

The fifth operation consisted of roughly trimming the open end of the shell, thus reducing its height to the dimension given at *E*, Fig. 2. This operation was accomplished by the die illustrated in Fig. 6. The base of this die and plug *A* are made of machine steel, but the plug is fitted with a hardened tool-steel block *B* which serves as a cutting edge. End *C* of the plug is also made of machine steel. Punch *D* is a hardened tool-steel piece, held in a machine-steel punch-holder of standard construction. In this operation, the shell is slipped over the plug and turned slowly by the operator while the punch is kept moving up and down, until the entire periphery of the shell has been trimmed. A production of about 2500 pieces was obtained with this die on a No. 3½ Toledo press. A far more efficient die for this sort of operation is a type known as the "Brehm," which is provided with cams that give it a rotary motion around its perpendicular axis. The expense of a die of this design, however, did not warrant its use in the production of the limited number of shells made.

The sixth operation sized the open end of the shell to the dimension shown at *F*, Fig. 2. This was found necessary, because, while the final drawing operation brought the top of the shell to size, it did not bring the open end to the proper dimension. The operation was performed on the push-through die shown in Fig. 8. This die is constructed in a manner assuring that the shell will pass through the die and not stick to the punch upon its upward stroke. The stripping of the shell is accomplished by means of three spring-plungers *A* which protrude into the opening of the die when the punch is in a raised position. These plungers are beveled at the top so that they are forced back flush with the internal surface of the die as the shell is pushed against them on the downward stroke of the punch. However, the pressures of the springs hold them against the outside of the shell, and as the open end passes them, the plungers are forced against the punch, thus enabling them to strip the shell from the punch when it ascends. The work is forced through the die by the next shell being sized. It will be seen that this punch is also provided with a vent. The die is mounted on a cast-iron circular base, and all parts coming in contact with the work are made of tool steel. A production of about 5000 pieces per day was obtained on a No. 55 Toledo press.

The diameter of the hole next punched at the center of the closed end of the shell is indicated at *F*, Fig. 2, and this operation is done by the piercing die shown in Fig. 9. It will be noted that the hole is pierced from the inside rather than from the outside. This method made it easy to dispose of the slugs punched from the shell, and permitted a simpler construction. The work is slipped over the machine-steel work-holder *A*, the top surface of which is on a level with the top of the tool-steel plug *B* when the punch is in the raised position, due to the action of pins *C*, which rest on rubber buffers. The hole is punched through the part as the tool-steel punch *D* descends and forces the work and holder *A* downward while plug *B* remains stationary. Each slug is knocked out of the punch at the end of the return stroke by the knock-out rod at the center of the punch. This piercing operation was performed on a No. 3½ Toledo press. The production was about 5000 pieces per day.

Final Trimming Operation

The shell was finish-trimmed to the height indicated at *G*, Fig. 2, in an operation performed on a small screw machine. The height of the shell was measured from the inside, and it will be seen that a tolerance of only 0.005 inch was allowed. If it had not been for the close limits, the shell could have been satisfactorily trimmed on a press equipped with a die similar to that used in the rough-trimming operation previously mentioned.

The chuck illustrated in Fig. 10 was made especially for this finish-trimming operation. Collet *A* is slit at four points for almost the entire length, so that it contracts when pushed against the inside tapered surface of sleeve *B*, thus securely holding work which has been inserted in the chuck. The collet is advanced by operating a lever on the side of the machine, which gives a horizontal movement to a sleeve bearing against the rear end of the collet member *C*. A knock-out rod extends through the hole at the center of member *C*, and forces the part from the chuck at the completion of an operation. Parts *A* and *C* are made of tool steel, while sleeve *B* is made of machine steel. This was the slowest operation of the series, but the production per day was about 900 pieces.

The spelter shown in the view of the shell at *H*, Fig. 2, was, as previously mentioned, placed in the bottom of the boss to give the latter sufficient thickness to permit the

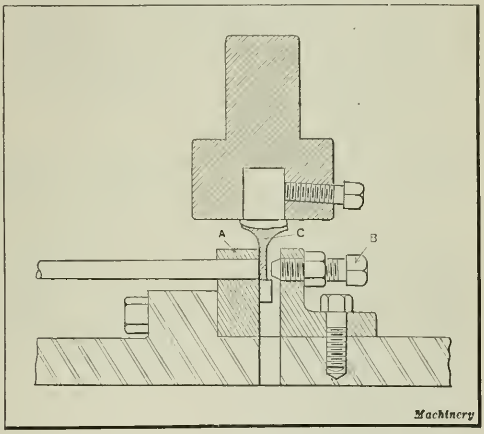
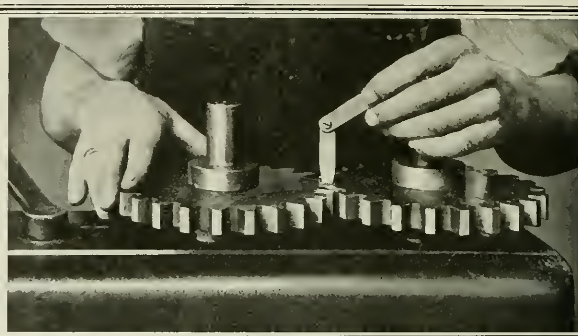


Fig. 11. Cutting the Spelter to the Proper Length

drilling and tapping of a hole to accommodate a pipe. The spelter was bought in rods ⅜ inch in diameter and 30 inches in length, and in order to cut the rod into small pieces of the proper size to fill the boss, the die shown in Fig. 11 was employed. The rod is fed through the tool-steel support *A* until it strikes the end of set-screw *B*, which serves as a stop-gage. The press is then tripped, and the descending punch *C* shears the spelter to the proper size. The die was mounted on a No. 3½ Toledo press, and the production was about 12,000 pieces per day. Punch *C* was, of course, made of tool steel.

The method used to fuse the spelter in the boss was simple, yet quite effective. The shell was placed on a small furnace with the open end upward, and the boss projecting through the top of the furnace into the flames. The work was kept in this position until the boss reached a red heat. A piece of spelter and a small amount of powdered borax were then placed in the boss and melted and fused in the steel shell. The latter when cooled was placed in a jig and a hole drilled through the boss. This operation was performed from the inside in order to prevent any danger of the spelter becoming loosened. The hole was finally tapped. All the dies described were designed, built, and operated in the shops of the Acklin Stamping Co., Toledo, Ohio.

Backlash in Hobbed Spur Gears



Amount of Backlash Recommended to Provide for Unavoidable Inaccuracies in Machining and Heat-treatment

By CARL G. OLSON, Chief Engineer, Illinois Tool Works, Chicago, Ill.

In cutting gears, it is often required to make the teeth slightly thinner than the spaces between the teeth measured on the pitch circle. The backlash thus produced provides freedom between the involute curves to accommodate any slight inaccuracy produced in machining, heat-treating, and assembling. The backlash should be in proportion to the pitch, and it should also be governed by the accuracy of the process used for cutting the gears. Because of the continuous generating action of the process of hobbing, the highest accuracy can be obtained in spacing the teeth and in their concentricity; and this will permit a minimum amount of backlash to be used in hobbed gears. The backlash is usually obtained by cutting the teeth deeper than standard depth. In using the standard involute hob, this method is satisfactory in most cases, but it is not generally recommended on account of a slight increase in the under-cutting of the teeth of small gears and pinions.

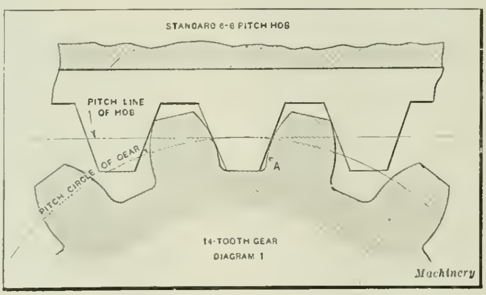


Fig. 1. Cutting Fourteen-tooth Gear of Standard Depth without Backlash

Special hobs formed to avoid under-cutting the teeth in the pinions should never be used to cut deeper than standard, but should be made with thick teeth to produce the desired backlash. The accompanying diagrams illustrate more clearly the reason for these recommendations. Fig. 1 represents a 6-8 pitch standard hob generating a fourteen-tooth gear having teeth of standard depth, and with no correction in the involute curve. The pitch line of the hob is tangent to the pitch circle of the gear, and the under-cut shown at *A* is very slight. This gear will have no backlash when running at the standard center distance with another gear having teeth cut to the same depth with the same hob.

For example, the recommended backlash for 6-8 pitch gears is 0.008 inch, and in order to produce this, it is necessary to feed the hob into each gear 0.0055 inch deeper than standard. The result is shown in Fig. 2, where the pitch line of the hob has been brought inside the pitch circle of the gear. However, it will be seen that the generating pitch line still remains tangent to the pitch circle of the gear and becomes a new pitch line, parallel to the measured or actual pitch line in the hob. The relation between the cutting edges of the teeth and the new generating pitch line remains the same, due to the fact that these cutting edges are straight lines and will still produce teeth with true involute curves. However, the added depth has increased the under-cut *A*, but this increase is very slight.

In Fig. 3 are shown two gears in mesh on standard center distances. These gears were hobbed 0.0055 inch deeper than standard, as previously recommended, and the backlash measured by the thickness gage inserted between the teeth

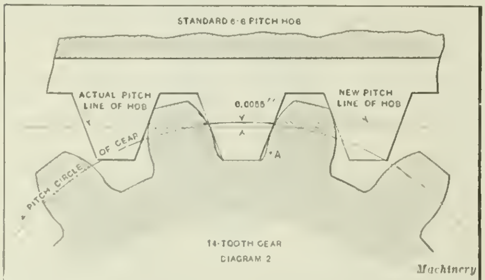


Fig. 2. Cutting Fourteen-tooth Gear Deeper than Standard to give Backlash between the Gears

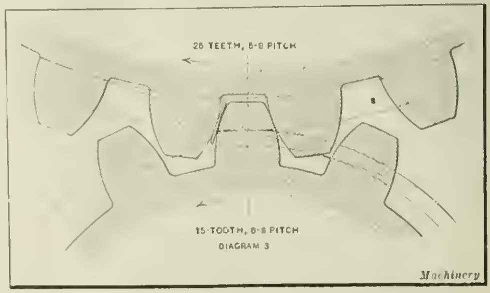


Fig. 3. Gears which have been cut Deeper than Standard to give Backlash

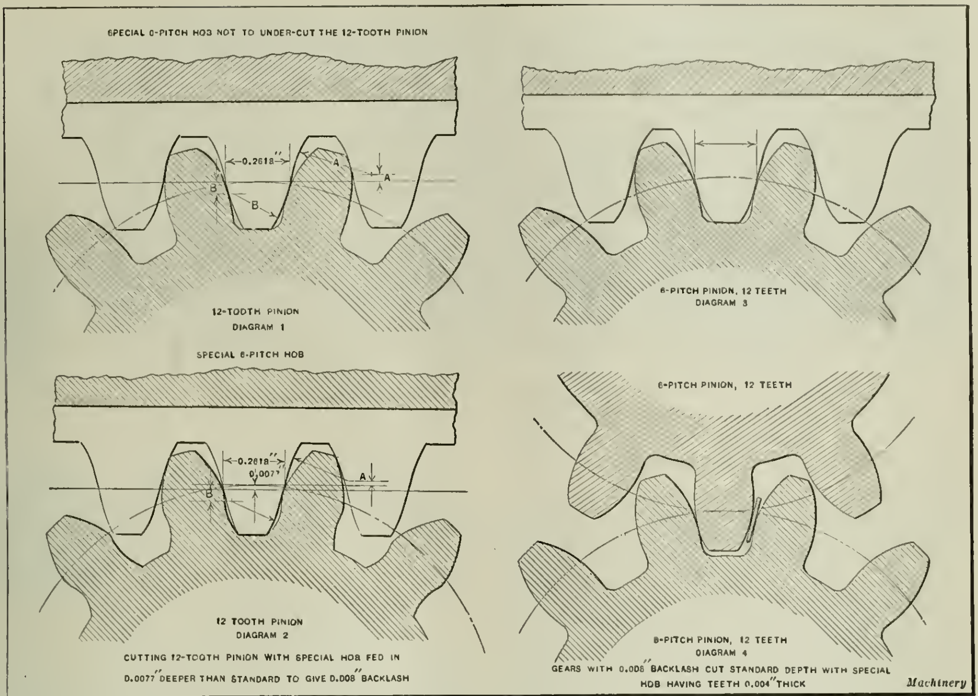


Fig. 4. (Diagram 1) Cutting Twelve-tooth Pinion without Backlash by the Use of Special Hob. (Diagram 2) Cutting Twelve-tooth Pinion with Special Hob Deeper than Standard to give Backlash. (Diagram 3) Cutting Twelve-tooth Pinion with Special Hob having Teeth Thicker than Standard to give Backlash. (Diagram 4) Gears with Backlash, cut to Standard Depth with Special Hob having Teeth Thicker than Standard

is found to be 0.008 inch. Fig. 4, Diagram 1, shows a hob designed not to under-cut the twelve-tooth pinion. The form of the teeth has been modified in fixed relation to the pitch line of the hob, as seen at *A* and *B*, and this will produce a corresponding modification in the fixed relation to the pitch circle of the gear. If it were attempted to cut deeper than standard with this hob, in order to produce backlash, we would have the condition shown in Diagram 2, Fig. 4. The recommended backlash is 0.008 inch, and as this hob has a 14½-degree pressure angle, it must be fed in 0.0077 inch deeper than standard. The relation of the modification has here been changed in relation to the new generating pitch line in the hob, and will no longer be correctly reproduced in the gear. The under-cut is more pronounced in this case, due to the fact that there is a 14½-degree pressure angle and a twelve-tooth pinion.

Diagram 3, Fig. 4, shows a 6-pitch hob made with teeth 0.004 inch thicker than standard, cutting a pinion with 0.008 inch backlash. This is the correct method, the appearance of the gear and pinion being shown in Diagram 4. This illustration also shows a gage placed between the teeth for measuring the backlash; this is done while the gears are held on studs of the correct center distance, as may be seen by reference to the heading illustration of this article.

A fixture for rapidly and accurately testing the backlash of gears is shown in Fig. 5. The gears are mounted on studs *A* and *B* which may be adjusted on base *C* to any desired center distance within the capacity of the fixture. The center distance may be measured over the studs with a vernier caliper or a micrometer. Half of the sum of the diameters of the plugs should be added to the correct center distance for this measurement. A swinging arm *D* hinged to bracket *E* carries a stop *F* and a dial indicator *G*, both of which may

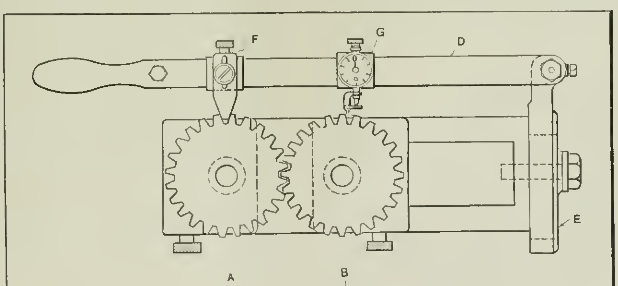


Fig. 5. Device for testing the Backlash of Gear Teeth

TABLE 1. BACKLASH RECOMMENDED FOR HOBBED SPUR GEARS

Pitch	Backlash, Inches	
	Average Condition	High-speed Gearing
3	0.014	0.007
4	0.012	0.006
5	0.010	0.005
6	0.008	0.005
7	0.007	0.004
8	0.006	0.004
9	0.005	0.003
10	0.005	0.003
12	0.004	0.002
14	0.004	0.002
20	0.003	0.001

Machinery

TABLE 2. AMOUNT HOB IS FED IN TO OBTAIN REQUIRED BACKLASH

Backlash (Inch)	14½-degree Pressure Angle, Full Depth		20-degree Pressure Angle, Stub Tooth	
	Added Depth	Difference from Standard Center Distance	Added Depth	Difference from Standard Center Distance
0.0010	0.0009	0.0018	0.0008	0.0017
0.0020	0.0019	0.0038	0.0014	0.0028
0.0030	0.0029	0.0058	0.0020	0.0040
0.0040	0.0038	0.0076	0.0027	0.0054
0.0050	0.0048	0.0096	0.0034	0.0068
0.0060	0.0058	0.0116	0.0041	0.0082
0.0070	0.0067	0.0134	0.0048	0.0096
0.0080	0.0077	0.0154	0.0055	0.0110
0.0100	0.0096	0.0192	0.0068	0.0136
0.0120	0.0116	0.0232	0.0082	0.0164
0.0140	0.0135	0.0270	0.0096	0.0192

Machinery

be adjusted to correspond with the center distance of the gears to be tested. The bracket E can also be adjusted to hold arm D in the correct relation to gears of differing diameters.

In using this fixture, the operator, with his left hand on the handle of arm D holds the stop tightly in contact with the teeth of the gear on stud A and with his right hand rocks the gear on stud B. As the indicator G is in contact with this gear, a direct reading may be obtained, showing the exact amount of backlash between the teeth of the gears. The test can be taken in several places to insure the uniformity of the gears. Table 1 gives the recommended backlash for hobbed gears of common pitches, and Table 2 gives the amount to feed the hob in deeper than the standard depth to get the required backlash. Table 2 is based on a table published in *Automotive Industries*, May 6, 1920. The added depth may be expressed by the following formula:

$$A = \frac{B}{4} \times \cot \alpha$$

where

A = added depth;
B = backlash; and
α = pressure angle

Gears cut with backlash may be brought closer together than the standard center distance. The difference is given in Column 3, Table 2, and this will be also found convenient for measuring.

* * *

CONGRESSIONAL HEARINGS ON THE METRIC SYSTEM

The congressional sub-committee of the Senate Committee on Manufactures, composed of Senator McNary, of Oregon, as chairman, and Senators Weller, of Maryland, and Jones, of New Mexico, will conduct hearings on the bill introduced in Congress providing for the compulsory adoption of the metric system. This bill provides that after a period of ten years, goods, wares, and merchandise, except for export, must be sold in accordance with the metric system, and that charges for transportation must also be made in accordance with this system. It is the intention of the sub-committee to have limited hearings at this time, so that those in favor of and opposed to this legislation may each state their cases. It is then intended to circulate as widely as possible a record of the hearing, with the idea of acquainting the public with the problems involved. Later, during the regular session of Congress beginning next December, it is planned to have further hearings, after which the committee will take action upon the bill. American manufacturers and business men are opposed to the introduction of the metric system into the United States because of the expense that a change would involve and the confusion that would necessarily follow. MACHINERY has repeatedly pointed out that the industries of the country are most vitally interested in the system of weights and measures used, and that it should be left to the industries themselves to determine what system they are to employ. Congress should not by compulsory legislation introduce a system that the industrial leaders, business men, and engineers of the country, do not want.

* * *

COOPERATION BETWEEN BRITISH AND AMERICAN ENGINEERS

Several hundred American engineers gathered with representatives of the principal engineering societies of Great Britain and France at a dinner at the Engineers' Club, New York City, on the evening of October 10. The event formally celebrated the homecoming of the distinguished American engineers who went abroad to confer the John Fritz medal upon Sir Robert Hadfield of London and Eugene Schneider of Paris. Heading this deputation, which in addition to the foreign representatives constituted the guests of honor, was Ambrose Swasey of the Warner & Swasey Co., Cleveland, Ohio, founder of the Engineering Foundation and past president of the American Society of Mechanical Engineers.

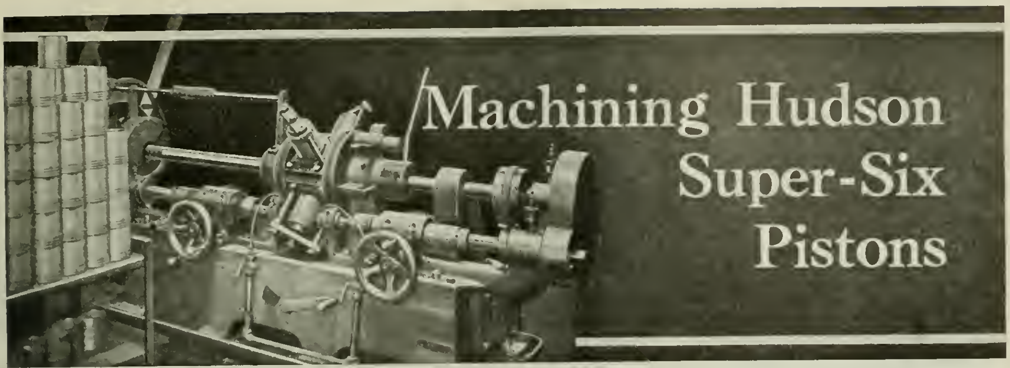
British organizations whose representatives were guests were the Institution of Civil Engineers, the Institution of Mechanical Engineers, the Institution of Mining Engineers, the Institution of Mining and Metallurgy, the Iron and Steel Institute, the Institution of Electrical Engineers, and the Royal Society of London. France was represented by La Société des Ingenieurs Civils de France.

Close cooperation between British and American engineers already exists as the result of the visit abroad of the mission. Communication is now in progress as to the method of engineering organization in the United Kingdom and the Dominions. British engineers are planning a federation of the British societies, and are closely studying the developments in America which resulted in the formation of the Federated American Engineering Societies.

* * *

SAFETY CODE FOR COMPRESSED AIR MACHINERY

The American Society of Safety Engineers has been designated as sponsor for a safety code for compressed air machinery by the American Engineering Standards Committee. The code will include rules for the construction and use of compressors, tanks, pipe lines, and the use of apparatus where compressed air is the active agent. In accordance with the usual procedure, the code will be formulated by a sectional committee composed of representatives designated by the various bodies interested in this phase of safety work.



Methods Used by the Hudson Motor Car Co. in Producing Pistons with High-production Machinery at Low Cost

How To Reduce Production Costs ?

THE pistons for the "Super-six" engines for automobiles built by the Hudson Motor Car Co., of Detroit, Mich., are made of cast iron. Many interesting methods have been developed for the machining of these parts, and excellent results are obtained through the application of automatic machines for performing certain operations.

As the castings are delivered to the machine shop, they are first subjected to a rough inspection; and they are then sent to a Gridley automatic on which the outside diameter is rough-turned, the closed end of the piston rough-faced, and the ring grooves rough-turned, the time per piece being about three and a half minutes. On this machine the turning tool *A*, Fig. 1, is carried by the back-rest, on which are also mounted two supporting rollers *B*. The closed end of the piston is faced by a tool *C*, mounted on the front slide; and the three tools which cut the piston-ring grooves are also carried on this slide, although they cannot be seen in the illustration.

In designing the cams, provision has been made for feeding the turning tool *A* from right to left, and at the same time when this tool begins its cut, the facing tool *C* also comes into action. The opposed position of these tools enables each to assist in preventing the pressure exerted by the other to spring the work out of place. As the turning tool *A* progresses toward the left-hand end of the work, facing tool *C* is also approaching the center of the piston; and toward the completion of the operation, the three piston-ring groove-turning tools come into operation. These tools greatly increase the pressure applied at the front of the work, and the tendency to throw the piston casting out of place is overcome by the two rollers *B* which are now in contact with the right-hand end of the work.

Rough-boring and Facing the Open End

After this preliminary operation, the castings are sent to a Fay automatic lathe on which the open end is rough-bored and rough-faced to the required length at a rate of about forty-five seconds per piece. These bored and faced surfaces are then used as locating points in setting up the work for subsequent operations.

Rough-drilling the Wrist-pin Holes

After the work on the castings has progressed to this point, they are delivered to a special drilling machine built by the Hoefer Mfg. Co., on which they are set up for rough-drilling the wrist-pin holes. This machine is shown in operation in Fig. 3. It consists of a turret *A* that carries castings *B* into position between two opposed spindles *C*; these spindles feed the drills in from opposite sides of the work, thus simultaneously drilling the holes through the two wrist-pin bosses. The spindles hold the twist drills in accurate alignment, so that the holes are drilled straight and in line with each other.

Each face of the turret is provided with a pilot that enters the previously bored and faced open end of the work, and there is a yoke over the casting, by means of which it is secured in place. The cross-bar *D* on the yoke has a C-slot in one end, which enables it to be pivoted about one of the side bolts *E*, so that the bar is brought into position over the casting to allow a nut on the second side bolt *F* to be tightened. The final clamping action is obtained by tightening the bolt *G* at the center, which forces a pressure pad down on the top of the work. The design of this machine is such that the drills *H* are automatically fed into the work, and the feed is tripped as soon as they have passed through the inner ends of the wrist-pin bosses. The spindles are then returned to their starting positions by turning handwheels *I* at each side of the machine; and the turret is indexed by hand to bring a fresh casting into the operating position.

After the operator has brought a new piece into place to be drilled, he occupies his time in removing the drilled casting which has made a complete circuit on the work-holding turret, and in setting up a fresh piece of work in its place. In this way, one drilled piston casting is secured for each index movement of the work-holding fixture, and the operator is kept busy unloading and reloading the machine while the drilling spindles are working on the holes in a piston casting which is in the operating position. As a result, the average time is only forty seconds per piece, and the idle time of both the machine and the operator is reduced to a minimum.

In this article attention is called to the number of automatic machines and lathes that are employed for machining the pistons for Hudson "Super-six" engines. It is apparent that the equipment used aids in greatly increasing the rate of production and thereby decreasing costs; and in the present instance this is especially true because the machines have been equipped with an unusually large number of tools that are simultaneously engaged in turning, facing, boring, and other operations. With automatic lathes used in this way, it is safe to assume that the cost of machining these pistons is very close to the minimum attainable through the use of any available types of machine shop equipment.

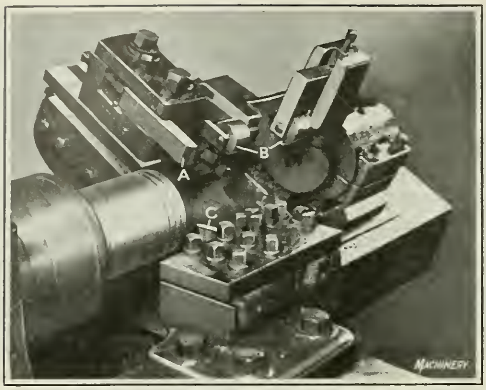


Fig. 1. Gridley Automatic equipped for rough-turning Outside Diameter, facing Closed End, and rough-turning Ring Grooves

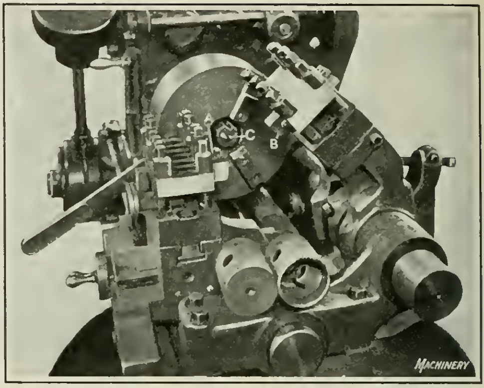


Fig. 2. Fay Automatic Lathe tooled up for finish-boring and facing the Open End, and centering the Closed End of the Piston

Finish-boring and Finish-facing Open End and Centering Boss on Closed End

After drilling, the castings are sent to the heat-treating department, where they are carefully annealed to remove strains that have been produced in machining; they are then sand-blasted on the inside to remove scale before being returned to the machine shop. This work is done in a Pangborn sand-blasting machine.

Next in the order of machining operations comes the finish-boring and finish-facing of the open end of the work, while the boss cast on the other end is centered and counterbored. This work is done on a Fay automatic lathe, equipped as illustrated in Fig. 2, at the rate of about forty seconds per piece. In this machine the boring is done by a tool *A* carried at the front of the cross-slide, while the facing operation is performed by a pivoted tool *B* at the rear. The centering and counterboring of the boss cast at the top or closed end of the casting is done by means of a tool *C* carried by a rod extending through the hollow spindle and actuated from the bar feed mechanism.

Another Fay automatic lathe, shown in Fig. 4, is then employed for finish-turning the outside diameter of the castings, taking a second roughing cut and a finishing cut in the ring grooves, and a finish-facing cut over the closed end of each casting, all of which requires about two minutes per piece. Referring to the illustration of the machine used for this purpose, it will be seen that on the front slide there are three tools *A* by which the finish-turning operation is performed on the outside diameter of the piston casting. For the intermediate- and the finish-turning operations in the piston-ring grooves, two sets of tools are provided, one of which will be seen at *B*. These tools are of somewhat the same form as the so-called "hob" used on a thread-milling machine of the type where the work makes one complete revolution in contact with a rotating cutter to complete an internal or an external thread-cutting operation. But in the present case the cutter does not revolve, the purpose of having a number of sets of teeth being to enable the tool to be loosened and reset with another set of teeth in the operating position. In this way, the cutter can be reset a number of times, as the teeth become dull, and it need only be sent to the tool-room for grinding when all of the teeth are dull. The tool that performs the final facing operation on the closed end of the piston will be seen at *C*, and it will be evident from the illustration that this tool is carried on the back-rest.

Recentering the Work Preparatory to Grinding

After the preceding turning and facing operations have been finished, the castings are sent to a special centering machine that is employed to recenter the open end of each piston, so that the work may be set up between centers for grinding. A special grinding machine was designed and built for this centering operation. In Fig. 5 a plug *A* with a knurled handle is slipped through the wrist-pin hole in the piston, to hold the center hole in the closed end of the work in contact with a center carried by the post *B*. Then, the formed grinding wheel *C*, which is mounted on a sliding spindle, is pulled forward into contact with the open end of the work by means of a handle *D* that has a yoke at its lower end, connected with a collar on the spindle. This is a very simple machine and one that gives entirely satisfactory results. After being recentered,

ORDER OF MACHINING OPERATIONS ON HUDSON "SUPER-SIX" PISTONS

Operation Number	Name of Operation	Type of Equipment Used
1	Rough-inspect	Bench
2	Rough-turn outside diameter, face closed end, and rough-turn ring grooves	Gridley automatic
3	Rough-bore open end and face to length	Fay automatic
4	Rough-drill wrist-pin holes	Special Hoefer drilling machine
5	Heat-treat	Gas furnace
6	Sand-blast inside	Pangborn sand-blasting machine
7	Finish-bore and face open end, and center closed end	Fay automatic
8	Finish-turn outside diameter, rough- and finish-turn ring grooves a second time, and face closed end	Fay automatic
9	Recenter open end	Special center-grinding machine
10	Rough-grind outside diameter	Fitchburg grinder
11	Rough- and finish-bore and ream wrist-pin hole	Warner & Swasey hand screw machine
12	Hand-ream wrist-pin hole	Bench
13	Face wrist-pin bosses	Whitney hand milling machine
14	Mill oil-grooves in wrist-pin holes	Sipp drilling machine with National oil-grooving tool
15	Grind clearance on sides	Norton cam-grinding machine
16	Drill six oil-holes through ring grooves	Avey sensitive drilling machine
17	Hand-ream wrist-pin hole to remove burrs	Bench
18	Rough- and finish-grind outside diameter	Norton cylindrical grinding machine
19	Inspect	Bench

Machinery

the castings go to a cylindrical grinder built by the Fitchburg Grinding Machine Co., which is used for grinding the outside diameter, the time required for the operation being approximately one and one-third minutes per piston.

Boring and Reaming the Wrist-pin Hole

Next in the order of machining operations comes the rough- and finish-boring and the reaming of the wrist-pin hole in the piston. For this purpose, the castings are sent to a Warner & Swasey hand screw machine which is equipped with a core-drill, a boring-bar, and a reamer to handle the required sequence of operations. The operation requires less than one and one-half minutes per piece. From this machine, the castings are sent to a bench where the wrist-pin hole is hand-reamed to assure obtaining accurate alignment.

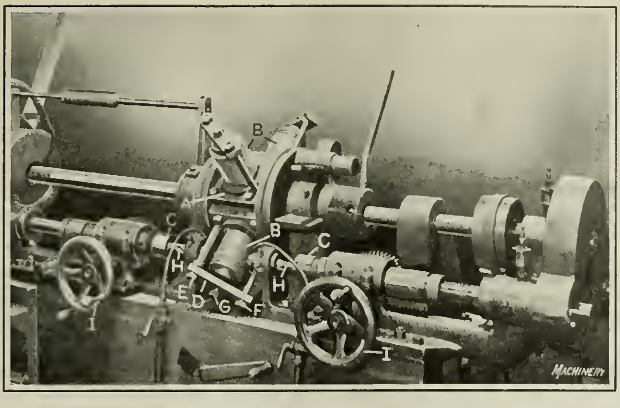


Fig. 3. Hoefer Special Opposed-spindle Duplex Drilling Machine for simultaneously drilling the Wrist-pin Bearing Holes in Piston Castings

Facing Wrist-pin Bearing Bosses, and Drilling Oil-holes

After this operation has been completed, the castings are sent to a hand milling machine built by the Whitney Mfg. Co., which is equipped with a work-holding fixture in which the castings can be located from the reamed wrist-pin holes; in this machine the inner ends of the wrist-pin bosses are milled by means of an offset attachment at the rate of nearly two a minute. Oil-grooves are then milled in the wrist-pin holes, at the rate of over three pistons a minute, with one of the No. 2 oil-grooving tools made by the National Machine Tool Co., carried in the spindle of an upright drilling machine built by the Sipp Machine Co.

Grinding Clearance at Sides of Piston

For grinding the clearance required at each side of the piston, at points where the wrist-pin holes come through, use is made of a Norton cam-grinding machine which is equipped with master cams of the same form as the cross-sectional area of the finished piston on a plane through the wrist-pin holes. Each piston requires about forty-five seconds for grinding. Next, six oil-holes are drilled through the piston in the ring grooves, using an indexing fixture on an upright drilling machine built by the Avey Drilling Machine Co. After this, the wrist-pin hole is hand-reamed to remove all burrs.

Rough- and Finish-grinding the Outside Diameter

The castings are next sent to a Norton cylindrical grinding machine, on which the outside diameter is rough- and finish-ground, one and one-half minutes per piece being the average time required. The pistons are then ready for assembly into engines as required.

* * *

WASTE BY FIRE LOSS

Carelessness is the main cause of the enormous loss due to fires in the United States. Our fire loss per capita is several times greater than that of any other civilized country in the world, and amounts now to about $300,000,000 a year —an amount almost sufficient to have provided for the building of the Panama Canal. Property loss is only one item. The human lives lost by fire amount, on an average, to 18,000 annually, while about 60,000 persons are injured by fire. Ultimately, the property loss is shared by every citizen of the country. Everyone has to help pay the $300,000,000 annually going up in smoke. Manufacturers should take active steps to impress upon employes the need for greater care in order to prevent fires, not only in the factories but around their homes as well. An educational campaign along these lines is of national importance.

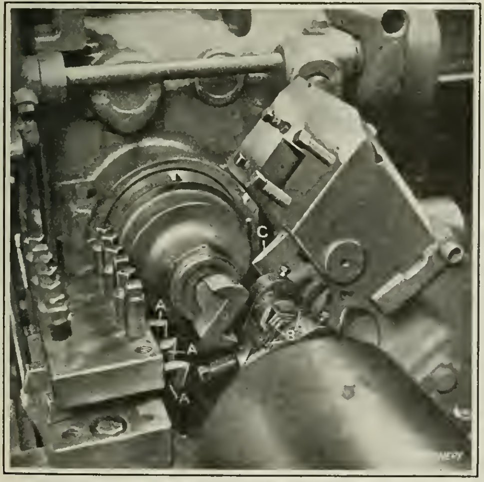


Fig. 4. Fay Automatic Lathe equipped for turning Outside Diameter, finishing Ring Grooves, and facing Closed End

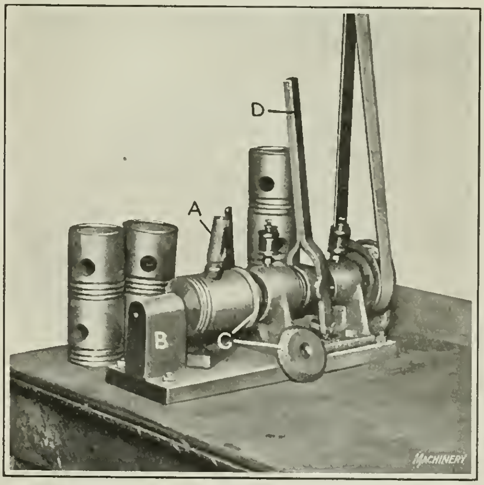


Fig. 5. Special Machine designed and built for Use in grinding the Center Bearing in the Open End of the Piston

Production Work in the Locomotive Shop

Application of the Bullard Vertical Turret Lathe in Locomotive Shop Practice
Second of Two Articles

The high cost of production in railroad shops has been the subject of many comments in both the daily and the technical press, in public speeches, and in governmental reports. Costs can be reduced in railroad shops in three ways—by capable management; by the efficiency of labor; and by the employment of labor-saving and cost-reducing machines and methods. The present article deals with the last phase, and shows a number of examples of economical production by the use of the vertical turret lathe in combination with carefully laid out tooling equipments.

In the first installment of this article, published in October MACHINERY, the machining of piston-heads and rings and cylinder heads was described. In the present installment the tooling up for machining cross-heads, main throttle valves and piston-heads will be dealt with.

Tooling up for Machining Cross-heads

The machining of locomotive cross-heads involves a number of special tooling and chucking arrangements. A complete lay-out showing each operation in the three chuckings required to finish a cross-head of typical design is shown in Fig. 11. The first point of interest is the method of presenting the work to be machined. It is located between suitable jaws, and is supported by wooden blocks from the bottom, and by a screw-jack between the two sides, to prevent the upper side from springing while being machined.

In the second chucking, it is not practical to use jaws to hold the work, so a special fixture is employed. A tapered bushing *B*, which fits the central stud of the fixture closely, is placed in the previously machined hole of the cross-head, and the work is clamped in the position shown in the lay-out by means of a nut and washer *A* seating against the inner surface of the cross-head. This securely anchors the work in the proper position on the fixture. A driver *C* is clamped in a slot of the machine table so that the work will revolve positively with the table.

In the third chucking, another special method of holding the work is required; in this case a special fixture is used, which is provided with the same means for securing

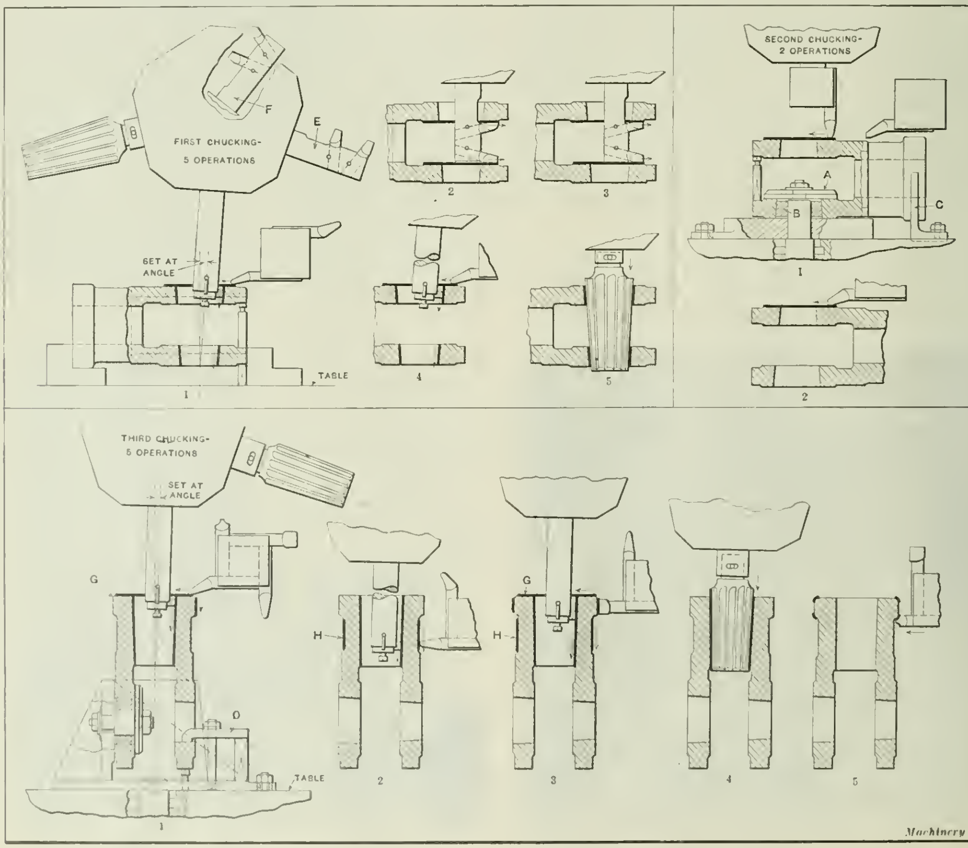


Fig. 11. Machining a Locomotive Cross-head in Three Chuckings on the Vertical Turret Lathe

the cross-head in position as was used in holding the work during the second chucking. Attention is also called to the use of a blocked-up strap *D*, which engages the small end of the tapered hole and binds the work down against an adjusting screw in the base of the fixture.

In machining the cross-head, the main turret is set at the desired angle, and in the first chucking, a combination boring-bar, equipped with a roughing cutter, rough-bores the tapered hole while the surrounding surface of this hole is rough-faced with a side-head turret roughing tool. The second and third operations are straddle-facing operations in which the special bars *E* and *F* are employed. The cutters are properly set in the bars, it being preferable to use two separate bars, one for roughing and one for finishing, rather than to change the cutters after the roughing operation. In the fourth operation, the tapered hole is trued up and the top surface finished by the tool in the side-head turret, as the lay-out indicates, while in the last operation of the first chucking, the hole is finished with a floating taper-reamer, by a method similar to the one employed in finishing the piston-heads, previously described. The second chucking consists of two operations, performed on the opposite side of the work. These operations are simply those of roughing and finishing the surface surrounding the tapered hole.

The cross-head is held in a vertical position during the third chucking, in which the piston-rod end of the cross-head is machined. In order to finish the tapered hole for the end of the piston-rod, the main turret is set at the required angle, while the hole is first rough-bored by a cutter carried in the boring-bar, and the surfaces of the head *G* are rough-faced and rough-turned with a side-head turret tool, as indicated by the arrows in the diagram. A second tool carried in the side-head turret is used in the next operation to rough-turn neck *H* while the remainder of the tapered hole is being rough-bored. The third operation is truing up the tapered hole by substituting another cutter for the roughing cutter in the boring-bar, and finish-facing and finish-turning the head *G*, and finish-turning neck *H* with a special tool carried in the side-head turret. A floating reamer is used in the fourth operation to finish the piston-rod hole, while in the fifth operation a double-radius formed tool carried in the side-head turret, is employed to form the radii of head *G*. This completes the machining of the cross-head, the total time being from 1½ to 1¾ hours.

Machining Locomotive Main Throttle Valves

The machining of locomotive throttle valves on vertical turret lathes is of interest principally as regards the holding method. Referring to Fig. 12, it will be seen that a special plate *A* is attached to the machine table, in which a tie-rod is carried. The work is located centrally in a special fixture by providing an extension *B* which is cast to the lower part of the valve stem and which fits into a hole in the fixture. By dropping a ring *C* into the upper end of the valve, provision is made for holding the work down by means of the tie-rods passed between the radial vanes, a positive driving arrangement being thus secured.

The machining of this valve requires two chuckings, as illustrated in the tooling lay-out. In the first chucking, the stem of the valve is rough-turned, and then the end of this stem is rough-faced with a special long-shank tool carried in the main turret tool-holder, this operation being performed simultaneously with the forming of the bevel and the roughing of the outside cylindrical surface by a tool carried in the side-head turret. The second operation finish-turns the outside of the stem and the shoulder at its upper end, while a special tool in the side-head turret is finishing the bevel at the top and finish-turning the outer surfaces which were roughed in the first operation. The position of the tool at the end of the finish-turning operation, when it reaches the lower flange of the casting, is indicated in the illustration. The third operation consists of finishing the angular surface at the lower part of the valve.

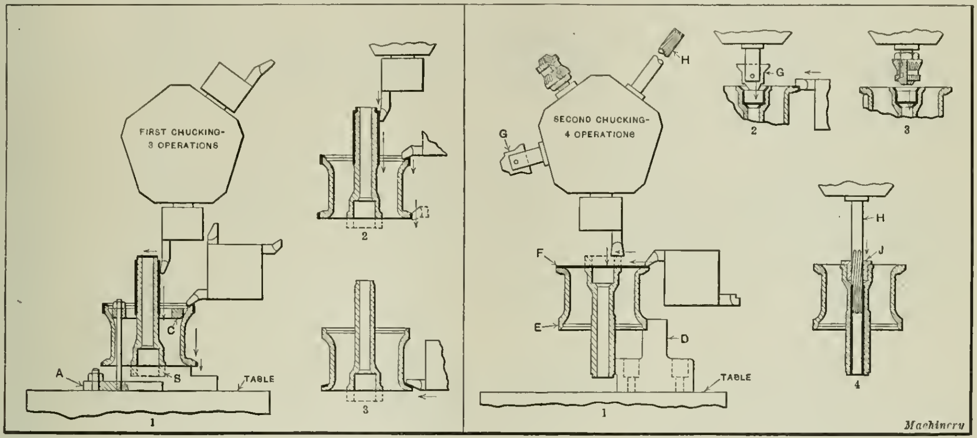


Fig. 12. Tooling Lay-out of the Two Chuckings required to machine a Main Throttle Valve for a Locomotive

In the second chucking, the work is secured by special soft jaws *D* which are so designed as to engage the work on the previously machined diameter *E* and on the extending end of the stem. The auxiliary boss which was cast on the valve stem for the purpose of locating the work in the first chucking, is turned off in the first operation by a tool carried in the main turret tool-holder. At the same time, the surface of flange *F* is faced by a tool carried in the side-head turret. As soon as the boss has been turned off, the same tool is used to face this end of the stem. During the second operation a special formed boring-bar *G*, rough-bores the counterbored hole in the end of the stem. This boring-bar is carried in the main turret, and while it is in operation, a radius-forming tool in the side-head turret forms the radius at the top of the flange. In the third operation a special reamer is employed to complete the machining of this counterbored hole. Finally, the central hole which passes entirely through the stem is reamed with a special length core-drill *H*, used in connection with a bushing *J* which fits into the counterbored hole as a means of securing perfect concentricity of this hole with the previously counterbored hole. These cast-iron throttle valves are about 18 inches in diameter, and are machined complete in from forty to forty-five minutes.

Compound Feed Gearing for Machining Angular Surfaces of Locomotive Piston-head

The tooling lay-out, Fig. 13, shows each operation in the two chuckings required to finish a locomotive piston-head all over, the special point of interest being the machining of the angular surfaces. Standard jaws and buttons are employed to chuck the work during each series of operations. Tools carried in the two turrets simultaneously rough-face surface *A* and rough-turn diameters *B* and *C*. In finishing the angular surface *D* during the second operation, a compound gear combination between the cross and vertical feeds of the machine is employed to traverse the main turret at the proper angle for machining the surface. While the angular surface is being machined, tool *C* of the side-head turret rough-faces the surface indicated by the position of the tool in the lay-out and also rough-faces the flange. For machining the tapered hole, the turret is set at the desired angle, and the boring-bar furnished with proper roughing and truing cutters, is employed. Simultaneously with the performance of this operation, a special hooked tool carried in the side-head turret finish-faces the top surface of the flange and finish-turns the adjacent shoulder, as indicated. The fourth operation consists of finishing the taper hole with a floating reamer while the bevel on the flange is being turned with a tool carried in the side-head turret. In the fifth and sixth operations, special formed tools, carried in the main turret, are used for rounding the edge of the hole and for blending the two curved surfaces.

The machining of more angular surfaces is involved in the second chucking, in which four operations are required to complete the machining of the work. With the feed gears properly compounded, the hub is rough-turned and rough-faced by the special tool *E*, carried in the main turret. While this tool is at work, the bottom flat surface of the flange is rough-faced and the outside diameter rough-turned by a tool in the side-head turret. Another angular setting of the main turret is employed in the second operation for finishing the angular surface *F*, while a hook-forming tool is carried in the side-head turret for finishing the radius. In the third step of the second chucking, the end of the piston-head hub is finish-faced while the end flat surface of the flange is being similarly machined with a hook tool carried in the side-head turret. The last operation required to complete the machining of this part employs a forming tool in the main turret to form the end of the hub and the same tool that was used in the third operation to finish-face the outside diameter of the flange. These heads are about 30 inches in diameter, and the total time required to perform the operations in which the parts are machined all over is from 1½ to 2 hours per casting.

* * *

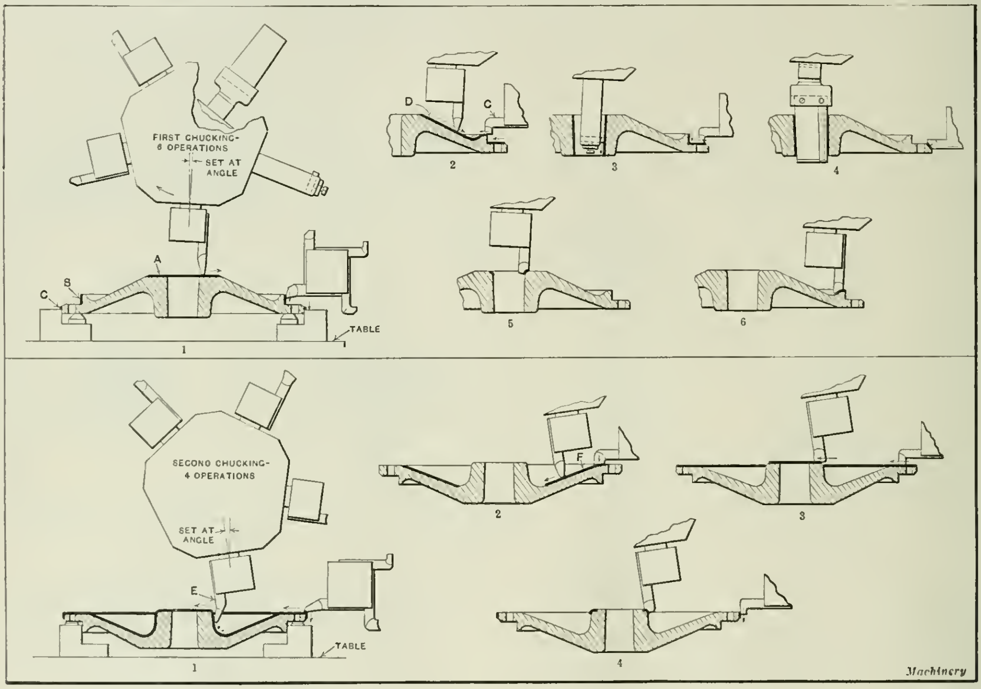
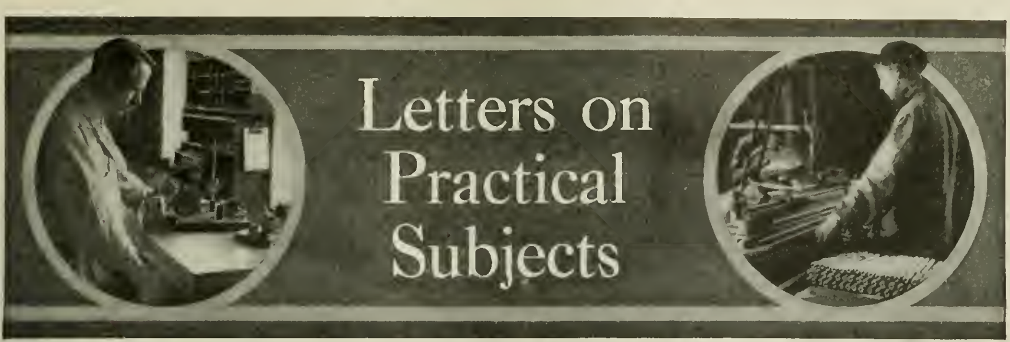


Fig. 13. Tooling Lay-out for machining a Locomotive Piston-head of the Mallet Type, showing the Method of machining Angular Surfaces

BELGIAN MACHINE TOOL INDUSTRY

A report originally published by the Bureau of Foreign and Domestic Commerce relating to Belgian machine tool trade was referred to in August MACHINERY, page 1113. We are informed by a correspondent who has specialized for twenty-five years in the manufacturing and selling of machine tools in Belgium that several of the statements made in this report are erroneous. While it is true that there are only four important Belgian plants for machine tool manufacture, two of these are located at Brussels and two in Liége, and there is none at Bruges. There are also a few other firms of lesser importance making special machine tools. In addition to the plants manufacturing machine tools there are two factories engaged in the production of wood-working machinery.

Our correspondent states that modern Belgian wheel lathes are quite equal to the best American machines, and that Belgian manufacturers do not only imitate, but have also done a great deal of development work in machine tool manufacture. Some German machine tools are said to be quite equal to those built in America, and one of the largest dealers in Liége has sold Swiss, German, French, and Belgian machine tools to the entire satisfaction of his customers.



ADJUSTABLE REAMER BLADE FOR LARGE HOLES

The machining of two large holes in revolving-frame steel castings used in the construction of steam-shovels, resulted in the development of the floating reamer blade described and illustrated herewith. One hole was required to be reamed to 9⅞ inches in diameter and was to be a press fit for a bushing. This hole was 8⅞ inches long and extended through the casting. The other hole was 10 inches in diameter, reamed for a bushing, and 13 inches long. The holes were first bored on a large radial drilling machine, using a boring-bar and an inserted-blade cutter-head. This type of tool permitted the amount of adjustment required, and the boring operation caused no difficulty. Before the adjustable blade illustrated in Fig. 1 was used, the reaming was done with a single blade placed loosely in the boring head and permitted to float during the operation. Considerable difficulty was experienced, in that the blade had to be reground with every hole in which it was used, necessitating the re-hardening and redrawing of the blade each time it was reground. In addition to this extra work, the repeated heat-treatments often resulted in checks in the finished tool at the cutting edge, rendering it useless and requiring the making of a new blade.

These difficulties were overcome in the design of the blade illustrated in Fig. 1. This one blade, by its special adjustable feature, was also used for reaming both the 9⅞-inch and 10-inch diameter holes. It will be seen that the tool consists of two members, the male half *A* and the female half *B*, which are adjusted by a suitable screw and which are fastened together by a taper pin that fits in one of the two holes *C*. The two members are fitted together by a dovetail slide to produce a fairly good push fit, and a standard No. 8 taper pin secures the two members together and makes a rigid solid tool. The construction and dimensions of the fitted members are shown in Fig. 2. It will be seen that the tapered holes for the pin are located ⅛ inch closer together in one member than those in the other half, so that by the proper selection of holes the tool is made available for either of the two diameter holes in the work to be reamed.

In regrinding this blade it is simply necessary to remove the taper pin, disassembling the two members, and replace the pin in the male member *A*. By slightly relieving the extending portion of the pin by filing, as indicated in the illustration, the tool may be lengthened the same amount, or enough to allow for regrinding. It will be understood that as soon as the two members are re-assembled and the adjusting screw brought to bear against the end of the male member, a slight elongation of the tool is accomplished. It will be seen that this device eliminates all heat-treatment after the first hardening and makes it possible if the filing of the pin is carefully done, to oftentimes put the blade into proper shape by simply slightly honing the cutting edges. The blade does not work loose under the cut and causes no trouble. It is made of high-speed steel, the taper pins are of drill rod, and the set-screw is made from machine steel. The device described in the foregoing was designed by F. Springer. L. O. K.

CARE NEEDED IN USE OF MURIATIC ACID

A cup of muriatic acid, employed as a flux for soldering, was recently left over night on the tool-room bench near a new lathe, where it had been used by the writer. In the morning it was found that the lathe ways, and other scraped or polished parts, instead of being bright and shiny, were a dull brownish color. Investigation showed that other polished iron surfaces near the cup of acid were similarly affected, evidently by the acid fumes. The writer hopes that this will serve as a warning to others against leaving muriatic acid in an open receptacle near machinery having polished surfaces, as it requires considerable polishing to remove the rust caused by the fumes of this acid.

Boston, Mass. Homer S. Tregartin

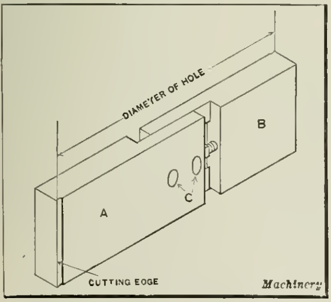


Fig. 1. Assembled Two-piece Reamer Blade

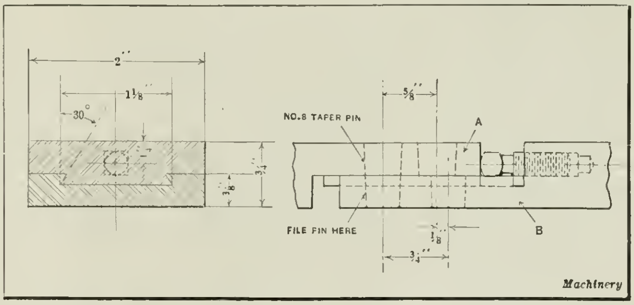


Fig. 2. Showing how Members are fastened together and adjusted

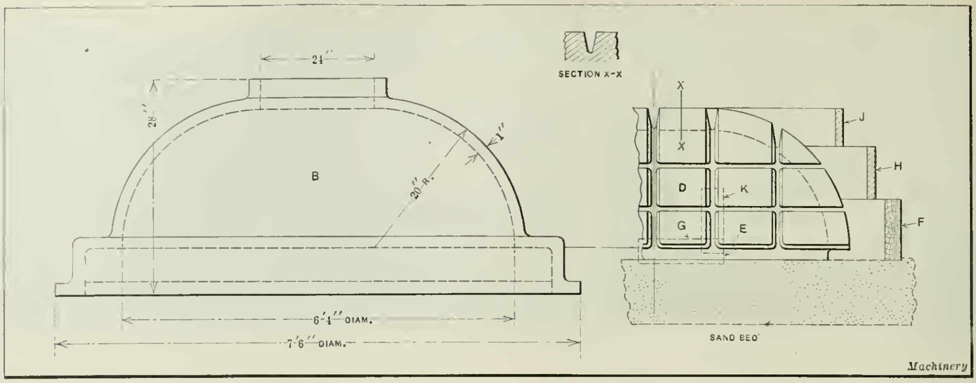


Fig. 1. Tank-head Casting and Method of molding Arbor or Sand-bar for Cope

MOLDING AN ARBOR OR SAND-BAR FOR A COPE MOLD

While on a visit to a foundry recently, the writer's attention was directed to the method employed in molding and casting the arbor or sand-bar *A*, shown in Fig. 2. This arbor was used in making the cope mold required in the production of the large tank-head casting shown at *B*, Fig. 1. The arbor was made without the use of a pattern other than that furnished for the tank-head casting. The pattern for this casting was of the simple built-up type, and was the same shape and approximately the same size as the casting to be produced, proper allowance, of course, being made to compensate for shrinkage. The molder, after looking the pattern over, decided that a very strong and rigid cope flask was required. He accordingly made a flask of steel which is shown at *C*, Fig. 2. The arbor or sand-bar *A*, required to support the heavy body of hanging sand that was to form the cope mold was next made. Ordinarily the maker of the pattern would be requested to furnish a pattern for the sand-bar, but as the casting was needed at once, the method of molding described in the following paragraphs was employed:

The pattern for the tank head shown in Fig. 1 was placed on a bed of molding sand, and the inside filled in with molding sand through the 24-inch hole at the top. When this molding operation was completed, the pattern was lifted, leaving a sand mold *D* of the form indicated at the right. At this stage there were not, of course, any grooves in the mold. With a piece of tin bent to the shape of the sand-bar, a cross-sectional view of which is shown at *X-X*, this body of sand was sectioned off by the eye, and at each section or division the sand was cut or gouged out as shown. The sand was next cut away at *E*, in order to form a flange ring at this point. When the gouging or cutting away of the mold that was to form the sand-bar had been completed, the wooden flask *F* was placed on the bed of sand. Small strips of tin, 4 inches wide and any convenient length, were placed on the mold over the grooves or slots.

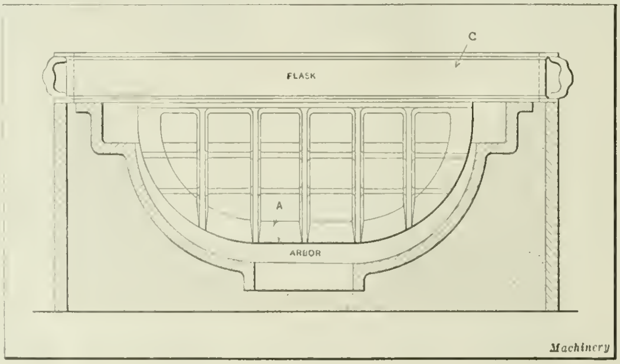


Fig. 2. Mold with Sand-bar or Arbor in Place

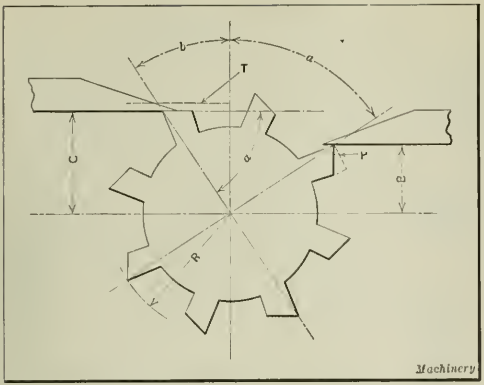
The first strips were placed over the flange-ring groove, as indicated by the dotted lines at *G*. The grooves at right angles with the horizontal grooves were also covered over with tin strips, the position of one of these strips being indicated by dotted lines at *K*. The sand was then filled in as in the making of a regular mold. Steel flasks *H* and *J* were stacked up as shown, pieces of tin being placed over the slots as the filling in and tamping progressed. When the sand had been filled in up to a level with the top of flask *J*, a pouring basin was formed at the top of the mold. This completed the mold, ready for pouring. The time required by the molder and his helper for making the mold was fourteen hours. The arbor or sand-bar casting *A* made from this mold was bolted securely to the flask, as shown in Fig. 2. The making of the mold for the tank-head casting then proceeded in the usual manner.

Kenosha, Wis. M. E. Duggan

MILLING TEETH OF ESCAPEMENT WHEEL

The following method of locating the work when milling the teeth of an escapement wheel was used by the writer with excellent results. A simple adaptation of this method also proved to be the best means of inspecting the work, as the faces of the teeth were so narrow that a sine bar could not easily be employed. The procedure followed in locating and milling the teeth was as follows: The recesses or spaces between the teeth were first milled, then the tops of the teeth, as shown by dotted lines *P*, were milled to radius *R*. The work can also be turned to diameter before milling.

The locating of the work for the operation was the difficult part of the job. After carefully removing the burrs from the work, leaving the corners sharp (although a slight rounding at the points of the teeth would probably affect the accuracy but little), the work was mounted on the dividing head and was rotated until measurement *B* was made to equal $R \times \sin b$. After clamping the work in this position, a trial cut was taken at the approximate height indicated by dotted line *T*. The height of *T* above the center



Method of setting up Escapement Wheel to obtain Correct Tooth Angle

line of the wheel was next measured by the use of a height gage, and the depth of cut required to finish the milling operation was obtained by subtracting dimension *C* from this measurement.

As an example showing how the calculations are performed let angle $a = 60$ degrees; $b = 30$ degrees; $a + b = 90$ degrees; and $R = 0.375$ inch. Then

$$B = R \times \sin b = 0.375 \times 0.5 = 0.1875 \text{ inch}$$

and

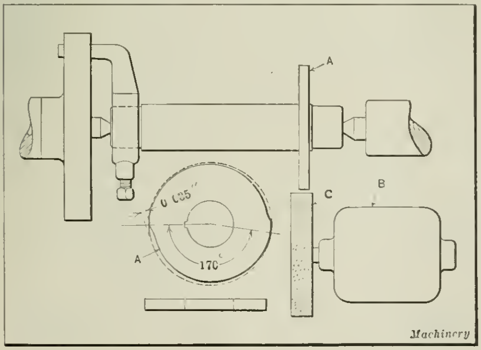
$$C = R \times \cos b = 0.375 \times 0.8660 = 0.3247 \text{ inch}$$

Cincinnati, Ohio J. F. Thornton

GRINDING A SPECIAL CAM

The special cam shown at *A* in the accompanying illustration was ground on a lathe by the use of a portable motor-driven grinder and a taper-turning attachment. The cam is about 3 inches in diameter, ¼ inch thick, and is of hardened steel. The edge or the contour is in the form of a double spiral, and the high degree of accuracy required made it necessary to use considerable care in grinding this edge. The piece was mounted on an arbor held between the lathe centers as shown, and the spiral ground by using a taper attachment and gearing the lathe as for screw cutting.

The 0.035-inch rise in the 170-degree sector was obtained by gearing the lathe for 2 threads per inch or, in other words, advancing the carriage ½ inch for each revolution of the work, and setting the taper-turning attachment to give a taper of 0.074 inch per inch, which is the rise or pitch in one complete revolution required to give a rise of 0.035 inch when the work is rotated through an arc of 170 degrees. The lathe can be geared for a finer pitch or lead,



Method of grinding a Special Cam

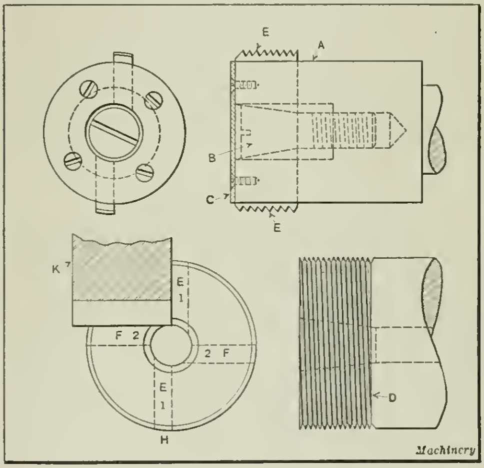
but this would necessitate setting the taper attachment to an angle which would be rather steep. The motor of the portable grinder employed is shown at *B* and the grinding wheel at *C*. The carriage on which the motor is mounted (not shown in the illustration) is run back and forth the same as in screw cutting. The compound rest is employed to feed the grinding wheel to the work.

A lathe without a taper attachment was used in a similar manner for grinding a small cam by setting the tailstock over, as in turning tapers. In this case the compound rest was set in line with the arbor. If it were necessary to grind a sharp corner at the point of drop in the cam, this could be accomplished by setting the grinding wheel in such a position that its face would cut at the upper corner only.

Providence, R. I. John T. Slocomb

ADJUSTABLE TAP

The adjustable tap shown in the upper view of the accompanying illustration was designed for tapping brass elbows to be assembled on pipes. The diameter of the threads on different lots, or orders of pipe, varied to such an extent that it was necessary to increase or decrease the diameter of the threads in the elbows to obtain the proper fit. Accordingly, the tap shown was provided with means of making sufficient adjustment to compensate for the maximum variation in the diameters of the pipe threads.



Adjustable Tap, and Blank from which Chasers are made

The tap consists of body *A*, a cone-shaped adjusting screw *B*, chasers *E*, and a cover plate *C*. The chasers were made from a piece of tool steel *D* which was threaded in a lathe to correspond with the nominal pitch and size of the required thread. Before removing this piece from the lathe, a tapered hole was bored to fit the taper of the adjusting screw *B*. After completing the threading and boring operation, piece *D* was placed on a milling machine and four cuts were taken. A section of the milling cutter is shown at *K* in the position which it occupied when taking the first milling cut. By properly indexing the work after each cut the metal was finally cut away so that only the four chasers *E* and *F* remained. These chasers were stamped with the numbers 1 and 2, as indicated in the view at *H*, after which they were hardened. It will be noted that two sets of cutters were obtained from one piece *D*, but of course only two chasers having corresponding numbers were used in the tap at the same time.

Rosemount, Montreal, Canada Harry Moore

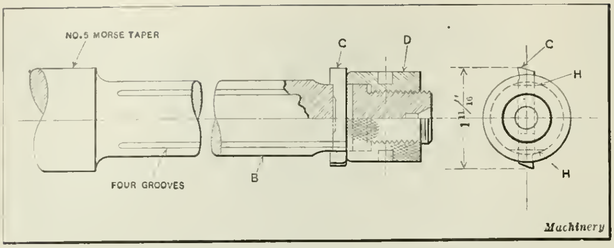


Fig. 1. Boring-bar used in boring Piston-pin Hole in Connecting-rods

FORGING LEAD MODELS FOR PRACTICE

Lead has proved to be an excellent metal for use in teaching forging practice. It requires no heating, and small models of various tools or articles can be readily forged or formed to the desired shape while cold. This is an advantage in schools or colleges when a considerable number of students are under instruction and the equipment is limited. Models for lathe and planer tools, for instance, may be formed from pieces of lead about 4 inches long, and 3/8 inch thick, by 3/4 inch wide, or 1/4 inch thick by 1/2 inch wide.

New Britain, Conn. WILLIAM C. BETZ

CONNECTING-ROD BORING-BARS

Two boring-bars used for boring the small and large bearing holes in Fiat automobile engine connecting-rods are shown in Figs. 1 and 2. These boring-bars are of the inserted-blade type, and are provided with cutter-locking features of an unusual type. In performing the boring operations, the connecting-rod is held in a horizontal position in a heavy jig. This jig is first placed on the table of a drilling machine, where the small end of the connecting-rod is drilled, bored with the boring-bar shown in Fig. 1, and reamed to fit the piston-pin. After finish-boring and reaming the piston-pin hole, the jig with the connecting-rod still in place is transferred to another drilling machine where the large, or crankshaft bearing, hole is drilled, bored with the boring-bar shown in Fig. 2, and then reamed to size.

The small boring-bar shown in Fig. 1 is made of a solid bar with the end tapered to fit the taper in the spindle of the drilling machine. A bearing *B* is ground to fit a bushing in the jig which serves to guide and support the tool. At the end of this bearing is the inserted cutter *C*, which is held in a rectangular hole in the bar. The cutter is notched to fit the dimension across flats *H*, milled in the bar at each end of the rectangular hole. This arrangement enables the cutter to be accurately located and held in place by nut *D*. Nut *D* has right-hand threads, so that any chatter of the tool will only screw the nut up tighter.

The larger bar shown in Fig. 2 is provided with a front pilot *C* which insures greater rigidity. Small cutter blades *E* inserted in holder *F* are employed, as solid cutters would be too expensive. In this design the clamping nut *A* is placed behind the cutter. Left-hand threads are used in order to keep the cutters or cutter-block tight. The inserted piece *F* is located in the rectangular hole, and has flats at *H*. The two cutter blades *E* are held securely in the slots in *F* by means of taper pins *D*. Pins *B* serve to locate and take the thrust of cutters *E*. The boring-bars described are not expensive to make and can be kept supplied with fresh cutter blades at a small cost.

Irvington, N. J. C. H. DENGLER

MEASURING DISTANCE BETWEEN CENTER-PUNCH MARKS

The device illustrated is designed for accurately spacing center-punch marks when laying out work, and for measuring or checking the distance between center marks already made in the work. The main body *A* is made of machine or tool steel, the latter being preferable. The micrometer head support *B* and the stop support *C* are made of machine steel. The measuring or marking centers *D* and *E* are made of tool steel, and are hardened and ground to a conical point having a 60-degree angle. The head support *B* should be a good sliding fit in the elongated slot in body *A*, and no up-and-down or sidewise play should be allowed. The stop support *C* is stationary in the main body, and is provided with an adjustable stop-screw *F*, which is locked in place by screw *G*. Center *D* moves with the micrometer head support *B* into which it is screwed.

Center *E* should have no play in any of the equally spaced holes in which it is inserted. The holes for center *E* are spaced exactly one inch apart, and the number of holes depends on the purpose for which the device is to be used. In this particular case centers *D* and *E* can be brought to within 2 inches of each other. In making a device of this kind, it is best to machine and assemble all the parts before boring the holes for center *E*. By bringing the spindle of the micrometer head up against the stop, it is a simple matter to locate the first hole for center *E* at a distance of 2 inches from center *D*. The positions of the succeeding holes may then be laid out and accurately machined—preferably in a milling machine.

In using this device for measuring the distance between any two center marks, it is only necessary to move center *E* to the proper hole in body *A*, and adjust the micrometer head support which carries center *D* until both points or centers are located in the punch-marks. Next

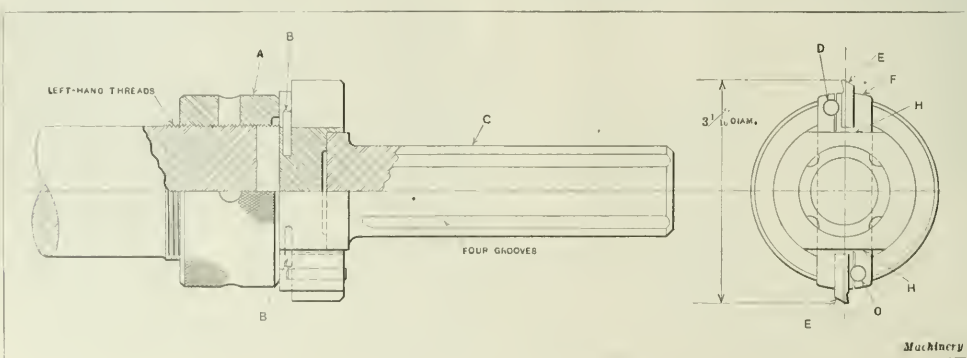
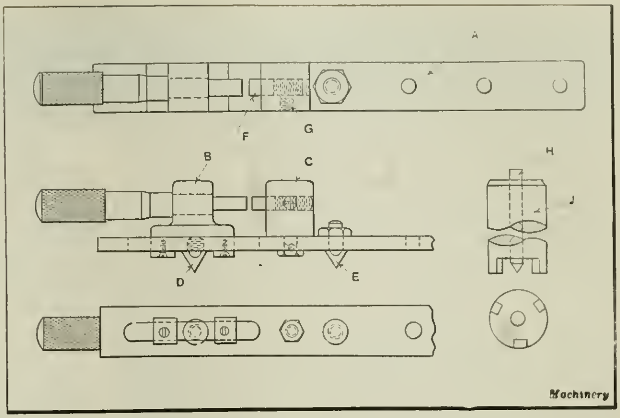


Fig. 2. Boring-bar for boring Crankshaft Hole in Connecting-rods

turn the micrometer head up until the spindle strikes stop F and take the micrometer reading, which will enable the distance between the center-punch marks to be accurately determined.

To lay out dimensions, centers D and E are moved to the correct positions, and a light hammer blow is given to the device above each of the centers in order to make slight impressions in the work, which may be enlarged by using the center-punch and holder shown in the lower right-hand corner of the illustration. Referring to this view, punch H is a piece of hardened drill rod ground to a conical point having an angle of 60 degrees. This punch is a sliding fit in block J which holds it in a vertical position when delivering the hammer blow.



Device for measuring Distance between Center-punch Marks

If the distance between the center-punch marks is found to be incorrect, one of the punch marks can be shifted by using an ordinary center-punch held at an angle with the face of the work. After the center mark has been moved in this way, the punch shown can be used to straighten up the center before again measuring the distance between the marks. This measuring device has proved very handy for laying out work on jigs, fixtures, and dies and it is also very dependable for measuring lengths. The writer has found that spacings aggregating many feet show a variation of but a few thousandths inch in total length when this device is used.

Ilion, N. Y. D. R. GALLAGHER

RELIEVING WORN TWIST DRILLS

Twist drills that have the lands worn down until there is insufficient relief back of the cutting edges of the flutes, or drills that have been ground down for special work, may be put into serviceable condition by regrinding in the following manner. The drill should first be trued up in the chuck of a cylindrical grinder, after which the periphery should be ground to clean up all worn portions and bring the drill down to a size, or diameter, that is commonly employed in the shop. In performing this grinding operation, care must be taken to back-taper the drill from 0.003 to 0.006 inch per foot, the amount depending on the size of the drill. This grinding should be done with a hard and comparatively fine-grained wheel. On small machines a No. 60 J alundum wheel has been found to give good results. As the cut is intermittent, on account of the flutes, and as no support is provided on the outer or cutting end of the drill, the depth of cut or feed should be light.

The drill is next placed in the V-block fixture shown in Fig. 1. This V-block and an additional block for supporting the shank of the drill are then placed on the magnetic chuck of the surface grinder in an angular position relative to the wheel, as shown in Fig. 2. After locating in this position, the drill is drawn past or under the grinding wheel, the V-block being set at an angle of about 20 degrees from the center line of the grinding machine spindle. The spring-plunger finger A, Fig. 1, guides the drill as it is pushed or drawn past the wheel, imparting a rotary or spiral motion to it. The plunger is left soft to prevent roughing or scratching the cutting edge of the drill flute. The platen of the machine, of course, remains stationary while the drill is being fed back and forth past the grinding wheel.

The amount of clearance can be regulated by adjusting the platen in relation to the wheel. In passing the drill through the V-blocks, a rotary motion is given to the work, which results in a clean-cut spiral relief back of the cutting edge of the flute. The width or amount of land may be regulated to suit the conditions of service. For the relieving operation, a No. 46 I Norton wheel is satisfactory.

New Britain, Conn. WILLIAM C. BETZ

* * *

INDUSTRIAL CONDITIONS IN RUSSIA

An almost inconceivable slump in Russian industries is indicated by the following figures compiled by the Department of Commerce from various reliable sources, showing the production of different industrial products during 1920, as compared with the production of the same products in Russia annually previous to the war: Pig iron, 2 per cent; copper ore, 0.6 per cent; rubber industry, 5 per cent; sugar industry, 5 per cent; cotton industry, 3 per cent; woolen industry, 4 per cent; coal production, 20 per cent. An average for all industries indicates that the production was less than 10 per cent of the pre-war production. The number of railway cars in running order is about one-half the number in use previous to the war. The road-beds are reported in very bad condition, and if extensive repairs are not made within the next few months, some sections of the railroads will have to be entirely closed to traffic. According to the latest estimate, at least 25,000,000 ties must be replaced. A considerable mileage of branch lines has been removed, the material being used for repairs on the main lines.

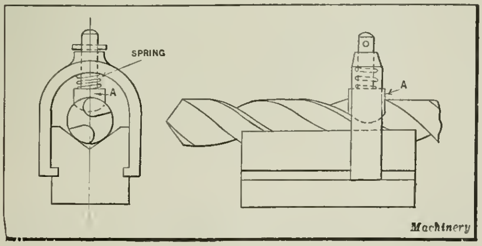


Fig. 1. V-block provided with Spiraling Device

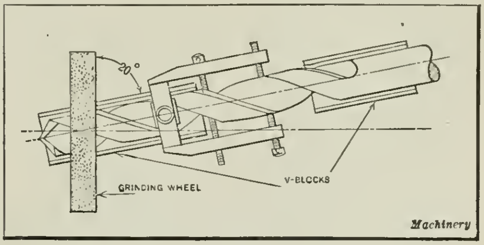
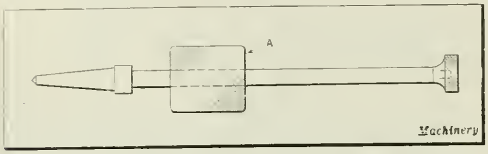


Fig. 2. Set-up for relieving Twist Drills

SHOP AND DRAFTING-ROOM KINKS

PRICK-PUNCH FOR ACCURATE WORK

The illustration shows a prick-punch having a long shank upon which a weight *A* may readily be slid. When desiring to produce a mark on a piece of work, the punch shank is held perpendicular to the work, after which the weight is lifted and allowed to drop on the shoulder of the punch. This tool is especially useful in laying out fine work, it being possible to produce a punch mark in much less time than with an ordinary punch and hammer. A small knurled head is attached to the upper end of the shank to prevent removal of the weight from the tool.



Prick-punch provided with Weight to facilitate the Marking of Work

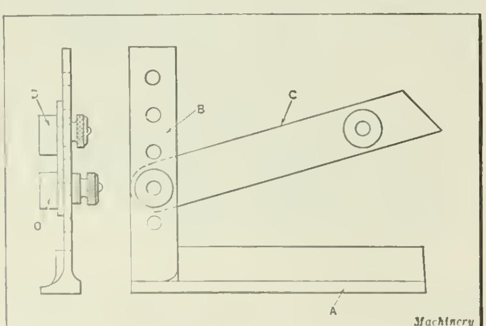
Rosemount, Montreal, Canada — STANLEY ALMOND

SINE-BAR TAPER GAGE

In turning or grinding tapers, it often happens that no suitable gage is available, and the only recourse is to gage the piece being ground by inserting it in the machine spindle or part in which it is to be used. The sine-bar taper gage shown in the accompanying illustration is designed to facilitate the gaging of the taper when performing this class of work. The simplicity of the design permits this device to be made by any skilled mechanic. The base *A* should be square with the sides and outer edge of the vertical blade section *B*. The holes in the blade must be accurately located from the bottom of the base or beam *A* and at an even distance from the outer edge of the blade. The adjustable blade *C* should be ground square, and so that its sides are parallel. The two holes for buttons *D* must be the same distance from one edge and have a given center distance, which in the case of the gage shown is 3 inches.

The procedure in setting the tool is practically the same as for a regular sine bar. It will be noted that the bottom of the beam projects the same distance as the buttons, so that micrometers may be used for setting. With this device, tapers and angles within the range of the instrument can be accurately measured.

New Britain, Conn. — WILLIAM C. BETZ



Sine-bar Taper Gage

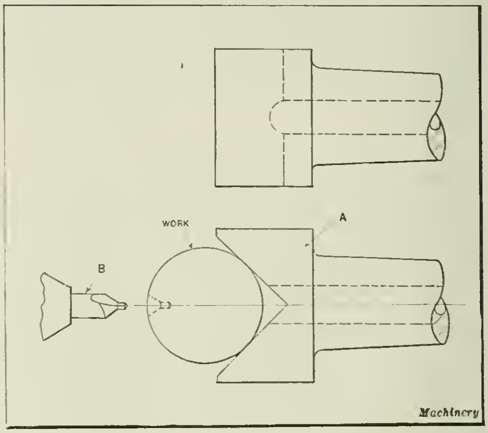
ENLARGING A REAMED HOLE

It sometimes happens that a hole is to be produced in a piece a few thousandths inch larger than the reamer will normally cut. This may be done by placing wires in two adjacent flutes of the reamer so that one side of the reamer rides on the wires, which should not project over 0.002 inch beyond the cutting edges.

New Britain, Conn. — WILLIAM C. BETZ

VEE FOR LATHE TAILSTOCK

The lathe tailstock vee shown at *A* in the accompanying illustration is intended for use in drilling small holes through round stock or such small parts as wrench handles, etc. The taper shank fits the hole in the tailstock, and has a hole drilled through the center as indicated. By placing the work in the vee as shown, then employing a center drill *B*, and afterward the size drill required, a hole can be drilled through the work that will be accurately centered.



Vee used in drilling Round Stock

Ontario, Cal. — J. HOMEWOOD

RENEWING WORN CORNERS OF DRAFTING-BOARD

The following method can be used to prevent the surface of a drawing-board from being damaged by the insertion of thumb-tacks. With a wood bit about ¾ inch in diameter, bore holes through the board near the corners where the thumb-tacks are to be inserted. Carefully measure the diameter of the hole in the board (as all bits do not bore to size) and have a hole drilled in a piece of iron plate the size of the hole in the board. Next, obtain a piece of white pine, poplar or similar wood, shave it down almost to size, and drive it through the hole drilled in the iron plate. Then, using a miter box, cut this piece into sections equal in length to the thickness of the board. Drive four of these sections or pieces into the holes in the drawing-board so that their ends will be flush with the upper surface of the board. When these pieces have become worn, it is a simple matter to reverse them in the board or insert new ones. For some work such as free-hand drawing, an ordinary cork can be used in place of the wooden plugs.

Fort Wayne, Ind. — NELSON HALL

HOW AND WHY

QUESTIONS ON PRACTICAL SUBJECTS OF GENERAL INTEREST

STANDARDS FOR COMPOSITION GEARING

W. E. G.—Have any standards been adopted for rawhide and other non-metallic gearing?

A.—Standards for composition gearing were adopted by the American Gear Manufacturers Association in 1919. An abstract of the specifications adopted was published in MACHINERY, January, 1920, page 476.

FORMING DIE PROBLEM

ANSWERED BY J. F. THORNTON, CINCINNATI, OHIO

The following method of forming a shell of the shape shown at *A*, Fig. 1, is proposed as a solution for the problem submitted by R. A. B. in April MACHINERY, page 792. The writer wishes to state that the extrusion-by-oil principle incorporated in the method to be described has proved practical for the production of similarly shaped shells of lighter material. Some experimental work, however, is necessary to obtain satisfactory results. In the problem as submitted some of the work had already been performed on the shell, and for such partially completed work the writer can offer no solution. However, it is assumed that it is not necessary to carry out the forming operations in any particular order. In producing the shell the writer would first form a straight tube having an inside diameter of 1 1/16 inches as shown at *A*, Fig. 2. The length of this tube can best be determined by experiment. After forming the straight tube, the open end should be curled in to the shape shown at *B*.

The extruding operation, which completes the forming of the shell, should be performed in a split die consisting of two members *C* and *D*, Fig. 1. One half *D* of the die is hinged, which permits the die to open on center line *X–X*. After filling the closed-in shell with an oil of low compressibility, it is inserted in the extruding die. In descending, the plunger *E* first effectually closes the vent *F*, and then as it continues on its downward stroke it compresses the oil so that it will flow to the points of least resistance as indicated by the arrows. This action forces the metal into the crevices of the die, thus giving the shell the desired form.

The writer would make the capacity of the first trial tube, as shown at *B*, Fig. 2, about 1¼ times the capacity of the finished piece. If the cubical contents of this shell are too great, the plunger cannot be forced deep enough, and if the capacity of the shell is too small, the corners of the shell will not be square. A number of small vent holes, as shown in Fig. 1, should be drilled in the hinged die member *D* to release the air which would otherwise be trapped in the corners of the die. These holes must be small or the metal will be extruded at the points where they enter the die cavity.

Some slight difficulty may be encountered in preventing the spherical form at the top of the tube shown at *B*, Fig. 2, from becoming wrinkled. It should be borne in mind that the smaller the hole at the top of the spherical end of the tube, the better will be the results obtained in the final forming operation. As a last resort, hole *F* might be closed by soldering after the tube has been filled with oil. After the last forming operation, the holes at the top and bottom of the shell may be finished by drilling.

INTERNATIONAL PATENT PROTECTION

H. A. F.—Is there such a thing as an "international patent," that is, some kind of patent that, under an agreement between various countries, will protect an inventor in a number of countries by the making of a single application? In that case, does such a patent protect a foreign inventor in the United States for a given time, and if so, for how long?

A.—There is no such thing as an international patent. Under the International Convention for the Protection of Industrial Property, inventors may file applications in the countries that have agreed to this convention at any time within twelve months from the filing of the application on which a patent would be issued in any one of the countries; but in order to obtain patent protection in the different countries, separate applications must be filed in each.

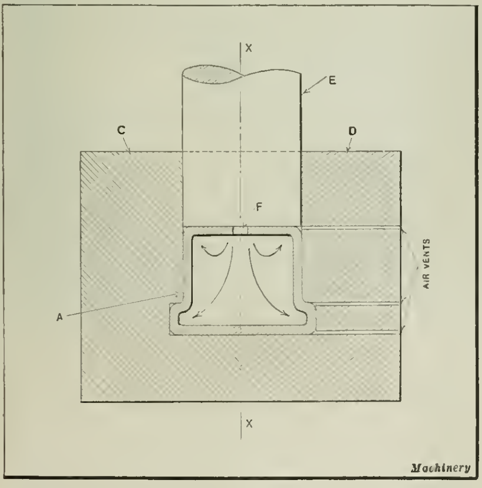


Fig. 1. Sectional View of "Oil Extrusion" Die for Final Forming Operation on Shell A

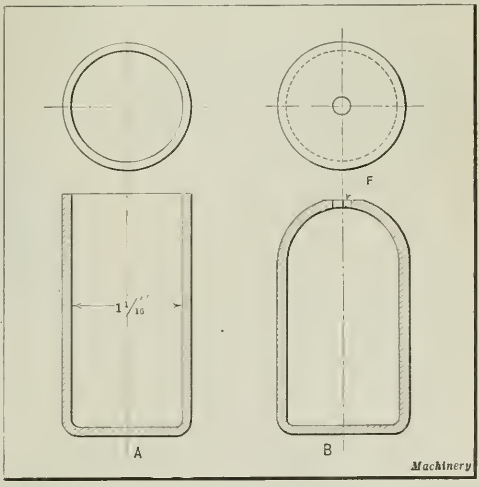


Fig. 2. Shell after First and Second Operations preparatory to forming in Die shown in Fig. 1

PROBLEM IN GAGE DESIGN

H. A. B.—In designing the gage shown in Fig. 1, a mathematical problem is involved which requires the solution of angle β. How can the magnitude of this angle be found?

ANSWERED BY W. W. JOHNSON, CLEVELAND, OHIO

A.—With the values for a, b, h, and r given in Fig. 1, the magnitude of angle β can be calculated as follows (see Fig. 2):

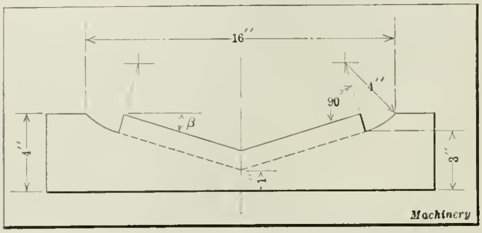


Fig. 1. Gage having Angular Surface, involving Mathematical Calculations

$$z = h \cot \beta; \text{ also } z - x = r \sin \beta$$

Then

$$x = h \cot \beta - r \sin \beta \quad (1) \qquad y = h + r \cos \beta \quad (2)$$

$$r^2 = (y - a)^2 + (b - x)^2 \quad (3)$$

Substituting (1) and (2) in (3),

$$r^2 = (h + r \cos \beta - a)^2 + (b + r \sin \beta - h \cot \beta)^2$$

Expanding and combining,

$$(a - h)^2 + b^2 - 2ar \cos \beta + 2br \sin \beta - 2bh \cot \beta + h^2 \cot^2 \beta = 0$$

But

$$\sqrt{1 - \sin^2\beta} = \cos \beta \text{ and } \frac{\sqrt{1 - \sin^2\beta}}{\sin \beta} = \cot \beta$$

Then

$$(a - h)^2 + b^2 - 2ar\sqrt{1 - \sin^2\beta} + 2br \sin \beta - \frac{2bh\sqrt{1 - \sin^2\beta}}{\sin \beta} + \frac{h^2(1 - \sin^2\beta)}{\sin^2\beta} = 0$$

Clearing of fractions, factoring, and transposing,

$$(a^2 + b^2 - 2ah) \sin^2\beta + 2br \sin^3\beta + h^2 = 2 \sin \beta \times (ar \sin \beta + bh) \sqrt{1 - \sin^2\beta}$$

Squaring both sides of the equation, combining, and arranging terms with reference to sin β, we get

$$4r^2(a^2 + b^2) \sin^6\beta + 4br(a^2 + b^2) \sin^5\beta + [(a^2 + b^2 - 2ah)^2 + 4(b^2h^2 - a^2r^2)] \sin^4\beta - 4bhr(2a - h) \sin^3\beta + 2h^2(a^2 - b^2 - 2ah) \sin^2\beta + h^4 = 0 \quad (4)$$

Substituting the known values in Equation (4) we obtain

$$4672 \sin^6\beta + 9344 \sin^5\beta + 4169 \sin^4\beta - 1024 \sin^3\beta - 536 \sin^2\beta + 16 = 0$$

Solving this equation by Horner's method, we find Sin β = 0.3000244, and angle β = 17 deg. 27 min. 33 sec.

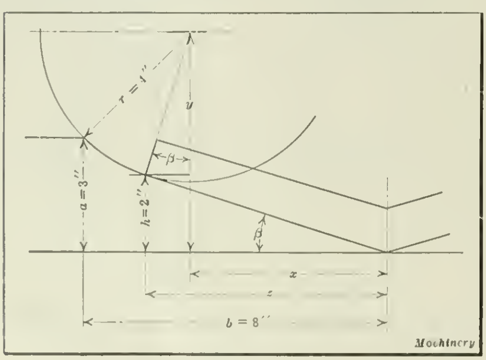


Fig. 2. Diagram used in the Solution of the Gage Angle

COST OF CYLINDER REGRINDING EQUIPMENT

H. E. W.—Will you please tell me what equipment is required for handling a small gas engine cylinder regrinding business and what would be the approximate initial expenditure?

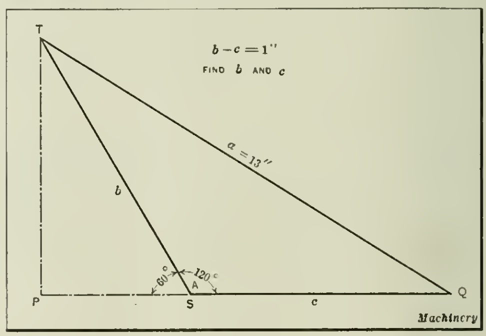
A.—It would be necessary to have a fully equipped bore-grinder, costing about \$2500 when new; a small lathe which can be bought for about \$200; a drilling machine costing about \$125; a supply of over-size pistons costing \$2.60 each, say half a dozen sizes in sets of four, representing \$62.40; piston-rings for the pistons at 30 cents a piece, \$7.20; wrist-pins, \$15; small tools, not over \$100; making a total of slightly over \$3000. If a small cylindrical grinder for external work is included (or a grinding attachment for the lathe), over-size pistons could be ground to size from the semi-finished state and their cost correspondingly lowered, resulting in ultimate economy.

DETERMINING THE LENGTHS OF TWO SIDES OF AN OBLIQUE TRIANGLE

H. W. P.—The accompanying illustration shows an oblique triangle in which the difference between the lengths of sides b and c = 1 inch; the length of side a = 13 inches; and angle A = 120 degrees. How can the lengths of sides b and c be found?

ANSWERED BY C. N. PICKWORTH, MANCHESTER, ENGLAND

In the following is given a solution to this problem which is believed by the writer to be simpler and more direct than that presented on page 580 of February MACHINERY. Referring to the accompanying illustration, continue QS to



Oblique Triangle of which the Lengths of Sides b and c are to be found

P and draw TP at right angles to PQ. It will be obvious that angle TSP = 60 degrees. Then, PS = ½ ST and PT = $\sqrt{3}$ × ½ ST. Also, if $b - c = 1$, $b = c + 1$. Therefore,

$$QP = c + \frac{c + 1}{2} \text{ and } PT = \sqrt{3} \times \frac{c + 1}{2}$$

Hence

$$\left(c + \frac{c + 1}{2}\right)^2 + \left(\sqrt{3} \times \frac{c + 1}{2}\right)^2 = 13^2 = 169$$

$$\frac{9c^2 + 6c + 1}{4} + \frac{3c^2 + 6c + 3}{4} = \frac{12c^2 + 12c + 4}{4} = 169$$

$$3c^2 + 3c + 1 = 169$$

$$3c^2 + 3c = 168$$

$$c^2 + c = 56$$

Then

$$c^2 + c + 0.25 = 56.25$$

$$c + 0.5 = 7.5$$

and

$$c = 7.5 - 0.5 = 7 \text{ inches}$$

Finally, as

$$b = c + 1$$

$$b = 7 + 1 = 8 \text{ inches}$$

DUPLEX MULTI-SPINDLE TURRET MACHINE

The machine shown in the accompanying illustrations, which is built by the Blomquist-Eck Machine Co., Cleveland, Ohio, is intended for work that is to be machined from both ends simultaneously and on which a number of turning, boring, facing, drilling, and threading operations have to be performed. The machine is entirely automatic, except that it is loaded and unloaded by the operator. It consists mainly of a revolving turret for holding the work and six work-spindles operating upon the work, three from each side, two of these being roughing spindles, two finishing spindles, and two drilling and threading spindles. The turret has eight flat faces, each with a groove in the center to receive the tongue of the work-holding fixture. While the work is being performed, the turret and the work being actuated upon remain stationary and the spindles holding the cutting tools rotate. These spindles are fed in to the work automatically by means of cams, after which they return rapidly to the outward position, when the work-holding turret is automatically unlocked, the index-plunger released, and the turret automatically indexed to the next station, at which time the index-plunger drops into the next index-hole in the turret. The turret is then automatically locked, after which the same cycle is repeated.

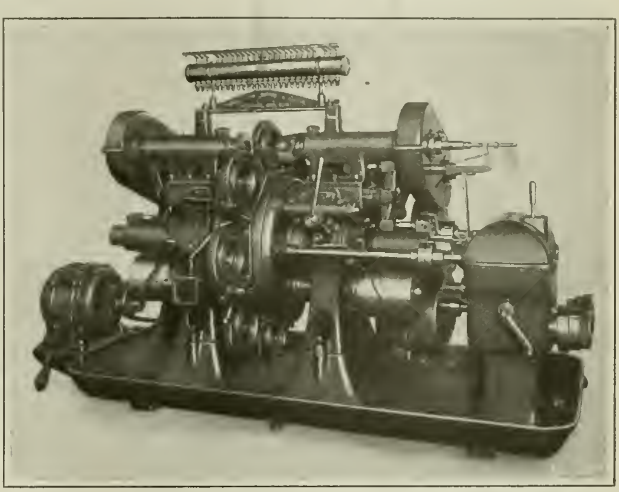


Fig. 1. Duplex Multi-spindle Turret Machine made by the Blomquist-Eck Machine Co.

The machine is motor-driven. Power is transmitted from the motor to a jack-shaft at the rear of the machine by means of a chain drive, and from the jack-shaft another chain drive transmits power to the finishing spindles; from these, in turn, power is transmitted by a chain drive to the roughing spindles. There is also a separate chain drive from the jack-shaft to the die-head and drilling spindles. These chain drives are duplicated at each end of the machine.

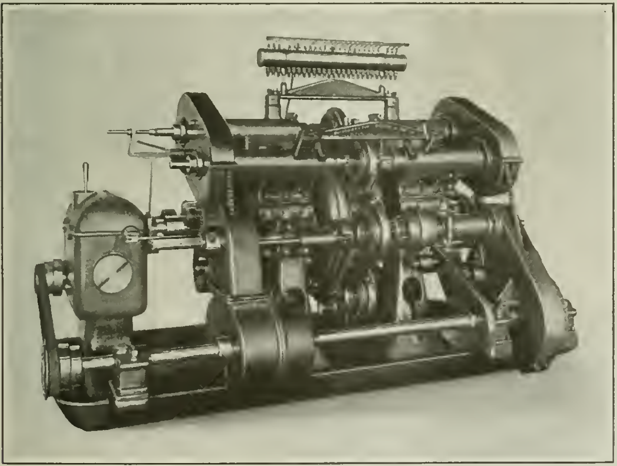


Fig. 2. Rear View of Blomquist-Eck Duplex Multi-spindle Turret Machine

The feed to the spindles is actuated from the jack-shaft through a gear-box. The drive from the jack-shaft to the gear-box is by a belt on a three-step cone pulley, from which the motion is transmitted by a pair of helical gears, and a worm and worm-wheel to a shaft geared to the shafts on which the cams are mounted. The indexing is also controlled by the mechanism in the gear-box, which is so arranged that the feed motion is temporarily disengaged while the indexing takes place. At the front of the gear-box a crank is provided for hand adjustment and for setting the spindles when setting up the machine. The gear-box runs in a bath of oil. The sub-base and pan of the machine are cast hollow and act as a reservoir for holding the oil, a pump being provided for the circulation of the lubricant.

The main advantage of the machine is its capacity for machining pieces from both ends at one setting, assuring on the one hand concentricity and accuracy in the product, and on the other, increased production because of the reduced amount of handling. The machine was originally designed for the machining of Studebaker automobile front and rear stamped steel hubs, of which a production of 520 hubs in ten hours was obtained.

The large production required in the automobile field has paved the way for special automatic machinery of the type described. The necessity for reducing manufacturing costs to meet present prices in the automobile field makes the need for labor saving machinery all the more urgent.

* * *

LABOR AND READJUSTMENT

Large classes of labor have taken their losses by severe wage cuts. Among those that have accepted them have been many skilled crafts which have seen that in the long run wages on the new basis will have a purchasing power equivalent to that when wages were higher.

Certain classes of labor contrast unfavorably, however, with labor as a whole. The time is not far distant when not only that uncertain group known as the "general public" but those sections of it consisting of other classes of workers and farmers will have come to a realization that labor pays its own wages, which are ultimately measured, not in money, but in goods. The money wage only measures the estimated worth to other consumers of the goods produced by the wage earner. When any class of labor attempts to force its wages out of line with other wages and the price level, that group endeavors primarily to take advantage, not of capital, but of other workers, who must suffer as others gain.—*National Bank of Commerce*

The Metal-working Industries

NOTWITHSTANDING present conditions in the machine tool industry, which, regarded by themselves would offer but little encouragement to those engaged in this basic field, it is not impossible, in surveying the entire metal-working field, to share the belief that a change for the better is in sight. It is natural that the machine tool industry should be in a state of depression when the iron and steel industry as a whole is declining or remaining stationary at a point of low activity. But when iron and steel show definite signs of renewed activity, there is every reason to believe that a demand for machine tools will make itself felt within a reasonable time. It has been aptly said that "the only use for machine tools is to cut up iron and steel," and unless there is some iron and steel to be cut up, there can be no demand for machine tools.

Everyone engaged directly or indirectly in the machine tool field should therefore note that all reports from the iron and steel industry confirm a continued improvement in orders, operation, and inquiries. There is slow but steady improvement in the entire iron and steel trade, from pig iron to finished products. The United States Steel Corporation, as a whole, is operating at about 35 per cent capacity, as against 25 per cent a few weeks ago, and the operation for the entire industry is placed at about 40 per cent, with 50 per cent in sight. Tin plate mills are working at considerably more than 50 per cent, and sheet mills at nearly 85 per cent of their capacity. As a consequence, prices of sheet steel have advanced $5 a ton, and prices on bars, shapes, and plates have been advanced by some companies from $1 to $3 a ton. The demand for pipe and wire is also stronger, and the market for structural materials is more active.

General Conditions in the Machine-building Field

Another indication of a slow but definite improvement in the metal-working industries is reported from the small tool manufacturers, who, in general, found the lowest point of their business reached in June or July, with a gradual gain since that time. Isolated cases of great activity in the machine-building field may also be mentioned. One large Pennsylvania engine builder operates day and night in the building of steam shovels for construction work, and another large Pennsylvania shop keeps its plant occupied on nail-making machinery. In the northern Ohio district, in and adjacent to Akron, the tire mold business shows activity. In the gear-cutting field, where the depression was felt much later than in the machine tool field, there has been considerable reduction in activity, and many plants are running at greatly reduced capacity; yet in the case of manufacturers engaged in cutting automobile service gears, very active business is reported, one manufacturer, at least, running two shifts.

Some of the gray iron foundries are running full time with full force, but prices on castings have been reduced to such a point that practically all profit has been wiped out and just the bare costs are covered. In many lines of machine tools, so substantial have been the reductions that further price cuts cannot be expected.

The Railroad Situation

Most manufacturers of medium and heavy machine tools, as well as dealers handling these lines, agree that unless the railroads are in a position to buy within the near future, there is no immediate prospect for any considerable business in this class of machines. At the present writing, just when the constantly increasing operating income of the railroads might have placed them in a position to rehabilitate their shop equipment and rolling stock, comes the threat of a nation-wide railroad strike against accepting the 12 per cent wage reduction which became effective July 1. It is most unfortunate that at the very moment when the railroads were in a position to buy shop equipment, the unions should deal them another blow from which it may take them a long time to recover.

The net railway operating income in August amounted to over $85,000,000, contrasted with the deficit of $150,000,000 in the same month a year ago; and this in the face of the fact that the railroads will pay labor in 1921, on the basis of the wages paid in the first six months of the year, $1,175,000,000 more than in 1917. Furthermore, the railroads have been seriously contemplating the reduction of freight rates, and in some instances such reductions have already taken place. All these steps toward more favorable industrial conditions may now be frustrated by the action of the railroad unions. It has been estimated that $1,600,000,000 is needed to bring the railroads of the country back to the standard of 1911. If the railroads continue to pay excessive wages, there will be nothing left for necessary improvements and equipment, and sooner or later they will have to pass into receiverships.

The Automobile Industry

The reports from different automobile manufacturers vary considerably. On the whole, automobile production is decreasing for the moment, this being the usual seasonal falling off, and the output in October is estimated to be 20 per cent less than during the previous month. Ford production, which has been at high tide for the last five months, each month breaking the record of the previous one, has dropped off from 10 to 15 per cent. On the other hand, there is an increasing demand for some of the higher priced cars, and the Cadillac and Packard plants are reported to be operating at a higher capacity than at any time during the past year. More Franklin cars were also shipped in September than during August, and in the trade this is interpreted as indicating that the purchasers of higher grade cars are convinced that industrially the country has now turned the corner. Another sign of increased activity is the report of the Motor and Accessory Manufacturers' Association, that purchases of parts have somewhat increased, and that there are fewer unpaid accounts and notes outstanding.

Labor Conditions

During the month of September, according to the statistics of the Department of Labor, there was an increase of 1.2 per cent in the number of men employed in the plants included in the Department's survey, the increases being mainly in the textile and iron and steel industry and in the railroad field. The influence of the labor unions in retarding the return of industrial activity by refusing to accept reasonable wage reductions is indicated in a statement by George E. Roberts of the National City Bank of New York, who says:

"One-half of our population is engaged in producing foodstuffs and raw materials, a considerable share of which must be exported and sold in world markets. These products have fallen almost to the pre-war level, while the products of urban industries, held up by labor costs and understandings of various kinds, have undergone comparatively slight reductions. The result is that the producers of the former goods can buy but one-half as much of the products of urban industries as formerly. There can be no revival of prosperity until a readjustment of these relations is accomplished."

NEW MACHINERY AND TOOLS

THE COMPLETE MONTHLY RECORD OF NEW AMERICAN METAL-WORKING MACHINERY

The New Tool descriptions in MACHINERY are restricted to the special field the journal covers—machine tools and accessories and other machine shop equipment. The editorial policy is to describe the machine or accessory so as to give the technical reader a definite idea of the design, construction, and function of the machine, of the mechanical principles involved, and of its application.

How To Reduce Production Costs ?

Davis-Bournonville Tube Manufacturing Equipment

A COMPLETE line of equipment for the oxy-acetylene welding and fabricating of tubing for use in the construction of automobiles, bicycles, motorcycles, furniture, office appliances and machinery, in which strength combined with lightness is a prime requisite, has been developed by the Davis-Bournonville Co., Jersey City, N. J. This line includes gang-slitting, tube-forming, welding, straightening, seam-grinding, cutting-off, swaging and bending machines and draw-benches.

Manufacturing plants which are equipped with this line of machinery have the means for producing tubes of any common diameter and gage on short notice. Commercial steel sheets of any gage between Nos. 10 and 22 may be cut into strips, formed into tubes from 5/8 to 4 inches in diameter, and welded. Thus it is unnecessary to carry in stock tubes of many diameters and gages to meet anticipated uses, but instead, commercial sheets may be bought in the open market, as required, or sheet stock in few gages may be kept on hand ready for slitting, forming, welding and subsequent fabrication. It is generally found advantageous to purchase tube stock in strips trimmed to the required widths, as this practice results in comparatively little waste.

Slitting and Tube-forming Machines

When tubing is made from commercial sheets, slitting machines are required to cut the sheets into strips suitable for the forming operation. The lengths of tubing before drawing are limited to the length of the sheets used. If tubing is produced from strip stock, a slitter is not required unless it is necessary to trim the strips to width, in order to insure uniformity and smooth edges. A gang slitter is shown in Fig. 1. The shafts of this machine are made of alloy steel, ground and fitted with keys for the entire working length. Provision is made for simultaneous adjustment of the bearings, thus maintaining accurate alignment. The cutters are made from steel forgings, accurately ground, and are resharpened by face-grinding, which results in the original settings being maintained. The cutters are used in opposed pairs and are set up by means of wide and narrow ring spacers.

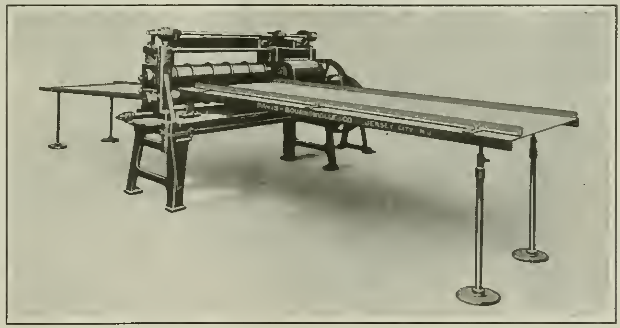


Fig. 1. Machine for slitting Commercial Steel Sheets, which is built by the Davis-Bournonville Co.

One end-bearing housing may be drawn off the shafts through the operation of a screw, and then swung out of position to permit the removal of cutters and spacers. The latter can be changed in a few minutes. Tables having a width equal to that of the widest sheet which can be accommodated by the machine are placed on each side of the cutters, the feed table being equipped with adjustable guides. The power is conveyed to the machine through a friction clutch, and the normal cutting speed is 50 feet per minute. Gang slitters are built by this company in various styles and sizes for cutting steel sheets ranging from 18 to 52 inches in width and up to No. 10 gage in thickness.

Tube stock, whether cut from mill sheets or supplied in rolled strips, must be form-rolled preparatory to welding. The Davis-Bournonville tube-forming mills are of the two- and three-roll stand types, the former being illustrated in Fig. 2. It comprises a break-down and finishing roll stand. The machine is operated by one man who handles both the strips and the formed tubes. A

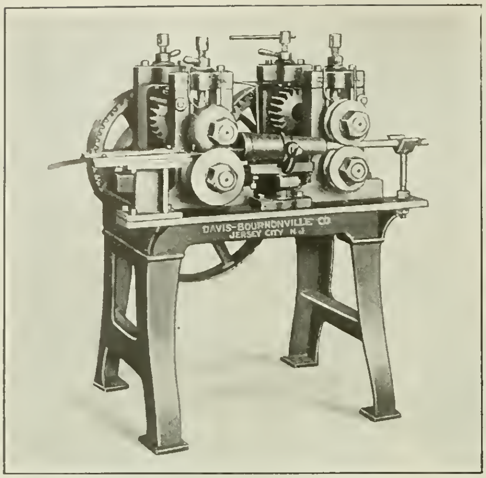


Fig. 2. Two-roll Stand Type of Tube-forming Mill

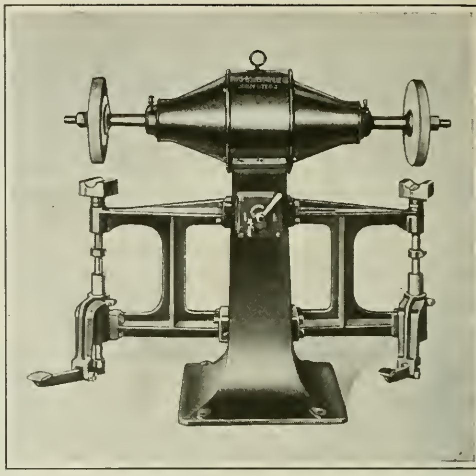


Fig. 3. Machine for grinding off Ridge produced in Welding

hollow conical conductor between the roll stands completes the forming started by the first pair of rolls, and the second pair compresses the formed tube into a truly circular shape. Adjustments of the tube-forming rolls may be made while the machine is in operation. The speeds are from 50 to 100 feet per minute, depending on the diameter and gage of the material being operated upon. The three-roll stand tube-forming mill is similar in construction and arrangement to the two-roll type, except that it is provided with an extra stand of rolls.

Tube-welding Machines

From the tube-forming machine the tubing goes to a welding machine and thence to an inspector's station at which unwelded spots are welded by means of hand torches. The No. 1 tube-welding machines illustrated in Fig. 4 are built for right- or left-hand operation, and with or without a motor drive and push-button control. The usual power equipment comprises a 230-volt adjustable-speed direct-current motor, field rheostat, magnetic control panel and push-botton station, with reverse. There are thirty-six different speeds, which is ample for all gages of metal and diameters of tubing within the capacity of the machine. The motor drives through a belt, and dynamic braking gives instant control. Starting, stopping, and reversing of the machine are effected without shock. The rolls are individually adjustable for alignment, and the guide rolls are adjustable relative to the welding rolls. The welding rolls are vertically adjustable to compensate for the stresses produced by the contraction of the cooling metal.

The welding torches used on these tube-welding machines are of the multiple-flame type, the number and arrangement of flames varying with the gage and diameter of the tubing, speed of welding, and kind of metal. The larger tips are

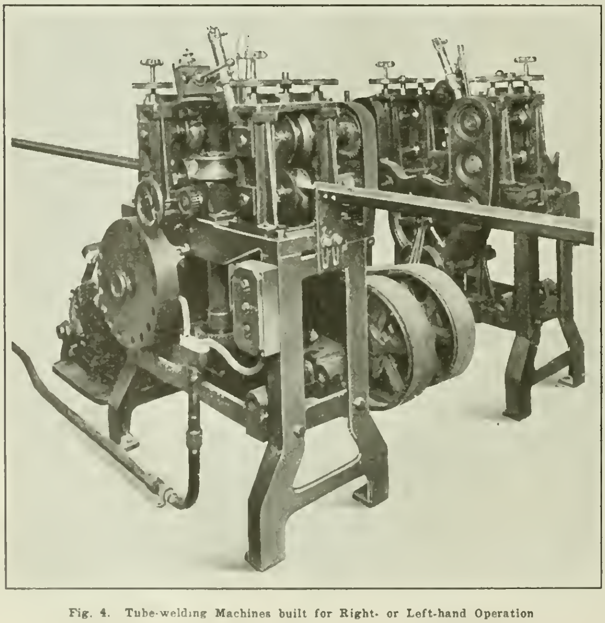


Fig. 4. Tube-welding Machines built for Right- or Left-hand Operation

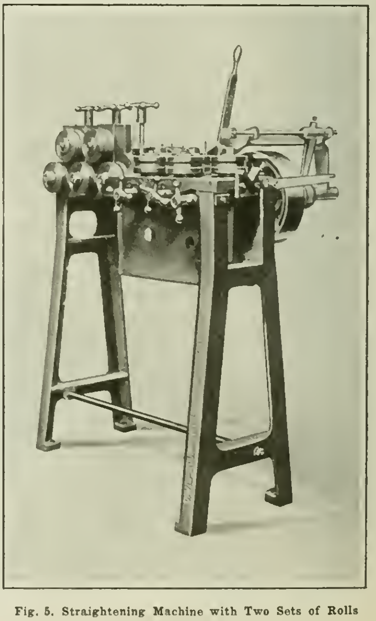


Fig. 5. Straightening Machine with Two Sets of Rolls

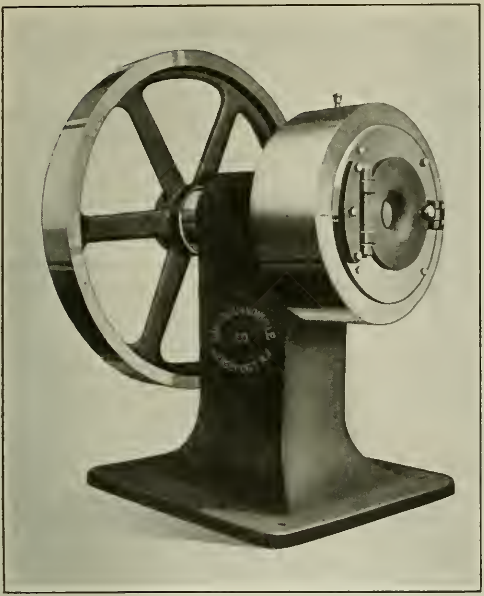


Fig. 6. Rotary Swaging Machine with Ten or More Rolls in the Head

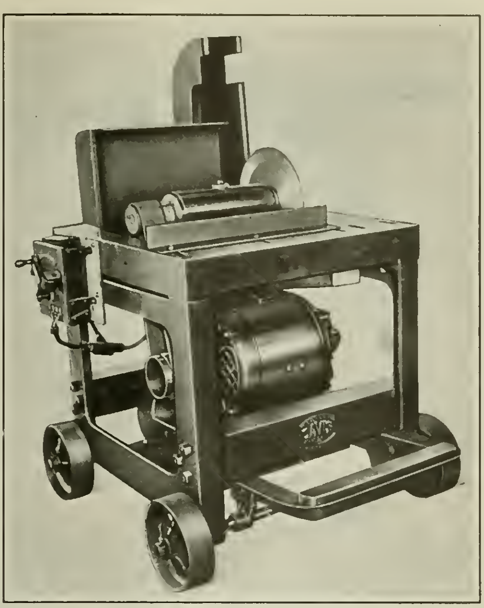


Fig. 7. Motor-driven Tube-cutting Machine having an Oscillating Head

water-cooled in order to maintain uniform heating conditions, the cooling water being circulated through the tip and then into the barrel of the torch. Rolls are furnished for any diameter of tube from ½ to 3 inches, inclusive, and the welding speeds vary between 36 and 72 inches per minute. Conductors are placed between the welding and finishing rolls for tubes 1¼ inches and smaller in diameter. A universal torch-adjusting arm is supplied with these machines when required.

An important feature of the No. 2 tube-welding machine is the overhung mounting of the rolls, which facilitates changes. This machine is supplied for right-hand operations only. A two-speed gear change in the base, together with an adjustable-speed motor, provides variations in welding speeds ranging from 24 to 168 inches per minute. The bearings subjected to heat are cooled by the circulation of water through cored spaces in the housings. Welding at the higher speeds is facilitated by the provision of two sets of following rolls. The No. 2 welding machine has a capacity for welding tubes ranging in size from 1¼ to 4 inches diameter, and up to No. 10 gage.

Straightening Machine

The next machine used in the process of tube manufacture is the straightening machine shown in Fig. 5. This machine is built in three sizes, all of which are of the ten-roll type having rolls arranged in two sets of five each, the axes of the rolls in one set being placed in a horizontal plane, while those of the other set are placed in a vertical plane. Three rolls of each set are power driven, and the last roll in each set is adjustable. The two idler rolls are mounted on studs attached to cross-slides provided with a screw adjustment. The No. 1 machine has a capacity for straightening tubes up to 1 inch in diameter; the No. 2 machine, up to 2 inches in diameter; and the No. 3 machine, from 1½ to 3 inches in diameter.

Seam Grinding Machine

From the straightening machine, the tubes go to a seam-grinding machine for the removal of the slight ridge produced in the welding operation, or else they go to a draw-bench. When the tubes are finished by drawing, it is unnecessary to grind off the flash, as this is smoothed out in the drawing process. The grinding machine shown in Fig. 3 is designed to grind off the flash rapidly and to provide for uniform wear of the grinding wheels across the face. The tube passes under the wheel at an angle while supported in a formed rest elevated by foot pressure. The machine is driven by a 7½-horsepower alternating-current ball bearing motor having a large-diameter armature shaft that extends at each end, on which the grinding wheels are mounted. The foot-control pressure mechanism and the tube guides are arranged to enable the grinding of tubes at any desired angle. As the wheel faces wear concave, the grinding of flat spots is obviated. The machine is so designed that two operators may work simultaneously, one on each end of the machine. The motor has an integral starting device and is of any standard voltage and frequency.

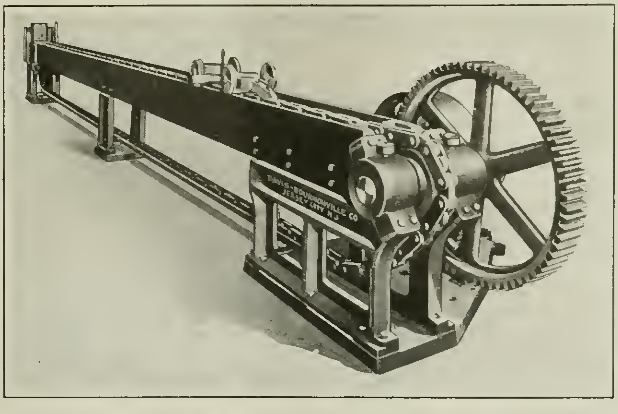


Fig. 8. No. 1 Draw-bench which has a Capacity for Tubes up to 2 Inches in Diameter and No. 14 Gage

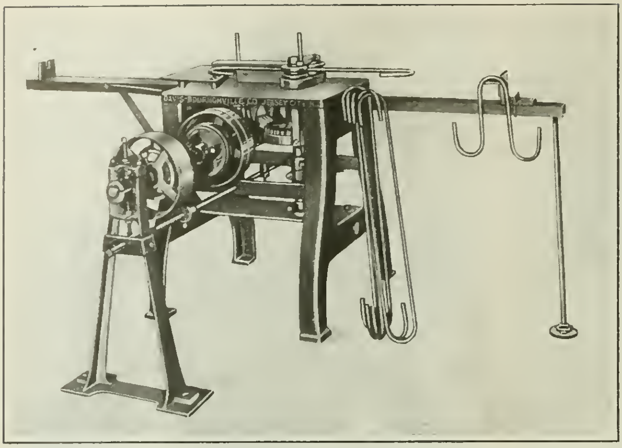


Fig. 9. One Style of Tube-bending Machine developed by the Davis-Bournonville Co.

Swaging and Cutting-off Machines

Tapered tubes and a great variety of shapes are produced by swaging. A swaging machine of the rotary type, using ten or more rolls in the head, and so designed and constructed that its operation is practically noiseless, is shown in Fig. 6. The dies have cam surfaces that engage the rollers easily, and produce a smooth acceleration. This machine is made in three sizes, each of which may be fitted with dies of different lengths, but the swaging is not limited by the length of the dies. Mechanical feeding devices are furnished when required, as well as equipment for special work. The roll cages and shafts are made from forgings machined all over, and the rolls, dies, and hammers are made from special alloy steel, hardened and heat-treated. The maximum die dimensions on the No. 1 machine are 1 3/8 inches in diameter and 2 1/4 inches in length; on the No. 2 machine, 2 inches in diameter and 4 inches in length; and on the No. 3 machine, 3 inches in diameter and 5 inches in length.

A motor-driven machine designed for the rapid cutting of tubes is shown in Fig. 7. The motor is mounted on the base of an oscillating cutting head which carries the saw arbor. The cutting head is held back against a stop by means of a coil spring, and is actuated by a foot-treadle through a mechanism which enables the operator to exert the required pressure of the saw on the tube without undue fatigue. The saw is usually 14 inches in diameter and from 3/32 to 1/8 inch thick. A 5-horsepower motor of any suitable type drives the saw at speeds of from 3000 to 4000 revolutions per minute. All exposed working parts are guarded by hinged covers.

Draw-benches and Bending Machines

The No. 1 draw-bench, which has a capacity for drawing tubes up to 2 inches in diameter and up to No. 14 gage, is illustrated in Fig. 8. The No. 2 draw-bench has a capacity up to 3 inches in diameter and up to No. 14 gage. The machines are made in various lengths, and their construction embodies a single heavy steel H-section bolted between head and transmission castings. The chain is of the usual construction, and runs over a steel sprocket driven through double reduction gearing. It is adjusted by a grooved idler wheel, the bearings of which slide in slots in the head casting. The dog is made of steel castings mounted on rollers running on the beam flanges. The dog jaws are machined to accommodate removable grips which may be serrated or machined to grip round tubing without marring it. The draw-benches are equipped with back benches for drawing tubes over a plug or mandrel, when necessary. The driving clutch is operated through a shaft running the length of the bed and having a lever at the head of the bench.

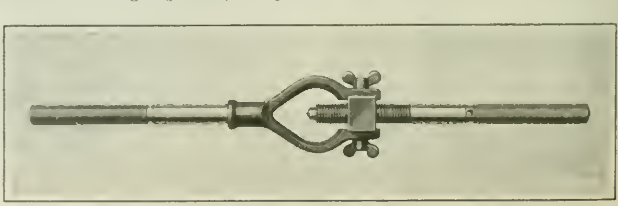
Three regular styles of tube-bending machines are also made. The No. 1 machine illustrated in Fig. 9 has a maximum bending radius of 8 inches; the No. 2 machine, of 12 inches; and the No. 3. of 35 inches. A special No. 2 machine will bend to a radius of 25 inches, while a special No. 3 machine can also be built for bending to a larger radius than the regular type. The standard machines are equipped with double clutch pulleys for operation in either direction. The Nos. 2 and 3 machines are provided with power attachments and a back bench when required. The power attachments are made in various forms suited to the class of work to be done, and operate a rack to which is attached a plug that gives internal support when bending. The rack that controls the plug may be operated by power in either direction.

The main drive of the machines is through reduction gearing and a steel worm which drives a bronze worm-wheel, or a cast-iron worm-wheel provided with a bronze band for the teeth, the construction depending on the work for which the machine is employed. The oscillating tube carriage, carrying the roll, vise, and other parts, is mounted on the same shaft as the worm-wheel. The carriage is so designed as to enable tools for any diameter of tube and bending radius to be readily mounted in place. A stationary half-die furnished with the oscillating members is actuated by a cam, screw, or in conjunction with a follower.

The construction of the bending mechanism makes possible the bending of light-walled tubing without wrinkling or distortion. A dog directly beneath the worm-wheel, which operates on adjustable knock-outs, limits the angle to which a bend is made. These bending machines are suitable for bending tubes of all kinds of metal, of any shape, and to angles not exceeding 180 degrees. The operating levers are so located that a machine is readily controlled by one operator. The number of bends made per hour vary with the length, diameter, and angle, and is usually between 60 and 120.

MARTIN DIE-STOCK

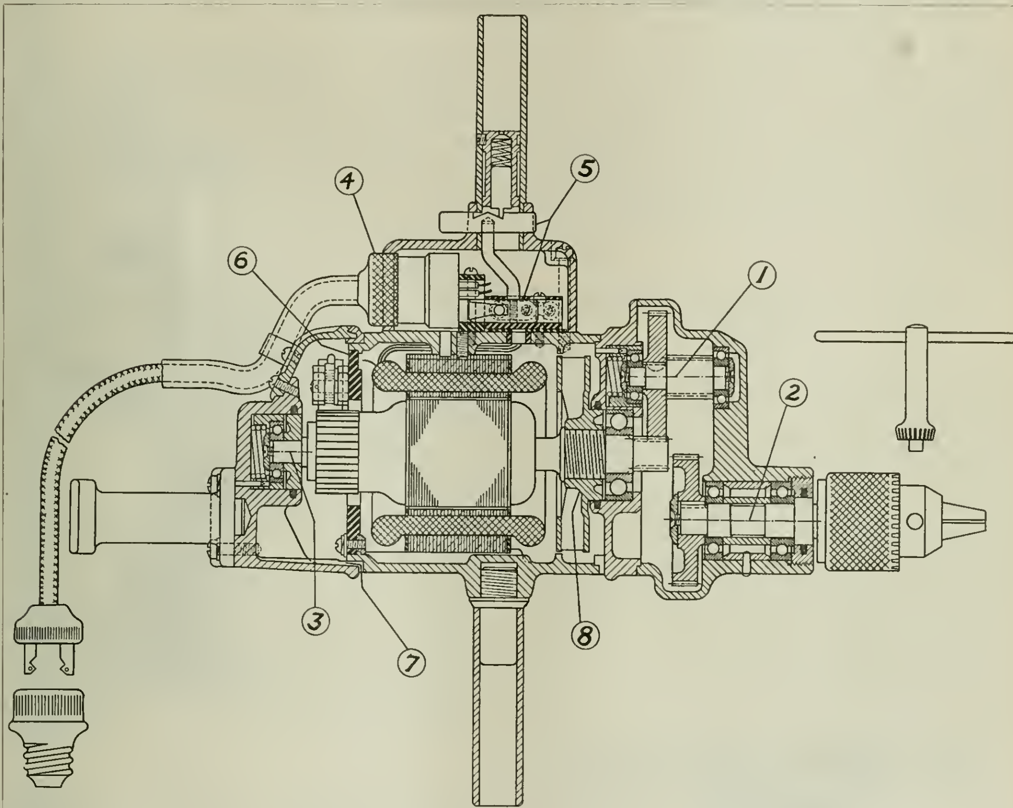
The No. 8 "All-In-One" die-stock shown in the accompanying illustration has just been placed on the market by the Martin Machine Co., Inc., Turner Falls, Mass. This stock will take round dies ranging from 5/8 to 2 1/4 inches in outside diameter. The loose handle of the stock may be quickly adjusted to line up with a spot hole in the side of a die by means of a sliding block, which is then held firmly in place by tightening two thumb-screws. The point of the die-stock which engages the spot hole of the die is made of hardened tool steel to withstand wear. The advantage of this tool is the possibility of using one stock for dies of various diameters. It is especially intended for the use of machinists, garage men, and plumbers.



No. 8 "All-In-One" Die-stock made by the Martin Machine Co., Inc.

HISEY-WOLF PORTABLE ELECTRIC DRILL

Two sizes of a universal portable electric drill equipped with ball bearings throughout have lately been brought out by the Hisey-Wolf Machine Co., Cincinnati, Ohio, under the trade name of "Super." The Type 38 KU has a capacity for drilling holes up to 3/8 inch in diameter, while the Type 50 KU drills holes up to 1/2 inch in diameter. The distinctive features of this drill may be seen in the accompanying illustration, which shows a sectional view. The motor is built by the Hisey-Wolf Machine Co., and patents are pending for its design. All revolving spindles, three of which are shown at 1, 2, and 3, are fitted with ball bearings. Coil springs are also provided at the bearings to allow expansion and contraction of shafts to take place without resulting in distortion, which is likely to occur with fixed bearings. The quick cable connector 4 permits cable repairs and renewals to be made without dismantling the drill; hence such repairs can be accomplished with a minimum loss of time. Switch 5 is patented and, although externally mounted, is protected by a removable handle cover.



Cross-sectional View of "Super" Universal Portable Electric Drill made by the Hisey-Wolf Machine Co.

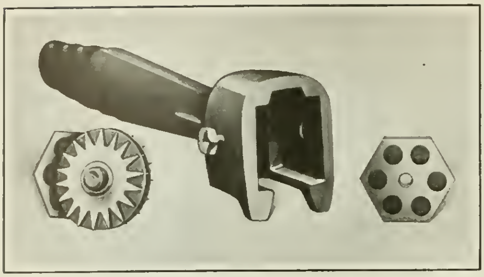
The brush-holder yoke 6 is made of bakelite, and is not affected by oil, moisture, or atmospheric conditions. The complete yoke is adjustable and the brushes can be shifted without dismantling the equipment. Forced ventilation is obtained through vents such as shown at 7, which are so designed that all cool incoming air must pass over the commutator and brushes before being drawn through the motor and expelled. The fan, which is shown at 8, is so designed and mounted as to prevent the lubricating grease in the gear head from working into the motor parts.

LOSHBOUGH-JORDAN INCLINABLE PRESSES

Two recent additions to the line of inclinable presses built by the Loshbough-Jordan Tool & Machine Co., Elkhart, Ind., are known as the "No. 5 Special" and the "No. 0." The No. 5 special press is identical with the regular No. 5 machine described on page 1155 of August, 1918, MACHINERY, except that the die space is 12 inches, whereas on the regular machine it is only 7 inches. The No. 0 press is similar in design to standard presses of the inclinable type built by this concern, but it is of smaller dimensions, some of which are as follows: Opening in bed, 3 by 5 inches; opening through back, 5 1/2 inches; depth of throat, 3 1/2 inches; adjustment of stroke, 4 1/2 inches; and standard stroke, 1 inch. The pressure exerted by the slide is between 5 and 7 tons, for which approximately 1/2 horsepower is required. The weight of the machine is about 300 pounds, and when supplied with a floor stand, 475 pounds.

"DESMOND-HEX" GRINDING WHEEL DRESSER

The accompanying illustration shows the disassembled parts of the "Desmond-Hex" grinding wheel dresser which has just been placed on the market by the Desmond-Stephan Mfg. Co., Urbana, Ohio. An important feature of this dresser is that the parts subject to wear can be readily replaced. The inside of the handle jaws are machined to accommodate hexagonal members having a tapped hole at the center to receive a set-screw, by means of which they are secured to



New Design of Grinding Wheel Dresser made by the Desmond-Stephen Mfg. Co.

the handle. These hexagonal members are provided with six circular recesses, any of which may serve as a bearing for the spindle carrying the cutters. Wear during use will be on these recesses, and as a set becomes worn, the hexagonal members are given a sixth turn and the spindle of the cutters advanced to the next set. When all the recesses have been worn out, new hexagonal members may be substituted. The dresser is made in two sizes, one for cutters 1½ inches in diameter, the other for cutters 2⅜ inches in diameter. The small cutter is intended for use on ordinary grinding wheels, while the other size is for large and coarse wheels.

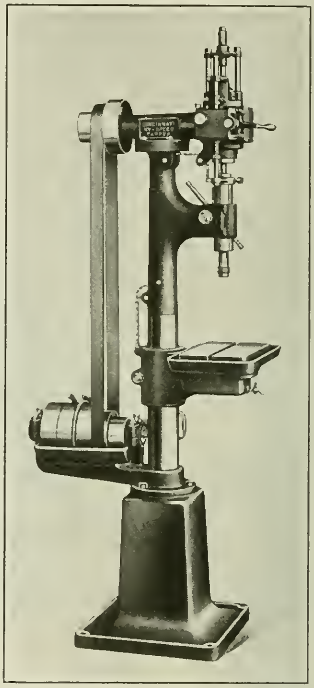
BLOUNT BALL-BEARING BUFFING MACHINES

The J. G. Blount Co., Everett, Mass., has just placed on the market a line of ball-bearing buffing machines consisting of three sizes. The No. 5 machine illustrated is the medium size. The design of these machines is very similar to that of the regular buffing machines manufactured by this concern, but an added feature is the S K F ball bearings contained in dustproof mountings, with which they are equipped. The bearings are secured to the spindle by a light driving fit and lock-nuts. The spindles are made of a high-carbon steel, ground to size, and carefully balanced before fitting to the head. A taper point is fitted to the right-hand end of the spindle to accommodate small wheels. The contact surfaces of all parts bolted together are planed or milled to insure a rigid unit. The head can be furnished separate, for mounting on a bench. The countershaft may be of a self-oiling type or equipped with Hyatt roller bearings.

No. 5 Ball-bearing Buffing Machine built by the J. G. Blount Co.

CINCINNATI HY-SPEED AUTOMATIC TAPPING MACHINE

The Cincinnati Hy-Speed Machine Co., Cincinnati, Ohio, has recently developed and placed on the market a line of tapping machines, the operation of which may be semi- or full-automatic. One of these machines is shown in the accompanying illustration. Among the features of these machines are a patented spindle lead and an automatic reversing mechanism. Through the use of the spindle lead device, the tap is fed and returned in a positive way entirely independent of the operator, it being stated that holes are tapped accurately without danger of threads being stripped or taps broken. By giving the stop-plunger at the side of the control handle a half turn, the machine is changed from semi- to full-automatic, or vice versa. When set for semi-automatic operation, the spindle feeds downward, reverses automatically, and stops at the end of the return stroke. To cause the spindle to feed again, the operator merely pulls down on the control lever.



Semi- and Full-automatic Tapping Machine placed on the Market by the Cincinnati Hy-Speed Machine Co.

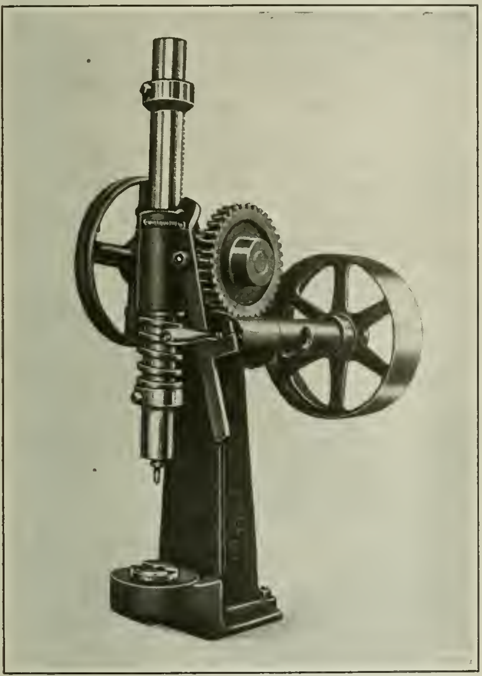
When set for full-automatic operation, the stop-plunger is withdrawn, and the spindle then reverses automatically at each end of its travel. The spindle can be stopped at any point, reversed and fed again, through the operation of the control lever. Adjustable dogs with limit stops on a trip-rod regulate the depth to be tapped. The chuck is driven by a clutch-end on the spindle, and is locked in position. The machines are equipped with S K F ball bearings throughout, and are regularly furnished for right-hand tapping, but an attachment is included to enable left-hand tapping operations to be performed, this attachment being quickly secured to the end of the rack sleeve. The machines are built in styles having from one to three spindles, and in two sizes of which the maximum tapping capacities are ½ and ⅞ inch diameter in steel, respectively. The ½-inch machine is equipped with tight and loose pulleys, while the ⅞-inch machine is equipped with a single-pulley direct overhead drive. In addition to the type illustrated, the machines are also built in bench and belted motor-drive styles.

THREE- AND FOUR-WAY INDEX-BASES

In July, 1920, a description appeared in MACHINERY of a two-way index-base for milling and drilling machines, etc., which had been brought out by the Industrial Engineering Co., 407-425 E. Fort St., Detroit, Mich. By means of this index-base, work can be placed on one side of the fixture table while another part is being machined diametrically opposite. Then when the operation on one piece has been completed, the table can be indexed 180 degrees to bring the unfinished part in line with the cutters. The same company has now placed on the market two more styles of bases which can be indexed to three and four positions, respectively. These bases are made the same dimensions as the original style, 10 and 16 inches in diameter, and the mechanism is based on the same principle.

AMERICAN BENCH BROACH PRESS

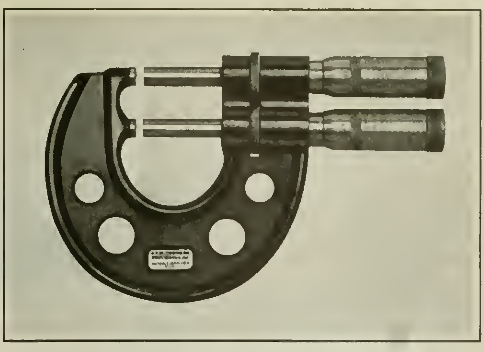
A power broach press of a bench type which is being placed on the market by the American Broach & Machine Co., Ann Arbor, Mich., is here illustrated. This machine is intended not only for push broaching operations, but also for pressing into place or removing mandrels, bushings, etc. The machine is driven through a pulley 10 inches in diameter, having a face width suitable for a 2½-inch belt. Power from the driving shaft is transmitted through worm-gearing to a steel pinion that engages rack teeth cut directly on the ram. The worm-gearing has a 30 to 1 reduction. The worm is arranged to disengage automatically at the end of a predetermined stroke, through the medium of a collar at the upper end of the ram. Automatic return of the ram is effected through a weight and cord, the rack being wound in a groove around the handwheel. The machine has a stroke of 14 inches, and the bore in the table is 2½ inches in diameter.



Combination Broaching and Assembling Press developed by the American Broach & Machine Co.

SLOCOMB SNAP GAGE MICROMETER

In order to eliminate the necessity of having a large number of snap or limit gages on hand, the J. T. Slocomb Co., Providence, R. I., has brought out a duplex micrometer intended for use as an adjustable limit snap gage. The gaging surfaces are the anvils and spindles of two micrometers, which are set in the frame of the instrument. The construction will be apparent by reference to the illustration. This design enables any dimension within the range of the micrometers to be gaged by merely setting one spindle to the "Go" dimension and the other to the "Not Go" dimension. Provision is made for locking the spindles after they have been set. Application has been made for a patent covering this instrument.

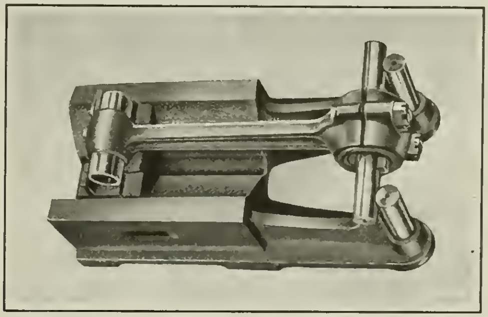


Micrometer Snap Gage produced by the J. T. Slocomb Co.

ALLEN CONNECTING-ROD ALIGNING FIXTURE

A fixture for testing the parallelism of holes and the twist in automobile engine connecting-rods is now being manufactured by the Allen Wrench & Tool Co., Public St., corner of Eddy St., Providence, R. I. From the illustration it will be seen that the base of the fixture is a heavy iron casting having a 45-degree scraped V-bearing for the accommodation of a sliding member. This slide has horizontal and vertical surfaces on which the projecting ends of the wrist-pin in one end of a rod are seated while the rod is being tested. A special arbor is inserted in the crankshaft bearing of the connecting-rod; this arbor rests on two horizontal seats and makes contact with two vertical posts secured to the base. It is held in the bearing by means of a sliding key tapered on the under side to fit a keyway on the arbor, and an eccentrically bored steel bushing that is slotted to receive the projecting tapered key. This construction enables the upper side of the key to bind against the bearing cap as the key is advanced by lightly tapping on its end.

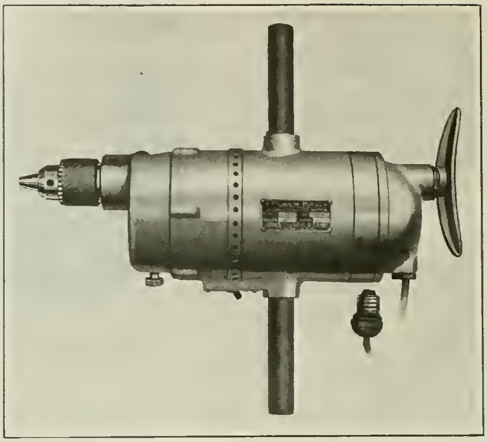
By the use of the eccentric bushing and sliding key it is possible for the outside diameter of the bushing to be slightly less than the diameter of the crankshaft bearing, and so the bushing makes contact on one side of the hole and the taper key diametrically opposite. This feature eliminates the necessity of pressing the bushing into place, and greatly facilitate its removal. The wrist-pin, arbor, and vertical



Fixture made by the Allen Wrench & Tool Co. for detecting Inaccuracies in Conneoting-rods posts are made of steel, hardened and ground to size. By placing a connecting-rod on the fixture in the manner illustrated, and bearing down on the wrist-pin to produce an even contact on the slide, the twist in the rod can be readily detected either by sight or by placing feelers between the under side of one end of the arbor and the seat upon which it is intended to rest. Similarly, if the wrist-pin is held securely against the vertical faces of the slide, deviation from parallelism of the two holes is shown by a space between a post and the corresponding end of the arbor.

The accuracy with which the wrist-pin holes are machined in the piston may be checked by assembling the piston on the connecting-rod and then placing the entire unit on the fixture after the slide has been removed so that the piston will have a two-point bearing in the vee. Inaccuracies are then determined by using the arbor in the crankshaft bearing of the rod in the same manner as when ascertaining the parallelism of the wrist-pin hole with the crankshaft bearing hole. For general garage use it is necessary to provide two arbors, one 1¼ inches in diameter for Ford cars, and another 1½ inches in diameter for other types of automobiles. A complete set of bushings ranges from 1¾ to 2½ inches in outside diameter, varying by increments of ⅛ inch. It is stated that inaccuracies of 0.001 inch can be detected. A pair of bench vise jaws are supplied as auxiliary equipment for use in straightening rods.

JONES, MAC NEAL & CAMP PORTABLE ELECTRIC DRILLS



One of a Line of Portable Electric Drills manufactured by Jones, MacNeal & Camp

The "Power King" portable electric drill shown in the accompanying illustration is made in eight sizes of various capacities for drilling up to 1 inch in diameter, by Jones, MacNeal & Camp, 522 S. Clinton St., Chicago, Ill. Each drill has a patented two-speed mechanism and is equipped with a universal ball-bearing motor. The two-speed mechanism enables the equipment to be used effectively for drilling in either metal or wood and with either carbon or high-speed steel tools. The drill consists of three distinct units; the unit on the drilling end contains all gears and the speed-shifting mechanism. The middle unit contains the motor, switch, and wiring, and the handle end is a protecting cap of sufficient strength to take pressures from a jack or to resist shocks produced by a fall. Combined radial and thrust ball bearings are placed at each end of the driving shaft, and ball bearings are also provided for the motor shaft. The brushes are easily accessible for inspection. A standard three-jaw chuck, interchangeable with a No. 2 Morse taper socket, is supplied as regular equipment. The switch is of the quick make-and-break type and is mounted for convenient operation.

ONSRUD GRINDING TURBINE ATTACHMENTS

A small pneumatic turbine equipped with a grinding arbor, which has been brought out by the Onsrud Machine Works, Inc., 3908-3932 Palmer St., Chicago, Ill., was referred to in October MACHINERY. The accompanying illustrations show two attachments for this turbine which may be supplied to increase its field of usefulness. The attachment shown in Fig. 1 converts the turbine into a bench machine, and thus provides a convenient equipment for the light grinding and sharpening of tools, cutters, dies, and taps. This unit may be used as a portable equipment or it may be mounted permanently in one place. The attachment illustrated in Fig. 2 makes the turbine suitable for the accurate grinding of 60-degree centers. A detachable plug is inserted in the spindle of the tailstock, and a bracket mounted on this plug holds the face of the grinding wheel at the proper angle so that when the tailstock is advanced on the center, the latter will be ground correctly. The tailstock plugs make the attachment applicable to both large and small machines.

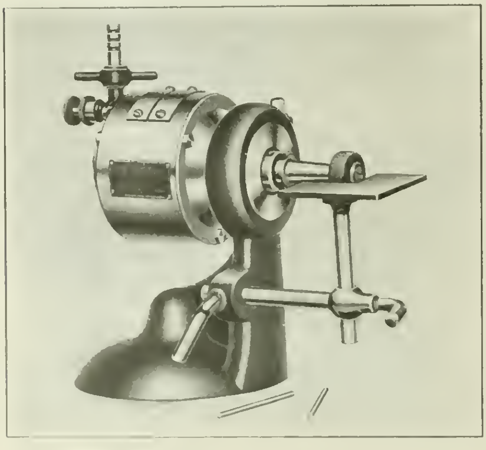


Fig. 1. Bench Stand for Pneumatic Grinding Turbine made by the Onsrud Machine Works, Inc.

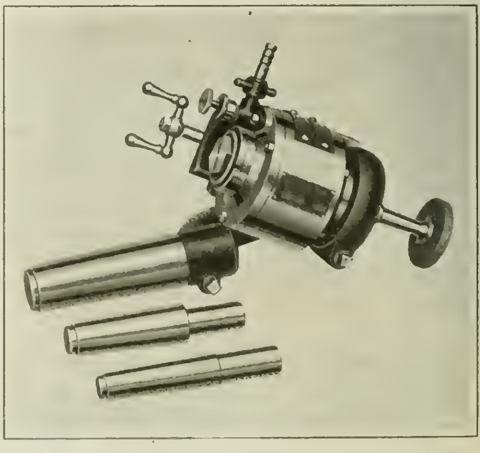


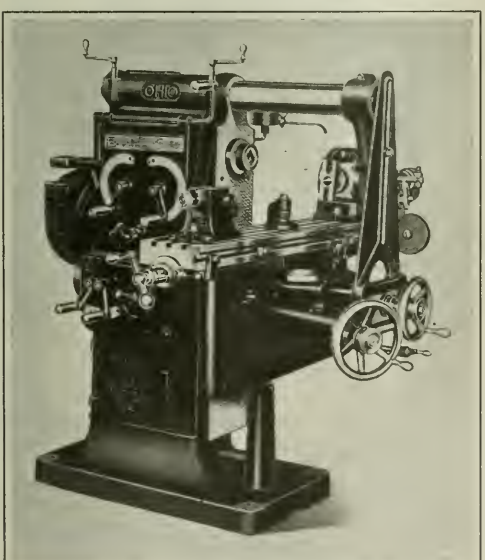
Fig. 2. Attachment which adapts the Pneumatic Turbine for grinding 60-degree Centers

OHIO ALL-GEARED MILLING MACHINES

The Oesterlein Machine Co., Cincinnati, Ohio, has placed on the market a line of milling machines of the constant-speed or all-geared type consisting of six sizes, each of which is made in both plain and universal styles. The No. 2 universal machine is here illustrated. The speed mechanism furnishes sixteen geometric speeds through fifteen gears and 1 shaft, in addition to the spindle and pulley shaft. Speed changes are effected by means of "two-position" levers and a "four-position" knob, the latter controlling the selection of four adjacent spindle speeds. All speed changes may be made without stopping the machine.

Each gear is made from a low-carbon forging that is put through annealing, carburizing, and hardening processes and is sand-blasted to remove furnace scale. Automatic lubrication of the machine is effected by a system of three reservoirs; in the first of these, which is located in the top of the column, the fresh oil is poured. This oil seeps through felt and runs down tubing to cavities cast under the main spindle bearings, the intermediate shaft bearings, and the driving pulley. The oil is carried to the spindle bearings by means of wicks that dip into the cavities under the spindle. By this arrangement only fresh oil is admitted to the bearings that are heavily loaded. The oil passing through these bearings overflows into a second reservoir from which it is distributed to the speed gears and minor bearings by splash lubrication. The overflow from the second reservoir passes to the speed-box, which is the third reservoir, this being also oiled by splash lubrication. The capacity of the first reservoir is sufficient to supply the machine for about two months of ordinary service. Provision is made for raising the level of the oil in the last reservoir if the established level should decrease.

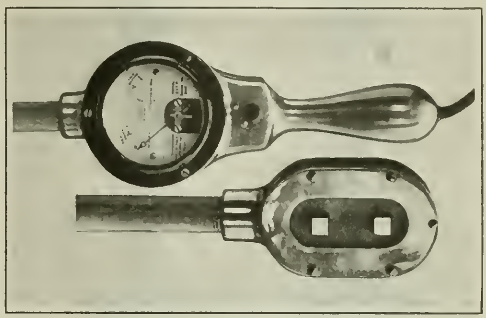
The driving pulley on each machine is 14 inches in diameter and runs at the rate of 400 revolutions per minute. A brake designed for stopping the spindle quickly is connected with the belt-shifter in such a way that as the belt is partially carried to the loose pulley, the brake is applied to the tight pulley by means of a spring-plunger releasing mechanism. The feed-box, knee, and table are similar to those supplied on the cone-type milling machines built by the same concern.



No. 2 All-geared Universal Milling Machine developed by the Oesterlein Machine Co.

"CRIT-POINT" HEAT-TREATING INSTRUMENT

Several years ago, the "Crit-Point," an instrument used in hardening steels, was placed on the market by the Gibb Instrument Co., Detroit, Mich. Patents and manufacturing rights for this instrument have now been taken over by the Illinois Testing Laboratories, Inc., 430 S. Green St., Chicago, Ill., and the instrument has been completely redesigned. The device is employed to indicate when the critical points are reached in heat-treating steels so as to enable the work to be hardened between these points. Steels lose their magnetic properties when heated to the decalescent point, and the principle upon which the device is based is to detect the absence of the magnetic properties.



Instrument made by the Illinois Testing Laboratories, Inc., for indicating Critical Points when heat-treating Steel

The instrument is used by making contact with the work in the furnace through the medium of special iron cores surrounded with two heat-proof electromagnets forming a small transformer, these coils being connected to the source of current and a suitable voltmeter. When the steel being heated becomes non-magnetic, a small amount of current is imparted to the voltmeter, causing the indicator on the instrument dial to move to the position marked "critical point." The dial end of the instrument is shown in the upper portion of the accompanying illustration while the end placed in contact with the work is shown in the lower portion, these two ends being connected by a long rod. This device is made in two types: Model 220 P is a portable unit, which is used by attaching it to a conveniently located electric light socket. Model 220 W is intended for use as a permanently installed instrument in connection with suitable switch and wire arrangements. Such an installation permits the use of one large instrument on several furnaces. Modifications of the fire-end are possible to permit its use with special shaped articles and under unusual conditions.

ST. LOUIS GRINDING AND POLISHING MACHINES

Among a complete line of grinding and polishing machines lately developed by the St. Louis Machine Tool Co., 932 Loughborough Ave., St. Louis, Mo., are the machines shown in the accompanying illustrations. The machine to the left in Fig. 1 is a grinding machine, while the machine to the right is equipped for polishing. A machine of the same general design but arranged for mounting a grinding wheel on one end of the spindle and a polishing wheel on the other end, is also built. Each machine is driven by belt from a fully enclosed motor of the repulsion start induction run type, either single- or three-phase squirrel-cage. The three phase motor will operate on only three-phase lines at one voltage, while the single-phase motor will operate on a one-, two- or three-phase current and at 110 or 220 volts. A

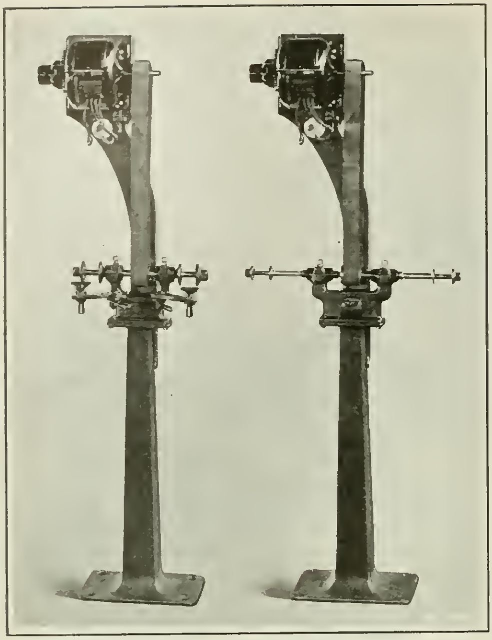


Fig. 1. Grinding and Polishing Machines of a Line brought out by the St. Louis Machine Tool Co.

direct-current motor may also be supplied. The wheels on the grinding machine are driven at a surface speed of 5000 feet per minute, and those on the polishing machine, at a surface speed of 7500 feet per minute. These machines are made in a large range of sizes and in stationary and portable types. The weight of the smallest size of portable machine is 170 pounds, and that of the largest, 290 pounds.

The heavy floor-type grinding machine illustrated in Fig. 2 is built in three sizes for which the dimensions of the grinding wheels recommended are 18 by 3 inches, 20 by 3 inches, and 24 by 4 inches, respectively. The arbors are made from 0.40 per cent carbon steel and have coarse-pitch square threads. The machine is driven through a pulley which may be either of a plain or cone type as desired. The bearings are provided with large oil chambers, which are filled and drained through a pipe connection at the back, so arranged as to prevent overflow of oil. The weight of the smallest size of this machine is 700 pounds, and that of the largest, 1000 pounds.

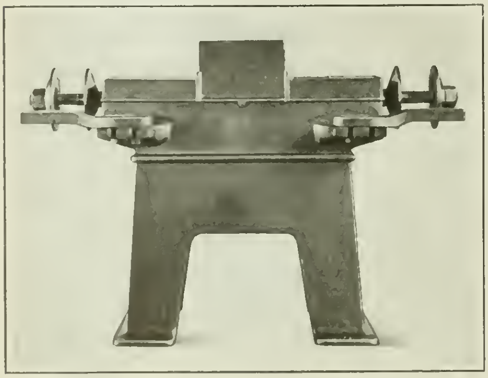
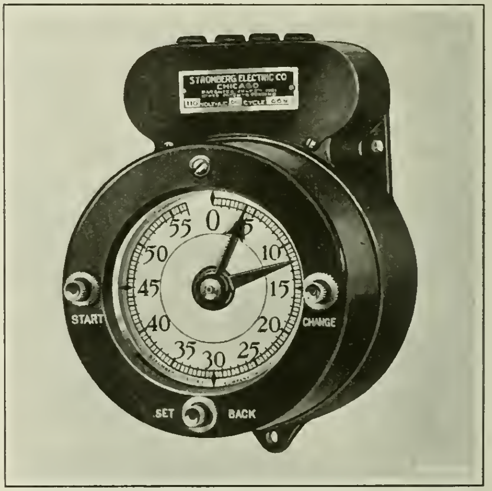


Fig. 2. St. Louis Heavy Floor Grinding Machine

STROMBERG PROCESS TIMING AND SIGNALING INSTRUMENT

For use in manufacturing processes where the element of time is a factor, such as the heat-treatment of steel and rubber, the molding of insulating materials and enameling, plating, etching, and similar operations, the Stromberg Electric Co., 209 W. Jackson Blvd., Chicago, Ill., has developed a line of timing and signaling instruments, one of which is here illustrated. Each instrument is driven by a small synchronous motor connecting to any convenient alternating-current circuit. There are two indicating hands for the dial which are enameled red and black, respectively. The red pointer is set to indicate the length of the process, after which it remains stationary while the arrow indicator travels from this point to zero. When the latter point is reached, the duration of the process is at an end, and a signal (either a light or a bell) is operated until stopped by the attendant. At any position of the arrow pointer, the remaining time of the process can be ascertained by noting the graduation to which the pointer indicates.

Three buttons on the face of the housing control the indicating hands. By pushing in the one on the right and turning it, the setting hand may be placed to any graduation on the dial. By means of the button at the bottom of the case, the arrow hand, after having reached zero, may be quickly returned to the position of the setting hand for

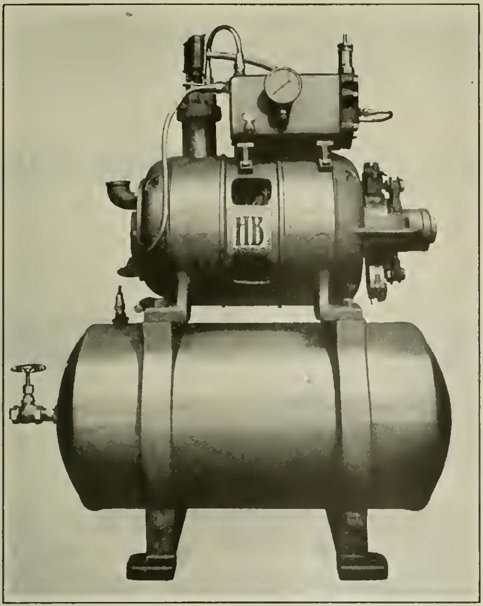


Process Timing and Signaling Instrument developed by the Stromberg Electric Co.

a second process of the same duration. The third button is used to start the arrow hand toward zero. The instruments are made with four standard dials which are graded in seconds, three-seconds, half-minutes, and minutes, respectively, and the maximum lengths of process which can be timed are 3 minutes 48 seconds, 11 minutes 24 seconds, 57 minutes, and 1 hour 54 minutes, respectively. The instrument illustrated is equipped with the 57-minute dial, so that the setting hand indicates twelve minutes while the arrow hand points to four minutes.

HOBART AUTOMATIC AIR COMPRESSOR

Automatic maintenance of air pressures between 125 and 140 pounds per square inch, or higher, in compressed air lines is the service for which the direct motor-driven compressor here illustrated has been designed by the Hobart Bros. Co., Troy, Ohio. An interesting feature of the outfit is a pressure release or magnetic pressure unloader, which

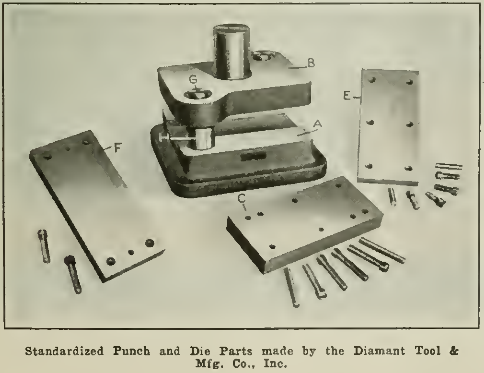


Gearless Automatic Air Compressor brought out by the Hobart Bros. Co.

automatically holds open the compressor valve until the motor develops full speed, and then releases when the outfit begins pumping. The pump is mounted directly on the motor shaft. The motor operates at a speed of 600 revolutions per minute, and is equipped with ball bearings to insure quiet running. The motor and pump housing is mounted directly on the tank, and on top of the motor and pump housing are located the air and oil filter, air gage, and automatic switch which starts up the motor without attention. This method of assembling the unit has resulted in a compact equipment. The current for the motor may be supplied from a light or power line.

DIAMANT STANDARD PUNCH AND DIE SETS

Certain detail parts of punch and die sets are invariably the same as regards shape, size, and the method of machining, and in order to reduce the cost of punches and dies and to enable sets to be provided for a new job with minimum delay, the Diamant Tool & Mfg. Co., Inc., 95 Runyon St., Newark, N. J., is manufacturing, on a quantity production basis, a line of standard parts that are complete in every respect except for the die openings and the holes for inserting punches in the punch-plate. Referring to the illustration, the standard parts consist of die-shoe *A*, punch-holder *B*, die blank *C*, stripper-plate *E*, punch-plate *F*, liner pins *G*, liner pin bushings *H*, and the necessary dowels and screws.



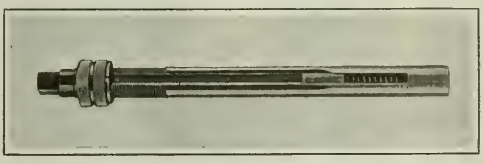
Standardized Punch and Die Parts made by the Diamant Tool & Mfg. Co., Inc.

When the designing stage of a die has been completed, a diemaker can take one of these sets and, by machining the openings in the die, stripper- and punch-plate and assembling the parts, have the die quickly ready for use. Although the dowel holes are shown on the parts in the illustration, these holes are not drilled when the parts are supplied to a customer, because different conditions control their location. The die blank is made of an oil-hardened tool steel, and is from 0.006 to 0.010 inch over size in width to allow for shrinkage in hardening and for final grinding of the sides.

In addition to the style of die-shoe illustrated, one is made with U-lugs at the ends for securing it to the machine, instead of having a flange running around the base. The slot in the die-shoe may run lengthwise or crosswise, or the shoe may be furnished without any slot. A set is also made with both liner pins at the rear rather than placed diagonally as shown. When a customer does not want all the parts mentioned, a four-component set, consisting of a punch-holder, die-shoe, liner pins, and liner pin bushings, can be furnished. All sets are made in a number of sizes.

LARSON ADJUSTABLE REAMER

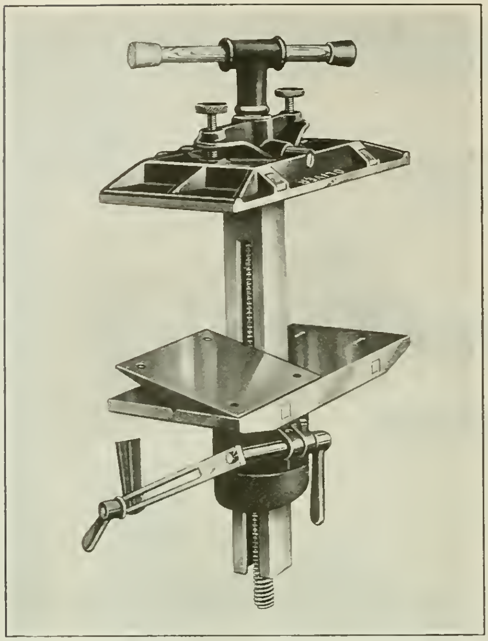
An adjustable reamer known as the "Larson," which is being manufactured by the Standard Tool & Supply Co., 651 S. Polk Ave., Mason City, Iowa, is designed especially for reaming the bushings of automobile pistons. In use, the reamer is inserted through both bushings, thus insuring proper alignment, and then expanded by turning the adjustable nut so as to permit the spring in the reamer at the opposite end to actuate the cutter-blade. One complete turn of the adjusting nut causes the reamer to be enlarged 0.001 inch. The cutter-blade is of a double-edge type, so that it can be rotated in either direction. It can be readily sharpened, replaced, or shimmed up.



Tool for reaming Bushings of Automobile Pistons which is made by the Standard Tool & Supply Co.

OLIVER NO. 1 UNIVERSAL VISE

A recent product added to the line of patternmakers' and woodworkers' equipment manufactured by the Oliver Machinery Co., Grand Rapids, Mich., is a No. 1 universal vise, which is shown in the illustration with the jaws in horizontal positions and an angle jaw in place. The usual mounting of this vise, of course, is with the jaws in vertical planes. The jaws are 7¼ inches wide, 18 inches long, and open up to a distance of 16 inches. The steel screw for the jaws has a double-buttress thread and a self-centering and detachable nut which can be readily removed for replacement. The jaws may be clamped in any position about a complete circle. The angle jaw is detachable and used with small irregular shaped pieces. The locking bar is flat and so prevents slipping of the vise, regardless of the position in which the jaws are set. The swiveling front jaw pivots at the center,

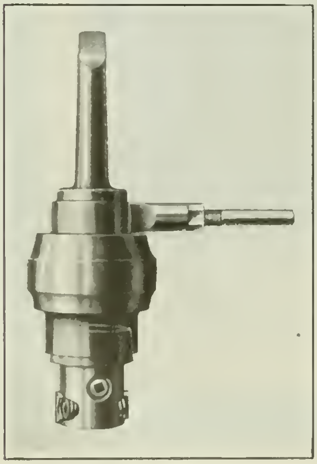


Vise for Woodworkers and Patternmakers, which is a Recent Product of the Oliver Machinery Co.

and therefore, can be set by means of thumb screws to take a wedge-shaped piece. Work can also be clamped on parallel sides without resetting the adjusting screws. The tilting feature of the jaws makes the vise convenient for working on frames and box forms. Dogs provided on the jaws facilitate the clamping of irregular and thin work.

JARVIS FRICTION TAPPING DEVICE

The feature of the Jarvis Style FD tapping device here illustrated, which is now being introduced to the trade by the Geometric Tool Co., New Haven, Conn., is a cone friction drive that is controlled by the pressure exerted on the machine spindle with which the device is employed. The dotted lines in the illustration indicate the relative size of the friction cone. Little pressure is necessary to drive this tool, and the starting and stopping of the tap while the spindle is rotating is under a free control. The device is equipped with a standard chuck. The tapping range is from 0 to 1/4 inch in diameter, the device being suitable for the tapping of light holes in tough metal.

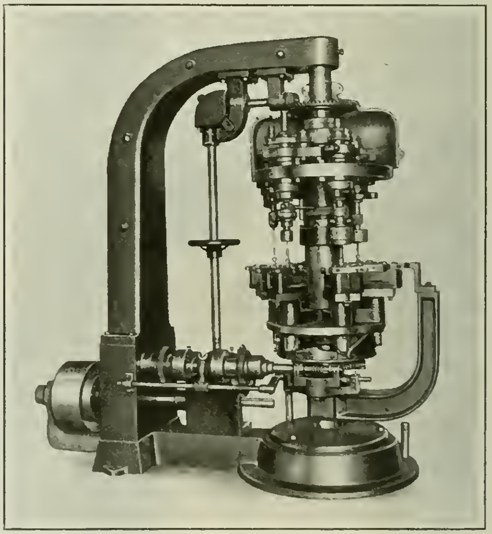


Jarvis Friction Tapping Device sold by the Geometric Tool Co.

JACKSON VERTICAL AUTOMATIC CHUCKING MACHINE

The Jackson vertical automatic chucking machine described in December, 1920, MACHINERY is now being brought out in several redesigned types by the Vertomatic Mfg. Co., Third and Buttonwood Sts., Reading, Pa., one of which is shown in the illustration. Type A is intended for work requiring a series of from three to five operations at one setting, such as spotting, sizing, facing, threading, and tapping. Type B is for work requiring two or three operations. These two machines are identical in construction, except that Type A has six chucks and five active spindles while Type B has four double chucks and three pairs of spindles. By providing one less spindle than the number of chucks, one chuck can be unloaded and loaded without interfering with the continuous operation of the machine.

The Type C machine is for work requiring but one operation or two operations performed by a combination tool, such as the facing and tapping of nuts or the pointing and threading of bolts. Types A and B are indexing machines on which the spindles remain stationary while the chucks are fed to the tools, independently of each other, at the desired speed and to the proper height, by the use of cams. When the chucks are dropped, the chuck turret is indexed to the next working position. On the Type C machine, each



Vertical Automatic Chucking Machine redesigned by the Vertomatic Mfg. Co.

spindle is mated with a certain chuck, and operates on the work placed in that particular chuck. The chuck and the spindle turrets are locked together and rotated in one direction. As the chucks leave the loading station they run up a continuous cam so that the work is raised to the tool in the spindle. The work is ejected when returned to the loading station. The machines are automatic throughout.

* * *

The College of the City of New York announces a course in cost reduction, largely in the interests of those already actively engaged in manufacture or commerce. The course is principally devoted to an analysis of the causes of expenses that may be either prevented or reduced, and to various financial, technical, organizational, or other remedies. Concrete examples from machine shops, foundries, etc., will be presented, and definite methods for reducing costs of material and labor and of overhead will be included.

NEW MACHINERY AND TOOLS NOTES

Gas Pressure Regulator: Alexander Milburn Co., 1420 W. Baltimore St., Baltimore, Md. A pressure regulator intended for the control and delivery of acetylene, oxygen, hydrogen, and other gases under high pressure, such as are used in welding. This device is said to maintain a constant predetermined pressure, regardless of fluctuations in the initial pressure line and variations in consumption at the torch.

Oil Reclaiming Outfit: S. F. Bowser & Co., Inc., Fort Wayne, Ind. An outfit adapted for reclaiming different kinds of lubricating oils, but especially intended for use on oils employed in internal combustion engines. The apparatus is said to restore the oil to its original viscosity, flash-point, and purity. The outfit is made in two sizes with capacities of 50 and 100 gallons, respectively, per twenty-four hours.

Adjustable Boring-bars: Power-Vosberg Co., Detroit, Mich. Adjustable boring-bars made in three styles (the angle adjustable, straight adjustable, and removable block types) for boring holes from 7/8 to 15 inches in diameter. These bars are intended for both rough- and finish-boring and reaming, and can be used on drilling machines, lathes, boring mills and other machine tools. The sales agent is the Firmhil Machine Supply Co., 602 Kerr Bldg., Detroit, Mich.

Combination Lathe and Grinding and Drilling Machine: Electric Motor Mfg. Co., Ludington, Mich. A combination machine sold under the trade name of "Utility," which is designed to handle a wide range of repair work requiring lathe, drilling, and grinding operations. The machine is driven by an electric motor, and is intended for bench use. The grinding wheel is mounted on the motor shaft, while the lathe spindle is driven from the motor shaft by gears.

Bench Drilling Machine: Model Specialty Co., 401 E. 19th St., New York City. A small portable bench drilling machine weighing only 34 pounds, which is intended for accurate work and all-around shop use. The column is high enough to permit objects up to 18 inches in height to be drilled. The table can be tilted to any angle and locked in position. The spindle is driven directly from a motor, and the head carrying the spindle and the motor can be positioned at any point on the column.

Brinell Hardness-testing Punch: Case Hardening Service Co., 2279 Scranton Road, Cleveland, Ohio. A punch for quick hardness testing by the Brinell method. A spring hammer in the barrel delivers to a 1/4-inch steel ball inside the cap at the bottom, a blow of sufficient force to make a depression of three millimeters diameter or less, according to the hardness of the test piece. The test is accomplished by gripping the knurled barrel of the punch and pressing downward quickly until the spring hammer is released.

* * *

NEW BOOK ON EMPLOYMENT METHODS

Employment Management, Wage Systems, and Rate Setting. 103 pages, 6 by 9 inches; 32 illustrations. Published by The Industrial Press, 140-148 Lafayette St., New York City. Price, $1.

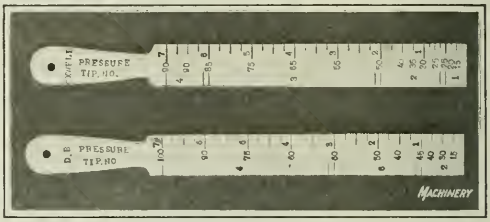
Haphazard methods of hiring men and of determining their compensation have probably caused more dissatisfaction on the part of labor and greater production losses to manufacturers than any other single factor. In addition to the manufacturers' losses the losses of employes due to being placed at work for which they are not adapted, are also very great. No doubt such losses are to some extent unavoidable, but more care on the part of those who hire would eliminate a large percentage of this waste. The problem expressed in simple language is to fit the "round pegs" in round holes and the "square pegs" in square holes.

This treatise deals with systems for use in employing men and placing them where they can do the most effective work; it also covers wage payment systems, explains the fundamental principles involved, and presents certain approved plans for determining compensation on the basis of individual merit. Articles on these different subjects previously published in Machinery aroused such interest among shop executives that it was decided to use them as the basis for this treatise, especially in view of the fact that the systems described have proved successful in well organized manufacturing plants. This material was contributed by several authorities, including W. D. Stearns, Secretary of the Occupations and Rates Committee of the Westinghouse Electric & Mfg. Co.; John C. Bower, Superintendent of the Employment Department, Westinghouse Electric & Mfg. Co.; R. K. Le Blond Machine Tool Co.; A. H. Dittmer, President of the Dittmer Gear & Mfg. Corporation; Russell Waldo; J. B. Conway; and John C. Spence, Superintendent of the Grinding Machine Division of the Norton Co.

RULE FOR OXY-ACETYLENE CUTTERS

A convenient rule for metal cutters who use the oxy-acetylene blowpipe was devised recently by K. McDermott, steam engineer and assistant mechanical engineer of the South Chicago Works of the Illinois Steel Co. It is in the form of a nickel-plated hand rule, about 12 inches long by 1 1/8 inches wide and 1/8 inch thick, so graduated as to indicate the tip sizes and oxygen pressures best suited for cutting steel sections of any thickness up to 7 inches. The rule shown in the accompanying illustration is graduated for use with "Oxweld" and Davis-Bournonville tips. As a common scale would not apply to both of these makes, one side of the rule is graduated for the "Oxweld" and the other for the Davis-Bournonville tips, as shown.

The device is simple and can be applied easily. Instead of reading thickness in inches and fractions, the tip size and pressure are read off directly, thus making it unnecessary to resort to memory or refer to a cutting table. The device saves time and eliminates waste by providing a simple means of determining the proper size of tip and the correct pressure to employ for each job. The idea is not patented, and anyone can easily make a rule of this type adapted for the equipment being used.



Metal-cutters' Rule for determining Correct Tip Size and Oxygen Pressure

* * *

CONVENTION OF INDUSTRIAL ENGINEERS

The fall convention of the Society of Industrial Engineers was held in Springfield, Mass., in the Municipal Auditorium, October 5 to 7. The principal subject of the meeting was industrial stability. In addition to the main gatherings, sectional meetings were held for the groups dealing with the departments of education, manufacture and selling, financing and accounting, and industrial relations. Tours of inspection were made to the principal manufacturing plants of Springfield and the vicinity. The officers elected for the year 1922 were as follows: President, Joseph W. Roe, head of the industrial engineering department of New York University; treasurer, F. C. Schwedtman, vice-president of the National City Bank, New York; secretary, W. G. Sheehan of Detroit, Mich.; and business manager, George C. Dent of Chicago, Ill.

* * *

The Board of Education of the City of New York offers during the coming winter evening courses in machine shop practice, machine shop theory and acetylene welding at a number of the evening trade schools in the city. The courses are open to those now employed in some branch of the industry, and the instruction given is to be supplementary to the day-time occupation, the aim being to fit the worker for greater earning capacity. Courses will also be given in shop mathematics, toolmaking and millwrighting.

* * *

The index to the twenty-seventh volume of Machinery, covering the year September, 1920, to August, 1921 inclusive, is ready for distribution, and copies will be sent upon request.

OBITUARIES

Allan Ransom, who was closely connected with the machine tool industry for many years, died in San Francisco, September 21, at the age of sixty-one. Mr. Ransom was associated at one time with the Lodge & Davis Machine Tool Co., in Cincinnati, and later was in the Chicago store of the Prentiss Tool & Supply Co. For a number of years he was one of the partners of the Marshall & Huschart Machinery Co. of Chicago.

* * *

PERSONALS

Lyle W. Orr has resigned as general manager of the Modern Tool Co., Erie, Pa., with whom he had been connected for ten years. His plans for the future have not yet been announced.

Alan A. Wood, for a number of years connected in an engineering and sales capacity with the Providence plant of the Builders Iron Foundry and the Diamond Machine Co., associated companies, is now sales manager of the Philadelphia district, and is located at 419 Widener Bldg., Philadelphia, Pa.

M. A. Green, who for ten years was superintendent of branches and agencies of the Crucible Steel Co. of America, has become associated with the Newman-Andrew Co., 26 Cortlandt St., New York City, as manager of its tool steel department. Mr. Green's experience in the tool steel field extends over a period of more than twenty years.

George L. Sawyer, formerly sales manager of material handling machinery for the Barber-Greene Co., Aurora, Ill., has been appointed New York representative of the Universal Crane Co., Cleveland, Ohio, for the sale of universal cranes. His headquarters will be at the Allied Machinery Center, 141 Center St., New York City.

Fritz R. Lindh, formerly chief engineer of the Graton & Knight Mfg. Co., Worcester, Mass., has joined the sales organization of the Chicago Belting Co., Chicago, Ill. Mr. Lindh will be in charge of the Pittsburg factory branch, and will also make personal engineering surveys for many of the larger users of belting throughout the United States. His headquarters will be at 336 Third Ave., Pittsburg.

Mortimer Elwyn Cooley, dean of the College of Engineering and Architecture of the University of Michigan, has been elected president of the American Engineering Council of the Federated American Engineering Societies. Mr. Cooley is a past president of the American Society of Mechanical Engineers, and has a long record of distinguished service in education under the government and in private capacities.

William H. Severns has been appointed assistant professor of mechanical engineering at the College of Engineering, University of Illinois, Urbana, Ill. Professor Severns was graduated from the University of Kansas in 1914, and since then has served as instructor at the University of Kansas, Purdue University, New Hampshire College, University of Wisconsin, and University of Illinois. He has also been employed as assistant field engineer by the New Jersey Zinc Co., Palmerton, Pa.

R. A. Lundquist of Minneapolis, Minn., will head the newly created electrical machinery division of the Bureau of Foreign and Domestic Commerce. This is one of the new industrial divisions made possible by Congress through the Export Industries Act. It is expected to secure the services of experts to specialize on the more important export commodities. Mr. Lundquist is a graduate of the University of Minnesota, and an electrical engineer of wide experience. He has also made extensive studies of the sale of electrical machinery in Australia, New Zealand, China, Japan, and South Africa, the results of which have been published by the Bureau of Foreign and Domestic Commerce.

* * *

NEW PRESIDENT OF THE A. S. M. E.

Dexter S. Kimball, dean of the College of Engineering of Cornell University, has been elected president of the American Society of Mechanical Engineers, and will take office at the next annual meeting to be held in New York City early in December. Dean Kimball was born in New River, New Brunswick, Canada, in 1865, and graduated from the Leland Stanford Jr. University in 1896. He served his apprenticeship with Pope & Talbot, Port Gamble, Wash., and in the shops and the engineering department of the Union Iron Works, San Francisco. In 1898 he became designing engineer for the Anaconda Mining Co. For three years he served as assistant professor of machine design at Sibley College, Cornell University, and later became works manager for the Stanley Electric Mfg. Co., Pittsfield, Mass. In 1904 he returned to Cornell University as professor of machine design and construction, and since 1915 he has occupied the chair of industrial engineering. He became Dean of the College of Engineering in 1920.

Dexter S. Kimball, Newly Elected President of the American Society of Mechanical Engineers

Since 1911, Dean Kimball has been a member of the Council on Industrial Engineering, New York State Department of Education. He is also a member of the Society for the Promotion of Engineering Education, and of the Society of Industrial Engineers. He is vice-president of The Federated American Engineering Societies. He is co-author with John H. Barr of "Elements of Machine Design," and author of "Industrial Education," "Principles of Industrial Organization," "Elements of Cost Finding," and "Plant Management," as well as of many contributions to the technical press.

Dean Kimball became a member of the American Society of Mechanical Engineers in 1900. He has served as chairman of the Committee on Meetings and Program of the society, having charge of the professional features of the annual and spring meetings. He has also served on the Committee on Aims and Organization and as chairman of the sub-committee on Relation of the Engineer to his Work. He was elected a manager of the society in 1919.

COMING EVENTS

November 1-4—Annual convention of the Industrial Relations Association of America in New York City; headquarters, Waldorf-Astoria Hotel. Acting executive secretary, E. A. Shay, 671 Broad St., Newark, N. J.

November 2-4—Fall conference of Industrial Cost Association in Pittsburg, Pa. Headquarters of the association, 2828 Smallman St., Pittsburg.

November 4-5—Regional meeting of the American Society of Mechanical Engineers in Kansas City, Mo.

December 1-3—Fall meeting of the Taylor Society in New York City. Secretary, Harlow S. Pearson, 29 W. 39th St., New York City.

December 6-9—Annual convention of the American Society of Mechanical Engineers in the Engineering Societies' Building, 29 W. 39th St., New York City.

May 8-11, 1922—Spring meeting of the American Society of Mechanical Engineers in Atlanta, Ga. Assistant Secretary (Meetings), C. E. Davies, 29 W. 39th St., New York City.

The sectional meetings of the American Society of Mechanical Engineers for the month of November are as follows: November 1—Cleveland Section at Hotel Winton, Cleveland, Ohio, and Virginia Section at Richmond, Va.; November 2—Buffalo Section at the Lafayette Hotel, Buffalo, N. Y.; November 3—Hartford Section at the Bond Hotel, Hartford, Conn.; November 8—Waterbury Section at the Chamber of Commerce Hall, Waterbury, Conn.; November 9—Baltimore Section at the Engineers' Club, Baltimore, Md.; November 14—New Haven Section at Mason Laboratory, Yale University, New Haven, Conn.; November 17—Bridgeport Section at the Chamber of Commerce, Bridgeport, Conn., Toledo Section at the Toledo Commerce Club, Toledo, Ohio, and Worcester Section at Worcester, Mass.; November 21—Chicago Section—joint meeting with the Western Engineering Society at the headquarters of that society; November 22—Atlanta Section at Atlanta, Ga., and Philadelphia Section at the Roof Garden of the Adelphia Hotel, Philadelphia, Pa.; November 25—Colorado Section at the Metropole Hotel, Denver, Col.; November 28-29—Kansas City Section at Kansas City, Mo.

NEW BOOKS AND PAMPHLETS

The Working of Steel. By Fred H. Colvin and K. A. Juthe. 245 pages, 6 by 9 inches. Published by the McGraw-Hill Book Co., Inc., New York City. Price, $3.

This book contains a discussion of the annealing, heat-treating, and hardening of carbon and alloy steel. It describes approved methods of working the various kinds of steel now in commercial use. As is well known, the automotive field has done much to develop new alloys and methods of working them, and this field has been drawn on liberally by the authors to show the best practice. The practice in government arsenals on steels used in firearms is also described. The book contains twelve chapters having the following headings: Steel Making; Composition and Properties of Steels; Alloys and their Effect upon Steel; Application of "Liberty" Engine Materials to the Automotive Industry; the Forging of Steel; Annealing; Casehardening or Surface-carburizing; Heat-treatment of Steel; Hardening Carbon Steel for Tools; High-speed Steel; Furnaces; and Pyrometry and Pyrometers.

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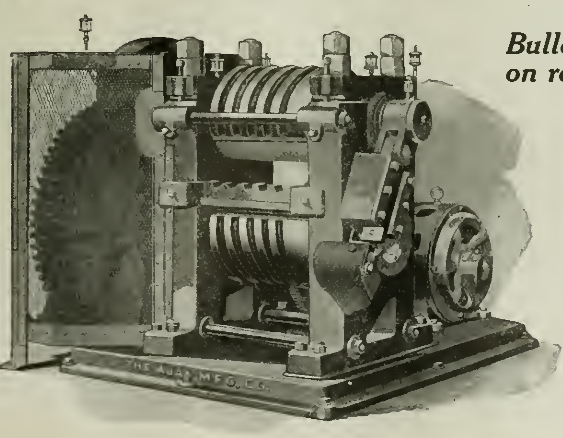


Centrifugal Pumps. By J. W. Cameron. 142 pages, 5½ by 8½ inches. Published by the D. Van Nostrand Co., 8 Warren St., New York City, and Scott, Greenwood & Son, 8 Broadway, Ludgate, E. C. 4, London, England. Price, $3.75.

The development of the electric motor and the steam turbine has led to a tendency in present-day practice to substitute rotary for reciprocating machinery, and the author of this work believes that the time is not far distant when the centrifugal or turbine pump will displace the reciprocating type of pump. The book deals with the theory, action, and design of centrifugal pumps, and contains considerable formula matter for making the necessary calculations in design. It is intended to be used by engineers, draftsmen, and students who have a knowledge of the elementary principles of hydraulics. The examples on the design of centrifugal pumps illustrate the method used by the author in fixing upon the principal dimensions of this type of pump, and may serve as a guide to the young designer. The book contains twelve chapters headed as follows: Action and Advantages of Centrifugal or Turbine Pumps; The Theory of the Centrifugal Pump; Hydraulic Losses during the Passage of Fluid through Pump; Manometric Head, Change of Pressure, and Hydraulic Efficiency of Centrifugal Pumps; Bearings, Disk Friction; Effect of Angle at Discharge on the Efficiency of a Centrifugal Pump; Details of Centrifugal Pump; Axial Thrust and Its Balancing; Calculation and Design of a Single-stage Pump; Calculation and Design of Multi-stage Pumps; Types of Pumps; and Testing.

NEW CATALOGUES AND CIRCULARS

Electrical Alloy Co., Morristown, N. J. Circular advertising "Magno" ignition metal, especially suitable for spark plug electrodes.

New Departure Mfg. Co., Bristol, Conn. Loose-leaf data sheets, 137 and 138 FE, showing the application of ball bearings to motor-driven grinders, and "Sirocco" blowers.

Cutler-Hammer Mfg. Co., Milwaukee, Wis. Circular 2038, illustrating and describing the Type 9604 automatic starter for small alternating-current motors, which is equipped with mercury type overload relays, enclosed in a safety case.

Armington Engineering Co., Wickliffe, Ohio. Catalogue containing illustrations, specifications, and price lists for Armington hand-power hoisting equipment, including I-beam trolleys, flat-rail trolleys, hand-power hoists, and jib and traveling cranes.

Northern Engineering Works, Detroit, Mich. Bulletin 517, containing illustrations showing the application of Northern electric traveling cranes in foundry service, where the enclosed features and strong design of the trolley are particularly valuable features.

Cleveland Punch & Shear Works Co., Cleveland, Ohio. Circular illustrating Cleveland punches and shears and some of their products. The illustration of an aisle in the emergency stock-room of the company gives an idea of the large quantity of small tools carried in stock.

Union Switch & Signal Co., Swissvale, Pa. Booklet entitled "What is a Drop-forging?" containing general information relating to the drop-forging process and methods, as well as characteristics of drop-forgings. The booklet contains several pages of illustrations, picturing typical drop-forgings made by this company.

Geometric Tool Co., New Haven, Conn. Circular descriptive of the Jarvis friction tapping device, which is equipped with a cone friction drive, designed to prevent the breakage of taps when tapping holes in tough metal. Circular describing the features of the Geometric solid adjustable tap for machine and hand tapping.

Cincinnati Lathe & Tool Co., Oakley, Cincinnati, Ohio. Circular entitled "Guaranteed Service at a Fair Price with Cincinnati Lathes," containing illustrations and descriptions of the different types of lathes made by this company which include cone type and geared-head lathes in 16-, 18-, 20-, 22-, 24-, 26-, and 28-inch sizes.

Smalley-General Co., Inc., Bay City, Mich. Circular containing a number of time studies showing the time required for producing six different parts on the Smalley-General No. 23 thread milling machine. A time study is also given of the threading of a rotary tool joint by the use of the adjustable taper attachment supplied with the No. 23 machine.

Kinite Co., 1338 St. Paul Ave., Milwaukee, Wis. Booklet illustrating and describing the use of "Kinite" for shear blades, redrawing tools, blanking dies, drawing dies, embossing and forming dies, broaches, etc. Examples of increases in the number of pieces that may be produced per each dressing of the tool when this alloy steel is employed are given.

Pawling & Harnischfeger Co., 38th and National Aves., Milwaukee, Wis. Bulletin 56X, illustrating and describing P & H excavating equipment. Records are given of the actual performance of P & H excavators under a wide diversity of service in different sections of the country. Copies will be sent to anyone interested in this class of machinery.

National Safety Council, 168 N. Michigan Ave., Chicago, Ill. Safety calendar for 1922, containing on each sheet the calendar for the current month and a cartoon showing common dangers in the industrial world, and the results of ignoring the necessary precautions. The calendar is available to manufacturers in quantities at a nominal cost, by application to the National Safety Council.

Ingersoll Milling Machine Co., Rockford, Ill. Bulletin 41, containing a brief description and illustrations of Ingersoll drum type continuous milling machines. The possibilities of this type of machine are clearly indicated by the illustrations showing some of the different classes of work for which these machines are adapted, and the production figures which are given for each job.

W. S. Rockwell Co., 50 Church St., New York City. Bulletin 234, discussing the continuous heat-treatment of metals with automatic and semi-automatic furnaces. This pamphlet is the fourth of a series dealing with fundamentals influencing the quality and cost of heated products. The illustrations show various types of Rockwell furnaces for heat-treating, hardening, tempering, and annealing.

Cleveland Automatic Machine Co., Cleveland, Ohio. Loose-leaf catalogue, 9 by 12 inches, entitled "Production by Users of 'Clevelands'" containing reprints of articles descriptive of Cleveland automatics, previously published in MACHINERY, as well as reprints of advertisements showing the high rates of production which have actually been attained with these machines on various classes of work.

Sharon Pressed Steel Co., Sharon, Pa. Circular containing illustrations, general specifications, and description of the Sharon "Bluenose" all-steel truck, which is made in two sizes with lengths of 54 and 64½ inches. Circular containing specifications for the Sharon "Brute" all-steel trailer, which is also made in two sizes—46 by 60 inches and 42 by 60 inches—with capacity for carrying 6000 pounds.

Timken Roller Bearing Co., Canton, Ohio, is issuing a publication known as "The Timken Engineering Journal," which contains general information on the selection, fitting practices, adjustments, tolerances, enclosures, and use of Timken roller bearings on machinery and industrial appliances. It is the intention to issue different editions covering specific fields of application, which will be furnished upon request.

W. S. Rockwell Co., 50 Church St., New York City. Bulletin 239, descriptive of the "Economizer" shield type of forge furnace, designed to meet the demand for equipment which will lower production costs. The features to which especial attention is called are the means for better application of heat, protection of the operator, utilization of waste gases to preheat air and fuel for combustion, and the close grouping of furnaces made possible by the comparatively cool working end.

Smith & Serrell, Central Ave. at Halsey St., Newark, N. J. Bulletin 32, containing data on Francke flexible couplings for direct-connected machines. In addition to a general description of these couplings, directions are given for selecting the correct size of coupling for different classes of machines, as well as information on the installation of direct-connected machinery. Particular attention is called to the new light-duty type of flexible coupling for use with small light-duty motors up to from 50 to 75 horsepower.

Supreme Machine & Tool Co., Cleveland, Ohio. Bulletin AC-3, containing a detailed description of the "Supreme" universal boring, milling and drilling attachment, which is designed to meet the need for a jig boring machine that will eliminate the slow and costly process of figuring angles and sines. Instructions are given for the use of the chart, with which the attachment is equipped, by means of which the exact movement of the dividing gears may be determined for setting the boring head at the required angle.

Oakley Chemical Co., 26 Thames St., New York City. Booklet 1042, entitled "Modern Cutting and Grinding," containing information on cutting and grinding compounds and their relation to production. The application of "Oakite" compounds is described, and formulas for Oakite cutting and grinding compounds are given. Suggestions relating to the best practice in metal cutting and grinding are included, as well as tables of cutting and grinding speeds, tap drill sizes, and other useful data. Copies will be sent free upon request.

Metals Coating Co. of America, 495 N. Third St., Philadelphia, Pa. Booklet entitled "The Schoop Metal Spraying Process," containing a detailed description of this process of metal spraying, by means of which metallic coatings of any kind may be sprayed on all kinds of surfaces. The equipment used in connection with the process is also illustrated and described. The process may be applied for five different purposes as follows: Protective coatings, bonding or junction coatings, electrical coatings, decorative coatings, and detachable coatings.

Williams Tool Corporation, Erie, Pa. Booklet entitled "Don't Let It Happen to You," written for the purpose of instructing operators of power pipe machines in producing better threads and securing greater production. Considerable general information is given which is applicable not only to the machines made by this concern but also to other types of pipe machines. The principles of correct pipe threading are discussed, such points being considered as proper alignment of pipe and dies, proper lip, chip space, clearance, number of chasers, etc., and instructions are given relative to the care and use of dies. At the end of the book illustrations are shown of two styles of Williams pipe threading machines, which are built in eight sizes with capacities ranging from ¼ inch to 16 inches. Copies of this booklet will be sent upon request.

TRADE NOTES

Lovejoy Tool Co., Inc., Springfield, Vt., manufacturer of metal-cutting tools, announces that on October 10 a 25 per cent reduction was made on the list price of high-speed steel inserted cutters for Lovejoy holders.

Kearney & Trecker Corporation, Milwaukee, Wis., announces that the New York branch office of the company is now located at Room 371, Hudson Terminal Bldg., 50 Church St., having been moved on October 1 to this location from 1801 Singer Bldg.

Austin Machinery Corporation, Chicago, Ill., announces that Canadian Austin Machinery, Ltd., of Woodstock, Ontario, Canada, will henceforth act as sole manufacturer and distributor in Canada of the complete Austin line of earth-moving and concrete-mixing equipment.

Wilmarth & Morman Co., 1180 Monroe Ave., N. W., Grand Rapids, Mich., manufacturer of grinding machinery, announces that it has issued revised price lists of its products, effective October 1, which represent pronounced reductions in the prices of the different styles of grinding machines.

Metals Coating Co. of America, 495 N. Third St., Philadelphia, Pa., manufacturer and distributor of the Schoop metal spraying process, announces that it is now in full operation at its new plant in Philadelphia, to which it has recently removed from its former locations in Boston and Woonsocket.

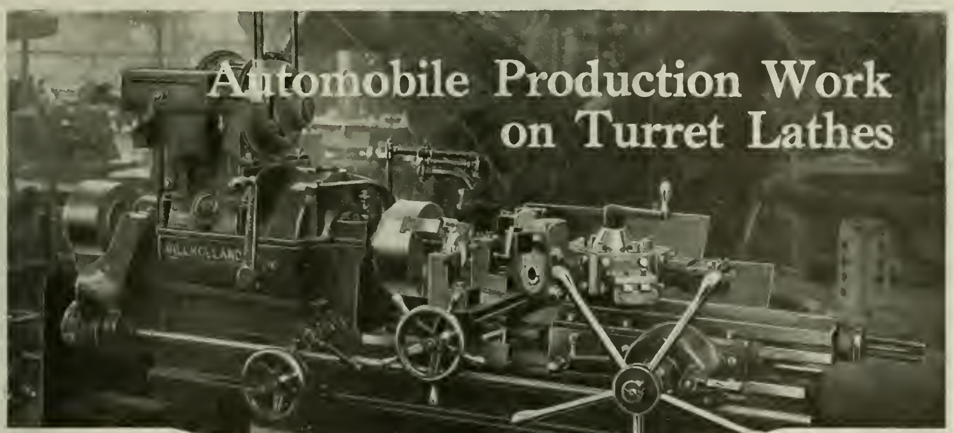
Heppenstall Forge Co., Bridgeport, Conn., announces that it is changing all the heating furnaces in its forge department from the coal to the oil-fired type, because of the satisfactory experience it has had with furnaces of the latter type. The machine shop of the company is working single time, and preparations are being made for putting the forge shop on a schedule of two or three days a week.

Fay & Scott, Dexter, Me., manufacturers of lathes, announce that their plant started operation on full time on October 3, with a fifty-two-hour weekly schedule, this being the first time for nine months that the plant has been operated on full time. With the present slight upward trend in business the company hopes to maintain this schedule with its present force of approximately 100 men, which represents one-fourth the normal force.

Chain Belt Co., Milwaukee, Wis., has opened offices at 735 Ellicott Square, Buffalo, N. Y., and has announced the appointment of T. E. Cocker as district manager of that territory. Mr. Cocker will handle the "Rex" line, including chain, sprocket wheels, traveling water screens, elevators and conveyors. For the last five years Mr. Cocker has been handling elevating and conveying equipment. He is a civil engineer, having graduated from the Rensselaer Polytechnic Institute in 1907. From 1907 to 1917 he was connected with the New York Central Railroad at Buffalo, and at the time he left this company was assistant engineer.

L. C. Biglow & Co., Inc., 232 W. 55th St., New York City, have been appointed New York district agents for the Hartford Tap & Gauge Co., the Hanson-Whitney Machine Co., Inc., the Taylor & Fenn Co., and the Whitney Mfg. Co., all of Hartford, Conn. L. C. Biglow & Co., as agents for these companies, will handle taps of all kinds, finished after hardening to correct lead, pitch, and outside diameter; plug thread gages; bore grinding machines; two-spindle automatic spline-milling machines; sensitive drilling machines; vertical die-shaping machines; centering machines; automatic thread-milling machines; roller, block and silent types of chain; and Woodruff keys.

Central Steel Co., Massillon, Ohio, announces the consolidation and merger of that company with the Massillon Rolling Mill Co. and the National Pressed Steel Co., also of Massillon. The new corporation will take the name of the Central Steel Co., and the other two companies will be operated, respectively, as the Massillon Rolling Mill Division, and the National Pressed Steel Division, of the Central Steel Co. The officers of the company are as follows: President and chairman of the board of directors, R. E. Bebb; first vice-president, F. J. Griffiths; second vice-president, C. C. Chase; third vice-president, H. M. Naugle; and secretary and treasurer, C. E. Stuart. The combined companies will have facilities for making all kinds of commercial alloy steels, hot- and cold-rolled sheets, hot-rolled strip steel, and light structural steel sections, with a capacity for producing 450,000 to 475,000 tons of finished material annually.



Automobile Production Work on Turret Lathes

Time-saving and Cost-reducing Methods Developed for Use in the Engine Department of a Motor Car Plant

By EDWARD K. HAMMOND

IN the engine plant of the Olds Motor Works in Lansing, Mich., a number of turret lathes built by the W. K. Millholland Machine Co., of Indianapolis, Ind., are used for machining operations on parts produced in large lots. When these machines were ordered, the turret lathe builder was also required to design and supply the work-holding fixtures and all the tools used for taking successive cuts. As all these turret lathes were to be used on repetition manufacturing work, care was taken to develop the designs in such a way that a minimum of time would be required for loading and unloading the fixtures. Wherever possible, the order of successive cuts was worked out in such a way that two or more tools could operate simultaneously. It is only through the application of such methods that repetition turret lathe work can be handled with maximum efficiency.

How To Reduce Production Costs ?

This article describes a number of tools and methods that could be used to advantage in the turret lathe department of manufacturing plants handling widely diversified lines of work. Particular attention is called to the design of work-holding fixtures for locating a piece for boring eccentric holes or for turning eccentric bosses. Other valuable features of the tool equipments shown are the provision made for operating two or more cutting tools simultaneously, and the use of air chucks for increasing the speed with which castings can be set up and removed.

Machining Operations on Water Pump Bodies

Fig. 1 shows a No. 4 Millholland turret lathe equipped for the machining of Olds water pump bodies, which are made of aluminum. On this job there is a small hole (not shown) which is concentric with hole *A*. The first turret face carries a combination tool *B* for rough-boring the large hole *A* and the small hole. On the second face there is a boring-bar *C* for taking an intermediate cut in the small hole; and a reamer *D* on the third face finishes this diameter to the required degree of accuracy. The fourth turret face carries a combination tool *E* for facing three surfaces at the top and bottom of hole *A*, and at the top of a boss surrounding the small hole in the work.

A combination tool *F*, on the fifth face of the turret, breaks the corners of the work at the tops of the large and small holes; and on the sixth turret face, there is a Murchey collapsible tap *G*, which is employed for threading the small hole. The machine is equipped with a Hannifin air chuck, which greatly facilitates the rapidity with which the castings can be set up in and removed from the lathe. The rate of production attained in handling this job is twelve finished pump bodies per hour.

Machining Rear Crankcase Covers

Fig. 2 shows another No. 4 Millholland turret lathe equipped for the rapid machining of duplicate aluminum castings. The piece shown in this illustration is a rear crankcase cover and, being made of aluminum, it is of light weight and can be handled rapidly; this material can also be worked at an unusually high cutting speed, which is an important factor in expediting production. On the first face of the turret there is a plug *A* which is moved forward into contact with the work to force it firmly back against the chuck jaws prior to tightening them. In this way, a uniform location of the successive pieces of work is assured.

After the casting has been set up in the manner described,

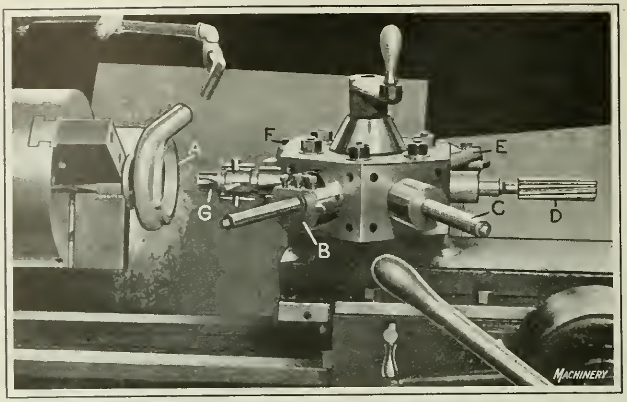


Fig. 1. Tool Equipment of a Turret Lathe used for facing, boring, reaming, and tapping Water Pump Bodies

the following sequence of operations is performed: On the second turret face, there is a tool *B* that is used for rough-boring; and the third turret face is equipped with a tool *C* for finishing the rough-bored hole. The final cut in this hole is then taken by a reamer *D* carried on the fourth turret face. The surface of a boss at the opposite side of the work from that on which the tools have been operating must now be back-faced.

For back-facing this surface, use is made of a tool-slide *E* carried by the fifth turret face, which is furnished with stops to locate the cutting tool in the proper positions for starting and concluding its cut. The tool is inserted through the opening in the work, after which the starting stop is brought into contact with it, and the point of the tool is then brought up against the work. The cross-slide on the tool-holder *E* is then brought into operation, so that the point of the tool is fed across the surface of the boss at the back of the work, thus facing it down to a uniform surface. The depth of cut is determined by means of a stop on the carriage slide. Finally, a surface *F*, adjacent to the periphery at the front of the work, is faced off with a cross-slide tool *G*.

These rear crankcase covers are cast in two pieces. As they come to the machine shown in Fig. 2, the flanges between the two halves of the casting have been milled, so that the two members may be bolted together. On this job the production is twelve rear crankcase covers per hour.

Indexing Fixture for Machining Distributor Brackets

In Fig. 3 is shown an aluminum part of the Olds engine known as a "distributor bracket," in which it is required to finish two eccentric holes and to turn and face the body. In handling this job on a lathe, it can be done only by successively locating the work in line with the center of rotation of the spindle for performing operations at different points on the casting. To obtain the three centers of rotation necessary, an indexing type of work-holding fixture is used. This fixture allows the casting to be centered in such a way that the body can be turned and faced; then it is indexed to locate the casting in position for machining one hole; and after that has been done, the fixture must be indexed a third time to locate the work for finishing the other hole.

On the first turret face, there is a tool *A* that rough-turns the outside diameter *B*, and faces the flange and lugs *C* at each side of the work. The second turret face carries a tool *D* for finishing the same surfaces. The cutter bit in each of these tools is formed in such a way that it turns the outside diameter *B* and faces the flange and lugs *C*. Feeding of the tool to the work is checked by a carriage stop. Next in the order of operations comes the facing of the area surrounding the two holes at the front *E* of the work, by a tool *F* mounted at the rear of the cross-slide. After the work has progressed to this point, it is necessary to index the fixture in order to center the work on the axis of the large hole *G;* and with the piece located in this way, a boring cut is taken with a tool *H* on the third turret face. After the boring operation, this hole is reamed with a chucking reamer *I* on the fourth face of the turret.

After the reaming operation, the fixture is once more indexed to center the casting in a position corresponding to the axis of the small hole *J;* a boring tool *K* on the fifth turret face then takes a roughing cut. Next the turret is indexed to bring a reamer on the sixth face into the operating position, for taking the finishing cut in the small hole. The work-holding fixture is mounted on a cross-slide *L*, and has an index-pin *M* which enters one of three holes to give the different work settings necessary to complete the job. It is required to hold all dimensions on this piece within limits of 0.0005 inch. Handling this job on a No. 4 Millholland turret lathe, the rate of production is eleven pieces per hour.

Machining Operations on Water Pump Impellers

In machining aluminum impellers for pumps used on Olds automobile engines, the sequence of turret lathe operations is different from that employed in the cases previously described. For the manufacture of these parts, it is necessary to remove the work from the chuck and turn it over during the process of machining, as operations are required on both sides. The method of procedure is first to face a hub at the center of the impeller with a tool *A*, Fig. 4, carried at the rear of the cross-slide. After this has been done, the work is removed from the chuck and turned over, and a small flange at the outside diameter is faced with a tool *B* mounted at the front of the cross-slide. The casting is held by means of a Hannifin air chuck, so that little time is required to set up and remove the work; hence, the necessity of resetting is not a serious hindrance.

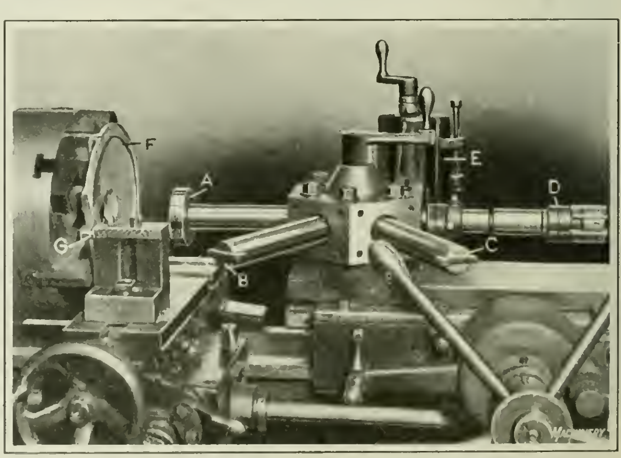


Fig. 2. Tool Equipment of a Turret Lathe used for boring, reaming, and facing Rear Crankcase Covers

After the work has been reset in the chuck, the next step is to drill the center hole and rough-turn the outside diameter of the casting. This work is done by a combination tool-holder on the first turret face, which carries a twist drill *C* and a turning tool *D*. Next the drilled hole is bored and the outside diameter finish-turned. This is done by a similar tool-holder on the second turret face, which carries a boring tool *E* and a turning tool *F*. Then a tool *G* carried on the fourth face of the turret is indexed into the operating position, for counterboring the rim and facing the area immediately surrounding the center hole in the work. When this step has been taken, the hole is reamed by a tool *H* on the fifth face of the turret. Finally, the corners at the top of the hole and at the periphery of the work are broken by a tool on the sixth turret face, thus completing the required sequence of operations. This job is handled on a No. 3 Millholland turret lathe, and the production is twenty-four pump impellers per hour.

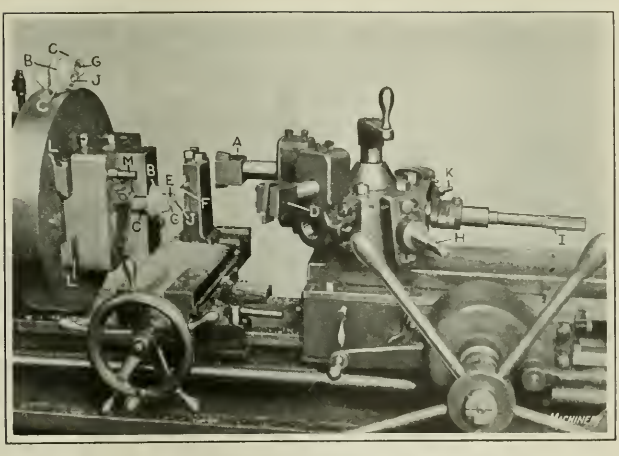


Fig. 3. Three-station Indexing Fixture for locating Distributor Brackets for turning the Body and boring Two Eccentric Holes

Machining Bronze Camshaft Bearing Bushings

When a plant is engaged in the quantity production of duplicate parts, but when the number of a given part to be machined is not great enough to occupy all the time of a machine tool, it may be possible to equip a machine in such a way that two or more production jobs can be handled, without a serious loss of time in changing tools, thus substantially reducing the amount of overhead to be charged against each of the jobs.

An example of this kind is illustrated in Fig. 5, which shows a close-up view of the tools and Hannifin air chuck used on a No. 4 Millholland turret lathe, for machining bronze bushings for the front and rear camshaft bearings of the Olds engine. The rear bearing *A* is shown in position in the chuck, while one of the front bearings will be seen lying on the bed of the lathe at *B*. The procedure in machining the rear bearings is as follows: On the first turret face there is a combination tool *C* that faces the end and takes a preliminary cut on the inside of the bushing. The combination tool *D* carried on the second turret face takes an intermediate boring cut, and also breaks the corner of the hole. Reamer *E* on the third face of the turret finishes the inside diameter of the bushing.

When the machine is working on the front bearing bushings *B*, the order of operations is as follows: Rough-bore, finish-bore, face, and ream. From the description of the machining of the rear bushings, it will be apparent that there are three turret faces available for carrying tools for machining the front bearing brasses. The rough-boring tool *F*, the finish-boring tool *G* and the facing tool *H* are permanently carried on these three turret faces, so that in order to switch over from one job to the other, it is merely a case of removing the rough-boring and facing tool *C* used on the rear bearing brass *A* and substituting the holder which carries a reamer *I* for finishing the inside of the front bearing brass. The same Hannifin air chuck can be used for holding both the front and rear brasses. On each of these jobs the rate of production is twenty brasses per hour.

Machining Oil-pump Covers

In machining cast-iron covers for oil-pumps used on Olds engines, there are two holes to be finished. This is another case where an indexing type of turret lathe fixture is used for centering the work in two positions. From Fig. 6 it will be seen that the method of setting up this job is quite different from those previously described. As the castings come to the machine they have been turned and faced, and these finished surfaces are utilized as locating points. There is a space behind the top plate *A* of the work-holding fixture, and the turned diameter of the oil-pump cover enters a counterbored pocket in the back of this plate. Two hooked bolts *B* are then tightened to pull the work firmly up against the back of the fixture.

In finishing these parts, the actual machining operations are quite simple, consisting of drilling, rough-reaming, and finish-reaming one hole, after which the fixture is indexed to center the work for the same sequence of operations in the other hole. The twist drill *C* and the roughing reamer *D* are carried on the first and second turret faces; and the finishing reamer is carried by a floating holder *E* which is shown on the third turret face. It will be seen that a slip bushing *F* is provided, which enters either of two openings in the work-holding fixture to bring it into line with the positions where the holes are to be drilled in the work. The drill is guided by the bushing, while the reamer is guided by the

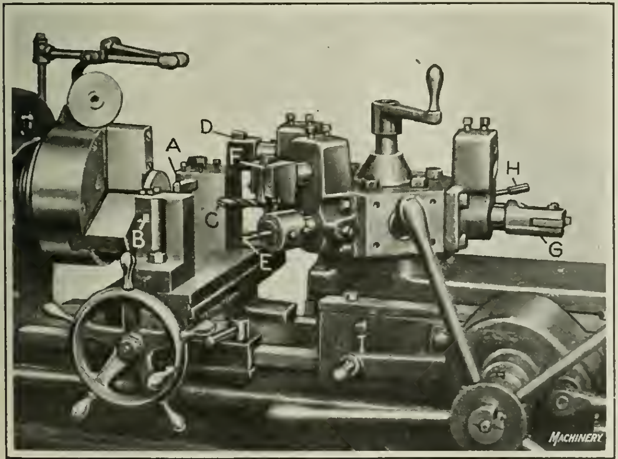


Fig. 4. Turret Lathe Equipment used for boring, counterboring, and facing Water Pump Impellers

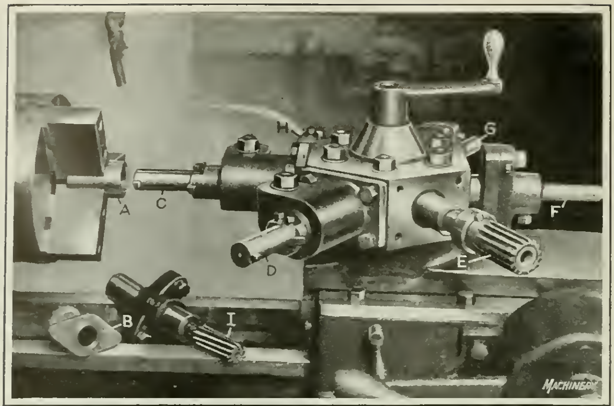


Fig. 5. Equipment for machining Bronze Bushings for Front and Rear Camshaft Bearings

finished cylindrical part of the shank directly behind the reamer blades. There is a cross-slide *G* and an index-pin *H* for locating the fixture properly for machining the two holes. In this way a good accurate job is secured. This job is done on a No. 4 Millholland turret lathe. The rate of production is twelve castings per hour.

Machining Operations on Fan Driving Pulley Hub

Fan driving pulley hubs for Olds engines are made of cast iron, and in Fig. 7 is shown a close-up view of a No. 4 Millholland turret lathe tooled up for the required machining operations on these pieces. One of the castings *A* is shown lying on the cross-slide. On the first turret face there is a twist drill *B* which takes a preliminary cut through the hub, and carried by the same toolholder, there is a tool *C* for rough-turning the hub. Tools *D* and *E*, arranged similarly on the second turret face, bore and finish-turn the hub.

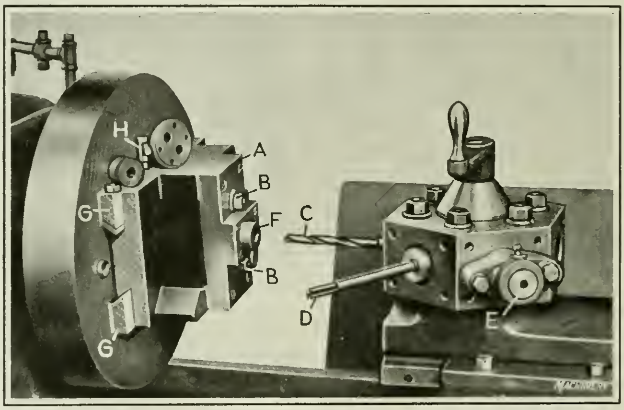


Fig. 6. Indexing Turret Lathe Fixture used for drilling and reaming Two Eccentric Holes in Oil-pump Covers

Next, it is required to break the corners of the hub and of the hole, and for this purpose a combination tool *F* is provided on the third turret face. This tool has a cutter bit slotted in such a way that the notched portion straddles the face of the hub and simultaneously breaks the corners of the hole and of the outside diameter. A reamer *G* on the fourth turret face then finishes the hole.

The next operation in the series is the facing of the front of the hub, and for this purpose there is a tool *H* mounted at the front of the cross-slide. The final operation consists of facing the back of the hub with a tool *I* carried on a rod extending through the lathe spindle and connected to the bar feed in such a way that it may be moved up into contact with the rear side of the work as it rotates. The rate of production attained in performing this series of operations is twelve castings per hour.

Turret Lathe Operations on Water Pump Covers

In the heading illustration is shown one of the No. 4 Millholland turret lathes equipped with a Hannifin air chuck and tooled up for machining covers for water pumps used on Olds engines. These pieces are made of aluminum, and it is required to perform roughing and finishing operations on the front faces of the flange and hub. Two tools are provided at the rear of the cross-slide, which simultaneously rough these two faces of the work, and after the preliminary cut has been taken, two similar tools mounted at the front of the cross-slide, perform the finishing operations on the same surfaces of the work.

On the first face of the turret, there is a drill for taking a preliminary cut through the center hole, and another tool with which a rough-turning operation is performed on the outside of the hub. On the second turret face, a similar tool provides for finish-turning the hub. Carried on the third face of the turret, there is a tool for facing the area adjacent to the center hole in the work. Finally, on the fourth face of the turret, there is a combination tool that breaks the corners of the inside of the hole and the outside of the hub. It consists of a holder with two bits, one of which extends farther than the other, so that it is able to reach the hole which is some distance inside the level of the front face of the hub. The rate of production in performing the machining operations on these water pump covers is eighteen pieces per hour.

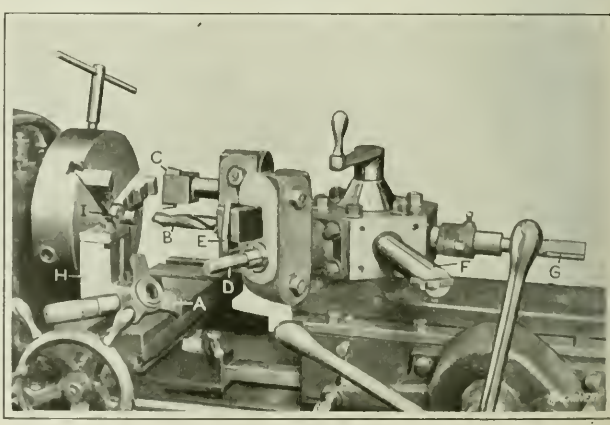


Fig. 7. Equipment for machining Hubs of Fan Driving Pulleys

Some Aspects of the Present Situation

By A. W. HENN, President, National Acme Co., Cleveland, Ohio

THE question that doubtless causes the greatest amount of anxiety in the machine tool field today is prompted by the great expansion in the industry during the last five years. Many believe that it will be several years before there will be sufficient demand for machine tools to absorb the entire machine-building capacity of the country as we know it today. This belief seems reasonable, and in view of all conditions to which we can point today, it would seem entirely too optimistic to hold a contrary view. The foreign trade, which in past depressions has been an important source of business, is at the present time reduced to very small proportions; and in the domestic field there is no great and important outlet for machine tools in view. Hence, it would seem that a much smaller machine tool building capacity than that at present available would be sufficient to meet the needs of both the domestic and the foreign trade for several years to come.

What has been our Past Experience?

As I look back upon my experience in the machine tool field for the last thirty years, however, I find that we have passed through several periods that in many respects were similar to the present one, although the details differ, and in view of those experiences it is difficult to look toward the future without considerable faith in the prospects of the machine tool industry. In the early nineties, previous to the depression which then held the country in its grip for several years, there was a great expansion in the machine tool industry. Many new concerns were started, and as compared with the ten years previous, the expansion in the machine tool building capacity of the country assumed great proportions; so much so that when the depression struck us, many of the older machine tool builders pointed to what they called an over-expansion, and predicted that it would be a great many years before the demands for machine tools would be equal to the capacity then existing. Yet a few years later—owing in a large measure to the activity in the bicycle industry—not only did the domestic and foreign trade absorb the entire capacity at that time, but the demand was so great that in the late nineties a number of new concerns started which have since grown into important factors in our machine tool industry, and which have found ever since sufficient employment for their activities to warrant their existence.

In the fall of 1903 we had another depression, and there did not seem to be a reasonable prospect for an early revival. Yet a couple of years later the machine tool builders found themselves engaged to capacity in building machine tools for many industries, but largely for the automobile industry which then entered upon its first stage of real development. A few years later we entered upon another depression, again followed by a boom and an expansion in the machine tool industry due to the second expansion in the automobile industry. In 1914 business was again almost at a standstill, and many manufacturers were working almost exclusively for stock. Then came the war with the effect on the industry well known to everybody; and finally, after the armistice, when everyone in the machine tool business predicted several years of stagnation because the world had all the machine tools that it could absorb for five years to come, at least, we found ourselves after a few months again fully occupied in building machine tools for various industrial purposes, but mainly for what might be called the third stage of development in the automobile industry.

Now we have again reached the bottom of a depression, and we can see nothing definitely ahead for years to come. Yet, in the light of past experiences, it is almost certain that the new developments that are constantly taking place in the entire industrial field will make demands on the machine tool builders, so that the industry that now appears to be over-expanded will again find itself occupied to such an extent that it will regain a healthy condition. It seems quite certain that we have already passed the lowest point in the depression. In many cases in the machine tool industry this occurred in July and August, with a slow but steady improvement since that time.

Possible Outlets for Machine Tools

As soon as business conditions in the general industrial field become normal, or nearly so, the machine tool builder will find an outlet for his products in two directions: He will enter new fields where machine tools will be required for the manufacture of new articles constantly being invented for the comfort and convenience of modern life, and he will be busy replacing machines that have become obsolete, with new and improved types. In the foreign trade the greatest opportunities now seem to offer themselves in the Far East, there being little hope for any great demand from Europe for some time to come. We all know that the railroad field would offer a great opportunity for machine tool equipment, if the railways were financially in a position to buy. This problem is a difficult one, and at present it is the most pressing of any now confronting us as an industrial nation. Freight rates must be reduced, but in order to reduce freight rates there must also come reductions in wages and an increase in the working efficiency of railroad employes.

The most important thing in regard to wages at the present time is not so much what might be termed a *reduction* in wages, as an *equalization* in wages. There are certain classes of labor that have not received, during the last five years, any more than a fair compensation for their work. There have been other classes of labor, again, who have received a great deal more, proportionately, than their fellow workers. Compare, for example, the wages in the railroad field and in the building industries with those in the general machine building field, and it becomes evident that in justice to the highly skilled men in the field last mentioned, the wages of overpaid workers should be proportionately reduced. In that manner industry can get under way again, and the prosperity of all can be insured.

Importance of Education of Workers

The last years have been an era of extravagance—there has been waste not only of money and the things bought with money, but also of time. The young men who years ago entered the trade devoted their spare time to study in order to qualify themselves by knowledge and skill in that trade. During recent years of high wages and short hours, the spare time has not generally been thus employed. Motion pictures and other pleasures and entertainments have taken a position in our community life that has temporarily overshadowed the value of educational development along specialized lines.

The motion picture, however, lends itself exceptionally well to the furthering of an educational campaign, and it is to be expected that after the present era of abnormal conditions, we will see this effective means of transmitting information used more and more for serious purposes.

Reducing Costs by Gang Drilling

How To Reduce Production Costs?

THE practice of grouping machines to facilitate the performance of a number of operations in rapid succession on a part, or the mounting of several machines in a gang on one base for the same purpose, makes possible high production rates at low costs. The accompanying illustrations are representative of typical jobs on which standard machines built by the Barnes Drill Co., Rockford, Ill., have been successfully applied to effect reductions in manufacturing costs. The photograph reproduced in Fig. 1 was taken in the shops of the Benjamin Electric Mfg. Co., Chicago, Ill., and shows three drilling machines and one tapping machine placed in a line for the manufacture of small flanged parts.

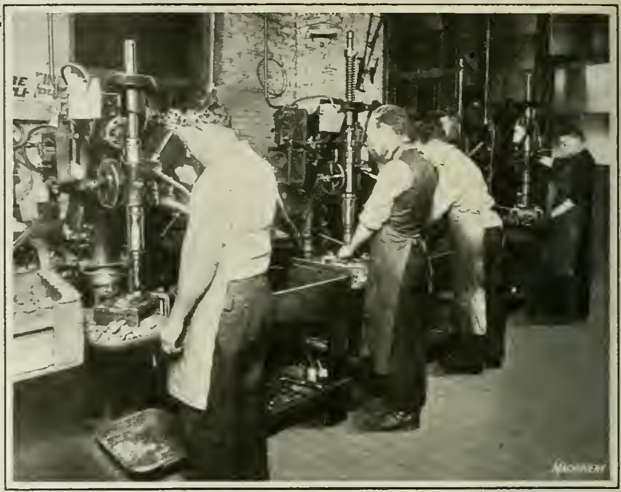


Fig. 1. Three Drilling Machines and a Tapping Machine grouped to obtain High Production Rates on a Small Flanged Part

Each machine is supplied with an individual motor drive and a controller. The machine at the left is used for drilling a hole through the center of the part, and the next machine is employed for tapping this hole. The third machine turns and faces the hub, while the tapping machine at the extreme right threads the hub, a Wells self-opening die-head being utilized for this operation. The outside diameter of the hub is 1 inch, and the length of the threaded portion 3/8 inch. The production obtained with these machines averages 334 completed parts per hour.

Drilling Automobile Axles

An all-geared gang drilling machine equipped with four 24-inch adjustable spindle heads is used in the plant of the Adams Axle Co., Findlay, Ohio, for drilling the king-pin hole at each end of an automobile axle and the spring-pad holes. This operation is illustrated in Fig. 2. The center distance between the spindles at each end is about 12 inches. The outside spindles and their guide bushings have a quick adjustment to compensate for small variations in the lengths of axles. This adjustment is obtained by revolving the handwheel at the right to rotate a shaft having threads engaging with nuts, which shift the spindle heads and jig members to the desired locations. Special equipment is supplied for supporting and locating the axle forgings, which are made from S. A. E. specification No. 1035 steel. The inner spindles used for drilling the spring-pad holes are each provided with a five-spindle auxiliary head.

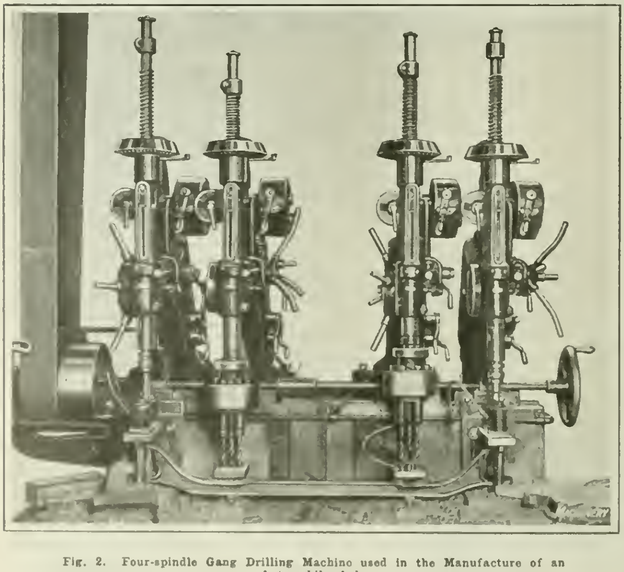


Fig. 2. Four-spindle Gang Drilling Machine used in the Manufacture of an Automobile Axle

At the top of each main spindle there is a coil spring and adjustable return stops. When an operation is completed the automatic feed is tripped, and the spindle and tool are lifted. through the action of the coil spring, sufficiently to clear the work. The raised position is governed by a shock absorber, located in a sliding member at the front of each head, with which the upper end of the spindle sleeve comes in contact. The king-pin holes are drilled 31/32 inch in diameter and reamed to 1 inch in diameter, while the spring-pad holes are drilled 17/32 and 1/2 inch in diameter. The production obtained with this machine is from ten to twelve axles per hour, with the drills driven and fed at their maximum speeds and feeds, respectively.

Machining Forged Clutch Levers on Gang Drilling Machine

Another four-spindle gang drilling machine having independent columns and tables is employed by the Hart-Parr Co., Charles City, Iowa, for drilling, reaming, and hollow-milling operations on forged clutch levers. This machine is illustrated in Fig. 3. The spindles are equipped with an automatic raising mechanism similar to that described

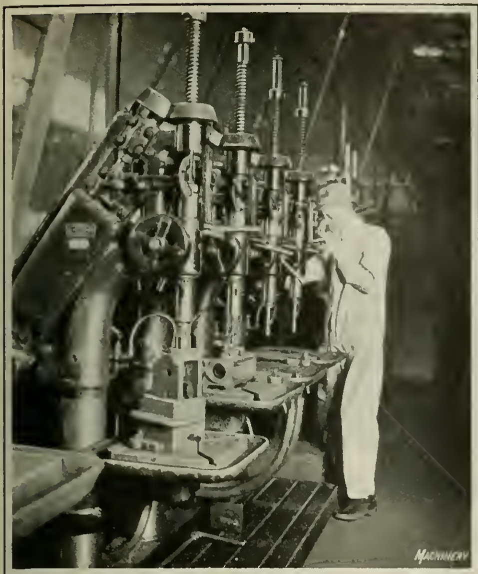


Fig. 3. Four-spindle Gang Drilling Machine used for machining Forged Clutch Levers

in connection with the machine shown in Fig. 2. In feeding a spindle, the operator simply lifts a throw-in lever and begins to feed. One operator attends to the four spindles, dividing his time about evenly between them. The production rate attained with this machine is one lever per minute or sixty per hour.

* * *

NATIONAL INDUSTRIAL COST CONFERENCE

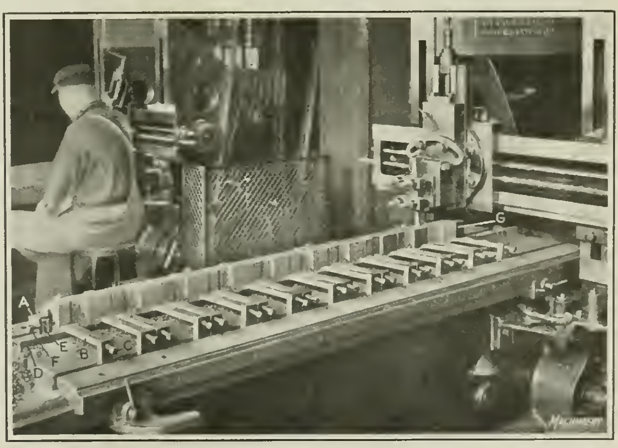
The Industrial Cost Association held its second national conference in Pittsburg, Pa., November 2 to 4. The objects of the association are to stimulate the interest of all manufacturers in correctly determined costs; to standardize cost and accounting terminology and establish governing principles in order to simplify cost accounting; to educate the members in the use and advantages of graphic charts and other methods of cost analysis and control; to assist members who are identified with cost committees of trade organizations in formulating uniform cost methods and to recommend the adoption of such methods; to provide a forum for the discussion of cost problems and practices through general and local meetings, and to gather and disseminate such information; to establish a cost library and maintain a bureau of information through which members may be assisted in solving their individual cost problems; and to coordinate the efforts of members so that cost of production may be considered in its proper relation to the problems of industrial management. Among the papers presented were: "What the Sales Manager Should Have from the Accounting Department"; "Inventories—Methods of Taking"; "Responsibility of the Comptroller or Accountant in Times of Business Depression"; "Terminology"; "Budgeting the Plant and Office"; "Sanitation and Safety"; "Cost and Profits of Welfare, Sanitation, and Safety"; "Looking into the Future"; and "How Can a Cost System, Although Efficient, Demoralize an Organization?".

MULTIPLE SET-UPS FOR PLANING

Attention has previously been called in these columns to the advantages of setting up a number of pieces of work at one time for planing. In this way the non-productive time of the machine is decreased, and the setting-up time per piece is usually less.

The economies resulting from this method of setting up work for planing are not always in direct proportion to the number of pieces that are set up at one time. For example, in one case where milling machine table castings were to be planed, two set-ups were tried, and it was found more economical to do the work with four castings set up at a time, rather than with eight, although ample power was provided to pull the work under the planer tools in each case. This is probably due to the fact that when too many pieces are set up at one time the non-productive time of the machine while the operator is engaged in setting up the work, and the idle time of the operator while the machine is at work, more than counterbalance the savings effected by the multiple set-up. The number of pieces that can best be planed at a time can only be determined by experience in handling many different classes of work, or by experimenting for each new job.

An example of the way in which a string of castings can be advantageously set up on a planer is shown in the accompanying illustration. The method of mounting is the important point in this case, because the job itself is very simple, consisting merely of planing a flat top face on each of ten castings. The planer is a 24- by 28-inch machine built by the G. A. Gray Co., of Cincinnati, Ohio, and it is shown in use in the plant of the National Acme Co., Cleveland, Ohio. Secured to the planer table there is a finished parallel bar *A*, the sides of which are in accurate alignment with the line of travel of the planer table. This bar is used as the locating point against which the castings are clamped by fingers or so-called "butters" *B*, which are tightened against the work by bolts *C* carried by stops placed in one of the table T-slots. A bar *D* is placed on the planer table to support the forward end of the clamping fingers *B*, so that their pressure is applied at a point about midway up the side of locating bar *A*. Means for supporting the end thrust of the cutting tools are furnished by a plug *E* placed in one of the clamping bolt holes in the table; this plug carries a bolt *F* which is screwed up against the end of the first casting. As all of the pieces of work are in contact with each other, end to end, it will be evident that pressure is transmitted from one piece to another. At the opposite end of the string of castings there is a plug *G* against which the work is tightened by bolt *F*.



Application of the Multiple Set-up Principle on Planer Work

Planning in Large Contract Plants

Organization of a Department for Planning the Progress of Work through the Shop

By GEORGE H. SHEPARD, Professor of Industrial Engineering and Management, Purdue University

ADEQUATE planning in a large contract or jobbing plant requires a well-organized planning department. This department should be a part of the shop organization with each departmental chief planner directly under the authority of the general foreman of the particular department, as shown in the organization diagrams presented in connection with the article entitled "Organization of Large Contract Plants," which was published in August MACHINERY.

The accompanying diagram shows the organization of a planning department in a contract or jobbing machine shop employing about one thousand workmen. It will be noted that the departmental chief planner is again directly responsible to the general foreman, and that the technical experts who are in an advisory relation to the method man are responsible only to the chief of staff. The following detailed description of a departmental planning office is based on an actual functioning organization, plans for which were originally prepared by W. H. Smith, first assistant to the author at the time when he was engaged in this line of work.

Purpose of a Planning Department

The general foreman of a large plant requires a special organization to assist him in handling the vast amount of detail involved in properly planning and preparing the work of the various shops, and, this is the particular function of a planning department. In the organization illustrated, the planning department provides a central point to which persons outside of the machine shop send all information and instructions which pertain to the work to be done by the shop. The planning department converts such information and instructions into shape for use in the shop. In so doing, the actual functions of the planning department consist of: (1) Issuing instructions as to what, how, where, and when work will be done; (2) providing all material, special tools, etc., necessary to complete the work on a given job; (3) keeping record of the actual progress and production of work to know how the scheduled plans are being carried out.

Many a shop has a staff of executives highly experienced in machine shop work and capable in devising and introducing labor-saving methods. Such shops may be excellently equipped with modern machine tools, and have every facility for producing at low cost, and yet find it difficult to compete with other plants less ably manned and equipped. The difficulty can sometimes be traced back to the lack of proper planning of the work, which sometimes is overlooked even by the best mechanical executives. Careful planning is especially necessary in shops where a variety of work is handled; for lack of planning may, in cases of that kind, greatly increase costs. A study of the possibilities for reducing costs by adequate planning of the work in the shop is well worth the careful attention of the best executive.

Function of Each Man or Unit in the Organization

According to the organization diagram the departmental chief planner has general charge of the department. The method man is the first assistant to the chief planner, and when the latter is absent, he automatically becomes the head of the department. The progress man is directly responsible to the chief planner, but in the absence of this supervisor he reports to the method man. The material man, planners, and the blueprint man are directly responsible to the method man; men in the material section, to the material man; men in the progress section, to the progress man; and jacket file clerks and messengers, to the departmental chief planner. The duties of each man are given in the following:

Departmental Chief Planner. The departmental chief planner has general supervision of the planning department and is responsible for its efficiency and results obtained. His main duty is to see that the various sections of the office are performing their work properly. He should handle personally only the most important questions, turning over all detail work possible to his subordinates, and to that end should train them to handle whatever work he gives them.

Method Man — The method man has general supervision of the method section and should maintain the same relation to that section as does the departmental chief planner to the entire department. He is responsible for the clerical work involved in writing up instruction cards, progress cards, etc., and should see that the planners analyze the jobs correctly. He should answer all questions from shop supervisors pertaining to the work of the planners and should consult fully regarding the various details with the technical experts of the plant staff.

Progress Man—The progress man has general supervision of the progress section and should maintain the same relation to that section as does the departmental chief planner to the whole department. The progress man is responsible for the accuracy of progress records, the soundness of schedule dates, and the constant surveillance of work in the shop to see that it is not delayed. He should reply to important inquiries from outside of the shop and from supervisors relative to the work in his section.

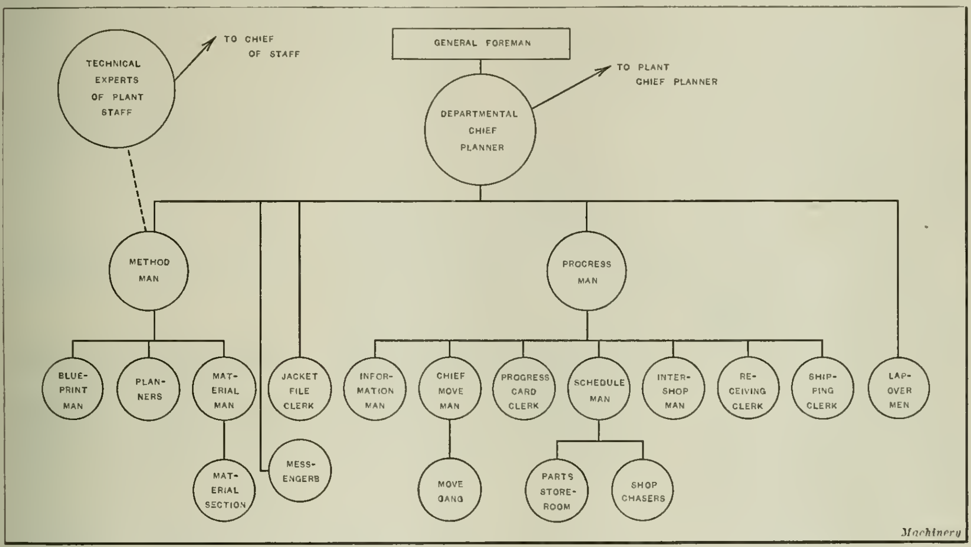
Planners—The work of the planners is to decide what work must be done; what operations are to be performed on each job; what classes of machines are to be used and the routing of the work from section to section of the shop; what kind and size of material is to be used; and as far as possible, what special tools will be needed.

In making these decisions the planners should consult job orders, drawings, and other instructions, and inspect samples and equipment to be repaired, etc. The aim of planners should be: (1) To specify the most economical method of performing operations from the standpoint of time and equipment; (2) to assign the jobs to machines best adapted to the work; (3) to make the best possible use of material, that is, a piece of material should be no larger than necessary to do the job. If the kind of material is not specified, the least expensive material suitable for the job should be used; tobin bronze should not be used in cases where brass would do, and solid material should not be used when a casting or forging would be more economical.

Planners write the necessary instructions and route tags to cover the jobs, and advise the blueprint man as to what sections of the shop should receive prints. In handling repair work, planners are responsible for issuing sufficient instructions to do the work properly. Planners should endeavor to foresee what will be required to complete a job and should either make necessary provision for it, or else refer the case to the method man.

Blueprint Man—The blueprint man obtains the necessary number of blueprints for a job from the drawing-room as directed by a planner, and files them. He issues them to the shop as directed by the planner, or when called for by the shop. He keeps an index of the blueprint file showing the supply of prints on hand, and to whom prints have been issued.

Material Man—The material man keeps a perpetual inventory of material in shop stores, and looks after the replenishment of the material; issues all necessary requisitions for material from stores, and has the material delivered to the shop. He is also assistant to the method man relative to materials, and in such matters, his decisions are accepted by the planners. In this capacity the material man must keep in close touch with the condition of materials in store, must carefully censor all lists of material for jobs made out by the planners, and take up doubtful points with them. In short, his main duty is to secure the most economical specifications from the planning office, so planners should consult him freely as to the availability of material.



Organization of a Planning Department for a Machine Shop employing about One Thousand Workmen

General Function of Progress Section

Repair jobs coming to a plant, as a rule, must be completed by a certain date, and, in the same way, job orders on new work may have to be finished at stated times. It is the work of the progress section not only to determine when each job shall be done, but also to secure information, material from other shops, etc., and to guide the work through the shop so that each job order will be finished by the specified date.

Inter-shop Man—The inter-shop man deals with other shops in the plant for the planning office and determines when the machine shop should deliver work on a job order to the next shop, so the latter will be able to complete work in time; secures from other shops any information needed by the machine shop in completing its work; consults the progress man or the schedule man, and then advises shops which feed work into the machine shop when the work should be delivered to it; and follows up these other shops when they fail to deliver material on the date specified.

Schedule Man—The work of the schedule man is: (1) To make a daily schedule of important jobs, showing the required dates of completion, and to issue this list to the foremen. This schedule is the means whereby the planning department guides work through the shops, and sets completion dates for the shops to attain and for the general foreman to hold the shops to. (2) To make a daily schedule of important jobs to be worked on at night by the night shift. (3) To watch the progress of every item on all classes of orders, particularly important work, by using the progress section records and shop chasers, to see that nothing falls behind. He should start action on delayed items through the inter-shop man where other shops are involved, and through the shop chasers or the progress man where the machine shop is at fault. (4) To notify the method man when any job orders ahead of the shop should be planned by the planners, the information being obtained by reference to the progress section records. (5) To keep in touch with the store-room man by means of shop chasers as to the condition of the assemblies in the store-room, and take action to get assemblies ready for the assembly section, reference also being made to the progress section records.

Parts Store-room—It is essential to economical production that, when a job is sent to the assembly section, all the necessary parts are together, so that the job can be worked on steadily until completed, and then shipped out of the section. In this way only live jobs will be on the assembly floor, and there will be no delay because parts are lacking. This is true for sub-assemblies as well as for final assemblies. To attain this end it is necessary to collect the parts after they have been machined until all parts for one job are ready for assembly. The store-room provides a reservoir in which these parts can be collected and turned over to the assembly section as a complete group. The planners, therefore, route all such parts to the store-room preparatory to assembly.

In order to expedite work it is equally essential that the planning department have some means of knowing definitely at all times what parts are ready for an assembly and what parts are lacking. It is apparent that different parts take different routes through the shops and require varying amounts of machine work. The store-room provides a means whereby the planning department can know just how assemblies stand; hence, parts which are lacking can be pushed. For this purpose, a card-index inventory is kept of parts in the store-room. The store-room also serves to collect partial deliveries of castings from the foundry until all the castings for a part have been received, at which time they are sent through the shops. By this means the planning office can avoid the machining of castings in partial lots with the consequent extra expense.

Shop Chasers—The shop chasers secure any information on work in the machine shop asked for by the schedule man. Each chaser has certain jobs assigned to him to watch particularly, and any noteworthy facts observed are reported to the schedule man.

Information Man—The information man answers all questions relating to the status of work in which the machine shop is involved, and acts as a censor on the condition of the progress section records, calling any defects to the attention of the progress man.

Chief Move Man and Move Gang—The move men who are not definitely assigned to a section of the shop and work directly under its foreman for movement within the section only, are organized in a general gang under the chief move man. The duties of the latter in directing this gang are, in the main, to carry out inter-sectional movement, as directed by the route tags on work deposited at the outgoing space by the section move men. The chief move man is in all matters under the orders of the progress man, and will perform such other duties as the latter may direct.

Progress Card Clerk—The duties of the progress card clerk are to keep the records of the progress section; the various forms used will be discussed in a subsequent article.

Receiving Clerk—The duties of the receiving clerk are to check incoming material and turn in all papers, shipping tags, etc., to the progress card clerk, after ascertaining whether all essential information is on the papers and tags. He sends partial deliveries of castings to the parts store-room.

Shipping Clerk—The shipping clerk sees that every sample piece of work delivered from the shop is provided with a delivery tag. He also insures proper identification of work sent to another shop for repairs.

Jacket File Clerk—The file of jackets (large manila envelopes) provides a receptacle for each job order for copies of all written matter pertaining to an order, job order, instructions, tags, etc. This is a reference file only, and the majority of questions as to the status of work should be answered from the progress section records as previously mentioned.

Messengers—The messengers maintain a mail service within the planning department between the office and the shop, and between sections of the shop. They also perform miscellaneous messenger work.

Lap-over Men—The duties of the lap-over men are to consult day foremen and assistant foremen and arrange the work for the night force of workmen.

The superintendent or general foreman of a large contract plant requires a special organization to assist him in handling the immense amount of detail involved in properly planning and preparing the work of the various departments, and this is the particular function of a planning room. The planning department provides a central point to which is sent all the required information and instructions from the customers' plants which pertain to the work to be done by the shop. The planning department converts this information and all instructions given into proper shape for use in the shop.

* * *

SIMPLIFICATION OF AUTOMOBILE DESIGN

With reduced prices for automobiles comes, by necessity, renewed efforts to reduce manufacturing costs. These reductions will come about partly through lower labor costs and improved means of production, but also through renewed activity among automobile manufacturers and their engineering staffs toward greater simplicity in automobile design. It is apparent that the fewer the parts, the less the cost, and it is also more generally recognized than ever before that the fewer the parts, the less the liability of trouble to the user. The Willys-Overland Co. is especially emphasizing this point in a recent circular, pointing to the fact that if fewer parts reduce motor troubles they will tend to increase the reputation of the car, increase the sales, make possible greater production, and, through greater production, reduce manufacturing costs. There is much food for thought in this reasoning, and there is no doubt that there is still great room for improvement in the simplification of automobile design and in so arranging the parts that may need adjustment that they are easily accessible.

* * *

DUTCH EAST INDIAN MACHINE TOOL MARKET

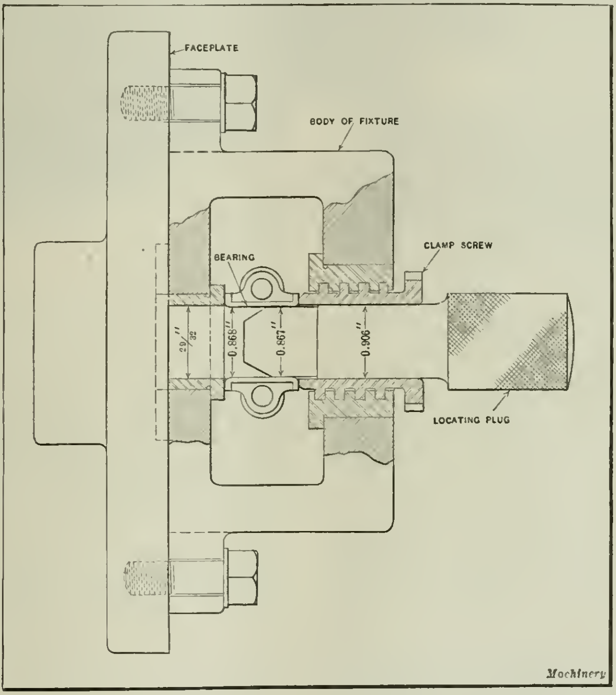
The Dutch East Indies are a colony with which Americans as a whole are not very well acquainted. The Island of Java is practically as long as the distance from Chicago to New York and has a population of 39,000,000 people. In addition to the sugar industry, there is the rubber industry, and the mining industry. The Dutch East Indies are the greatest tin producers in the world. The exports of metal-working machinery ran from $4000 in 1910 to $326,000 in 1920, while in 1919 the machine tool exports alone amounted to $614,000.

REDUCING COST OF FITTING CONNECTING-ROD BEARINGS

By A. K. SCHWARZ
Superintendent, American Motorcycle Mfg. Co., Louisville, Ky.

The writer was recently confronted with the problem of cutting down the cost of fitting and assembling the split bearings at the large ends of connecting-rods used on small motorcycle engines of the two-cylinder opposed type. Owing to the scarcity of skilled mechanics in the locality in which the plant was situated, this problem proved anything but an easy one to solve. The halves of the bearing referred to are made of the best grade of bronze obtainable, and run on carburized, hardened, and ground crankpins, 7/8 inch in diameter by 15/16 inch in length. The piston displacement of the engine is 21 cubic inches, and the maximum speed of the engine under load is 4100 revolutions per minute. These facts are mentioned to show the necessity of obtaining as nearly a perfectly fitted bearing as possible.

Broaches and several types of reamers were given a trial, but owing to the light sections of the connecting-rod, they did not produce a hole having the required roundness and straightness. As a last resort grinding was tried. This method proved a complete success, and in fact, resulted in the production of a better bearing than the writer has ever seen produced by other methods. A set of bearings finished in this manner, which were carefully examined after a run of 500 miles, were found to be in such good condition that less than 0.001 inch removed from the shims between the halves of the bearing would cause the shaft to bind or "freeze." The speed of the motorcycle during this run was thirty miles per hour. The speed ratio between the motor crankshaft and the motorcycle wheel equipped with tires 26 inches in diameter was 6½ to 1.



Fixture used in grinding Connecting-rod Bearing

The following description of the method and grinding fixture developed for grinding the connecting-rod bearing may be of interest to those having similar work to do. The connecting-rod caps with the bearing shells in place were faced off on a disk grinder to allow from 0.005 to 0.007 inch for finish-grinding the bearing to the required diameter. While the fixture illustrated was being built, a grinding wheel manufacturer was asked to recommend a grinding wheel for this job. Using the wheel recommended, the actual time required to grind the bearing was about 3½ minutes, while the time necessary for loading and unloading the fixture was about forty seconds. The limits on the 0.875 diameter were plus 0.0005 and minus 0. Before adopting the grinding method, it required two hours to produce a hand-finished bearing which would be passable, and even then it was not nearly as perfect as one finished by grinding.

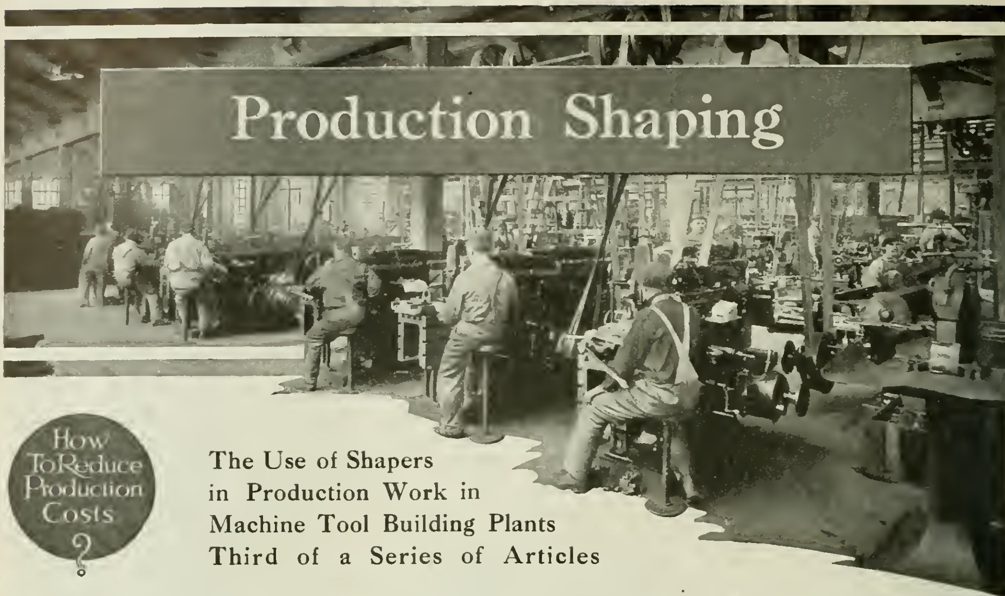
UNDERPAID POSTAGE ON FOREIGN MAILS

The American Chamber of Commerce in France calls attention to the constant lack of full foreign postage on mail received from the United States. It is pointed out that much adverse criticism results from sending letters, circulars, and advertising matter with underpaid postage to foreign countries. The penalty paid by the receiver is double the amount of postage lacking, so that on a letter that should have five cents postage, mailed with a two-cent stamp, the penalty payment would be six cents. Now six cents, it is pointed out, is not much, but if 100 letters are received with underpaid postage, the extra expense amounts to $6 or, at present exchange, nearly 100 francs.

It is also pointed out that the United States appears to be the only country in the world where business houses do not put sufficient postage on their foreign mail, and that, therefore, the feeling of resentment toward this country is all the greater. Attention is called to cases where an agency abroad had gone to the trouble of writing to the firms who had sent letters with underpaid postage, and in several cases very nice letters were received in reply with two-cent stamps on them, so that it was necessary to pay the penalty again.

One correspondent refers to a case of a firm doing business with him, that always sent him letters with short-paid postage. He collected all the envelopes with the penalty stamps due, and returned them to this firm. In reply, he received a very apologetic letter, and was allowed full credit for the amount of underpaid postage, but the reply was placed in an envelope with a two-cent stamp, so that he paid extra postage to receive the apology, and to cap the climax, he received a Christmas card on which he was obliged to pay extra postage.

This neglect on the part of American business houses finally resulted in a complaint being made to the Postmaster General at Washington, about the amount of mail that is allowed to leave the United States with underpaid postage. The Department took up the question at considerable length; the correspondent who made the complaint received a copy of the departmental circular being sent out relating to the matter, together with copies of the entire correspondence. When this letter from the Post Office Department of the United States was received it had on it a postage-due stamp, so that the correspondent was obliged to pay the equivalent of twenty cents in order to find out what the Postmaster General had to say about the matter. Recently, however, a ruling has been made by the Post Office that all foreign mail on which the postage is underpaid will be returned to the sender, provided a return address is on the envelope.



Production Shaping

How To Reduce Production Costs ?

The Use of Shapers in Production Work in Machine Tool Building Plants Third of a Series of Articles

THE shaper is a machine having sufficient flexibility to adapt it for handling a wide range of production work, provided care is taken in the planning of operations and in the designing of tools and fixtures. The following article illustrates the application of shapers for the performance of miscellaneous manufacturing operations in machine tool building plants. All the methods referred to involve the use of principles of general application, so that although these methods are applied to the manufacture of parts of machine tools, they could be utilized with equal success in plants handling various other classes of work.

Planing the Legs of Springfield Lathes on the Shaper

Engine lathes and shapers are built by the Springfield Machine Tool Co., of Springfield, Ohio, and in this firm's plant it is the regular practice to use shapers of their manufacture for planing lathe bed legs. In Fig. 1 a Springfield shaper is shown equipped for this operation, and it will be seen that the table has been removed so that a fixture *A* may be bolted to the saddle, this fixture being of much the same shape as the lathe bed legs. There are two projecting feet *B* on which the casting rests until it has been secured in place.

The cast-iron member *C* of the clamping mechanism carries three hardened plugs (two of which are shown at *D*); these plugs are held in contact with the lathe bed leg casting by three bolts *E*, thus clamping the casting in place on the fixture. The simplicity of the arrangement makes it possible to employ apprentices to do work for which high-priced mechanics might otherwise be required. These lathe bed leg castings are generally rather hard, and for that reason the cutting speed is kept within conservative limits, so that the figures given in the following do not represent maximum production. The cutting tool is carried by a holder and located behind the point of support, as it has been found that a tool of this type gives better results than are obtained with a straight one.

In machine tool building plants, as in many other shops engaged in the manufacture of metal products, there are numerous operations for which the shaper is well adapted. The following article describes methods that are employed in tooling up and operating shapers for such work in plants building lathes, milling machines, grinders, planers, and other types of machine tools. The examples selected are sufficiently general in their scope to suggest applications of similar principles and methods in plants that are engaged in the manufacture of a variety of products.

In planing these lathe legs, the work consists of taking roughing and finishing cuts. There are two surfaces to be planed at the top of the work; on a 16-inch lathe, these surfaces measure 12 inches long by 3 inches wide. A round-nosed, high-speed steel tool is used for taking the roughing cut at a speed of 50 feet per minute, with a feed of 0.011 inch per stroke, and a depth of cut of about 1/8 inch. The finishing cut is taken with a round-nosed, stellite tool of a greater radius of curvature than the one employed for roughing. This tool is operated at the same cutting speed, but with a feed of 0.008 inch per stroke and a depth of cut of about 1/16 inch. Approximately one-half hour is required to set up and plane a casting by the method described.

Facing Bosses on American Lathe Lead-screw Supports

A rather simple surfacing operation is shown in Fig. 2, which illustrates the use of a 16-inch shaper made by the American Tool Works Co., Cincinnati, Ohio. The operation consists of rough- and finish-planing a circular boss *A* on the lead-screw support for American engine lathes. A roughing cut is taken with a round-nosed tool at a speed of 45 feet per minute, using a feed of 0.032 inch, and leaving 0.006 inch of metal for removal by the finishing cut, which is taken at a speed of 45 feet per minute, with a feed of 1/2 inch. The production time on two pieces of work which are set up for simultaneous machining is ten minutes.

The method of setting up the work is the point of particular interest in this job. As the castings come to the machine, they have been planed on their under side, forming a finished right-angled shoulder that is located against the corner of the shaper table. The two pieces of work are held against the side of the table by means of a bar *B*, which passes through cored openings in the castings and is drawn toward the table by means of clamping bolts (not shown in the illustration). The work is held down on top of the table by straps *C*. The thrust of the cutting tools is taken by an end-stop *D*.

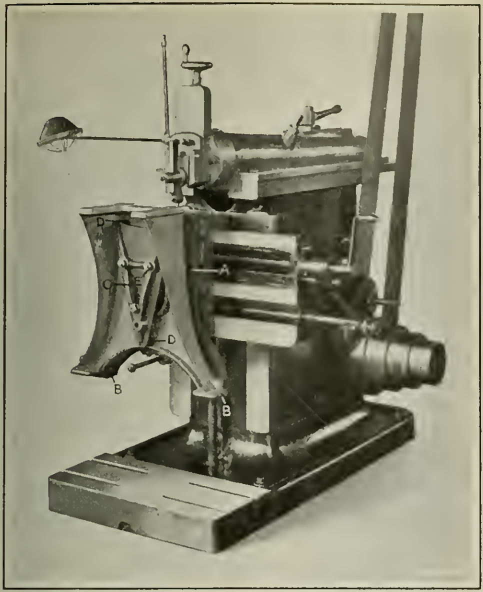


Fig. 1. Shaper equipped for a Short Planing Operation on the Legs of an Engine Lathe

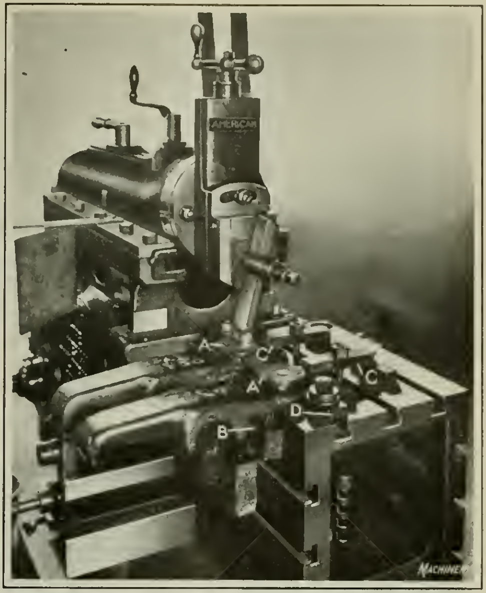


Fig. 2. Shaper equipped for planing the Faces of Bosses on Screw Supports for Engine Lathes

Planing Steptoe Milling Machine Knees on the Shaper

In machining knees for hand milling machines built by the John Steptoe Co., of Cincinnati, a practice is made of planing the dovetailed bearing for the saddle, with the work set up on one of the shapers of this company's manufacture. As the castings come to this machine, the back of the knee has been planed so that it may be used as the locating surface. The table is removed from the shaper and the milling machine knee to be planed is clamped directly to T-slots in the apron. This operation, as shown in Fig. 3, consists of planing the dovetailed bearing for the saddle on the knee, roughing and finishing cuts being taken, as in the preceding cases, with the standard forms of tools employed for this purpose. This is a regular production job in the Steptoe plant.

Shaping Queen City Grinder Driving Shaft Brackets

On grinding machines built by the Queen City Machine Tool Co., of Cincinnati, the main driving shaft located at the back of the machine is supported by brackets of the form shown set up on a shaper table in Fig. 4. While held in this way it is required to plane surface *A* on the casting. An interesting feature of this job is the provision made for holding pieces of work that are of rather an unusual form. The work is held in an offset jaw vise mounted on top of the shaper table, and an auxiliary bracket *B* is bolted to the finished side of the table to support the bearing boss, which would otherwise overhang and cause severe vibration while the cutting tool is at work. The upper part of the casting is further supported by a jack-screw *C* that is furnished with lock-nuts, so that it may be raised under the

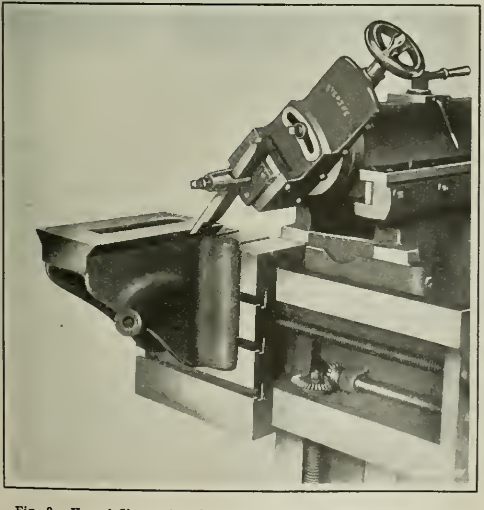


Fig. 3. Use of Shaper for planing the Dovetailed Saddle Bearing of a Hand Milling Machine Knee

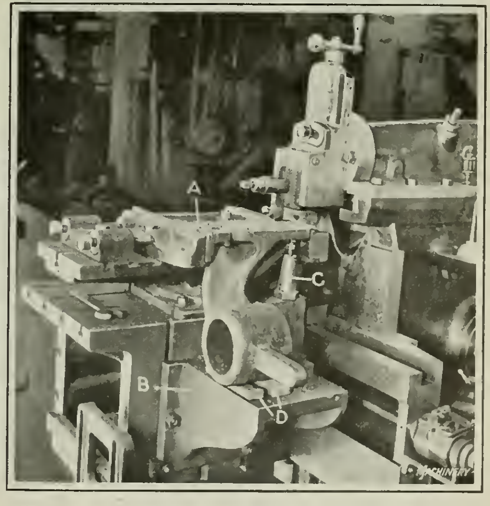


Fig. 4. Planing and tonguing the Face of a Grinding Machine Driving Shaft Supporting Bracket

corner of the casting and clamped in position to support a section of the work that is too thin and flexible to withstand the pressure of the tool without this additional support.

After the casting has been set in the vise and lined up ready for planing, hard wood wedges *D* are driven in between the surface of bracket *B* and the under side of the bearing boss, in order to afford a secure foundation. In the illustration the roughing cut is being taken on the face of the bracket with a round-nosed tool. The sequence of operations is quite simple, consisting of the planing of this face of the casting and the forming of a tongue that fits into a corresponding groove planed in the bed of the grinding machine. After the roughing cut has been completed, a finishing cut is taken with a square-nosed tool. The tongue is finished to the required width with a duplex tool which straddles the tongue and simultaneously finishes its two sides. The operation is performed on a 28-inch Queen City shaper and takes twenty-one minutes.

Shaping Front Plates for American Planer Frictions

In Fig. 5 is shown the work of planing a piece known as the "front plate" for an American planer friction. As the work comes to this shaper, it has been faced on the under side, and a fixture of the form shown is employed, because there is a boss on the bottom of the work, for which a clearance space must be provided in the fixture; otherwise, it would be practicable to strap this piece directly to the shaper table. The job consists of rough- and finish-planing the horizontal surface which surrounds the dovetail bearing, and also rough- and finish-planing the bearing. As the shoulder at the end of the dovetail makes it impracticable to handle more than one piece of work at a time, it is not possible to apply the principle of setting the work up in a string for planing, and consequently this may be regarded as a production job for which the shaper is particularly adapted.

At best, the planer could operate only on one piece at a time, for the reasons mentioned, and the positive stroke control of a shaper is a desirable feature when the tool traverses almost into contact with a shoulder on the work, as in the present case. This job is done on an American 24-inch shaper. At the back of the fixture on this machine is a tool-setting gage *A* used in setting the tools for operation on both the horizontal top face of the work and on the inclined surfaces of the dovetail. The method of procedure is first to rough the top face with a round-nosed tool, and then take a finishing cut with a broad square-nosed gooseneck tool.

Next, a dovetail roughing tool is used for taking the first cut on the inclined faces of the bearing, after which a finishing tool is substituted for the final operation. The dovetail bearing is required to be accurate within 0.001 inch. For testing the work after the finish-planing operation, a gage *B* is used, which is coated with a thin film of red lead and inserted in the bearing in order to test the accuracy of the form and the straightness of the inclined sides. All operations are performed at a cutting speed of 55 feet per minute. On the horizontal surface, the feed for roughing is 1/8 inch, and for finishing 3/4 inch; on the inclined faces of the dovetail, the feed for the roughing cut is 0.020 inch, and for the finishing cut 0.250 inch. There is an allowance of 0.006 inch of metal for the finishing cut. On this job an operator can finish five pieces in eight and three-quarter hours.

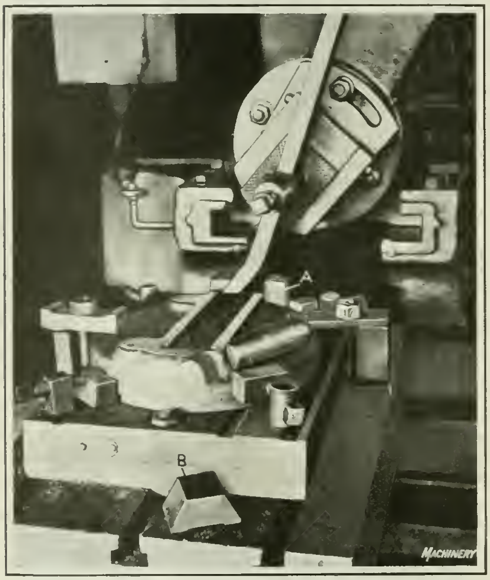


Fig. 5. A 24-inch Shaper equipped for planing the Dovetail Bearing and the Horizontal Face of Front Plates for Planer Frictions

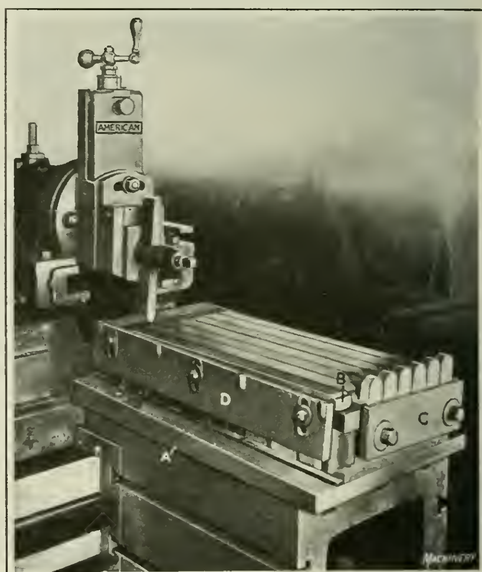


Fig. 6. A 24-inch Shaper equipped for planing the Tapered Face of Gibs held on a Magnetic Chuck

Planing Tapered Gibs on a Shaper

In the plant of the American Tool Works Co., 24-inch shapers of this company's manufacture, which are equipped with magnetic chucks as shown in Fig. 6, are used for taper planing operations on various types and sizes of gibs employed in the construction of American machine tools. The sides and straight under side of the gib are machined before the work is set up for planing the tapered side. It will be seen that six gibs are set up on the magnetic chuck at one time. In order to obtain the required location for the taper planing operation, a master plate *A* is placed between the shaper table and the chuck; this tilts the chuck to the proper angle, so that horizontal strokes of the shaper tool will result in planing the top face of each gib at the required taper to the previously finished lower side.

These gibs are required to be accurate, after finish-planing, within 0.001 inch from end to end. Hence it is important to set up the magnetic chuck on the tapered foundation plate *A* in such a way that the angle of the work will be brought within the required limits. For checking the set-up

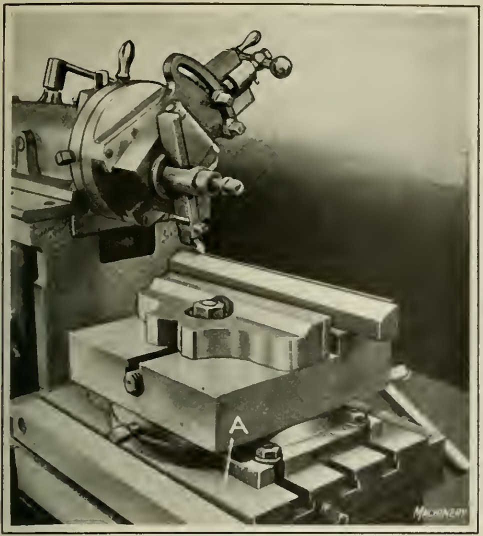


Fig. 7. Method of planing Double-angled Gibs

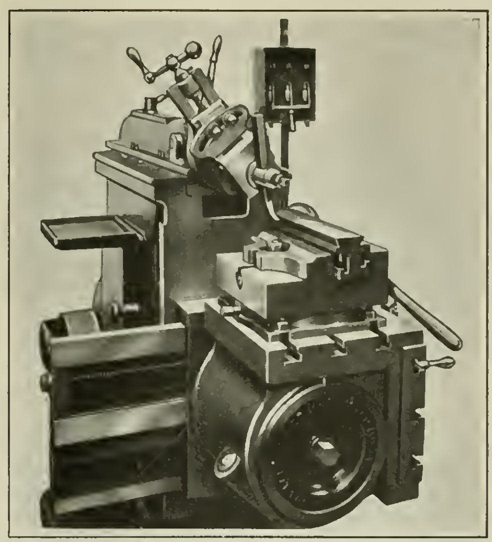


Fig. 8. Planing Inclined Side Faces of Dovetailed Slide Bearing

before planing, a master gib *B* is used, which is placed on the face of the magnetic chuck, a dial indicator being mounted in the shaper toolpost. This master gib is accurately planed, so that if the chuck has been properly set up, the indicator will give a uniform reading from end to end of the gib *B*. Any error which is discovered in making this test is corrected by placing one or more sheets of packing paper between the shaper table and the plate *A* at the low end. Then the operator can set up six of the gibs ready to be planed.

Provision for Supporting End Thrust

The magnetic chuck is furnished with an end plate *C* and a side plate *D* for the double purpose of assisting in locating the work against its previously planed side faces, and of supporting the end thrust of the tool that could not be carried by the holding power of the chuck. A roughing cut is taken over the work with a round-nosed tool, using a cutting speed of 55 feet per minute with a feed of 0.035 inch. For finishing, a round-nosed tool is used, the end of which has been slightly flattened by rubbing it down on an oilstone. This tool is also operated at a cutting speed of 55 feet per minute with a feed of 0.030 inch.

With an equipment of this kind, the setting fixtures may be depended upon to hold the work within accurate limits, after the original set-up has been made by an experienced mechanic. Consequently, it is found economical to employ a semi-skilled operator on this job, and it is for that reason that the finishing cut is taken with a tool of the type described. Otherwise, it would be regarded as better practice to employ a broad square-nosed finishing tool of the goose-neck type, with a feed of from ½ to ¾ inch per stroke. The production time for the rough- and finish-planing operations on the tapered side of six gibs is thirty minutes.

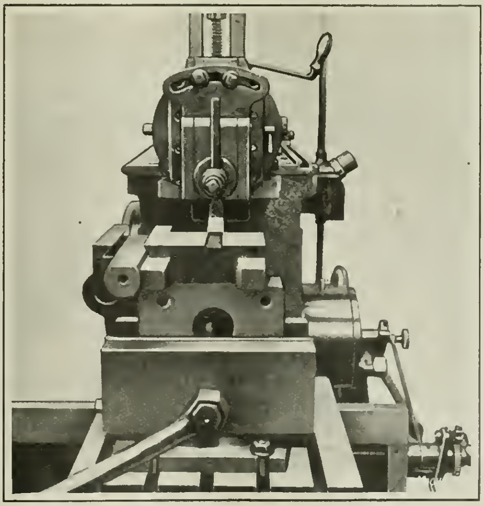


Fig. 9. Use of a Broad Square-nosed Tool for planing a Shallow Slot in the Work

Shaping a Gib Having a Double Taper

Fig. 7 shows how a shaper of the type made by the Potter & Johnston Machine Co., Pawtucket, R. I., can be utilized for machining a piece of work on which there is a double angle. The piece shown in process of manufacture is a tapered gib on which a 45-degree angle is required to fit the dovetailed bearing of the slide, while the usual lengthwise taper is also provided. On shapers of this company's manufacture there is a tilting flap (shown at *A*) at the top of the table, which can be raised to any required angle in order that the surface of the work being machined can be planed at any desired angle with the lower surface of the work that is clamped to the table. It is this application of the tilting flap that provides for obtaining the lengthwise taper on the work; and by setting the tool-head at an angle of 45 degrees, the single-point tool may be fed down the inclined side of the work, thus obtaining the desired form.

Shaping the Angular Sides of a Dovetailed Slide

Fig. 8 shows the method used in shaping the angular sides of a dovetailed slide bearing on a Potter & Johnston shaper. This job is similar to the one illustrated in Fig. 7 in so far as the planing of the 45-degree angular sides is concerned. It will be noticed that the tool-head is set at an angle to give the desired form to the work, but there is one noteworthy difference in this case, which is that the tool is required to cut on the under side of the inclined face instead of at the top. Consequently, the tool had to be forged with an offset on which the cutting point is ground, so that there will not be any interference between the side of the tool and the work. In Figs. 7 and 8 it will be seen that the pieces to be machined are secured in an ordinary shaper vise.

Cutting a Tongue-slot with a Shaper Tool

Fig. 9 shows a Potter & Johnston shaper on which the dovetailed bearing for a slide has just been machined at the setting illustrated. After completing this part of the work, the table is moved over to provide for cutting a tongue-slot; the tool is shown engaged in the performance of this operation in the illustration. For this job, the tool is made of the proper width to take the cut with only a vertical feed movement.

* * *

LENGTH OF ROPE FOR DRUMS

By G. W. TREWHELLA

The formulas given on page 768 in MACHINERY, April, 1921, for finding the length of rope that can be wound on a drum, appear to give results that are too high. One important point not taken into consideration in the previous discussion is that when a rope is wound on a drum the direction of the helix changes with every added layer so that the rope in the second layer will not lie in the groove between the coils of the first layer but must lie across these coils at an angle. This will make the distance between layers nearly equal to the diameter of the rope, so that for practical purposes it is allowable to use the diameter of the rope as the radial pitch of the coils.

The number of coils in a layer will be one less than the width of the drum divided by the diameter of the rope, which will be evident when considering the winding of a rope 1 inch in diameter on a drum 2 inches wide. There is room for but one coil in a layer if the rope forms a true helix. The coils in successive layers will be seen to cross every time at a point opposite the starting point. This will make the increase in radius per layer less than the diameter of the rope at the starting point of a coil, and equal to it at a point opposite the starting point, making each added coil eccentric relative to the first. For such a condition the diameter of the rope must be taken as the radial pitch of the coils, or the most eccentric side will project beyond the flanges. It will also be seen that if the drum is increased from 2 inches to 2½ inches in width, there will be room for 1½ coils under the same conditions, so that it is not "impossible to have a fraction of a coil," as stated in the former article.

In the case of the 1½-coil condition, the coils will cross at opposite sides in alternate layers, so that a dimension slightly less than the diameter of the rope should be used as the radial pitch of the layers. On a drum having a small number of coils per layer, there will be an error in the true helix, but on a longer drum any variation from the true helix will be very slight. In practice, it is not likely that eccentric windings will cause trouble.

The following formulas contain certain theoretical errors which are believed to be immaterial for most practical purposes. No account is taken of the extra length due to the helix of each coil; of the extra fraction of a coil in each layer due to the wedging action against the flanges; or of the rope lying in the groove of the under layer during a part of each coil. The last error works both ways, as it will in some cases allow an extra layer, but will slightly shorten each coil owing to its shorter radius when in the groove. It is only under very favorable conditions that a large number of layers is wound close enough to crowd more rope on the drum than the following formulas indicate; furthermore, for a few layers the errors are so minute that it is believed these formulas will answer the purpose in all ordinary cases.

In the following formulas,

d = diameter of rope, in inches;
D = diameter of drum, in inches;
F = diameter of flange, in inches;
W = width of drum, in inches;
N = number of layers;
O = total length, in feet, of rope in one coil taken from each layer;
Q = number of coils per layer;
L = length of rope, in feet, that can be wound on the drum = OQ

Then

$$N = \frac{F - D}{2d}$$

This formula gives the number of layers to the nearest whole number, unless it is not allowable for any part of the rope to project beyond the flanges of the drum. If such is the case, the fractional remainder should be dropped and the whole number used. If the diameters of the drum and of the flange are considered as the inner and outer circles, respectively, of a ring, the area of this ring may be used to obtain the value of O; thus,

$$O = \frac{0.7854\ (D + 2Nd + D)\ (D + 2Nd - D)}{12d}$$
$$= 0.2618N(D + Nd)$$
$$Q = \frac{W}{d} - 1$$
$$L = OQ = 0.2618N(D + Nd) \times \left(\frac{W}{d} - 1\right)$$

Applying the formulas to the conditions stated in the previous article in which the diameter of the drum equals 12 inches, the width 6 inches, the diameter of the flange 18½ inches, and the diameter of the rope ⅜ inch, we have:

$$N = \frac{18.5 - 12}{2 \times 0.375} = 8\ 2/3 \text{ or, say, } 9 \qquad Q = \frac{6}{0.375} - 1 = 15$$

Then,

$$L = 15 \times 0.2618 \times 9\ (12 + 9 \times 3/8) = 543.4 \text{ feet}$$

as compared with 620.5 feet, obtained from the previously published formula.

In the second case the drum is widened ¼ inch, and the other dimensions remain as before, so that $N = 9$ and $Q = (6.25 \div 3/8) - 1 = 15\ 2/3$.

Then

$$L = 15\ 2/3 \times 0.2618 \times 9\ (12 + 9 \times 3/8) = 567.5 \text{ feet}$$

as compared with 640.6 feet, obtained from the previously published formula.

When the flange is reduced to 18⅛ inches, and all the other dimensions are the same as in the first example,

$$N = \frac{18.125 - 12}{2 \times 0.375} = 8\ 1/6 \text{ or, say, } 8 \qquad Q = 15$$

Then,

$$L = 15 \times 0.2618 \times 8\ (12 + 8 \times 3/8) = 471.2 \text{ feet}$$

as compared with 548.4 feet, obtained from the previously published formula.

The only piece of rope available for checking these formulas was a reel containing 5000 feet of wire rope, 2¼ inches in circumference. The values used in checking the formulas were D = 14 inches; W = 29 inches; F = from 40 to 41 inches; and d = 0.75 inch. It was not practicable to test the concentricity of the windings, owing to the small hole in the end of the reel, but the larger value of F was used as representing the required diameter of a flange to support the rope. This was new rope, wound evenly on the reel, closer than would be the case in average usage. The formulas here presented give the length as 4881 feet, while the formulas published in April MACHINERY give the length as 5388 feet.

Selling Machine Tools

By a Machine Tool Sales Manager

As nearly as the writer has been able to determine, there were in the spring of this year approximately 1400 salesmen in the great manufacturing section of the United States east of the Mississippi and north of the Ohio and Potomac Rivers devoting their entire time to the selling of machine tools. This figure includes the members of firms dealing in machine tools who devote their time to selling, their outside salesmen, their store salesmen, and the direct selling representatives of machine tool manufacturers, as well as sales correspondents. It excludes service men, demonstrators, and those officials of machine tool firms and their assistants whose work is business routine rather than direct sales work.

On the Pacific Coast and in the southern states there are a great many machine tool salesmen, but in those sections there are probably not more than fifty who devote their entire time to the closing of sales agreements relative to machine tools. In those parts of the country the relative scarcity of machine shops requires the salesmen to handle more lines than machine tools only, thereby dividing their sales efforts. These salesmen usually sell supplies and equipment for woodworking and mining, and also handle contractors' machinery, in addition to machine tools. Were these "part-time" salesmen included, as well as those members of machine tool firms who are not directly active in the selling organization, the total number of men engaged in the distribution of machine tools in the United States would be in the neighborhood of 8000.

Tendencies in the Selling of Machine Tools

There is a rapidly growing tendency in industry in general for the manufacturer to get closer to the point of sale. In the machine tool industry this tendency is indicated by the rapid increase in the number of manufacturers who have their own selling organizations and salesmen and who deal directly with the consumer. It is also indicated by the number of sales engineers, district representatives, and special representatives traveling through the country for concerns who continue to distribute their machines through dealers.

In the distribution of some commodities, such as food products for example, a direct distribution system eliminates time and waste and results in a lower price to the consumer. This, however, does not apply to the machine tool industry. In the majority of cases manufacturers of machinery are not so much impressed by the economy of direct distribution; they are mainly interested in cutting down the distance between themselves and their customers in order that they may keep in closer touch with the trade. They desire to observe tendencies, combat harmful influences, and watch the effect of their sales and advertising work. The machine tool salesman enjoys the unique distinction of knowing the mechanical phases of the business almost as well as the manufacturer whom he represents. He is therefore able to pass on information that the manufacturer otherwise would find difficulty in obtaining.

Apart from this close contact with the trade, there is perhaps less to be gained in the machine tool industry from direct dealing with the customer than in other industries, and the question as to whether machinery house salesmen or manufacturers' direct salesmen are to be preferred is a question that must be settled individually. It depends to a considerable extent upon the product, the locality, and the machinery dealers in the territory under consideration.

Characteristics of Machine Tool Salesmen

Whether employed by a machinery dealer or by the machine tool manufacturer, the machine tool salesmen generally possess unique characteristics. They occupy a class by themselves in the selling profession. In knowledge and training in the business which they represent, machine tool salesmen can confidently challenge those of other industries. The majority of machine tool salesmen obtain their early training in machine tool plants and later branch out into the selling department, either as representatives of their own company or of machinery dealers. Many have developed into salesmen from minor positions within the organizations of machine tool dealers, and only a few have come into the field from industries not connected with the machine tool business.

Another characteristic of the machine tool salesman is that he seldom has sold any other product. The fact that he so largely originates from within the industry accounts for some of his distinguishing methods. The machine tool salesman depends almost exclusively upon his mechanical knowledge in his sales work. He knows the goods more thoroughly and gives to his customers and prospects a greater amount of definite and valuable information than the salesman in practically any other line of industry. The machine tool salesman also, in the course of his work, absorbs and is able to later distribute a great fund of mechanical information. On the other hand, he does not seek and is somewhat slow to absorb and practice many points of salesmanship that could be advantageously used.

The Salesman's Position Today

There are times when the business relations between the manufacturer and the customer in all industries need to be carefully handled. This is true of the machine tool industry as well as of any other industrial field. The late inflated period was to no man's liking. There are instances in it that are stamped upon our memory. The object of our late wrath may have been the landlord, or the butcher, or we may have a mental waiting list of those that were paid a higher price than we considered reasonable. In the excitement of boom times we paid what we were asked, reserving only the determination to even matters up in some way when the opportunity presented itself.

As a matter of fact we are justified in harboring a feeling of resentment in but few instances. The seller of articles or products at what we termed exorbitant prices was himself caught in the same whirlwind of economic conditions. Few understood or understand now these economic conditions. The average buyer of machine tools does not dig deeply into the study of economics—it is apart from his regular line of duty, and it is a very dry pastime. However, the position and the policy of the machine tool builders during the period of inflation was, as a rule, exceptional, and it is the machine tool salesmen's opportunity to capitalize that position. He need not be an economist in order to be able to represent fairly the machine tool manufacturer's position, and he can employ his opportunities as a salesman to gain advantage in giving accurate information as to the relation of costs and selling prices during the entire period of inflation. In this way he can safeguard his industry as well as gain greater results from his sales efforts. In articles to follow the writer will dwell in greater detail upon some of these points.

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HOW PRODUCTION COSTS ARE REDUCED

October and November MACHINERY presented numerous practical examples of cost-reducing methods, particular attention being directed to the necessity for a careful study of present shop practice in order to determine the possibilities for substantial cost reductions through the use of more efficient methods and equipment.

In this number the educational campaign is continued. Specific examples are mentioned here only to emphasize to mechanical executives the importance, in these rapidly changing times, of keeping abreast of the new machines, tools, methods and processes which automatically bring down manufacturing costs. These new tools and new ways of doing things cover a wide range of shop practice and are applicable in all branches of the metal-working industry.

The article in this number on reducing costs in the assembling department is typical in giving ideas and suggestions that may be profitably studied. The cost-reducing tooling equipments for automobile work described in two different articles show principles that may be applied with equally satisfactory results to any line of manufacture where the quantity is great enough to permit the use of such methods. Other articles refer to efficiency and lower costs obtained through careful study of drilling problems and of combination die design. The value of the die-casting process for reducing costs is more and more being recognized, and an article on this subject gives comparative costs on making certain parts by former methods and by die-casting.

The great need is for more radical thought in regard to equipment and methods. Because a method used for years proved satisfactory in days when cost was relatively unimportant, when more orders could be had than the factory could fill, it is far from certain that the same methods will serve today when price is almost the chief consideration.

* * *

THE NEW BASES FOR ADVANCEMENT

Jobs are not so plentiful as they were, and they will not be back to the heyday of 1917, 1918 and 1919 for many moons to come. The fevered period of war production ended long ago, and the day when any good-for-nothing could get a job has passed. The amazing labor replacement, which was as high as 70 per cent in many industries, no living man may see again. A job, almost any kind of job, has taken on greatly increased value. The better jobs are scarcer than at any time in twenty years, and hereafter it will take more knowledge and ability to get those jobs and hold them than ever before. Manufacturers are endeavoring to reduce their production costs to meet the keen competition for orders that is here now; machinists, toolmakers, draftsmen, machine designers, foremen, works managers, are also facing a period of keen competition—for jobs.

Prices have been reduced; costs must follow. Greater production for the dollar expended in the plant will force the elimination of every factor below the most efficient, and the human factor cannot hope to escape this inevitable readjustment. A great many designers, foremen and men higher up in the mechanical world have lost their places for good, but many of them do not know it yet; nor do they realize that there is a new deal in industry, that credentials which were satisfactory years ago will not do now. The world is demanding new men as well as new methods, men who are energetic, alert, better equipped, eager to win their way to the top, keen to note the new bases in industry.

Useful knowledge will be more important than ever before. Successful men are always great students. It is knowledge and character that advance a man, and now the tests are more severe. Success is won, not at the movies or in any of the other primrose paths of dalliance, but in the faithful hours of study and preparation for the bigger job ahead. Merchants and manufacturers are keenly watching for the men who are to carry on—to take up their burdens, as they took up the burdens of those who preceded them. Upon these men depends America's place in a world battling for industrial and commercial supremacy—which means everything else. It is a direct and ringing challenge to the men, especially the younger men, in the mechanical industries of America. Industry demands the best they have.

Every field has developed and more or less systematized a body of literature, a fund of craft data, available for the earnest worker determined to make his way up the ladder of success. It is a great treasure house in which is stored the priceless data worked out by generations of men in the exacting school of practical experience. Unless he masters this educational material and makes it his own, the worker in the engineering field is not equipped for advancement and responsibility and he will fail when the tests come. The data are there, the educational facilities are available for any man who can read and think. It is up to him. Unless he is willing to make the effort he must be content with a humble place in the ranks.

* * *

INTEREST IN STANDARDIZATION GROWS

In his address before the National Machine Tool Builders' Convention, the president, A. H. Tuechter, strongly emphasized the importance of machine tool builders taking more active interest in the work of standardization, and pointed out that if the machine tool builders did not voluntarily standardize such of their products as lend themselves to uniform design, engineering bodies representing the users of machine tools would be likely to take up this work, to the disadvantage of both manufacturer and user.

The American Gear Manufacturers' Association has done some excellent work in connection with the standardization of gearing. A comprehensive plan, covering all classes of gearing, has been laid out; and, step by step, each of the details making up this plan is studied by committees composed of men having the training needed for handling each particular detail. The standards accepted by the society are in many cases agreed upon by cooperation with the American Society of Mechanical Engineers and the Engineering Standards Committee, which acts as a clearing house for all standardization work in the United States.

It is evident to every manufacturer that standardization is one of the most important factors in cost reduction, and without question it will be applied more generally to manufactured products in the near future. Builders and users of machinery will be the first to benefit, but the general public will also profit in greater measure through the decrease of manufacturing costs. In Germany the engineering profession is now engaged in important standardization work, and our competitive strength in the world's markets will largely depend on our ability to keep abreast of the advances made there and in other manufacturing countries.

Reduced Prices of Machine Tools

THERE has been a decided reduction in the prices of machine tools during the past year, and those who are thoroughly familiar with the machine tool industry believe that further reductions can be expected only in exceptional instances. The reductions that have been made have not been uniform for all classes of machine tools, because the conditions governing the manufacture of different lines and types vary. Furthermore, the increases in prices in the last seven years have varied considerably for different types. There are some purchasing agents who seem to believe that machine tool prices should return to the 1914 level, but those who expect this are not familiar with the conditions in the machine tool industry and the reasons why it would be impossible to conceive of any return to the 1914 price level.

In February, 1921 MACHINERY, a thorough analysis was published of comparative machine tool prices in 1914 and 1921. Since that time conditions have changed somewhat. In many respects they have become more stabilized, and it is possible to show definitely why a return to pre-war prices in machine tools is impossible. In fact, even a near approach to the pre-war price is not to be expected. As machine tool builders appear to have some difficulty in obtaining orders even where the machines are needed at the present time, because some purchasers insist upon prices more nearly like those of 1914, it might be well to point out a few of the conditions prevailing in the manufacture and selling of machine tools, for the information of buyers who have not taken these conditions into consideration.

The 1914 Price Level

As pointed out in the article in MACHINERY previously referred to, the prices in 1914 were so low, because of extremely keen and ruinous competition, that they returned no profit. The prices at that time were too low to support the industry permanently. The competition due to the industrial depression at that time had forced manufacturers to accept prices that did not cover all their costs, and it was not until two years later—in 1916—that prices had risen to a level where a profit sufficient to sustain the industry permanently was obtained. The figures of a well-known manufacturer show that if the 1914 prices had been based upon costs with a fair profit, they should have been about 40 per cent higher than they were at that time. To expect prices to return to a level that even previous to the war did not produce sufficient profit to sustain the industry is evidently impossible.

Wages and Taxes in 1914 and 1921

It should not be necessary to point out to anyone familiar with industrial conditions that wages are permanently on a higher level than they were in 1914. Even in the industries, like the iron and steel industry, where wages have been most drastically cut, the rate for unskilled labor is now 50 per cent above the pre-war rate, and for skilled labor it is still higher. In addition to this, working hours are shorter now than before the war, and are likely to remain so, which means that there are added costs on that account.

It has been pointed out by many who have studied the history of wages that the wage rate never goes back to the same low point from which it has once started to rise, and therefore there is no reason to believe that machine tool builders will ever again be able to hire skilled machinists for 25 or 28 cents an hour, which was the rate commonly paid in many machine tool centers previous to the war.

The national taxation program due to the war, and the increased state and municipal taxes made necessary by the conditions created by the war, comprise a very important part of the cost of all products, and cannot be eliminated in determining upon the selling price. The influence of taxes upon price will continue to be an important factor of costs for many years to come, because we have an enormous national debt to pay, the interest of which alone is twice our largest national budget previous to the war. Any business man who thinks that business can be carried on without passing the taxes on to the consumer ignores one of the fundamental facts in economics, because a manufacturer must, out of his production, obtain a return over all expenditures, including taxes, or he will not be able to stay in business.

The Effect of Increased Freight Rates

Another element that enters into cost calculation all along the line is that of freight rates. Generally speaking, freight rates have been increased from 100 to 120 per cent on the materials and the finished products of the machine tool industry. Reductions in freight rates are desirable, but by necessity it must be quite a while before they can be materially reduced. If they are suddenly reduced to the detriment of the railroads, this will, in turn, react unfavorably upon the metal-working industries, because the railroads are big purchasers of the products of these industries; so that no matter how desirable it is that freight rates be reduced, it is even more important that the efficiency of railroad labor be increased and an equitable adjustment made in railroad wages, and this cannot be done suddenly. The transportation element, therefore, will continue to increase the cost of manufacturing for a long time to come.

Improvements Made in Machine Tools

In addition to all the factors mentioned, there is the fundamental one to be considered that all machine tool builders have greatly improved their product during the last seven years, so that even if there had been no abnormal price advance due to conditions created by the war, there would by necessity have been an advance in price due to the improvements in the product. This was specifically pointed out in the article in February MACHINERY, where reference was made to a machine that weighed 15,200 pounds in 1914, and which now, redesigned, weighs 19,000 pounds. Not only was the weight of this machine increased so as to afford increased strength and capacity for greater production, but the speed was also increased nearly 100 per cent, and the power from 8 to 20 horsepower. These changes necessitated gears made from higher grade material, properly heat-treated, and the material in some parts had to be made from steel costing three times as much as the material formerly used. The machine is known by the same designation as to size and other characteristics as it was seven years ago; yet no reasonable buyer would expect to purchase it for the same price even if there had been no other factors increasing costs and prices in the last seven years.

In comparing 1914 and 1921 prices, the factor of improved design should be particularly emphasized. The machines sold today are heavier, their capacities greater, they have more power and speed, they are made from better material, and they will therefore last longer and produce more. There are also many attachments provided that were not provided in the past. No such comparisons can be made in regard to clothing, shoes, sugar, or numerous other commodities which should be more likely to return to the pre-war price level than machine tools; these are an entirely different class of manufactured products.

Making One-piece Corrugated Elbows

Machines Employed for the Performance of Corrugating, Forming, Compressing, and Bending Operations

By separating the manufacture of one-piece corrugated stove-pipe elbows into a series of logical steps and designing a machine for performing each of these, the Niagara Machine & Tool Works, Buffalo, N. Y., have succeeded in building an equipment which produces elbows that are uniform in diameter, accurately bent to a right angle, and have tight throat seams and evenly spaced corrugations. Only four machines are required for producing the bent and corrugated elbows from blank sheets of metal, and by grouping these machines as shown in the heading illustration, the transportation of parts between the machines is eliminated, and a minimum amount of labor is required for maximum production. The process is such that the metal is not stretched along the outer curve of the bend, and hence its strength is not decreased nor the surface broken, the latter being a condition that mars the appearance and hastens corrosion.

Corrugating the Sheets and Rolling into Pipe Form

The blank sheets from which the elbows are formed may be purchased trimmed to the correct size, or they may be cut and squared by means of a squaring shear, a 30-inch machine of this type being satisfactory for the purpose. In the first operation, these blanks are fed between the two corrugating rolls of the machine illustrated in Fig. 1, which revolve at the rate of 20 revolutions per minute. Each sheet is placed on the table and properly positioned relative to the rolls by means of front and side gaging strips. When the foot-treadle is depressed, the sheet is automatically fed through the rolls. The number of corrugations produced can be varied to suit the different sizes of elbows. Offsets are formed in the corrugations along one edge of the sheet, which insures a close lap joint in the finished product. A piece of work, after having been operated on by this machine, is shown in the lower right-hand corner of the illustration.

In the next operation the sheets received from the corrugating machine are run through the machine shown in Fig. 2, the sheets again being aligned on the table by means of gaging strips while the upper roll is raised. This roll is then lowered, and an initial bend put in the front end of each blank by means of a vertically moving slide. Next by operating a friction clutch, the rolls are caused to revolve, with the result that the sheet is formed into a corrugated pipe, which can easily be removed after the upper roll has been raised. This machine can readily be adjusted to produce pipes of various diameters. The rolls make seventy-five revolutions per minute.

Compressing the Corrugations and Bending

In the third operation the corrugations of the pipe are compressed by means of the machine illustrated in Fig. 4, so that the pipe length is considerably shortened. A ring is inserted in each end of the work prior to placing it in the mold of the machine, the upper half of this mold being shown in a lifted position in the illustration. After the work has been inserted, the upper section of the mold is lowered and locked to the lower section. The pipe is compressed at one stroke of a ram which is controlled by a pin clutch, actuated by a foot-treadle. The rings placed in the ends of the pipe prior to the operation can be readily removed after the work is taken from the mold. This member may be adjusted to suit various sizes of elbows, by means of steel rings, inserts, and liners, and the amount of compression can also be varied. When the machine is operating continuously the ram makes fifty-one strokes per minute.

The fourth operation in the manufacture of the corrugated elbows consists of bending the pipe so that its ends form a right angle. The machine illustrated in Fig. 3 is employed for performing this operation, the work being firmly clamped on each end by means of a chuck. The relative positions of the chucks after the work has been placed in the machine is shown in the upper portion of Fig. 5. The operation of the machine

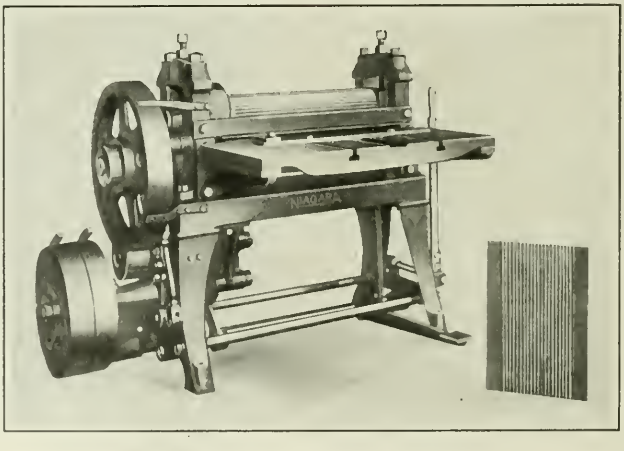


Fig. 1. Corrugating Machine on which the First Operation on the Blank is performed

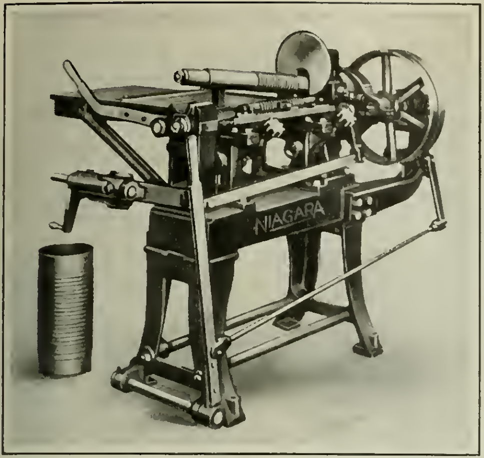


Fig. 2. Machine used to roll the Corrugated Sheet into the Form of a Pipe

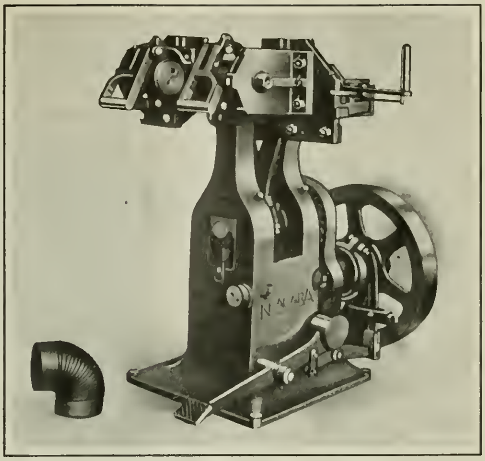


Fig. 3. Bending Machine with Chucks in Positions occupied prior to an Operation

causes these members to swivel to the position shown in the lower view, Fig. 5, in which they form a right angle to each other. The movement of the chucks separates the corrugations on the outer curve of the elbow and compresses them on the throat, thereby pressing the seams more firmly together, as the pipe is always so placed in the machine that the seam will come at the throat. In order that this machine may accommodate various sizes of elbows, it is provided with the essential adjustments and extra chucks and clamps. This operation completes the forming of the elbows. They are later spot-welded at each end, and then one end is crimped by means of a belt-driven machine having two crimping rollers between which the elbow end is passed. The bending machine may be operated at sixty-seven strokes per minute.

It is a known fact that the metal sheets supplied by the mills are not always uniform in gage, and so to compensate for any variations, the equipment described is designed to accommodate, without readjustment, sheets of more than ordinary variation. Metal sheets of No. 26 gage and lighter can be handled. The sheets also are not always uniform in quality, but it is said that sheets that could not be formed into elbows by other processes have been satisfactorily handled by means of the Niagara equipment. Usually a special quality of sheets is required for elbow manufacture, but with the machines described ordinary blue annealed sheets of good quality are suitable. The entire equipment may be driven by a 5-horsepower motor, and will produce elbows ranging from 4 to 8 inches in diameter.

* * *

SECTIONAL MEETINGS OF THE AMERICAN SOCIETY FOR STEEL TREATING

At a recent meeting of the board of directors of the American Society for Steel Treating it was decided to hold two sectional meetings of the society during the coming year, in addition to the regular annual convention. One meeting will be held in New York during January or February and the other in Pittsburg in May. The meetings will continue for one or two days and a few papers will be presented but no exhibits will be shown. The next annual convention and exposition will be held in Detroit on September 25 to 30.

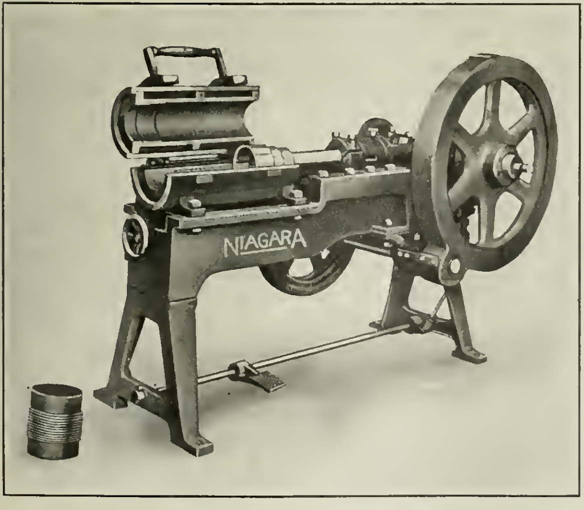


Fig. 4. Machine used for compressing Corrugated Pipe

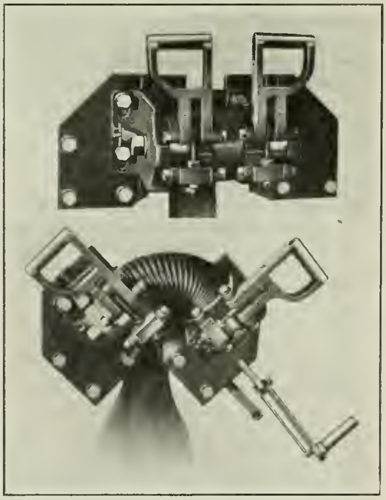


Fig. 5. Positions of Chucks before and after Bending

The Pratt & Whitney Automatic Lathe

VARIOUS types of hand-operated and automatic turret lathes and screw machines have been developed for rapidly turning short work from the bar or while holding it at one end only; however, the engine lathe is still used in innumerable cases of quantity production, when the work must be supported on centers during turning. These cases include work which, because of its length or peculiar requirements as to accuracy or finish, can only be satisfactorily turned on centers; work which is turned in preparation for a later grinding or machining operation, the engine lathe permitting the turning to be done on the same centers that are afterward used for other operations; forgings and other irregular pieces which, on account of their shape, cannot be readily held in chucking machines; and work in comparatively small quantities which does not warrant the cost involved in setting up a turret lathe or automatic screw machine.

With a view to eliminating a large part of the cost of turning work such as has been described, and at the same time retaining the advantages of the hand-operated engine lathe, the Pratt & Whitney Co., Hartford, Conn., has produced the automatic lathe shown in Fig. 1 equipped with a geared head. The rear view of a smaller machine driven by a four-step cone pulley is illustrated in Fig. 2. These lathes have a headstock, tailstock, magazine for holding the work, and an automatic work-handling and control mechanism. The automatic mechanism places the work on the centers, adjusts and clamps the tailstock spindle, grips the work by means of the rotating chuck, which serves only as a driver, starts the feed of the tool carriage, releases the tailstock and chuck at the end of the cut, and, finally, returns the carriage to the starting position. These steps are repeated automatically for each piece of work so long as the magazine is supplied with blanks. After setting up, the only attention required is that of refilling the magazine, taking away the finished parts, and grinding and setting the lathe tools. Because of this fact it is possible for a battery of machines to be handled by one man.

Although these lathes are only now being introduced to the trade they have been used in the Pratt & Whitney shops for years in turning high-grade tap and reamer blanks and other similar work, and have proved their ability to rapidly and cheaply turn cut-off bar stock, forgings and other parts with the accuracy and finish generally obtained in good engine lathe practice. The smaller machine takes work from 1/4 to 5/8 inch in diameter and up to 12 inches in length, and has a carriage travel of 8 inches. The larger lathe takes work from 1/2 to 1 1/8 inches in diameter and up to 15 inches in length, and has a carriage travel of 12 inches. Many forgings of irregular shape and with a swing larger than the diameters given can be handled to advantage.

As previously mentioned, the lathe has been developed with either a cone-head or a geared-head drive. On the cone-head machine a belt from a countershaft drives the headstock spindle and feed mechanism, while a separate belt from the countershaft drives the automatic mechanisms at a constant speed. On the geared-head machine, one belt from a lineshaft drives the entire machine, all speeds and feeds being obtained within the machine. The number and range of spindle speeds is greater with the geared-head machine, and the drive is more powerful. Speed changes are made by shifting the ball-handle lever *A*, Fig. 1, on the headstock, in an H-slot to any one of four positions, and also shifting the adjacent back-gear lever. This gives a total of eight speeds. On the larger machine four feeds are available for each spindle speed, and on the smaller machine, three feeds may be obtained for each spindle speed.

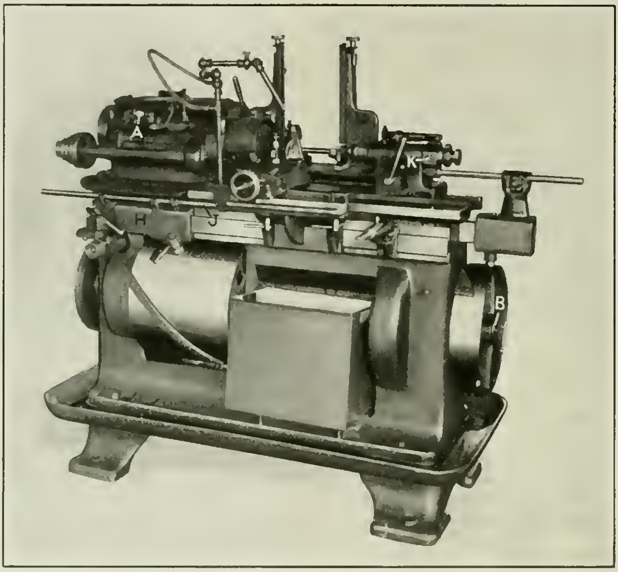


Fig. 1. Geared-head Automatic Lathe developed by the Pratt & Whitney Co.

The Camshaft Drive

The cams which operate the automatic mechanisms of the machine are mounted on shaft *B* running the entire length of the machine. This shaft is rotated at two different speeds. The slow rotation is adjustable and gives the advancing feed for the carriage, while during the rapid rotation, which is constant, the chuck is opened, the footstock spindle withdrawn, the carriage returned, the stock from the magazine advanced, the footstock spindle advanced and clamped, and the chuck closed. Power for the slow rotation is obtained through the small cone pulleys seen on the end of the machine in Fig. 2. The center distance between these cones is adjustable so that the proper belt tension may be maintained. The lower cone shaft transmits power through worms and worm-wheels, clutch *E*, and shaft *D* to camshaft *B*, as shown in the sectional view in Fig. 3.

Power for the rapid rotation of the camshaft is delivered to the small plain pulley *C*, Fig. 2, on the gear-box, a swinging idler being provided to maintain a sufficient belt tension to operate the mechanism. Power is transmitted from pulley *C* through spiral gears *F* to clutch *E*, Fig. 3, the drive from this point to the camshaft being through shaft *D* and a worm and worm-wheel used in the slow rotation. The toothed clutch serves to throw in alternately the feed and high-speed mechanism, at predetermined intervals, being actuated through the medium of levers by adjustable trip-dogs *G*, Fig. 2, mounted on a disk at the left-hand end of the camshaft. The piping for the cutting coolant and the circulating pump, which is chain-driven at a constant speed, are also shown in the same illustration.

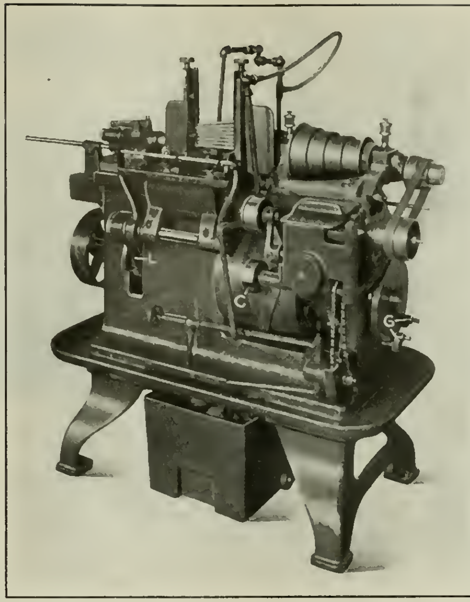


Fig. 2. Rear View of Cone-driven Automatic Lathe

The hand-lever seen at the left-hand end of the machine in Fig. 4 gives a complete control of all machine movements except the rotation of the headstock spindle. Depressing this lever stops the rotation of the camshaft, and when it is raised and drawn forward, the camshaft rotates at high speed. When the lever is pressed toward the machine, the feed is thrown into engagement, and when elevated above the horizontal position, the feed will stop at the end of the cut to permit calipering or inspection of the work. The squared end of the shaft which is located below this control lever enables the machine to be operated by a hand-crank for trial when it is being set up.

The Carriage and Footstock

The carriage slides on the front of the bed and allows finished work to drop through an opening in the bed to the box below. The carriage has a cross-slide with adjustments on which may be mounted a toolpost and a follow-rest when needed. A jointed taper bar carried on a heavy bracket clamped to the front of the bed provides for turning taper work, and both straight and taper surfaces can be turned in one continuous cut. Various former bars may be substituted for the adjustable taper bar. The carriage is traversed the desired length of cut by the rotation of the large drum which carries cam straps, that, through a roller on slide *H*, Fig. 1, move the carriage-actuating rod *J*. Slide *H* is dovetailed to the bed. Provision is made for hand adjustment of the carriage by a rack and pinion which may be seen near the right-hand end of the machine in Fig. 1.

The spindle of the footstock is drawn back to release finished work and advanced to take new work by the operation of cams mounted on the pulley which may be seen at the extreme right-hand end of the camshaft. These cams, through a roller, move the slide mounted directly above it, and this slide, in turn, is coupled to a friction ring *K* on the footstock spindle. The rod connecting the slide and friction ring allows the footstock to be placed as far forward on the ways of the bed as the shortest work will require.

A slight slip of the friction ring takes place each time the spindle is drawn back, this being caused by the stop-collar on the front end of the spindle coming into contact with the front of the footstock casting. Therefore, when the spindle is advanced into contact with the work, the friction will again slip, insuring the proper contact with work in

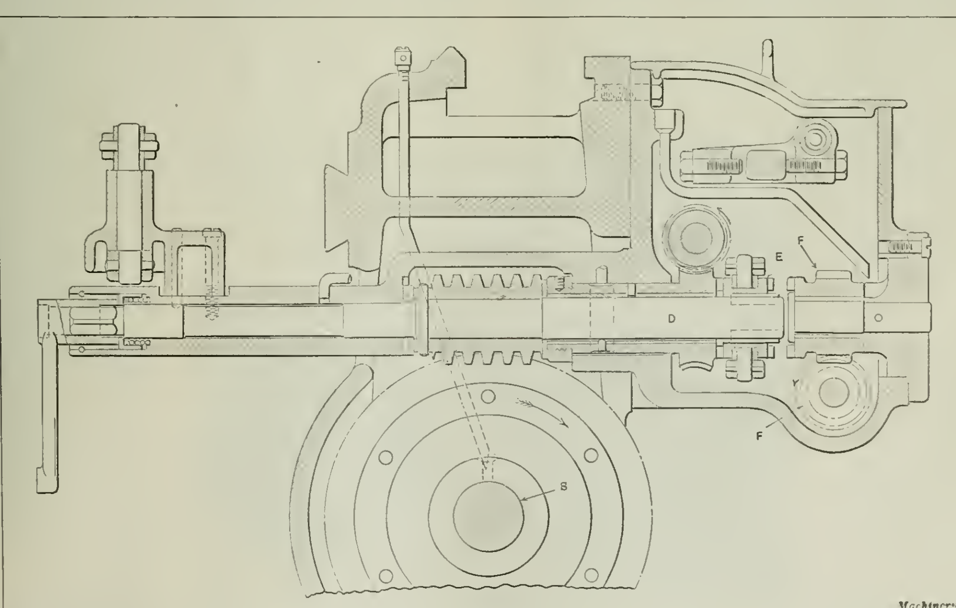


Fig. 3. Sectional View of Mechanism by Means of which Fast and Slow Rotation is imparted to the Camshaft

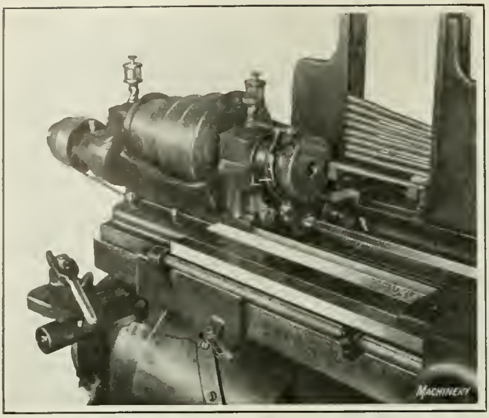


Fig. 4. Close-up View of Head End of Machine, showing Chuck and Work-feeding Mechanism

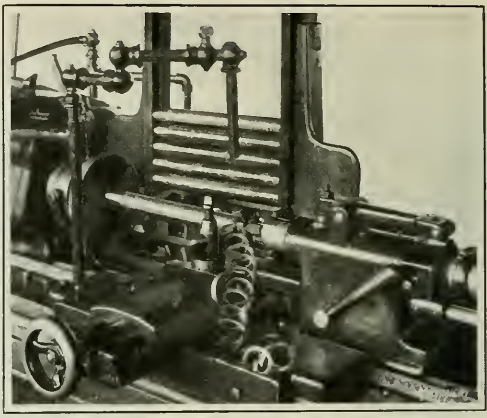


Fig. 5. Automatic Lathe engaged in taking a Heavy Cut on Work mounted on the Centers

spite of variations in length due to inaccuracies in cutting off and variations in depth of centering. The pressure with which the center is brought in contact with the work may be adjusted by the square-head screw on the friction ring. The footstock spindle is firmly clamped in place, after the center has made proper contact, by a further movement of the friction ring, which operates the horizontal lever over the footstock, thus forcing a plug on the spindle.

Construction of the Chuck

The chuck is mounted on the headstock spindle in such a manner that it floats laterally when necessary to compensate for inaccuracies in centering. Thus it can exert no lateral pressure on the work which is carried on the headstock center. Detail views of the chuck with the cover removed are shown in Fig. 6. At *A* the chuck is shown with the jaws drawn back ready to receive the work, which is inserted by the movement of the footstock spindle, as previously explained. The chuck jaws are moved into this position, while the lathe is running, by friction exerted on a drum carried by the chuck body. The friction is applied by the levers *L*, Fig. 4, and momentarily retards the rotation of the outer member of the chuck. This action not only draws the jaws back but also stretches the three springs shown in Fig. 6. Upon the release of the external friction, the springs move the outer member of the chuck in the forward direction, and thus swing the three jaws into contact with the work as shown at *B*.

An effective drive is obtained by the cam action of the jaws themselves without depending on the springs, and although the contact surface of the jaws is smooth so as not to mar the work, they will drive work under any cut which the lathe is capable of taking. The knurled surface on the outside of the chuck is used for setting it to the desired work diameter. Diameters between and including those indicated on the face of the chuck are taken care of by the rise of the cam surfaces on the jaws. Thus any size of stock within the capacity of the chuck may be driven if the knurled ring is revolved to the nearest indicated diameter on the chuck face. The alternate opening and closing of the chuck in proper sequence is controlled by a cam located on the camshaft directly beneath the headstock.

Operation of the Work Magazine

The position of the magazine, which is located on a bracket at the rear of the machine, is clearly shown in Fig. 4. The magazine consists of two uprights, adjustable to take both short and long work, and two guides on each upright adjustable to suit work of different diameters. Horizontal slides are provided for moving the pieces forward, one at a time, from the magazine to the machine centers. These slides are adjustable for all diameters within the capacity of the machine. As soon as a piece is brought into line with the centers, it is engaged at one end by the footstock center which pushes it endwise so that the other end enters the chuck and engages the headstock center. The tailstock is then clamped and the chuck closed on the work.

Yielding fingers are provided at the front of the transfer slides, so that when the work is securely mounted on the centers the slides withdraw before the lathe tool advances. In Fig. 4 the transfer slides are shown partially advanced with the work in place, the footstock and the carriage being removed so as not to obstruct the view. The transfer slides are operated simultaneously by levers shown at the rear of the machine in Fig. 2, which fulcrum on a horizontal shaft below the magazine. These levers, in turn, are actuated by the lever *L* which carries a roll engaging lugs on a cam. Leather friction washers are inserted between the cam lever and the adjacent vertical lever to allow slip in case work gets caught by being improperly inserted in the magazine.

Care was taken in designing the machine to make it fool-proof, yielding elements being inserted in the mechanism where trouble from irregularities in the work may occur. The geared-head machine can be driven by a constant-speed motor mounted on the rear of the bed. Fig. 5 shows a close-up view of an operation in which a heavy cut is being taken.

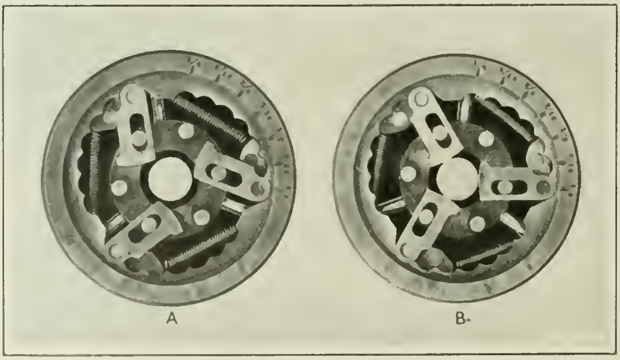
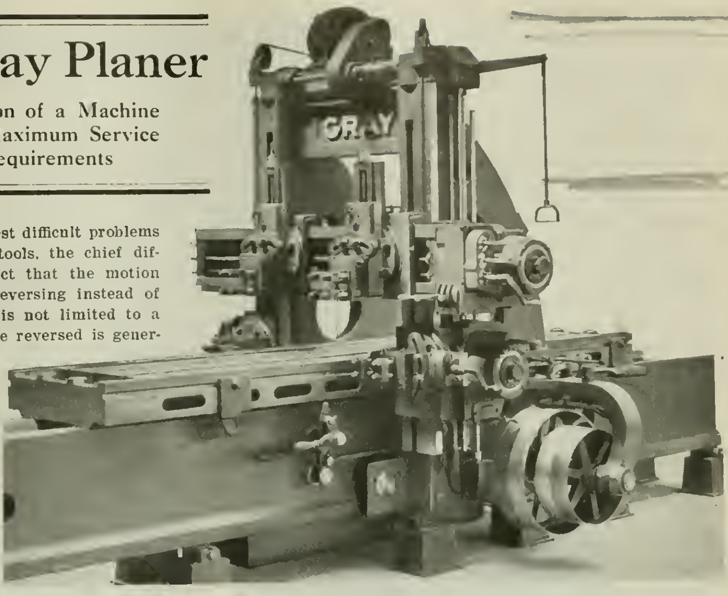


Fig. 6. Views of Chuck with Cover removed, showing Jaws in Open and Closed Positions

The New Gray Planer

Features of Construction of a Machine Designed to Render Maximum Service Under Modern Requirements



PLANERS offer some of the most difficult problems to the designer of machine tools, the chief difficulties arising from the fact that the motion of a planer is intermittent and reversing instead of continuous; the length of stroke is not limited to a short distance; and the work to be reversed is generally heavy, so that the whole mechanism must be strong and durable. Another difficulty is due to the fact that a planer is a general-purpose machine, and while it must be rugged and powerful for the rapid removal of large quantities of metal, it must also be accurate for the generation of flat surfaces, and must produce a finish free from chatter marks.

The new line of planers built by the G. A. Gray Co., Cincinnati, Ohio, and termed by the builder "Maximum-service" planers, presents a good example of recent developments in planer design. Power, rigidity, durability, automatic lubrication, finish of the work, and convenience and safety of operation have all received due attention in the design of this line. A general view of the 36-inch machine is shown in the heading illustration.

Helical-geared Table Drive

The table is driven by a system of helical gearing which produces a smooth and powerful drive. A properly designed pair of helical gears is stronger than a pair of spur gears of the same pitch and width of face for the following reasons: In the case of a spur gear, the load at a certain point of a tooth engagement is concentrated along a line at the tip of the tooth, and the leverage is practically equal to the depth of the tooth. In the case of a helical tooth, the load comes on a line passing obliquely across the tooth face, and the leverage of the force amounts to only one-half the depth of tooth. Further, the helical gear tooth enters engagement gradually, eliminating shock. In addition to their greater strength, helical gears give a continuous pitch-line rolling action, since there is always some point on the pitch circle where mating teeth of the gears are in actual contact.

The helical gearing in the Gray planer table drive has a tooth form which is thicker at the root than teeth of the conventional form. This modification is said to increase the strength 40 per cent, eliminate interference, and reduce the angle of approach. It is while moving through part of the arc of approach that the so-called "stuttering" action takes place in gearing of the ordinary type. The angle of recess is purposely lengthened, however, because while a tooth is passing through the arc of recess the tooth friction tends to reduce instead of increase vibration. In the design of this gearing, use has not been made of stub teeth and large pressure angles, because while these features are of great advantage in certain kinds of work, the requirements of general planer service prohibit their successful use except for roughing and other service where gear chatter is not objectionable. The full-length tooth and low pressure angle of the special tooth form adopted in this gearing distribute the load among a greater number of teeth than would be the case with a larger pressure angle.

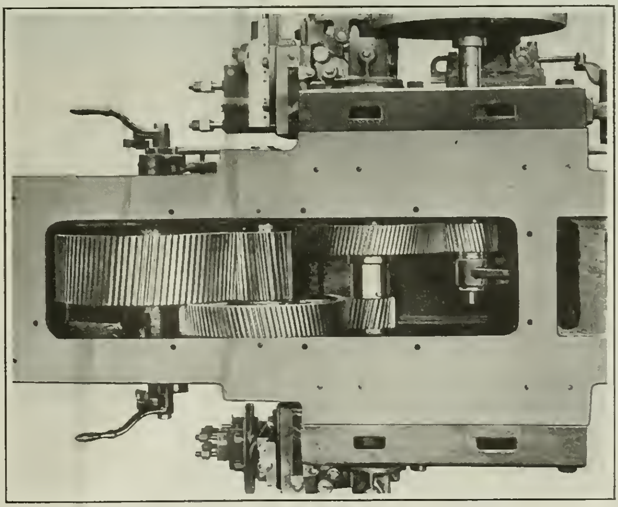


Fig. 1. Helical-geared Drive provided for the Planer Table

The gears dip into a reservoir of filtered oil so that the teeth are always covered with lubricant. This results in smooth action and long life of the gearing, because the oil film interposed between the teeth tends to cushion any shock that might be transmitted from one tooth to the other.

An objection to helical gearing sometimes raised is the fact that gears of this kind produce end thrusts. While such end thrusts may be eliminated by the use of herringbone gears, the Gray Co.

contends that a better system of gearing with wider faces, greater strength, smoother action, and longer life may be obtained if helical gears are used and advantage is taken of the end thrusts to counteract the tool pressure. A planer normally operates with the tools feeding from right to left, the operating side of a planer always being the right-hand side, and the side thrust of these tools tends to push the work and the table toward the left. The teeth of the bull gear in the planer design under discussion are so cut that the end thrust which the gear produces on the table is about one-tenth of the driving force, thus practically balancing the side thrust of ordinary cutting tools; because of this design the planer table bears equally on all four faces of the guiding ways.

The bull gear does not tend to move endwise since the end thrust of the bull pinion balances that of the table rack. The remaining gears of the train are so disposed that each one partially balances the end thrust of another, leaving only a small end thrust which is taken care of by bronze washers supplied with oil by forced lubrication. Most planer work does not occupy the entire width of the planer, and for convenience is placed close to the operating side of the machine. It is, of course, desirable that the line of action of the force which drives the table rack should coincide as nearly as possible with the line of action of the cutting tools. The rack of this planer is, therefore, widened toward the operating side of the machine which brings the line of action of the forces in an advantageous position.

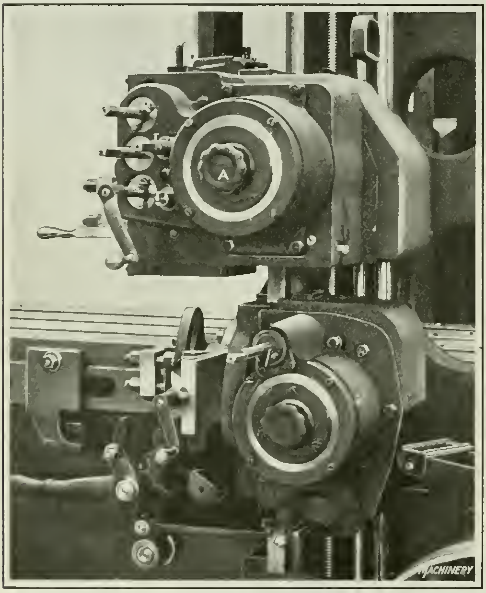


Fig. 2. Feeding Mechanisms for the Rail- and Side-heads

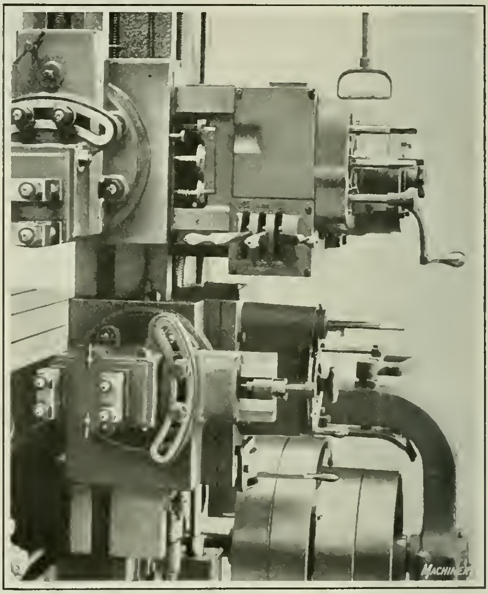


Fig. 3. Feeding and Power-traverse Mechanisms

The "Cantslip" Feeding Mechanism

One of the greatest advances in lathe design was the development of the quick-change-gear system, and it is not too much to say that quick-change gearing has increased the production of the lathe from 20 to 30 per cent by making instantly available the feed best adapted for the work in hand. While the conventional friction-and-rack feed of the planer has undergone a great deal of refinement that has made it much more satisfactory and efficient than originally, many engineers consider the positive feeding and quick-changing devices employed in the lathe, boring mill, and milling machine to be still better. In designing the feeding mechanism, the Gray Co. had in mind the following points:

1. The mechanism must be positive and not subject to slip or wear.
2. The mechanism must be enclosed so that chips and dirt cannot affect it.
3. The side-head feeds must be independent of the rail feeds.
4. The amount of feed must be instantly adjustable while the planer is operating.
5. The adjusting mechanism must indicate exactly the amount of feed for which it is set.
6. The direction of feed of the rail-heads must be instantly changeable.
7. The adjusting mechanism must be in a convenient and accessible position.

The design developed to meet these requirements is illustrated in Fig. 2. One of the intermediate shafts in the main drive is extended through the housing, and by means of a flexible coupling, drives a pair of bevel gears running in oil. From these gears there rises a vertical splined shaft which rotates alternately in either direction as the planer operates. This motion is transmitted to a ratchet mechanism on the cross-rail, so designed that pawl lifters projecting from the aluminum case which completely encloses the mechanism, strike upon stop-pins, one of which is fixed, while the other is adjustable. When one of the lifters strikes the corresponding stop-pin, the ratchet mechanism is automatically disengaged and the aluminum case brought to rest, remaining so until the vertical shaft which drives the mechanism reverses its direction with the reversal of the planer. The ratchet mechanism operates noiselessly, and all parts are lubricated by oil contained in the case and supplied through oil passages in the driving shaft. On the periphery of the case is pressed a large ring gear which transmits its motion to the gears on the feed-screws and feed-rod.

The ratchet box is enclosed in a cylindrical case which forms a gear guard and serves to support the feed-adjusting device, consisting of a circular plate in which a hole is broached for a sliding bolt. The bolt engages teeth cut in a nickel steel ring and is withdrawn from engagement by slightly turning knob *A*. Any further turning of the knob revolves the plate and its attached stop-pin to the desired position. When the knob is released, the bolt re-engages the teeth in the ring, and the plate and pin are locked firmly in place. Graduations on the disk indicate the amount of feed in thousandths of an inch. It will be seen from this description that only an instant is required to obtain any desired feed, which may be varied by multiples of 0.010 inch. The smallest feed obtainable is 0.010 inch and the largest 1.250 inches.

The side-head feed is independent of the rail-head feed, but is operated and adjusted in an identical manner. With this arrangement the side-head feed may be large while the rail-head feed is small, whereas with the conventional friction-and-rack feed, the side-head feed is necessarily equal to or less than the rail-head feed. The feed mechanism is provided with a safety device in the form of a small pin at the lower end of the vertical feed-shaft, which will shear without damaging the mechanism if the heads are fed together or any other accident results from carelessness or inattention on the part of the operator. The vertical shaft is hardened to receive the pin, and it is but the work of a moment to replace the latter.

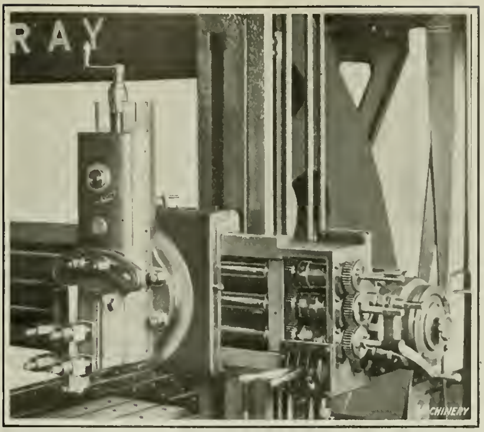


Fig. 4. Close-up View of Rapid Power-traverse Mechanism with Cover removed

Developing the Rapid-power Traverse

With the increased speed of cut permitted by the use of high-speed steel and the increased feed and depth of cut possible on modern machines, work is finished more rapidly and a larger proportion of the time is expended in changing tools and moving the heads from place to place. This calls for increased effort on the part of the workman, and a rapid-power traverse enables this work to be done without fatigue and in less than one-third of the time required if the heads must be traversed by hand. For a power traverse to be of value, it must be so simple and easy of manipulation that no appreciable time is required to put it in motion. It should not be necessary to do anything beyond moving a single member controlling the part to be traversed. Otherwise, so much time is taken in the manipulation of the mechanism that little saving results from the increased speed of head movement. Above all things, it is important that a workman should not be required to perform a series of steps before moving a head, if a serious accident to the machine may occur when one of these steps is neglected.

Accordingly, in designing the power traverse for the planer being described, the following points were borne in mind:

1. There must be only one handle for each movement required.
2. The movement of this handle must automatically perform all the functions necessary to disengage the feed, engage the power-traverse mechanism, and energize the source of power.
3. The direction in which this handle is moved must correspond to the direction in which the head controlled by it is moved.
4. It must be possible to move any head in either direction while the planer is in operation.
5. The moving of a head must not disturb the operation of any other head.
6. No part of the rapid power-traverse mechanism should run when it is not being used.
7. The mechanism must not revolve the handles or the handle shafts on account of the danger involved.
8. A power traverse must be provided for the side-heads, where it is sometimes even more important and desirable than it is for the rail-heads.

In addition to the requirements stated in the foregoing, which are vital to the operation of the machine, a number of other requirements had to be met relative to the manufacture and assembly of the mechanism. The device must be simple and compact, or it cannot be placed in the limited space available in the side-heads. A number of designs which filled the operation requirements were unsatisfactory because they did not lend themselves to the system of unit assembly which finds so large a place in modern machine tool practice.

Operation of the Rapid Power-traverse Mechanism

The design finally evolved is shown in the heading illustration and in Figs. 3 and 4. The mechanism is driven by an electric motor mounted on the top brace, which may be of either the alternating- or the direct-current type. The motor receives its current through a reversible controller. A gear-box, also mounted on the top brace, contains the necessary reduction gears which run in oil, and in addition serves to support the rail-elevating device. Power from the gear-box is transmitted to the power-traverse clutch mechanisms located at the end of the rail, and on the side-heads. The handles seen projecting from the power-traverse box at the end of the rail, and from the bottoms of the side-heads,

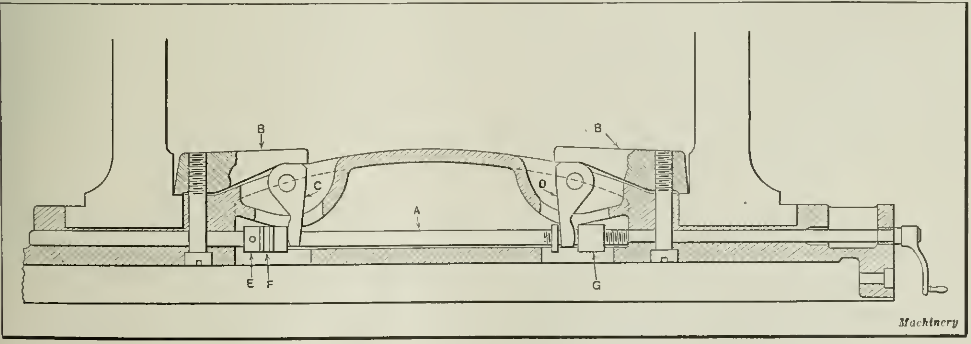


Fig. 5. Diagrammatic View of the Rail-locking Arrangement on the Gray Planer

are connected with rotary cylindrical cams which have an endwise motion and are concentric with the rail or side-head screws, as the case may be.

A movement of one of the handles rotates its cam and shifts it endwise, causing the unclutching of the corresponding screw from the feed mechanism and clutching it positively to the power-traverse gearing. The same movement causes the handle to engage and rotate a collar, the movement of which is transmitted to the controller. The direction in which the handles are moved determines the direction in which the controller rotates, and hence governs the direction of rotation of the motor and of the head movement. When one handle is moved from neutral to the operating position, all other handles are automatically prevented from moving so that the mechanism cannot be injured by carelessness on the part of the operator. The motor stands still except when the handles are moved. A lubricating system, which requires no attention except the filling of two reservoirs on the rail and one on each side-head every morning, carries oil to all parts of the power-traverse mechanism.

Rail Elevating and Clamping Devices

When the rail is clamped to the housings by means of a pair of cast-iron clamps bearing against ledges on the outside edge of the housing faces and drawn up by two bolts, in order to move the rail, it is necessary for the operator to take seven distinct steps as follows:

1. Loosen the two bolts on the right-hand clamp.
2. Walk around the planer.
3. Loosen the two bolts on the left-hand clamp.
4. Operate the lever controlling the elevating device while watching the height of the rail.
5. Clamp the two bolts on the left-hand clamp.
6. Walk around to the right-hand side.
7. Clamp the two bolts on the right-hand clamp.

In contrast to the foregoing the new Gray planer has a rail-elevating and a rail-clamping device, the operation of which involves only three simple steps that can all be performed without requiring the operator to move from his normal position.

The rail is clamped by means of the device illustrated in Fig. 5 in which two steel clamps *B* are fastened to the rail by heavy screws. These clamps engage ledges on the inner edge of the housing faces and are capable of slight rotation due to play of the screws in the rail. Bellcrank levers *C* and *D* bear against the inner end of the clamps, and are secured to the rail by pins. A collar *E* is pinned on shaft *A*, and interposed between this collar and the projecting end of lever *C* is a ball thrust bearing *F*. The longer end of bellcrank lever *D* engages a nut *G* on shaft *A*. The latter is parallel with the rail screws and projects from the operator's end of the rail, where it has a squared end similar to the rail screws. When it is desired to unclamp the rail, it is only necessary to remove the crank handle from one of the rail screws, place it on the end of the rail lock-shaft and give this shaft three turns. This causes nut *G* and collar *E* to separate, which results in rotating levers *C* and *D* about their pins and moving clamps *B* away from their ledges. Turning the handle in the opposite direction with a moderate effort draws the longer ends of *C* and *D* together, and clamps the rail securely to the housing.

The two clamps *B* bear on the ledges with exactly equal force, since the same pull is exerted upon each of the levers *C* and *D;* this prevents slippage of one side of the rail and resulting inaccuracy of the work. Moreover, it is impossible with this device to neglect to clamp or unclamp one side of the rail. By clamping the rail at the inside, the length subject to torsion is reduced, and the increased power of the clamp makes it unnecessary to use four clamps to hold the rail.

The rail-elevating mechanism is operated by a lever placed on the right-hand side of the machine. From this lever, a stirrup is suspended by a universal joint, as can be clearly seen in the heading illustration. The lever is normally locked in position, but a quarter turn of the wrist unlocks it, permitting it to be pushed up or pulled down. Moving the lever, clutches the elevating shaft to the reduction gears previously referred to, and simultaneously starts the motor. The operator, when holding the stirrup, stands in front of the housings where he can plainly see both the rail and the work. If the operator wishes to raise or lower the rail, he has only to turn the rail-locking shaft three turns to the left, push up or pull down on the stirrup, and then turn the rail-locking shaft again three turns to the right.

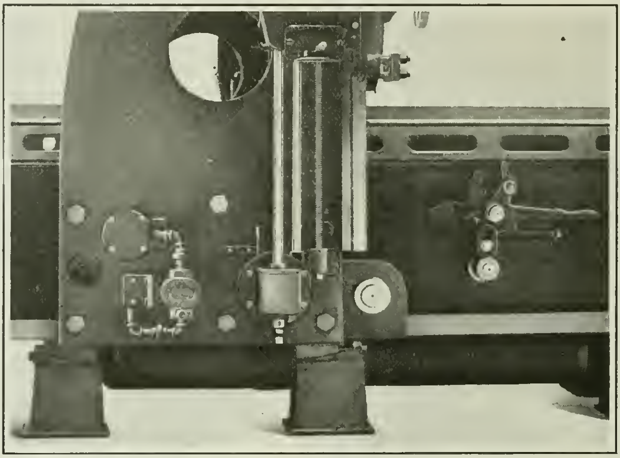


Fig. 6. View of Left-hand Side of Machine, showing Lubricating Pump and Filter

Provision for Lubrication

The accuracy and durability of a machine tool depend greatly upon the system of lubrication provided. If an oil film is always maintained between bearing surfaces, the surfaces are subjected to less wear and the machine will maintain its accuracy longer. The Gray planer is provided with a system of forced lubrication, a Brown & Sharpe geared pump being bolted to the left-hand housing and driven from the pulley shaft by means of a flexible coupling. The pump takes its supply of oil from a large cast-iron reservoir bolted to the bottom of the bed, and discharges through a filter in the housing. The filtering material can be readily removed and replaced by taking off the hand-hole cover shown in Fig. 6. Piping leading from the filter passes to the various bearings so that they are abundantly supplied with filtered oil, the used oil draining back into the reservoir from which it is pumped.

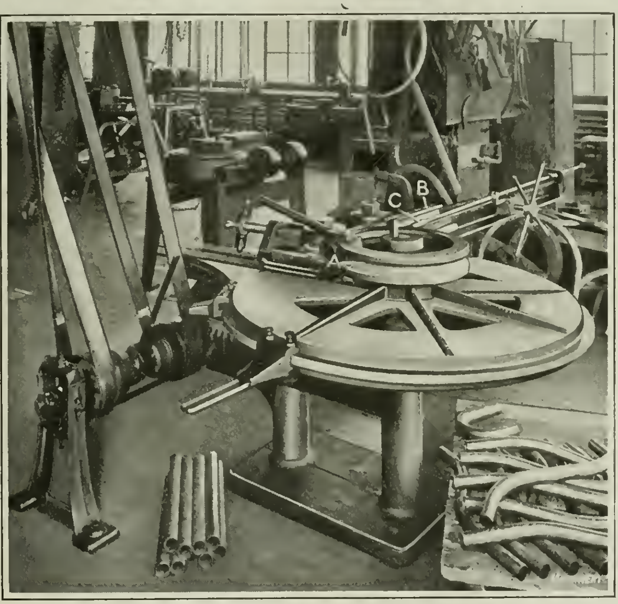
The oil supply is maintained at the proper pressure by a combination pressure relief valve and an accumulator placed in the line. Piping from the filter also leads to two holes drilled into the vees of the bed at the center of its length. Each table vee has a large oil-channel from which the numerous supplementary oil-grooves carry oil to all parts of the bearing surfaces. These oil-channels run the length of each table vee, and are closed at the ends. By this means the oil pressure is maintained constant throughout the entire length of the table. This design has the advantage that the oil supply is equal at all points, no matter what the relative position of the table and the oil supply in the bed may be. If short stroke work is being done near one end of the table, for instance, the oil does not have to flow through a long groove of limited area to reach the far end of the table. The surplus oil dripping from the vees and table rack flows through a heavy screen into a settling basin at each end of the bed and returns to the central reservoir through piping contained in the bed. In order to support the table when it is in its extreme position and to prevent the dripping of oil from the vees to the floor, the bed is made twice the length of the table. This prevents the table from springing, as there is no overhanging weight, and thus prevents the end of the bed from cutting the under side of the table. It also makes unnecessary special projections for catching the dripping oil, and constitutes a safety feature, since the table never extends beyond the bed.

* * *

BENDING LOCK-SEAM TUBING

The Lock Joint Tube Co., of Mishawaka, Ind., manufactures what is known as "lock-seam" tubing, which is made with a folded seam. This concern realized that there was a market for its product in making automotive exhaust manifolds, but the tubing could not be bent to the forms required for this purpose without opening the seams. It might have been possible to make the necessary bends by first filling the tubing with melted lead or rosin, but that method would be too expensive for commercial production.

This problem was submitted to the Wallace Supplies Mfg. Co., of Chicago, Ill., and a special form was made for the purpose for use on this company's No. 5B pipe-bending machine. This equipment is so designed that the work is continually supported around the complete circle, both inside and outside, at the point of bending. The form *A* around which the work is bent, is grooved to embrace half the circumference of the pipe, and a similarly grooved follower *B* embraces the other half of the pipe. There is a mandrel *C* of the same size as the inside diameter of the work to be bent. As the pipe is bent around the form, both the follower and the mandrel move with it, so that they always support the work at the point of bending, and the metal is made to flow. With this equipment, it was found possible to bend lock-seam tubing without any tendency for the folded seam to open, and many new applications for this product were developed.



Pipe-bending Machine equipped with Special Form for bending Lock-seam Tubing

* * *

The Bureau of Standards, Washington, D. C., has published a booklet known as Technologic Paper No. 198, by A. H. Stang and L. R. Strickenberg, containing information on the strength and properties of rope of different kinds. This publication contains formulas and rules for determining the strength of rope made in different ways, and other information that would be of value to the user of rope for handling loads with proper safety.

SAFE PACKING FOR MACHINERY

The railroads, steamship lines, express companies, and Post Office Department have combined in a movement to awaken nation-wide interest in careful and secure packing of shipments. The aim of the "Perfect Package Campaign" is to bring American shipping methods to such a high standard that the great economic losses due in part to careless packing by shippers will soon be a negligible factor in the transportation industry. The transportation lines in the past have suffered losses in excess of $150,000,000 a year, due to poor packing, and this loss amounted to a great deal more during and immediately after the war. The carriers do not wish to dictate to shippers just how they shall pack their commodities, but they feel that their experience enables them to make suggestions that should be of value. Generally speaking, shipments should be so prepared or packed as to insure safe transportation with ordinary care on the part of the carrier. A recent study by transportation men of the packing methods of machinery has developed the suggestions given in the following:

The proper preparation of machinery and machine parts for shipment should, as a rule, be assigned to an experienced mechanic, except when standard packages are used. When articles are small, such as portable typewriters or small talking machines, and properly braced in their own case, corrugated and fiber board are satisfactory as outside containers, if of standard construction. When packed in wooden boxes or crates, all fragile parts should be protected from direct contact with cleats, etc., and all loose parts secured to prevent shifting and possible damage. Wooden cleats covered at point of contact with pads of felt, in addition to securing the stand of the machine to the bottom of the box by means of screws, offer protection against damage in transit and possible damage in removing the part from the case. Large machines and their parts are frequently secured to skids or to a platform that will not withstand the strain caused by the weight of the machine being concentrated on the center when the ends only are supported, as, for instance, when a shipment is being transferred from a car to a truck. The bearings or cast-iron frames are often left uncovered so as to prevent injury from hard knocks incident to handling unwieldy objects of this kind in the limited time allowed at small stations.

* * *

Drop-forged automobile wheels have recently been developed. At present they are used mainly on lower-priced cars. As compared with wooden wheels, the forged wheel has the advantage that it consists of a single piece, and even the brake-drum can be made in one piece with the wheel. It is practically unbreakable, and all trouble due to the shrinkage of wood is eliminated.

POINTS TO BE OBSERVED IN MACHINE TAPPING

By H. H. ARMSTRONG

It is the purpose of this article to call attention to the general need for more careful supervision of machine drilling and tapping operations, and to give suggestions concerning satisfactory methods of handling this class of work. As the operators of drilling and tapping machines used for quantity production work are usually paid on a piece-work basis, it naturally follows that various expedients are employed to obtain high production rates. If every piece is required to pass a thorough inspection, no fault can be found with any method that gives the desired result, but unfortunately the work in many cases is not properly inspected when it comes from the tapping machine. In an endeavor to obtain high productive rates, a considerable amount of inferior work is often put through which may, or may not, be thrown out when it arrives at the assembling department. If inferior work is passed by this department, it will in all probability cause the purchaser annoyance and give an unfavorable impression of the company's product.

Cause of Poor Threads

The question of drilling and tapping castings is therefore an important one, particularly when the material to be tapped is cast iron. In order to show some of the causes of inferior work, let it be assumed that a load of clean rough castings has been delivered to the machine shop, bearing a red ticket with the word "Rush" printed across it in heavy type. The foreman directs the load to an operator, who obtains the blueprint called for and immediately sets up his machine for the job. Before beginning work the operator usually ascertains the piece rate, and then decides whether the price is high or low. If the price seems too low, he knows that he will have to speed up his work in order to obtain a fair day's wage. He also knows that taps will be broken off in the work if the tapping machine is run too fast when tapping holes drilled with a regular size tap drill. The result is that a larger size of drill is often used, and this, in turn, results in a thread of shallow depth.

Generally the first piece tapped after setting up the machine is submitted for inspection, and if this piece is approved the whole lot may be passed, but if each piece were to be properly inspected with a limit plug gage it is more than likely that a number of pieces would be thrown out, because the gage would fit too loosely in the tapped hole. The castings then go to the assembly floor where the piecework system is also employed. The assembler puts in the screws, and if in tightening them down he finds that some of them do not set or hold, he knows that the thread is stripped and he will either put the defective piece to one side or attempt to fix it by some makeshift method.

Tap Drill Sizes

It may seem strange that over-size drills are used in jigs which are supposed to be equipped with bushings of the proper size. Nevertheless it is a fact that bushings become worn under continual use, so that they will easily admit a larger size drill than that for which they are intended. The writer knows of some cases in which shop foremen have requested the tool department to enlarge the bushings of a new or changed drill jig slightly, claiming that the taps were over-size and were being broken too frequently. This is often due to the fact that the tapping machine is run at too high a speed, and if it is slowed down the trouble would be eliminated. The tool department should not comply with requests to enlarge the hole in a drill bushing, and no bushing should be changed from the dimensions called for by standard clearance tables unless the change is approved by the designing engineer.

In observing tapping machines in operation, it will be noticed that the spindle reverses its direction of rotation in backing out of the tapped hole, and that sometimes the tap is brought down again while the spindle is running in the reverse direction. This causes the threads of the tap to tear the metal at the mouth of the hole to a depth of perhaps 1/8 inch or more. On noting this, the operator will invariably pull up the tapping head, and by the time he finally gets the tap running in the right direction some of the thread will have been torn out, so that the screw will only hold in the section of the thread below the stripped portion. If, in addition to the stripping of the threads, the tap drill happens to be too large, the thread will be practically useless. The tap drills used in tapping machines are always larger than the ones used when tapping a full thread by hand, so that if the operators use still larger tap drills in order to speed up the machine tapping, it is sure to result in the stripping of threads in the assembling department.

Trouble from Sharpening Taps and Clogging of Chips—Need for Thorough Inspection

Another source of trouble may be mentioned here, namely, that resulting from the sharpening of the end of the tap by the operator. This is done by grinding a new taper on the tap, and while this may prove satisfactory for tapping operations on thin work, such practice should not be followed when tapping work in which the tap cannot pass entirely through, as the bottom of the hole will not have full threads. For the latter type of work, bottoming taps should, of course, be used, which permit cutting practically a full thread to the bottom of the hole. Recently the writer's attention was called to some work in which the assembler could not enter the screws to the required depth. On examining the pieces it was found that the tapped holes were filled with the chips from the tap that had lodged in the thread and become firmly attached by a coating of rust. These pieces had to be sent back to the machine shop to be retapped. In this case the operator was required to do the work on his own time. Had he used compressed air to blow the chips out, this trouble would not have been encountered.

If a steel screw is set down too tight in a cast-iron piece, the threads are likely to become crossed and stripped, especially if the thread in the iron piece is shallow. Success in tapping holes depends chiefly on having conscientious operators who are willing to follow instructions and set their machines up properly for each job. If trouble is encountered, it should be brought to the attention of the foreman, and not covered up to be discovered at some later period. All machine tapped holes requiring any considerable degree of accuracy should be given a thorough inspection with a limit plug gage. The operator can do this if there is no inspector, and the foreman should keep in touch with the work. It has been proved by experience that the quality of a man's work will invariably be higher if he knows that the work is to be inspected. When excessive tap breakage is experienced, it is well to investigate the cause; in many cases it will be found that breakage is due to inefficient holding methods, the work being allowed to move during the tapping operation.

* * *

BRITISH MACHINE TOOL TRADE

Statistics covering the import and export trade of machine tools to and from Great Britain during the first six months of 1921 show that the imports amounted to 2243 tons, as compared with 2040 tons in the same period in 1913. The value of the imports in 1921 was approximately $2,000,000, as compared with $725,000 in 1913. The exports also show a great increase in 1921 over the corresponding period in 1913. The exports amounted to 12,977 tons in the first six months of 1921, as compared with 8545 tons during the same period in 1913, and the value increased from approximately $2,500,000 in 1913 to $7,400,000 in 1921. The exports of machine tools from Great Britain in the first six months of 1921 are the highest on record for that country for any similar period.

A Railroad Shop Organized for Efficiency

A Description of the Angus Shops of the Canadian Pacific Railway Co., Montreal, Canada
First of Two Articles

EFFICIENCY in railroad operation is a matter of great importance, not merely to the stockholders of the railway companies, but also, and in an even greater measure, to all classes of business enterprises served by the railroads. Efficient freight and passenger service rendered at reasonable cost is one of the essential conditions upon which the return of business prosperity depends. There are many phases of railroad management. The one in which the readers of MACHINERY are most directly interested relates to the handling of railroad shop work. In dealing with this subject, it is important to emphasize the two general causes of inefficiency in railroad machine shops. These are, first, the inefficiency of railway shop labor, and, second, the use of equipment, in many railroad shops, which is of obsolete design, inadequate capacity, and in poor condition. To re-equip a railroad shop requires a large investment, but in the case of many shops it would be an expenditure from which the railroad would derive an adequate return in the reduction of the cost of handling the shop work.

Returning to the question of the inefficiency of labor, American railroad shops have failed to turn out work at a reasonable cost, largely because of the provisions of the National Agreement on Working Conditions, which was entered into between the United States Railroad Administration and the railway shop workers during the period of government control. After an extended hearing of both railway executives and labor leaders, the United States Railroad Labor Board decided to abrogate the provisions of this agreement; but the labor unions are now making demands upon the individual railways for agreements specifying exactly the same undesirable conditions governing the work of shop employes, and pending the settlement of these controversies, the objectionable terms of the National Agreement remain in effect.

The Need of Better Equipment

With the return of labor to a normal state of efficiency, the railroad shop problem would be about half solved. Then the final solution would lie in the provision of more adequate machine tools and other equipment. Some of our railway shops are fairly well provided with machinery, but there are many in which the equipment is composed largely of obsolete machines incapable of producing results that could be obtained with modern machines. In addition, many machines are in such a poor state of repair that they are unable to give satisfactory results, as regards either the rate of output or quality of workmanship, and their use makes the cost of the work very high.

The experience in railroad earnings during the latter part of 1921 indicates that the railroads are about to enter upon a period of better financial conditions. Railroad managements generally look forward to brighter days provided labor troubles do not seriously disturb present favorable tendencies. As far as the problem of shop work is concerned, however, a state of "normalcy" cannot be expected until the standards both of labor efficiency and of shop equipment have been greatly improved.

It is safe to say that in the majority of American railroad machine shops, it will be necessary to increase the efficiency of both the men and the machinery in order to obtain pre-war results. New shop rules must be established that will make it possible to get work done in a way that will insure normal costs. Equally important is the question of machinery. Much of the machine tool equipment in some of the railroad shops is of obsolete design and in such a poor state of repair that the money lost by its continued use would pay a fair rate of interest upon the investment required to provide new machines. There are a few modern railroad shops, however, and the present article describes the layout and methods of operating one of them—the Angus shops of the Canadian Pacific Railway Co., Montreal.

How One Road Solved its Shop Problem

It is believed by many that the work in a railroad shop does not lend itself to being handled on a quantity production basis. Jobbing shop work is always costly, and unless a determined effort is made to break away from such a method of railroad shop management and to apply modern manufacturing methods of setting up work in multiple, it is futile to expect efficient results. In discussing this question of shop efficiency, it will be of value to explain the results that have been obtained by the Canadian Pacific Railway Co. at its Angus shops in Montreal.

This railway formerly maintained what were known as the Delorimier shops located near the center of the city of Montreal. Gradually this plant became inadequate for existing requirements, and the high value of the real estate on which it was built placed a heavy overhead charge on all of the work. As a result, it was decided to construct an entirely new plant, and for that purpose the site of the Angus shops was purchased on the northeast side of the city. This plant is noteworthy as a railroad shop on account of the fact that it was completely planned on paper before any construction work was started. Henry L. Gantt was retained as consulting industrial engineer to make a complete study of the problem, working in cooperation with H. H. Vaughan, who was then assistant to the vice-president and in charge of the Canadian Pacific Railway Co.'s motive power and rolling stock. The final result assures the inter-relationship of departments and an arrangement of equipment in each individual department which will permit the work to be performed with a maximum degree of efficiency.

Fort Williams represents the point at which the Canadian Pacific Railway lines are subdivided into the eastern and the western systems, and on each of these systems there are four divisions so that the entire road is subdivided into eight districts, each of which is served by a local shop where minor repairs and some general work are handled. The facilities of these district shops are supplemented by the Angus plant at Montreal, which serves the entire Canadian-Pacific Railway system. On the eastern lines, the heaviest work is sent to Montreal; and the Angus shops also manufacture many small parts in quantities and ship them to store-rooms of the different districts, where they are available when necessary. In this way, advantage can be taken of the increased efficiency resulting from handling the work on a quantity production basis, instead of setting up single pieces on machines which have sufficient capacity to handle a number of parts at a time, thereby placing a greater machine time charge against each individual job.

Classes of Work Handled at the Angus Shops

Under normal conditions of operation, the Angus shops provide employment for as many as 9500 men. With this force the plant is operated for the double purpose of making repairs on engines and cars, and building both these classes of equipment. The capacity under full operation is about as follows:

Engines, Pacific or Mikado type................4 per month
Engine repairs (complete overhauling)......40 per month*
Steel frame, single-sheathed freight box cars.....15 per day
Steel frame automobile cars......................10 per day
Refrigerator cars.................................. 9 per day
Steel sleeping cars................................ 1 per day
Compartment sleeping cars................1 every two days
Car repairs (complete overhauling)..100 per summer month†
Car repairs (complete overhauling)...230 per winter month

*This represents average operation: from 45 to 70 engine repairs per month have been made when no locomotive building work was being put through the shops at the same time.

†The average capacity on car repair work is 230 per month, but in summer the heavy passenger travel makes it impossible to withdraw the necessary number of cars from the system and the repair work is so arranged that the majority of the cars are placed in the shop during the winter months.

Lay-out of the Angus Shops

The accompanying diagram shows a general plan of the lay-out of the Angus shops. As this plant was constructed with the idea of increasing efficiency by handling work on a quantity production basis, careful provision was made for the routing of all work so that no time and labor need be spent in the unnecessary moving of heavy engines or cars and the parts of such equipment. The general scheme of the plant lay-out is to bring locomotives and cars in from the main tracks which run along the southwest end of the property, and to carry them over tracks leading to the various departments.

In examining the lay-out of the plant with especial reference to the elimination of lost motion in handling the work, it must be borne in mind that the locomotive shop, the passenger car shop, the freight car shop, and the steel car shop are distinct units, so that no provision need be made for the transfer of work from one of these departments to another. On the other hand, it is necessary for each of these divisions to be served from the general stores, the blacksmith shop, the gray iron foundry, etc., and with that idea in mind it will be noticed that the buildings in which these three departments are grouped, are centrally located so that deliveries may be conveniently made to each of the main departments of the plant.

Arrangement of Equipment in Individual Departments

In order to see the way in which individual departments have been laid out to facilitate handling the work, let us consider first the freight car shop. Here it will be noticed that the wheel foundry is located in line with and southwest of the truck shop. The wheel castings made in this department are bored and turned and pressed on their axles, so that they may be easily rolled on tracks leading into the truck shop. Here the wheels and axles are assembled on the trucks which, in turn, are rolled out of the northeast end of the shop where they can be picked up by a midway crane and carried over opposite the end of the freight car shop. Here they are again dropped on tracks running through this shop. The building of freight car bodies is handled by a method similar to the progressive assembly used in some of the most progressive manufacturing plants.

It has been mentioned that as the trucks come out of the shop in which they were assembled, a midway crane carries them to tracks running longitudinally through the freight car shop. To the right of this crane, is the planing mill in which all timbers for the box cars are cut ready for assembly. This material is simply carried across by the midway crane to the freight car shop and there it is ready for use, the various parts being distributed along the shop so that as the cars are moved down the tracks, the different parts such as sills, flooring, walls, and roofing can be secured in place.

Arrangement for Handling Passenger Car Work

Passenger cars used on the Canadian Pacific Railway have either steel wheels or cast-steel wheel centers with steel tires. These wheels are purchased outside the plant, and in the passenger car shops there are truck departments where this material is assembled and prepared for the passenger cars. It will be noticed that the planing mill is so located that heavy timbers can be handled with almost equal facility for use on either passenger or freight cars. There is a difference of procedure in handling passenger car work, however, as a large part of the material used in such cars is hard wood, which must be kiln-dried and then placed in storage ready for delivery to the cabinet shop as required. A kiln is provided in connection with the hard wood storage which is located at the northeast corner of the plant; and this storage building is located adjacent to the cabinet shop, where the finer interior finish of various types of passenger cars is completed ready for assembly.

From this department, finished sections of the interior finish are drawn and taken direct to the cars in which they are to be assembled. Unlike the freight car work, the passenger cars remain stationary in the shop until they have been completed. Each car is mounted on tracks running crosswise in the shop, and upon completion it is pushed out to what is known as a transfer table which runs along the space between the two passenger car shops. A car placed on this transfer table is run down into alignment with a track at one end, from which it is moved out to the sidings and thence to the point of destination on the railway.

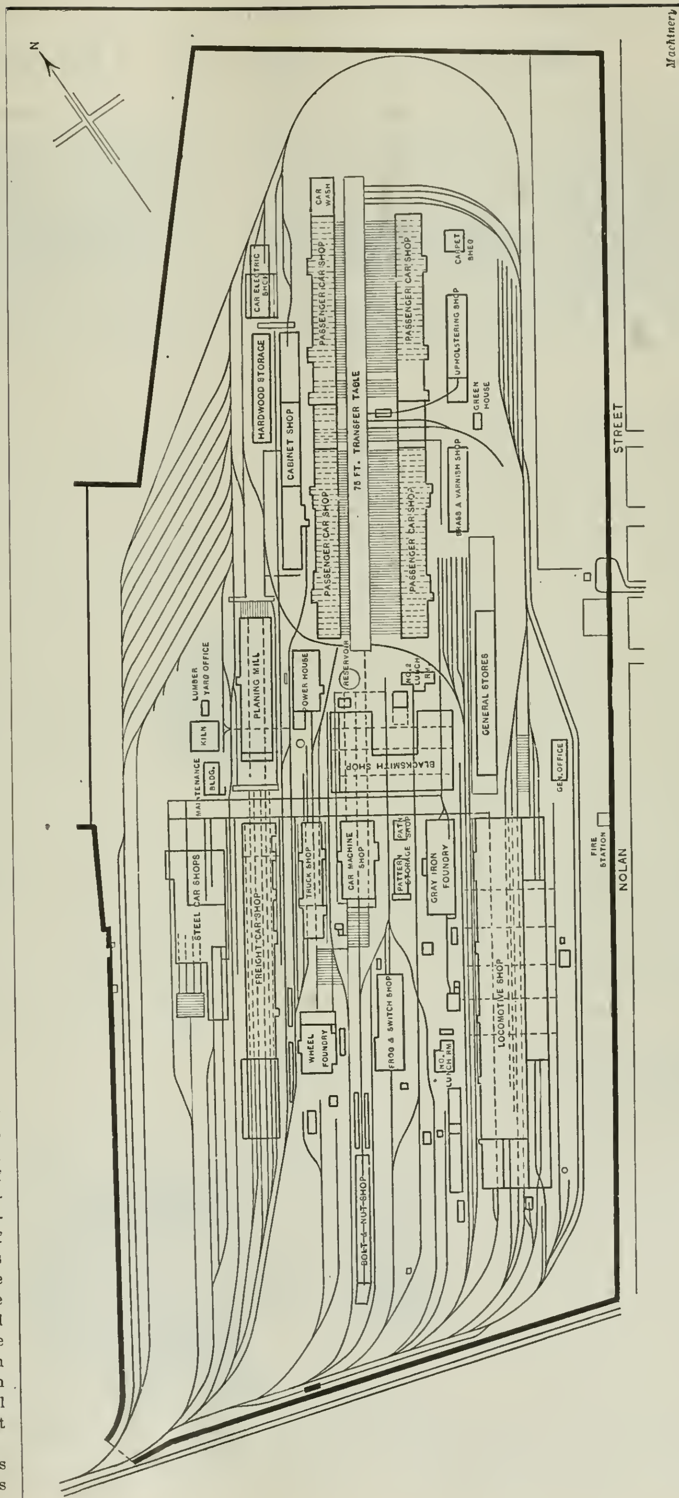
Manufacturing Car and Locomotive Parts for Stock

In line with the policy of adopting quantity production methods, as far as possible, the Angus shops are furnished with a general stores building measuring 600 by 85 feet. This building is equipped with the most approved arrangements of bins and other forms of containers, in which all classes of finished parts are stored pending their delivery to the plant on production orders or their shipment to one of the division shops of the system. In this connection it may be mentioned that a completely organized system has been evolved for the salvaging of the many classes of scrap material which accumulate on a railway, and these reclaimed parts are delivered to the store-room to await withdrawal for use in the shop departments. This subject will be discussed in detail in an article which will appear in a subsequent number.

Equipment of the Machine Shops

The same principle of stream-line production that has been followed in locating adjacent departments of the plant in such a way that the work can be handled to advantage, has been observed in laying out the sub-departments of each of the shops. Another important point in expediting production is the maintenance of open aisle spaces with white lines painted on each side, and the strict enforcement of the rule that no material must be allowed to project beyond these lines (see heading illustration.) With such a lay-out, electric trucks which are used for conveying material can be run at high speed without danger of interference.

The second installment of this article will deal with special tools used in the Angus shops.



General Plan of the Angus Shops of the Canadian Pacific Railway

Reducing Costs by Die-casting

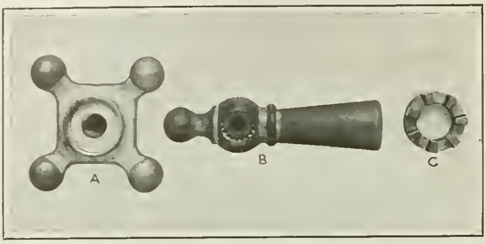


Fig. 1. Faucet Handles and Roller Bearing Cage made by the Die-casting Process

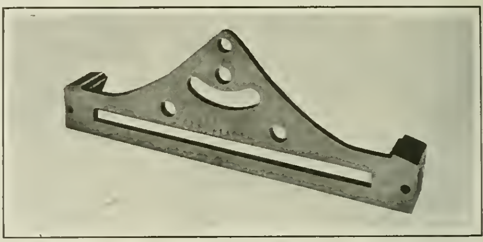


Fig. 2. Two-stand Bracket for an X-ray Apparatus, also produced by Die-casting

THE die-casting process offers many opportunities for reducing manufacturing costs, when the metals from which die-castings can be made are satisfactory for the parts required. By this process holes, recesses, etc., can be cast directly in the part being made with such accuracy that in most instances subsequent machining is unnecessary. The elimination of machining operations therefore constitutes one of the main savings in the use of die-castings. Even the first cost of the dies is negligible, as compared with the first cost of the machining equipment that would be required for making parts from steel, cast iron, or brass. In any line where die-castings can be used, therefore, their application should be investigated. Many manufacturers of specialties have found that not only is it possible to start a business for the manufacture of a new article with less capital, when the drop-forging process is employed (as the dies are cheaper than machine tool equipment), but it is also possible to get under way faster, as dies can be made in a fraction of the time that would be required for fitting up a machine shop.

How To Reduce Production Costs ?

It has been estimated that dies for making a given part on which a number of machining operations would be required would not cost more than 10 per cent of the cost for machinery and tools. The manufacturing of the article then reduces itself mainly to an assembling proposition and to the machining and making of such parts as cannot be advantageously die-cast.

Examples of Die-castings

The accompanying illustrations show a number of die-castings that have been manufactured by the Superior Die-Casting Co., Cleveland, Ohio, and figures indicating the saving resulting from their use will be given. Fig. 1 shows at *A* a star-shaped faucet handle. This handle costs, as delivered by the die-casting company, including the tapping operation, 65 per cent of what it cost when made from a brass casting. This includes the cost of dies distributed over a six-month period. The die-cast faucet handles are made from a zinc base alloy, having a tensile strength of 24,000 pounds per square inch. The composition is 88 per cent zinc, 4 per cent copper, 6 per cent tin, and 2 per cent aluminum. This metal is less expensive than brass, and in addition there is a saving of six machining operations, including a counterboring operation and two facing operations on each side. To prepare the brass casting for nickel-plating, it is also necessary to grind and buff it, while the die-casting needs to be buffed only. The only operations that need to be performed on the die-casting after it comes from the dies are to trim it and to tap the central hole. The counterbores on each end and the surfaces come so accurately from the dies that no further work is required except that of buffing before nickel-plating.

Faucet handles made in this manner have been used for a period of one year and have been found to be fully as satisfactory as brass handles. In fact, they have some advantages over those made from brass. They will take a heavier plate of nickel, and hence will wear longer, and if the nickel-plating wears off, the metal underneath will not show yellow, but the die-cast metal, being in the white metal class, will look more like nickel.

At *B* in Fig. 1 is shown another faucet handle, delivered at a cost of less than 5 cents, including the cost of the dies distributed over six months' production. No machining work needs to be done on this die-casting whatever. Formerly these handles had to be faced on one side, the center hole drilled and broached, and the hole for the button at the end counterbored.

At *C* is shown a roller bearing cage. In this case the die-casting costs more than the malleable iron casting that was formerly used, as there was no machining required on the malleable iron casting. However, the use of a die-casting meant a saving to the manufacturer of the roller bearings, as the die-cast cages all are uniform while the malleable iron cages are not. Therefore, in assembling the various parts, it was necessary, when using malleable iron cages, to try to fit a number of cages, which was found unsatisfactory for production work. Every one of the die-cast cages will fit, because it is possible to die-cast a part of this design within an accuracy of 0.001 inch. Thus the experience of this roller bearing manufacturer indicates the accuracy of die-castings, and shows that even in cases where the die-castings may cost more than a part made in some other manner, it might, nevertheless, be economical to use them because of other savings resulting

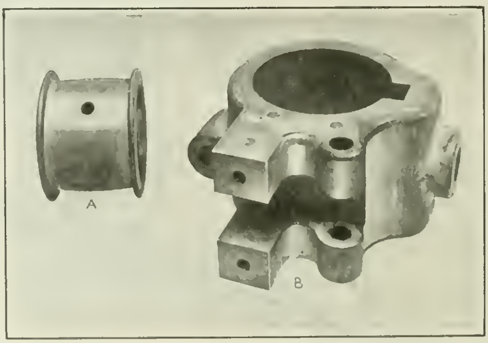


Fig. 3. Die-cast Pulley and Printing Press Part

from their uniformity and accuracy. The high rate of production obtainable in die-castings, assuring a supply of parts at all times, is also a point to be considered.

Bracket for an X-ray Apparatus

Fig. 2 shows a die-cast tube stand bracket for an X-ray apparatus. This bracket was formerly made from brass and nickel-plated. When made in this way, the holes had to be drilled and the various flat surfaces milled. The lines shown on the front of the bracket had to be produced by a graduating tool. Now this part is produced by the die-casting process, and no machining is required except the tapping of two of the holes. The large holes in each end of the bracket are in line with each other, and come accurately enough for the apparatus directly from the die-casting machine. All the holes formerly drilled are cast in place. The small holes are accurate within ± 0.0005 inch, and the rest of the holes within ± 0.001 inch. Lengthwise, an accuracy of ± 0.001 inch is assured for each two inches, and the width of the long slot is accurate within ± 0.001 inch. When zinc base metal is used for die-castings, it is generally possible to obtain a greater degree of accuracy in practically every dimension than can be obtained by ordinary machining methods, when producing work on a general commercial scale in interchangeable manufacture.

The total cost of this piece is less than the manufacturers' former cost for performing only one of the machining operations. On a comparatively small production, the cost of the die would be, say, from 20 to 25 cents per piece; but this figure is much less in comparison than the cost of the machine and tool equipment that would be required for machining a brass casting.

At *A* in Fig. 3 is shown a die-cast pulley, which was formerly made from bar stock. By die-casting, the cost was reduced 20 per cent. The feed-roll clamp *B* was formerly made from a gray-iron casting and required the boring and reaming of the large hole through it, the broaching of the keyway, the facing of both ends, the milling of the slot between the lugs, the facing of the lugs, the facing of two bosses, and five drilling operations.

These parts are now being die-cast; all holes are cast in place with sufficient accuracy without further machining, and the cost per piece is 55 per cent of the cost when a gray-iron casting was used, not including the die cost. The latter cost, however, is insignificant as compared with the cost of the machining equipment formerly required, because with a production of less than 2000 a year, the die was paid for by the first 1000 pieces through the difference between the cost of the die-casting and the machined gray-iron casting. Consequently, after 1000 pieces had been made, there was a clear saving of 45 per cent on every piece made thereafter.

The Cost of Dies

Many people do not realize that the first cost of the dies for a die-casting, when distributed over the number of parts to be made, is insignificant. The die cost that should be charged to each piece is, of course, proportionate to the quantity to be made. A die, when once made, will last almost indefinitely. The Superior Die-Casting Co. has had dies in operation for two years which have produced several hundred thousand castings, and which are still in good order. A die, for a piece of average design, would cost, say, $250. If there is a production of 5000 pieces a year, it will be seen that the die cost per piece distributed over a period of five years would be only one cent a piece.

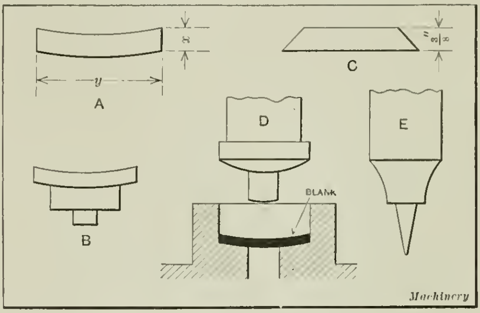
* * *

A small gas producer has recently been brought out by Gasmotoren-Fabrik Deutz in Germany, of a size suitable for yielding gas sufficient for from four to thirty-five horsepower engines. Even when not utilized to its full capacity, the power obtained by means of this small gas producer will, it is claimed, compare favorably with power obtained from central electric power stations.

MANUFACTURE OF COLLAPSIBLE TUBES

Collapsible tubes, such as are commonly used for artists' colors, are usually manufactured by the cold extrusion process. The metal from which these tubes is made is of either tin or lead composition and there is a large variety of alloys suitable for this class of work. These tubes are also often made from pure tin, and such tubes are considered superior to those made from the various compositions. The tubes are extruded from blanks of the shape shown at *A* in the accompanying illustration, punches and dies of comparatively simple design being employed. If a blank is to be drawn direct, the punch may be of the design shown at *D*. However, if a punch such as shown at *E* is to be used, it is necessary to perform a preliminary operation of forming the blank to the shape shown at *B*. Collapsible tubes vary in thickness from 0.005 to 0.010 inch, and the maximum size produced is 2½ inches in diameter by 9 inches long.

A blank of the type shown at *A* when x equals ¾ inch and y 4½ inches, can be drawn to a tube ¾ inch diameter by 4½ inches long, and will require a pressure of approximately 30 tons. When x equals 7/32 inch and y 1 inch,



Blanks from which Collapsible Tubes are extruded, and Types of Punches used

the size of tube will be 1 by 6 inches, and the pressure required, 42 tons. For a 1½- by 7-inch collapsible tube, x should be 5/16 inch and y 1½ inches, and an applied pressure of 84 tons should be used. In extruding a 2- by 8-inch tube, x equals ⅜ inch and y 2 inches, and the pressure required is 130 tons.

Caps for bottles, such as catsup bottles, are made from soft metal blanks, sometimes by the extrusion process and sometimes by rolling and forming the blanks. The usual method is to cast the blanks into the shape shown at *C*, and then to roll the metal to 0.078 inch in thickness and to cut out from this rolled material a 1-inch diameter blank. From this blank the cap is drawn to a wall thickness of approximately 0.010 inch and to a thickness of head of about 0.014 inch.

An alloy which will be found suitable for both collapsible tubes and soft metal bottle tops, consists of 4 ounces copper, 6 ounces antimony and 16 ounces tin, melted together, the resulting alloy being used with varying quantities of pig tin. For collapsible tubes 50 ounces of the alloy and 200 pounds of pig tin are used; for bottle tops, 134 ounces of the alloy and 200 pounds of pig tin. Any one of the three following compositions may also be used successfully in the manufacture of collapsible tubes: (1) antimony 14 per cent and tin 86 per cent; (2) antimony 5 per cent and tin 95 per cent; (3) copper 2 per cent and tin 98 per cent.

* * *

Of the forty-one tractors shown at an exhibition of agricultural tractors and accessories in Paris in the earlier part of the year, 19 were American, 18 French, 1 Italian, 1 English, and 2 Czecho-Slovakian.

Saving Time in Assembling

Examples Showing Savings Resulting from Investigation of Assembling Methods

By ALBERT A. DOWD, President, and FRANK W. CURTIS, Chief Engineer, Dowd Engineering Co., New York City

How To Reduce Production Costs?

IN quantity production, it is possible to perform manufacturing operations on parts at a comparatively low unit cost, yet the time consumed in the assembling department may be so great that the cost of the complete mechanism is increased much more than it should be. The efficient factory investigator makes a special study of methods used in the assembling department in order to reduce costs and increase production. If the production costs are high, the investigator may conclude to start his survey in the assembling department and work backward from this point, being governed more or less by conditions as he finds them. For example, as the various parts of the mechanism come to the assembling department and the workman starts to put them together, a certain piece is found to be a little too tight, and therefore must be touched up with a file before placing it in position; another piece has a burr along one edge, which must be scraped or filed off before assembling; the alignment of certain holes is not accurate enough and a line-reaming operation is required; or one surface of a part is not square with another, and the part must be refinished or scrapped, depending upon the seriousness of the error. Often parts must be scraped to a fit at assembly when proper machining would avoid the necessity for this.

Examples Showing Sources of Expense and their Remedies

In order to illustrate this point and bring it home more forcibly, several examples are here given with the remedies that were applied. An aluminum gear-case is fitted with a cap held down by six nuts placed on studs inserted in the case. The studs are assembled in the case by a workman using a stud setter, and formerly when the cover was applied and the nuts were put in place, some of the studs turned as the nuts were tightened, because the studs were too loose a fit in the tapped holes. This condition caused much annoyance and delay. An examination to determine the source of the trouble revealed a difference of from 0.002 to 0.004 inch in the stud diameters, some being made on one machine and some on another. One machine was producing work within the required limits, while the other turned out undersized studs. The remedy here was a more careful inspection which resulted in changes in the dies that produced the small studs. A matter of this sort would often be neglected and a great amount of time consumed in removing and replacing studs, which represents a needless expense.

Another case in point is that of a shaft assembled in a gear-box and running in bronze bushings. Although the hole in the bushings was inspected with a plug gage and found to be within the required limits, when the shaft was assembled it did not turn freely. In order to remedy the trouble the workman was obliged to ream one of the bushings with a hand reamer. This is a peculiar instance, yet an examination showed the reason to be that the holes in the bushings were slightly eccentric with the outside diameter. In some cases the bushings were assembled in the box with the eccentric portions in the same relative positions, and under this condition the shafts would enter all right and turn freely; but, when the eccentricity of the two bushings was in opposite directions, too tight a fit was the result. The remedy for this condition was found to be a change in the method of producing the bushings so that concentricity was obtained.

Another example of high cost remedied by a careful investigation of methods employed in the assembling department was a printing press platen which was scraped to alignment in the assembling department after being placed in position on the machine. The time consumed for this operation appeared to be excessive, and a careful inspection showed imperfect alignment and a surface slightly warped. Tracing the various operations back through the manufacturing departments it was found that the trouble originated in the planing department, the planers being old and inaccurate so that untrue results were obtained. The method of holding the work during the operation was also found to be incorrect, causing distortion and inaccuracies. The planers were overhauled and trued up, with the result that a saving of two days' time on each machine was effected when assembling, and much fitting was avoided.

Other matters that affect costs can be found by a careful investigation in the assembling department. Some of the points referred to may seem to be small matters, yet they are important on account of the time that can be saved by attending to them properly. For example, racks for screws, bolts, and other units used, and the placing of parts convenient to the workman, are matters of importance. Much time is saved by good arrangement of parts, and as the workman does not become so tired, he does more work. Accessories such as stud-setters, power-driven screw-drivers, and socket wrenches save time and help to obtain maximum production.

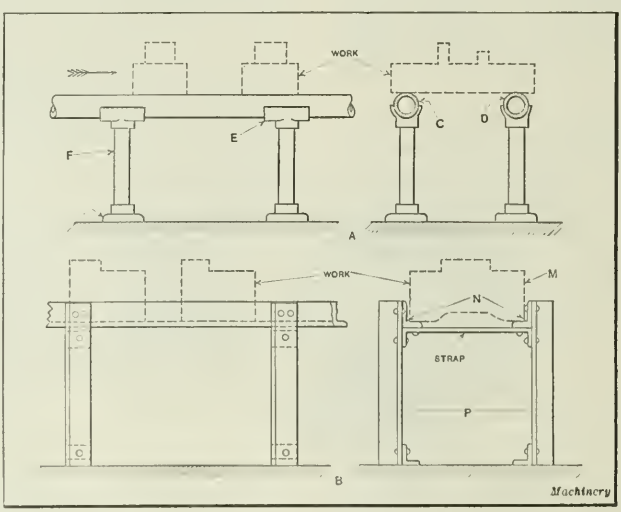


Fig. 1. Two Simple Designs for a Plain Assembling Conveyor

Matters Affecting Assembly

In determining the best method for assembling a given unit, several important factors must be considered. Conditions are quite different in a small shop with a low production from those in a large factory having a high production. The number of units to be produced is, therefore, an important factor, yet it does not necessarily follow that the assembling department should be neglected when only a small production is to be handled. On the contrary, "trimming the corners" by saving labor in assembling will reduce costs and stimulate production.

The amount of final fitting in assembly must be reduced to a minimum, as otherwise work will be done which should be taken care of in the manufacturing departments. The final fitting of parts should be watched closely by the assembling department foreman, and work which requires unnecessary fitting should be sent back to the inspection department with a notation as to the requirements. The inspection department should return the work to the department responsible, in order that it may be refinished to the size called for on the drawing. It is possible that the gages used in the inspection department may be worn or sprung out of shape so that parts made incorrectly pass inspection. In rare cases the engineering department may be at fault due to an incorrect setting of limits on the drawings. This trouble is not commonly found until the final test of the mechanism, at which time the necessary recommendations can be referred to the engineering department.

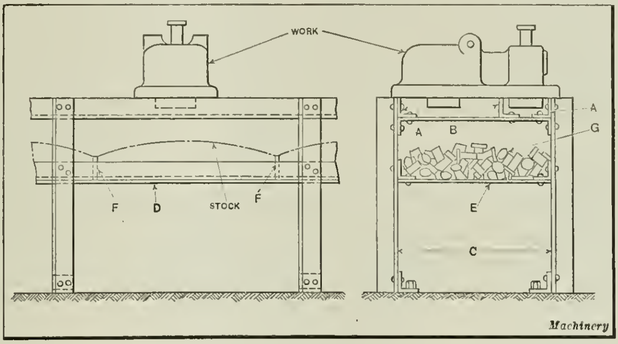


Fig. 2. Plain Assembling Conveyor having Compartments for the Stowing of Parts

Methods Used in Assembling

Many manufacturers do not consider the assembling of their product important enough to devote much study to improvement of methods used in this department, and there are numerous cases where workmen are left to their own devices and methods. One man out of ten may develop a good method, while the other nine work more or less profitably, according to their ability and general knowledge of the work. Progressive manufacturers realize the importance of keeping down assembly costs, and study the problems involved. A system of assembling is fully as important as an efficient method of production. When an investigator attempts to put into practice knowledge gained by experience, he is likely to meet with opposition from the men who should give him assistance. It is natural that any man familiar with a certain job of assembling should consider that he knows more about it than another man who sees it for the first time. He should not forget, however, that an investigating engineer is examining his work from a different angle and trying to devise means for doing it in an easier way and with less consumption of time.

In considering the various operations in an assembly department, an analysis of the number of movements a man makes, the number of times he is obliged to turn the mechanism over and his methods of inserting various units and holding them in place while putting in locating pins, nuts, or bolts should all be the subject of careful observation. It may be found that though a man is working conscientiously, he is handling the unit unnecessarily, so that often economies can be effected by the use of an assembling stand to assist in turning the device into different positions to make it easier of access. The need for a stand depends on the number of units produced, the size of the parts, and the difficulty in handling. For moderate production of small units, assembling stands are seldom necessary, but on larger work they may be found an advantage. When production is high, assembling stands or conveyors can be used to increase production. Assembling stands for various units are more or less expensive, but in some cases a simple wooden frame made at a nominal cost, will materially help production.

Assembling by the Conveyor Method

The advantages of conveyors and racks in the assembling of various products are not appreciated by many manufacturers, and when a conveyor is suggested for purposes of assembling, the manufacturer generally thinks of the large cost of installation and believes it necessary to reorganize and change his methods completely with a loss of considerable time. He also thinks of the possibility that the system may not prove successful after installation. In many large factories, however, the system has been developed to a wonderful degree, and there is no question as to its efficacy. A few specific cases which bring out the principles of the various types of conveyors for assembling, their use, application and advantages, will be given to show how important conveyors are and how easy it is to install the simpler types. It is evident that a conveyor system would hardly be needed in a factory where two or three men are sufficient to do all the assembling; yet even here there are possibilities of changes which would relieve these men for perhaps a part of their time so that they could work on some other operations. The points of importance to be considered when planning a conveyor or assembly line are as follows: Nature of the product, production, number of men needed in assembly, and time of each operation. The nature of the product determines the size of the conveyor and its general shape in accordance with the number of units or pieces which are to be assembled. It may be better to use two conveyor lines rather than one in order to avoid the length taken by too long a conveyor. The speed of a power-driven conveyor should be governed by the production required. It would not be good practice to design a conveyor to run at such a speed that a single operation would require an operator to move ten or fifteen feet, as this would be tiresome and the greatest efficiency would not be obtained. The number of men required is dependent upon the product and the spacing and apportioning of the operations so that they will time up with each other. The speed of the conveyor should be such that the operators do not interfere with each other, nor should one man have more work to do than another. The time of each operation is generally predetermined by the old method, although by the conveyor system there may be a slight gain in time, as the operator has only one thing to do, and consequently he becomes exceptionally expert in doing this particular thing.

Plain Type of Assembling Conveyor

A conveyor for assembling is usually designed to suit a particular product, although it is possible to standardize the construction so that it can be adapted to a number of kinds of work. The principal types which will be considered are the plain, roller, and power types. Fig. 1 shows at *A* one of the simplest forms of conveyors for assembling. This type is made up from pipe of suitable size and simple fittings which can be easily made and require little machining. The work rests on two lines of pipe C and D, which are spaced a suitable distance apart according to the width of the product. The pipes rest in cast-iron sockets E that are screwed to the upper end of short lengths of pipe F. Substantial cast-iron bases hold the lower end of the pipe, and these castings may be fastened to the floor or made heavy enough so that their weight is sufficient to hold them in position. The spacing of the uprights is determined by the size of pipe used and the weight to be carried. In using this type of conveyor, the assembler finishes a given operation on the part and then pushes it along the pipe to the next workman who does another portion of the assembling. This type of conveyor is suited to work of fairly good size not likely to be pushed off one side. There are no protecting guides, the workman being required to exercise sufficient care so that they are not necessary.

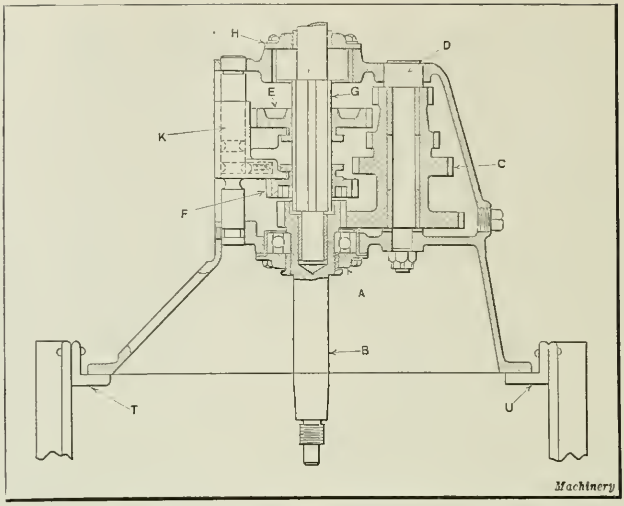


Fig. 3. Sectional View of Transmission Case assembled by the Conveyor Method

Another simple type of conveyor is shown at B; this form is composed entirely of angle-irons and straps. The dotted lines M indicate the piece of work to be assembled. The work is slid along from one operator to another in the guides formed by the legs of angle-irons N. These are set far enough apart so that the work will slide easily and yet cannot fall off. The uprights P are also composed of angle-irons with suitable reinforcements at the foot to allow them to be bolted to the floor if desired. When the work rests on a finished surface it may be found advantageous to place a strip of fiber or leather on top of angle-irons N for the purpose of keeping the finished surface from marring.

In order to obtain the greatest efficiency from the conveyor method of assembling parts, the operators' convenience should be carefully studied in order to make their movements as few as possible. In Fig. 2 is illustrated an angle-iron type of conveyor somewhat similar to the one previously mentioned. In this case, however, the work rests on the edges of the angle-irons A, a guide strip being placed at B to prevent it from being pushed off the conveyor. Uprights C are also angle-irons and between these, angle-irons D extend longitudinally and carry a plate E on which are placed a number of parts used in assembling. Suitable partitions F are inserted so that each workman's parts are kept separate from the others. In assembling, an operator simply reaches down and selects a part from the pile G, while the next operator has a similar pile of other parts which he uses when the work is pushed to him. This method allows an operator to work rapidly, and a high production rate is obtained.

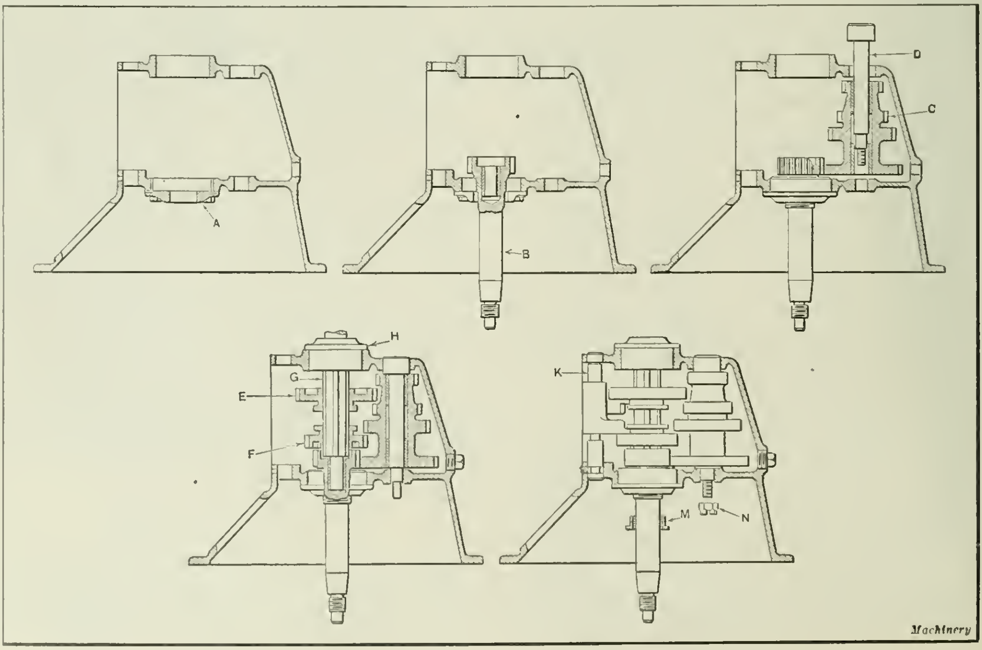


Fig. 4. Various Stages in the Assembling of the Transmission Case shown in Fig. 3

Roller and Power Types of Assembling Conveyors

The roller type of conveyor is not used much in actual assembly but rather for conveying parts from one position to another. For heavy work rollers having ball bearings allow the product to be moved very easily. The cost of such a conveyor is higher than that of a plain type, but its advantages for certain kinds of work offset the difference in cost. This form of conveyor is not generally used in assembling, as it is hard to keep the work steady enough so that parts can be placed in position with certainty.

The power type of conveyor is most commonly used in large manufacturing plants. In this type a chain or belt carries the work along at a uniform speed, and the workman who does the assembling walks with it when placing the various parts in position. The speed of the conveyor is so arranged that each workman has a given amount of time to do a certain operation, and the various jobs are carefully proportioned so that one man does not have more to do than another. The advantage of this form of conveyor is that the manufacturer knows exactly how many units he will obtain in a given length of time, as the parts are not moved with respect to the conveyor and they travel at a uniform speed. When this method of assembling is adopted, each operator is obliged to keep up with the speed of the conveyor, as the next man is always waiting for the part to come to him.

A conveyor of this sort can be designed to hold a considerable amount of stock in various locations. Provision can also be made for turning the work over in order to assemble units on either side. In cases where it is necessary to perform a machining operation after a certain amount of assembling has been done, the conveyor can be designed so that the work can be slid on a sheet-metal table at the level of the machine table on which the operations are performed. After the machining operations, the work can be slid back on the conveyor for further assembly. If the length of time necessary for assembling is such that a conveyor would be required longer than the length of the building, it can be turned around corners and returned in the opposite direction.

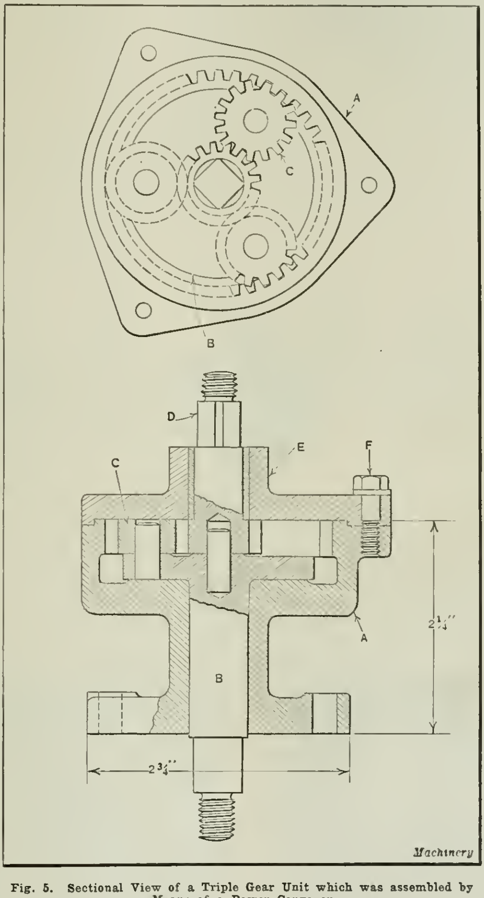


Fig. 5. Sectional View of a Triple Gear Unit which was assembled by Means of a Power Conveyor

Examples Showing Savings Resulting from Conveyor Assembling

In order to make the actual savings obtained by the use of a conveyor system of assembling more apparent, two specific examples will now be presented. Fig. 3 illustrates a transmission case assembly which had in times past been assembled on a bench. A number of men were employed on this work, and each man assembled and tested a complete unit. The work was picked up from the floor and placed on a bench, after which the different parts were taken from conveniently placed racks and assembled in the case, one at a time, bolts being tightened by hand and all adjustments made so that the unit, when finished, was ready for the final inspection. The time necessary for assembling a complete mechanism was twenty minutes.

An investigating engineer decided that this method was entirely too slow and, therefore, installed a conveyor arranged with angle-irons as shown at T and U which served to support the work and acted as guides. The work is placed on one end of the conveyor in the form shown at the extreme left of the top row in Fig. 4, the bearing cap A having been assembled in a previous operation. The first workman places the combination shaft and pinion B in position and pushes the work along to the next man, who assembles the shaft in its bearing and makes a superficial test to see that it runs properly. The next man places the gear C in the case and sets shaft D in position. After this, another operator drives the shaft D home and makes sure that the gears mesh correctly and revolve freely. The next step is the assembling of sliding gears E and F on shaft G by an operator who simply places the parts in position but does nothing more. The next man adjusts the parts, sees that they move freely, and places the bearing cap H in position, at the same time placing the bolts in the holes to secure the bearing cap. The next workman uses an electric drill provided with a socket wrench and rapidly screws the bolts into the nuts, the work being then passed to another operator who tightens the nuts by hand. The next operation is placing the gear-shifting shaft K in position and testing the gears to make sure that they move freely. After this has been done, another operator turns the work over and places bushing M and nut N in position. The last workman adjusts bushing M and tightens nut N, thus completing the assembly. A comparison of the two methods shows that it required twelve men using the new method to produce sixty pieces per hour, while the old method required twenty men for the same production. The cost of the conveyor was nominal, as the construction was very simple and standard angle-irons were used.

Assembling a Gear Unit

An investigation was recently conducted in a shop in which a triple gear unit was one of the products. A sectional view of this part is shown in Fig. 5. The production wanted was six hundred per eight-hour day. After carefully inspecting the methods of machining and improving these where it was found desirable, the assembling was considered. It was found that three men assembled the parts at the required rate of production and that the superintendent considered that this was satisfactory. One man assembled the parts while the others tightened the nuts, the average total time consumed for one piece being 2.4 minutes. The mechanism consists of a body *A* in which a flanged shaft *B* is contained. Three gears *C* are assembled on pins equidistantly spaced in the flange of shaft *B*, these gears meshing with an internal gear cut on the inside of body *A*. Shaft *D* has a pinion cut on one end, and this also meshes with gears *C*. A cover plate *E* is fastened to the body by means of three bolts *F*, each of which has a spring lock washer. The assembling is quite simple and no fitting is required.

After studying the old method, it appeared that a conveyor could be easily applied with a distinct gain in production, and so a study was made of the length of time necessary to assemble each of the parts by the old method. This gave a basis for comparison and an idea as to the speed at which the conveyor could be run. A preliminary sketch of the idea was made, and as it appeared worth while, the idea was put into practice as illustrated in Fig. 6. The two pulleys *G* and *H* were mounted in a wooden frame set on the floor, and motor *K* was connected to drive pulley *H*, the reduction being such that the surface speed of the canvas belt *L* permitted time for each man to assemble his portion of the work. Belt *L* was furnished with a series of blocks *M*, spaced at intervals of 3 feet. In each block a hole was bored to allow space for the central shaft of the unit when assembling. The work is located on studs projecting from blocks *M*, which hold it in position so that assembling can be done readily. The belt slides over the top surface of table *Q* which eliminates sag.

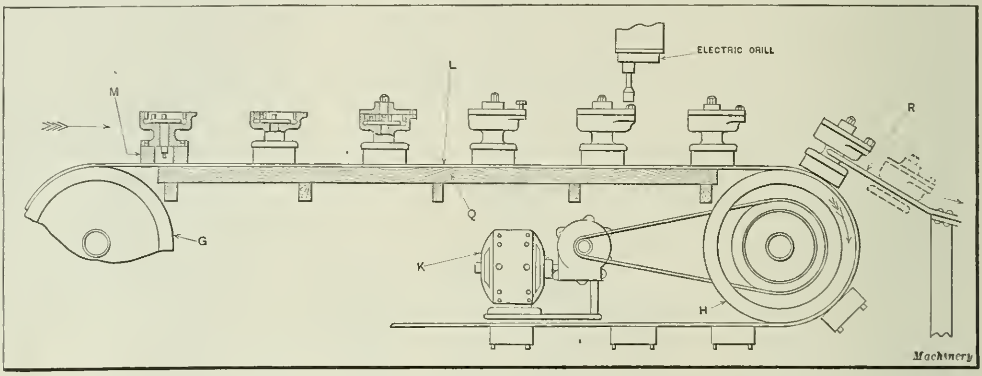


Fig. 6. Motor-driven Belt Conveyor used in assembling the Triple Gear Unit shown in Fig. 5

In the first operation a man places the work on the two studs and assembles the part *B*, Fig. 5, in position. The next workman places the three triple gears *C* in place, while in the third position, the central pinion *D* and the cover *E* are assembled. In the fourth position the three bolts *F* and their lock-washers are put in place, and in the fifth position an electric drill suspended over the conveyor is brought into place to tighten these bolts loosely by means of a socket wrench. In the sixth operation, a workman tightens the bolts by hand. Immediately after this operation the work passes over the pulley, at which time it is guided between the plates *R*, Fig. 6, and slides down an incline ready for inspection.

In addition to the mechanism shown a bench was provided on one side so that any defective parts could be set aside and replaced by a new part. The percentage of defective parts, however, was small, due to accurate machining. After the workmen had become familiar with the new method it was found that by running the conveyor one hour a day and employing six men, the desired production was obtained and the men liked the change from their work at the bench. The amount of space required was small, and the total cost of the equipment moderate.

By comparison, the time required per piece in the old method was found to be excessive, as is clearly shown by the following figures: Old method, 2.4 minutes per piece; new method, 0.60 minutes per piece; old method, 600 pieces required 1440 minutes; new method, 600 pieces required 360 minutes. The saving in time equals 75 per cent. This is a good example of the economies which can be effected by the judicious use of conveyors in assembling. The small manufacturer should not attempt to install a complicated system of assembling conveyors, but he can save a great deal of money by using simple forms like those described.

* * *

MOVING PICTURES OF MACHINE TOOLS

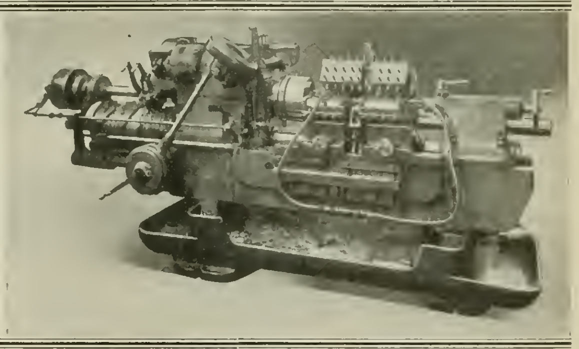
The educational value of motion pictures for teaching students of trade schools and colleges is coming more and more to be appreciated, and this is emphasized by the fact that the United States Government is now having motion pictures of machine tools taken, which are to be used for educational purposes in twenty-seven vocational schools throughout the country. The pictures are being filmed by the Society for Visual Education, and a ten-thousand foot film relating to milling machines has been taken in the shops of the Kempsmith Mfg. Co., Milwaukee, Wis. This film shows the assembly of the different parts of a milling machine into units, the assembly of the units, and the complete assembly of a machine. Then follow pictures of various milling operations, ranging from those of a simple nature up to complex operations requiring the use of a dividing head or special attachments. The cutting of gears is also presented. Close-up views of the revolving cutter in ultra-rapid pictures indicate clearly the manner in which the cutter tooth cuts into the metal and removes a chip. A series of such pictures should be of considerable interest to the student of machine shop practice.

* * *

STANDARDS FOR TESTING WELDS

The American Welding Society, 33 W. 39th St., New York City, has issued a bulletin entitled "Standards for Testing Welds," consisting of a report of the Committee on Standard Tests for Welds of the American Bureau of Welding, which is a joint advisory board of the American Welding Society and the Engineering Division of the National Research Council. Differences in the procedure of testing welds in the past have caused widely divergent results, and comparisons are frequently impossible, with the result that the usefulness of much of the research work on record becomes limited, and in many cases the results are actually misleading. The committee feels that the need for some immediate standards is great, and the universal use of the specifications contained in the bulletin is urged upon all those who have to do with the testing of welds.

Cost-reducing Tooling Equipments



Tooling Equipments Employed for Machining Steering Knuckles and Other Automobile Forgings at a High Rate of Production

By RALPH E. FLANDERS
Manager, Jones & Lamson Machine Co.
Springfield, Vt.

MACHINE tool developments, during the last decade, have been influenced to a remarkable degree by the automobile industry in the establishment of the high productive and efficient manufacturing methods now followed by most of the concerns connected with the industry. The present-day trend in the design of machines for performing lathe operations is either to provide the machine with several work-spindles and a corresponding number of tool positions, as on multiple-spindle automatic screw machines, or to provide one spindle and as many tools for taking simultaneous cuts as the work will stand without chattering or springing. The present article describes the turning of forged parts according to the second method referred to on automatic lathes produced by the Jones & Lamson Machine Co., of Springfield, Vt.

How To Reduce Production Costs ?

The machining of steering knuckles is typical of the jobs handled on the Fay automatic lathe. The tooling equipment used on this machine for one type of steering knuckle is illustrated in Fig. 3. The knuckle is centered on the axis of the wheel-spindle. The center at the large end is drilled to a uniform depth, as gaged in the centering machine from any support on the forging which will locate the bosses for the holes. The front tool-holder of the lathe feeds in at an angle, until the proper depth of cut is reached, and then feeds straight toward the left, the three tools finishing the two ball seats of the knuckle, ready for grinding, and the small end, ready for threading. Meanwhile, the two tools in the rear tool-holder take a roughing cut on the tapered portion, the length of the cut being divided between them, so that what would otherwise be the longest feed of the operation is considerably shortened. A supplementary holder beneath the rear holder also rocks into place so that the two tools held in it bevel and neck the small end to prepare it for a threading operation. All the tools on the machine work simultaneously.

Fig. 1 illustrates a similar job except that the small end is not necked and the bevel on this end is produced by a tool in the front holder. A designer can usually arrange to omit this neck, and so simplify the tooling for an operation of this sort. Only a roughing cut is needed on the steering knuckle, because the two ball seats are ground later. The forging shown in the machine in Fig. 1 is machined at the rate of about forty per hour, so that over 700 parts are produced in a nine-hour day by one

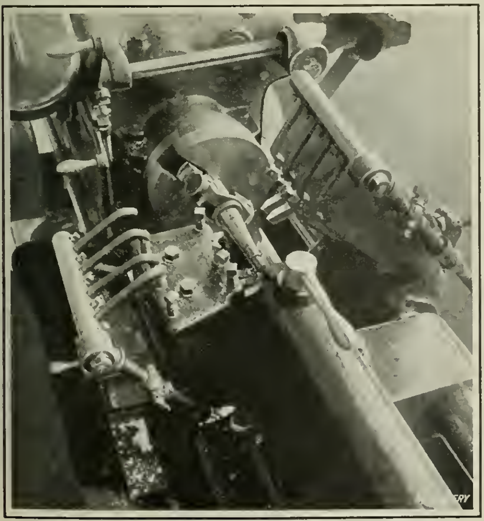


Fig. 1. Automatic Lathe furnished with Necessary Tooling for the machining of a Steering Knuckle

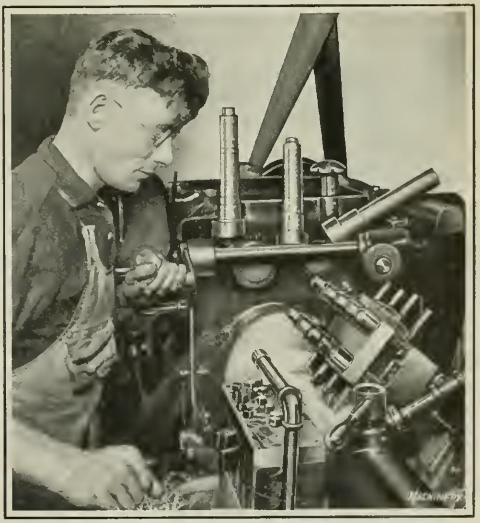


Fig. 2. Coolant being supplied copiously on a Machine equipped with Intensive Tooling

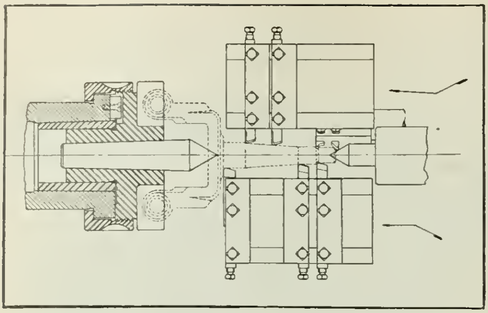


Fig. 3. Rough-turning Automobile Steering Knuckles on a Fay Automatic Lathe

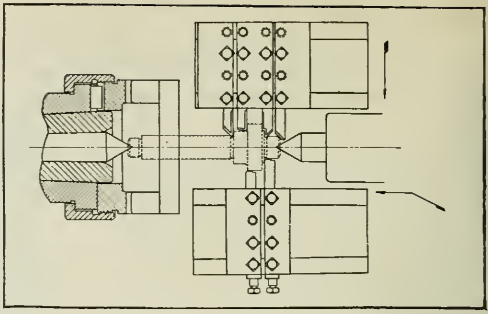


Fig. 4. Tooling Equipment provided for the First Operation on a Transmission Shaft

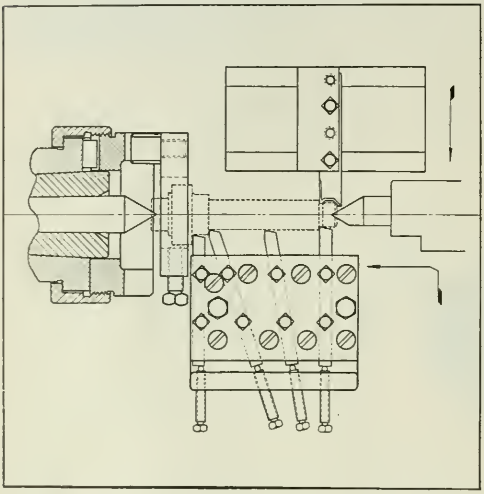


Fig. 5. Second Operation on the Transmission Shaft illustrated in Fig. 4

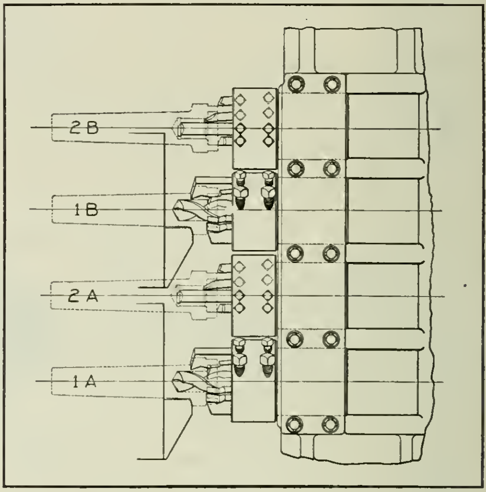


Fig. 6. Machining a Clutch Shaft on a Double-spindle Production Lathe

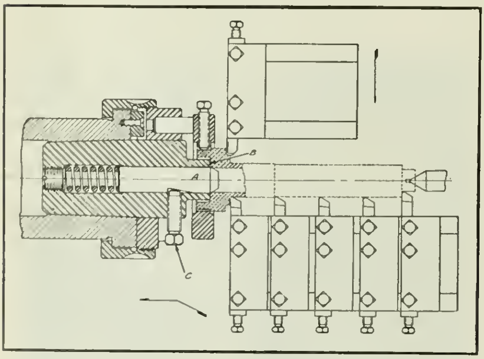


Fig. 7. Tool Set-up used in rough-turning Transmission Clutch Shaft

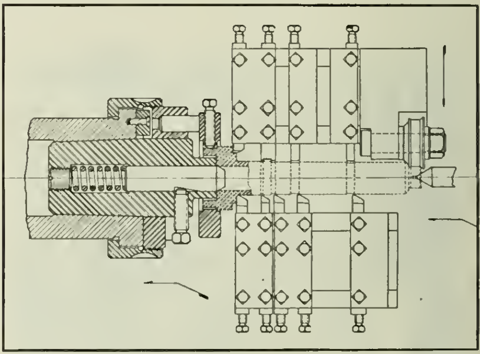


Fig. 8. Finish-turning Operation on the Shaft shown in Figs. 6 and 7

operator running two machines. The steering knuckles shown are of the forked type used with a T-headed front axle, but the tooling of the machine and the production would be the same with a T-type knuckle for a forked axle.

Tooling Equipments for a Transmission Shaft

Transmission shafts are also readily turned on Fay automatic lathes. The example shown in Figs. 4 and 5 is a lower or jack shaft having an integral pinion. With close-forged blanks of mild steel, a single cut over each surface is all that is necessary to prepare the part for the grinding and threading operations. With inaccurate forgings, however, and particularly with those made of tough alloys, roughing and finishing cuts must be taken over each surface. When two cuts are necessary and only two machines are available, it is best to run a lot through both roughing operations first, and then, without changing the camming of the machine, through both finishing operations.

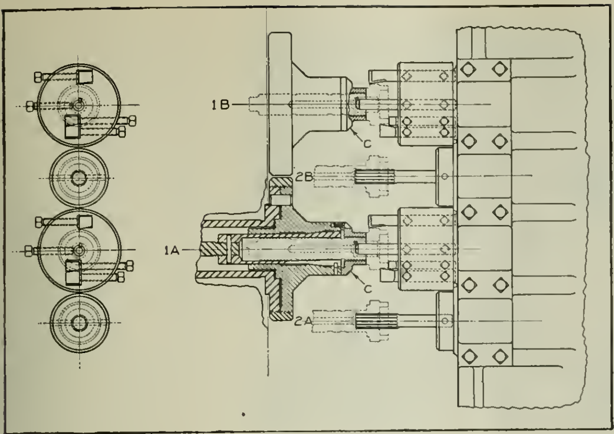


Fig. 9. Equipment provided on a Double-spindle Production Lathe for machining Transmission Clutch Shaft

All such parts as these are best handled if the ends are straddle-milled to length in a preliminary operation, gaging from the pinion blank, and then centered to a standard depth. This procedure saves facing into the centers and provides a smooth surface to center into as well. A rugged inexpensive machine for straddle-milling the ends of such work as forged shafts should find a ready sale in automobile factories. A simple gage for determining the depth of centers was shown at *C*, in Fig. 1 of an article describing the production of tractor camshafts, which was published in May, 1920, MACHINERY. The use of this gage in connection with straddle-milling permits work of ordinary accuracy to be put into the machine, taken out, and turned end for end in a second operation, without altering the positions of the shoulders. Longer forgings may be machined in the same manner as the shaft described, although it may be necessary to provide additional support at the middle of the work by the use of a steadyrest.

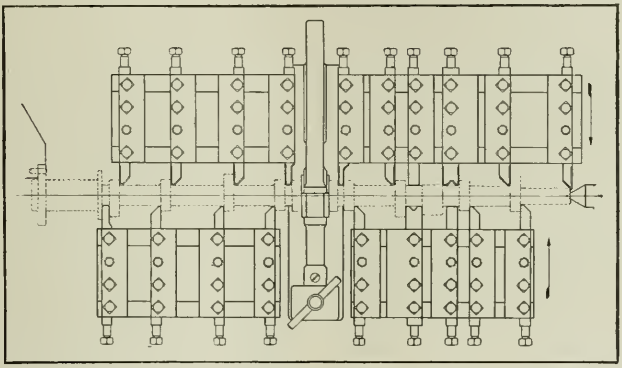


Fig. 10. Tooling provided on a Fay Automatic Lathe for squaring the Shoulders of Camshafts

Machining a Transmission Clutch Shaft

The first operation on a transmission clutch shaft is performed on a double-spindle production lathe equipped with the tooling shown in Fig. 6. Both spindles are fitted with an air-operated chuck for holding duplicate pieces of work, and two sets of tools simultaneously finish the two pieces in practically the same time as would be required for machining one piece in a single-spindle machine. When the carriage is fed forward, after the work has been chucked, the holes are drilled and counterbored and the two outside diameters of the large end are rough-turned, as shown at positions 1A and 1B. The carriage is then withdrawn and an automatic mechanism shifts the tool-slide over to bring the second set of tools, shown at positions 2A and 2B, into alignment with the work. As the carriage is again fed forward to its stop, two tools bevel the bottoms of the counterbores to form centers. Then, the tool-slide is fed toward the rear for a distance of about 3/16 inch to bring two tools into position to rough-face the end of each piece of work, the cut being divided between them as one tool works toward the outside and the other toward the center of the part. Meanwhile, a tool recesses the bottom of the drilled hole. If the forgings are straddle-milled prior to this operation, the facing tools can be omitted.

Figs. 7 and 8, respectively, show the roughing and finishing cuts on this part, which are taken in a Fay automatic lathe. The point of particular interest is the method of supporting, locating, and driving the work. The work is centered on a spring plunger *A* which recedes as the tail-center is advanced, until the bottom of the counterbore in the work comes in contact with the end of part *B*. All the cuts are thus gaged from the bottom of the counterbore, which is the logical place. Set-screw *C* is then clamped to hold parts *A* and *B* in the proper relation to each other. Attention is also called to the arrangement of the tools in the front holder; it will be seen that the machining of the shank is divided between four tools, so that the rough-turning is completed in about one-quarter the time that would be necessary with one tool.

Rigid support of the work at the headstock end is an essential feature in withstanding the pressure of these multiple cuts. On most work, it is advisable to use a revolving ball-bearing center in the tailstock, as otherwise the center hole will wear so badly as to

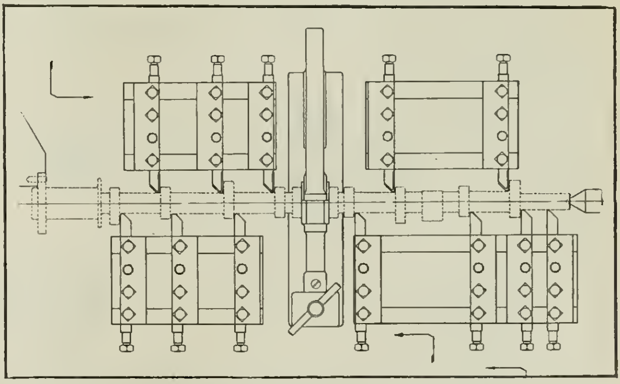


Fig. 11. Turning the Camshaft, the Cuts being divided between Tools in the Front and Rear Holders

allow the work to shift, with the result that it will be turned inaccurately and, perhaps, cause the tools to break. The ordinary solid tailstock center has a limited usefulness in intensive turning operations. A copious supply of cooling compound is also essential for the satisfactory accomplishment of such operations, and Fig. 2 shows to what extent coolant is furnished in practice.

In the finish-turning operation illustrated in Fig. 8, the tooling is obviously determined by the finished dimensions of the work. Much higher speeds and finer feeds are used than in the roughing operation, and the result is an accurate and well finished piece that is produced in the same time as that required for rough-turning. The tools in the rear tool-holder produce grooves on the shank, and finish-turn, bevel, and neck the small end. On this job one man operates two machines, and the production ranges from twenty-five to thirty completely finished pieces per hour.

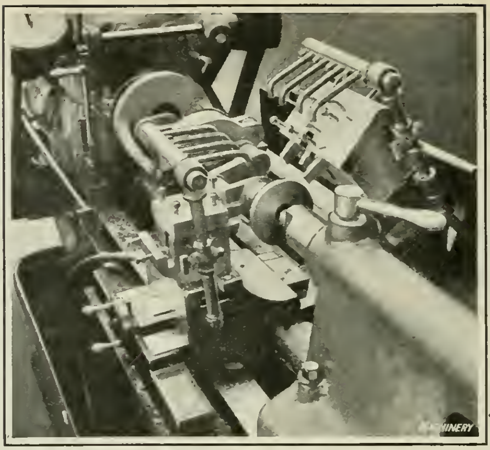


Fig. 12. Crankshaft End Bearings being machined with the Part supported by a Spindle Fixture

The part next goes to a drilling machine to have a long central hole drilled, although in some cases this operation is left until after it has been ground and gear teeth cut on one surface, as this provides a better means of holding. The final lathe operation then consists of finishing the large end on both the inside and the outside. For this purpose, the work goes to a second double-spindle production lathe equipped with the tooling shown in Fig. 9. The tools shown in positions 1A and 1B finish-bore the bearing seat, finish-turn the outside diameter of the gear and clutch portions, and finish-butt-face the end. A tool for recentering the bottom of the counterbore may also be provided, but this is not usually necessary, because the shank is finished true with the center and the work is held by the shank in an air-operated expansion collet.

Since the diameter of the shank may vary, the longitudinal position of each collet is not fixed and it is therefore necessary to stop the work against collars *C* which are fixed longitudinally. The holes in the shafts are reamed to size, ready for grinding, by the tools shown at positions 2A and 2B. The total time for this operation is but little more than would be required for producing one piece at a time.

Operations on Camshafts

The lathe work on camshafts can be performed on double-carriage Fay automatic lathes provided with tooling equipments as shown in the heading illustration and in Figs. 10 and 11. The particular forging shown in those illustrations comes to the machines with the end flange finished and drilled and the center bearing turned. It is necessary to have the center bearing turned previously, to provide bearing surface for the steadyrest. The flanged end is held in hardened and ground jaws in an air-operated chuck, the camshaft being driven by a dowel in one jaw engaging a bolt hole in the flange. There are two general methods of machining and hardening to obtain hardened cam and bearing surfaces and a soft body. One way is to machine the part completely and then carburize it, the surfaces to be left soft being copper-plated so that they will be protected during the carburizing process. The other method is to square the shoulders, rough-grind the cams and bearings, carburize the part, turn the body and other surfaces to be left soft, and then harden. In this way, the carbon is removed from the surfaces which have been turned, and consequently they will be left soft in the hardening process.

Fig. 10 shows the tool set-up used in squaring the shoulders, both the front and rear tool-holders being fed straight in. The camshaft is complicated by a pump cam located between the second and third valve cams from the right end. There is danger on a wide forming cut that a slender shaft will catch on the tools, ride up on them, and spring off the centers. For this reason, the cuts taken on both sides of the pump cam are divided into three chips by using alternate double and single tools at the front and rear of the work as shown. This arrangement tends to balance the stresses and makes heavier cuts possible on slender work of this sort. Fig. 11 shows the tooling equipment for the turning operation, the cuts being again balanced between the front and rear tool-holders. The rear tools are fed to the work at about the center of the space between the cams until they are cutting to depth, after which they are fed toward the tailstock. The operation of the front tools is similar except that they are fed toward the headstock. This permits the cuts to be overlapped somewhat so that surfaces of different lengths may be turned with one length of feed. It is also possible, as shown at the extreme right, to turn an extra long surface with two tools.

The heading illustration shows a machine set up for a job very similar to that shown in Fig. 10, and the production with one man running two machines is twenty-five camshafts per hour. The automatic feature of the machine is important in taking these short multiple cuts, as it saves the physical and nervous strength of an operator. All machine movements are automatic, with the exception of the opening and closing of the chuck and the changing of work. Six-cylinder camshafts are handled in a similar manner, except that, owing to their greater slenderness, it is often

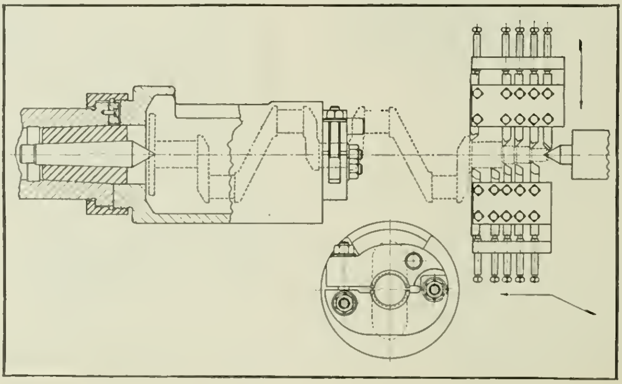


Fig. 13. Tool Set-up in which the Spindle Fixture used in Fig. 12 is also employed

necessary to divide the cuts into three operations and use fewer tools in each. It is important in shaft work to have all shoulders squared in one setting if possible, because this gives greater accuracy than when the work is transferred to another machine and, perhaps, turned end for end. It cannot be expected, of course, that the design of an automobile engine can be based on machining problems alone, but if it so happens that a designer can use a camshaft having the turned portions of approximately equal length and no form cut more than ½ inch in width, tooling problems will be considerably decreased.

Finishing Crankshaft End Bearings

Machining the end bearings of crankshafts bears a general resemblance to camshaft work, although it is simpler and heavier. An example is shown in Fig. 12; this is an ordinary three-bearing, four-cylinder crankshaft. The main bearing is supported in a clamp bushing mounted in a spindle fixture. The latter will be more clearly seen in Fig. 13. Of especial interest are the form of the spindle end and the means used for holding the overhanging fixture. The production obtained on these machines is twenty crankshafts per hour, with both ends machined, and one man running two machines.

* * *

IMPROVEMENTS IN LOCOMOTIVE DESIGN

By ARTHUR GORE

The railroad companies who are anxious to put their roads back on a paying basis realize the necessity for reducing their operating expenses as well as increasing efficiency in every way possible. The motive power is, of course, one of the principal sources of expense in the operation of a railroad. The price of coal has increased enormously in recent years, and it is therefore of the greatest importance that every available means be employed to cut down the fuel consumption.

The locomotive in its present form is very wasteful. Steam is used at the boiler pressure for 75 per cent of the piston stroke before being expanded, and is exhausted into the air when still at a high pressure. This practice is anything but economical, and some means of utilizing this exhaust steam for tractive purposes should be adopted. It may be said that it is general practice to shovel coal into the furnace by the ton, and allow a large percentage to be ejected at the stack in the form of smoke and cinders. A large proportion of the heat energy of the coal—sometimes as much as 50 per cent of the total amount—therefore does no useful work.

Coke as a Fuel

The purpose of this article is to suggest improvements in the design and method of operating locomotives that will not necessitate material alterations or changes, yet that will be of such a nature as to result in substantial reductions in the operating expense. With this idea in mind, attention is directed to the successful operation of by-product coke ovens, which has made it possible to solve many of the problems that at one time seemed unsurmountable. It is proposed that this vast industry and especially its new developments be studied carefully with a view to utilizing some of its products as locomotive fuel.

Motorizing Locomotive Tender

It is proposed that the present tender of the locomotive be changed to permit of the installation of a high-pressure steam turbine between the frames. This turbine would be coupled to the axle by suitable gearing. The exhaust from the main cylinders would drive the turbine, and the exhaust from the turbine would be directed to the uptake. Coke and tar would be the fuels utilized in the furnace, the latter being fed through suitable injectors by steam, and the former fed by hand in the usual way. A good draft and a very incandescent fire should result from this combination of fuels. Tar has been used as a fuel for a number of years by some of the European railroads and has given excellent results.

In the case under consideration, tar, being one of the chief by-products of the coke oven, would be a cheap fuel. It has given great satisfaction in steel furnaces in conjunction with coke oven gas. The use of the locomotive tender as a motor is not a new idea, but the introduction of a steam turbine seems original in locomotive practice, although there is no mechanical reason why it will not adapt itself to that service, and at present this plan is being tried out in Europe by one of the leading locomotive builders. Undoubtedly, the most economical method of using coal as a fuel is to extract its constituents in the by-product coke oven and use them separately, and not shovel it into the furnace as at present in an indiscriminate mass. It is understood that the present average consumption of coal on our railroads is about sixty pounds per mile.

Turbine-driven Tender

Objections will doubtless be raised against the use of turbines for railway work, but it should be remembered that some of the largest and fastest ships are driven by reciprocating engines which exhaust into low-pressure turbines. However, objections will undoubtedly be made against any radical change in the present design of locomotives. It may be recalled that when Parson's turbine was first introduced, it was rejected by the leading engineers of the day.

The Mallet type of articulated locomotive, while in use for many years in Europe, did not find favor in this country until the railroad managers were forced to find a means of hauling the ever-increasing train loads without injury to bridges and road-beds. The tender has always been a cumbersome element to deal with, and if it can be utilized for hauling or tractive purposes much expense may be eliminated. It would not be necessary to change the present design of tender materially in the improved type. A simple engine with two high-pressure cylinders equipped with the Walschaerts valve gear could also be employed. The boiler could, in the writer's opinion, be shortened without decreasing the efficiency of the heating surface.

* * *

SPECIAL LIBRARIES IN MANUFACTURING PLANTS

The increasing importance to the industrial executive of accurate facts and information is illustrated by the rapid growth of industrial research libraries, with trained library experts in charge. As the result of a survey recently made by the Special Libraries Association, it was found that there are over 1300 special libraries throughout the country, and of this number more than 200 are directly concerned with industrial and manufacturing subjects. Special libraries have demonstrated their value in all the more important lines of manufacture. Such collections are maintained by companies producing metal products, electrical supplies, explosives, rubber, oil, paper, textiles, shoes, office appliances, firearms, etc. While industrial libraries are maintained primarily to aid the executive officers of the concern, they have frequently rendered valuable service in the education of company employes. In some cases the central library has extended its facilities to factory branches in various parts of the country by the establishment of branch libraries and information departments. Many of the industrial libraries have interesting special features. In several instances bibliographical or news bulletins are issued. During six months, 1790 reference questions were answered by one library. The complete findings of the Special Libraries Association's survey have recently been published in the form of a "Special Libraries Directory," edited by Dorsey W. Hyde, Jr., president of the association, 3363 Sixteenth St., Washington, D. C.

Combination Dies for Finishing Parts in One Stroke

How To Reduce Production Costs ?

By J. BINGHAM, President, Bingham Stamping & Tool Co., Toledo, Ohio

COSTS may be reduced and the production of various styles of drawn covers for such articles as tobacco cans, etc., may be readily accomplished in one power-press operation, provided the machine is equipped with some type of combination die. Fig. 1 illustrates a combination blanking and drawing die employed in the manufacture of the cover shown at the bottom of the illustration, this part being made from 0.011-inch sheet iron, commonly called "tin." In the operation of this die, a strip of metal is placed on die ring *A*, the top of draw-ring *B* being raised to the same level as the cutting edge of ring *A* through the action of the rubber buffer which actuates the block upon which pins *C* rest.

When the punch descends, the face of ring *D* is advanced ahead of the face of section *F* by coil springs placed between the ring and section *E*, and cuts the blank to a diameter of 5⅝ inches as it enters die ring *A*. The draw-ring then holds the blank firmly against the face of ring *D* and retards the movement of the latter, so that the coil springs are compressed and the relation between the faces of ring *D* and section *F* is changed, permitting section *F* to draw the part to the desired shape on ring *G*. The operation is completed when ring *D* and section *E* come into contact. The draw-ring ejects the work from the die when the punch ascends while ring *D* forces it from the punch.

Although this job would be a difficult one if an ordinary solid punch were employed, it was accomplished satisfactorily by means of the sectional punch. The coil springs are made of 1/32- by 3/32-inch flat wire and are about ½ inch in diameter. Attention is called to the provision of a block *H* in a counterbored hole in the bolster plate. This arrangement eliminates the necessity of machining holes through the bolster plate to accommodate draw-ring pins, because they can be located in the special block. Therefore, the bolster plate does not become ruined after a number of dies on which the diameters of the draw-rings vary are mounted on the machine, because a suitable block may be provided for each die. The only holes required on the bolster plate are those for bolting the die-shoe to it. This construction has been used for years with complete satisfaction.

Drawing a Canister Top by the Inverted Method

The die shown in Fig. 2, which is used for producing canister tops, cuts the blank and then performs two distinct drawing operations, the part being first drawn as shown at *A* and then as shown at *B*. This method is known as "inverted drawing." The material used for the part is 0.028-inch sheet iron. Normally, the top of draw-ring *C* is held in the same plane as the top of die-ring *D*, by a stud and rubber buffer arrangement which functions similarly to that on the preceding die. The blank is cut to a diameter of 6½ inches by ring *E* of the punch as the latter enters the opening in ring *D*, after which the draw-ring holds the blank firmly against ring *E* as this member continues to descend, and draws the part on ring *F* of the die to the shape shown at *A*.

As this step is concluded, pad *G* and the spring-actuated ring *H* come in contact with the work and cause it to be drawn to the shape illustrated at *B*, during which time ring *H* is retarded so that the springs placed above it (not shown in the illustration), become compressed. By this construction ring *H* functions in the same manner as a draw-ring. Upon the return stroke of the punch, the springs

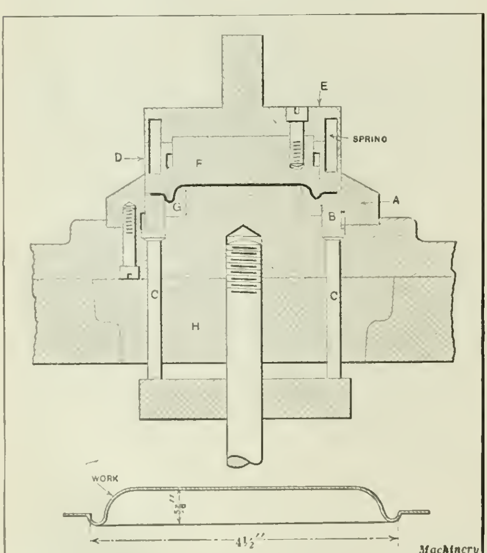


Fig. 1. Making a Tobacco Can Cover in One Operation by Means of a Combination Blanking and Drawing Die

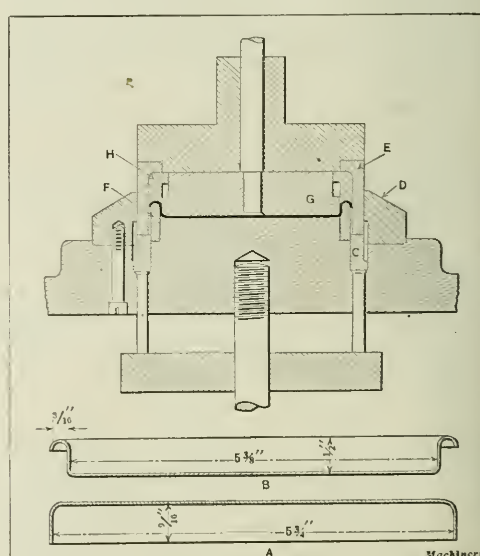


Fig. 2. Another Combination Die which produces a Canister Cover by the Inverted Method of drawing

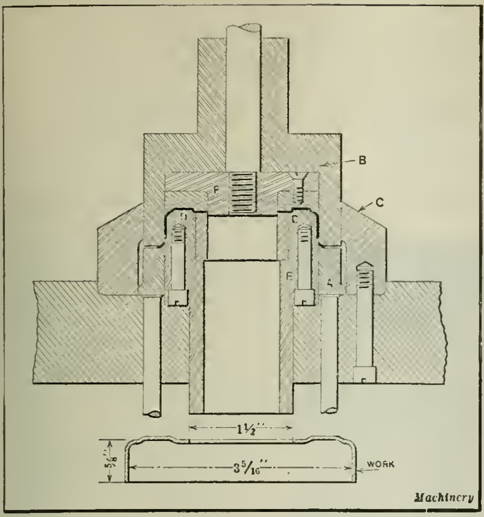


Fig. 3. Performing Blanking, Drawing, Trimming and Punching Operations in a Single Stroke of the Press

expand and cause ring *H* to eject the work from the punch. Ring *E* is secured to the punch-holder by means of machine screws. As indicated by the view of the work at *A*, the face of ring *E* projects 9/16 inch plus the thickness of the metal beyond pad *G*.

Die which Blanks, Draws, Punches, and Trims

Another interesting combination die is illustrated in Fig. 3. This die blanks, draws, punches the hole, and trims the lower edge of the part shown beneath the die, the material being 0.035-inch cold-rolled steel. Draw-ring *A* of this die serves in the same capacity as those on the dies previously discussed. The blank is cut as punch *B* enters ring *C*, and is drawn upon ring *D* as the punch continues to descend. During the lower portion of this stroke the bottom edge of the work is sheared off as the punch face passes the upper edge of die-sleeve *E* due to the outside diameter of the latter being the same as the internal diameter of the punch. As soon as this trimming step has been completed, section *F* comes in contact with the work and cuts the hole as the stroke of the ram is concluded.

Section *F* enters the die only a slight amount approximately equal to the thickness of the metal. If the section entered the hole much further, a perfectly round hole would not be obtained. The scrap from the operation falls through the die and an opening in the rubber buffer, which in this case is supported by two studs. Although the trimming step really consists of "pinching" off the metal rather than cutting it, the method has been satisfactory on metal up to 0.065 inch in thickness and is probably practical up to a thickness of 3/32 inch.

* * *

STANDARD PATTERN PRACTICE

Last year the American Society for Testing Materials requested the American Foundrymen's Association to sponsor an effort to standardize patterns, core-boxes, etc. A general committee was organized, consisting of two members from each of the following organizations: American Society for Testing Materials, Institute of Metals Division of the American Institute of Mining Engineers, Steel Founders' Society, American Malleable Castings Association, and the National Association of Pattern Manufacturers. Vaughan Reid of the City Pattern Works, Detroit, Mich., is chairman of the committee, and any suggestions on this subject will be welcome.

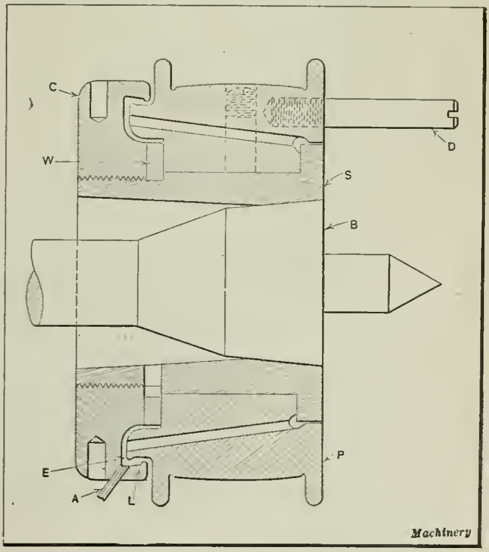
DEAD CENTER DRIVE FOR BENCH LATHE

The dead center drive shown in the accompanying illustration was designed to fill the need for an attachment not ordinarily included in the equipment of a bench lathe. Referring to the illustration, *S* is a hardened and ground sleeve made to fit over the tapered end of the hollow spindle of the lathe. This sleeve serves as a bearing for a light weight pulley *P* which may be made of cast iron but preferably of aluminum. The pulley is held securely between the flange on the sleeve and a hardened steel washer *W* which is tightened against a shoulder on the sleeve by the collar *C*.

In order to prevent oil from being thrown from the rims of the pulley, an oil-groove is cut into the corner which fits over the flange, and a series of holes drilled from the bottom of this groove, on an angle, so that centrifugal force will cause the oil to flow toward the collar *C*. The collar *C* is grooved in such a manner that a small lip *L* having a slight taper catches all the excess oil and allows it to drain off through a pipe *A* inserted at the bottom of the collar. The projection on the pulley, as shown in the illustration, enters the groove in the collar, and the holes through which the oil passes in the pulley break through in the projection so that oil which comes through them must be thrown from the lip *E* into the groove in the collar. Oil coming from the other end of the bearing is carried around the inner contour of the pulley projection and is thrown off lip *E* and caught by lip *L* in the same way.

The plug *B* takes the place of the draw-back collet and is threaded to suit the draw-back sleeve of the regular machine. The end of the plug is tapered to suit the taper in the sleeve. When the sleeve, pully, washer and collar assembly is placed over the end of the lathe spindle, the plug *B* is inserted and screwed into the draw-back sleeve. When the draw-back handwheel is turned up tight, the plug is drawn in so that the sleeve is firmly held on the spindle. The addition of a driving pin *D* in the pulley completes the attachment. Pin *D* should be slotted so that a screwdriver can be used to tighten it in the tapped hole in the pulley. Of course, an oil-hole is provided in the pulley which is plugged with a headless screw. The lathe center furnished with the machine may be used if desired, in which case it is driven into a tapered hole in the plug *B*. It is necessary to provide an extra pulley on the countershaft for driving the attachment pulley.

B. S.



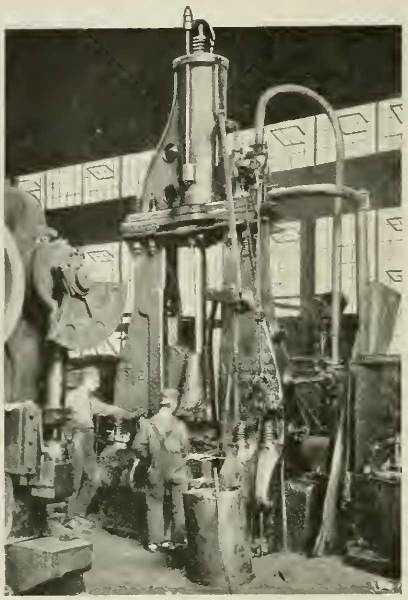
Dead Center Drive for Bench Lathe

Modern Drop-forging Practice

Trimming the Forgings—Forging Heats—Typical Examples of Drop-forging Work
Second of Two Articles

By FRED R. DANIELS

THE previous article on this subject published in November MACHINERY dealt with comparative characteristics of drop-forgings and castings, application, steels used for drop-forgings, and general methods of making drop-forgings. The present article takes up the trimming of the forgings and correct forging heats, and gives typical examples of drop-forging work.



Trimming the Forgings

After each operation has been performed on the drop-hammer, the flash, or surplus metal, must be trimmed from the forging, either while it is still hot or after it is cold. The percentage of metal lost by the trimming operation is necessarily great; the loss may be from 33 to 50 per cent, and is relatively greater on small work than on large forgings.

It seems to be best practice to use the cold-trimming process for small work. If a heavy geared press is used and the trimming dies are properly proportioned, rather large forgings can be trimmed cold, provided the flash is not excessively thick. On ordinary work where the design is not intricate, the flash should not be thicker than 1/16 inch, for cold-trimming, but on unusually large or intricate work the flash may be as thick as 3/16 or even 1/4 inch and still be cold-trimmed. A case where the formation of a thick flash seems unavoidable is the motor truck towing hook, the dies for which were illustrated in Fig. 9 of the article "Design and Making of Drop-forging Dies" published in September MACHINERY. The maintenance of a thin flash is, of course, the desirable condition.

Forgings which are to be cold-trimmed should first be pickled in a weak solution of sulphuric acid to remove the oxide scale. This practice will prolong the life of the cutting edge of the trimming dies. Drop-forgings, having a carbon content of 0.40 per cent or more should also be annealed before being trimmed.

For large work, the usual practice is to trim the forgings while hot. In fact, it is impossible to perform a cold-trimming operation on such parts as crankshafts. Whether the work should be trimmed hot or cold depends upon the steel used, the sizes of forgings produced, and the equipment available in the hammer shop. The question of cost is also a factor. Hot-trimming is more expensive than cold-trimming, because the drop-forger receives a higher rate of pay than the power press operator; an unskilled man, or even a boy, can operate a power press. Consequently, where it is practicable to make the trimming operation a separate one and trim cold, this should be done.

One reason that hot-trimming should not be done on comparatively small work, if it is possible to avoid it, is that the hammer man consumes so much time in transferring the forging to the hot-trimming dies and operating the press that the fires must be slowed down, and the entire cycle of operations is correspondingly affected. After the forgings have been hot-trimmed, they are usually placed in the finishing die again, and restruck to correct any distortions that may have been produced in the process of hot-trimming, and to remove irregularities at the parting line. In addition to this extra handling, it is necessary to crop off the sprue by means of which the forging is handled with the tongs. This may be done in a separate operation, after the forging is cold or it may be removed in the hot-trimming operation; in this case the forging is not restruck.

Hot-trimming dies will give much longer service, however, than cold-trimming dies. If the tools are properly hardened and drawn, they will last almost indefinitely, even though the steel from which they are made has 0.10 per cent less carbon content than that ordinarily used for cold trimmers. The design of the work to be trimmed and the composition of the steel from which the forging is made, rather than its size, affect the length of service of a cold-trimming die. On comparatively plain designs it is frequently possible to trim 20,000 parts without regrinding the cold trimming dies.

The process of drop-forging has been developed to a point where thousands of pieces are practically completed under the drop-hammer and require little or no further machining operations. As a cost-reducing method, drop-forging ranks high among metal-working processes. In the drop-forging plant itself, costs may be reduced by applying certain principles and methods making for economy—by selecting steel of the right quality, and by keeping dies and stock in such a manner that they are readily accessible and the required die and the right size and kind of steel may be easily located. Drop-forgings, when used in quantity, can sometimes be made as cheaply as castings, and are superior in strength. Actual costs are then reduced by employing them, because of the improved quality obtained at an equal price. Furthermore, a saving is usually made in the cost of machining, due to the fact that a drop-forging generally requires less finishing than a casting.

Forging Heat—Life of Dies

The determination of the proper heat to use in a forge furnace is under the general supervision of the forge foreman and is governed entirely by his experience. The pieces are placed on the hearth of the furnace by the furnace man,

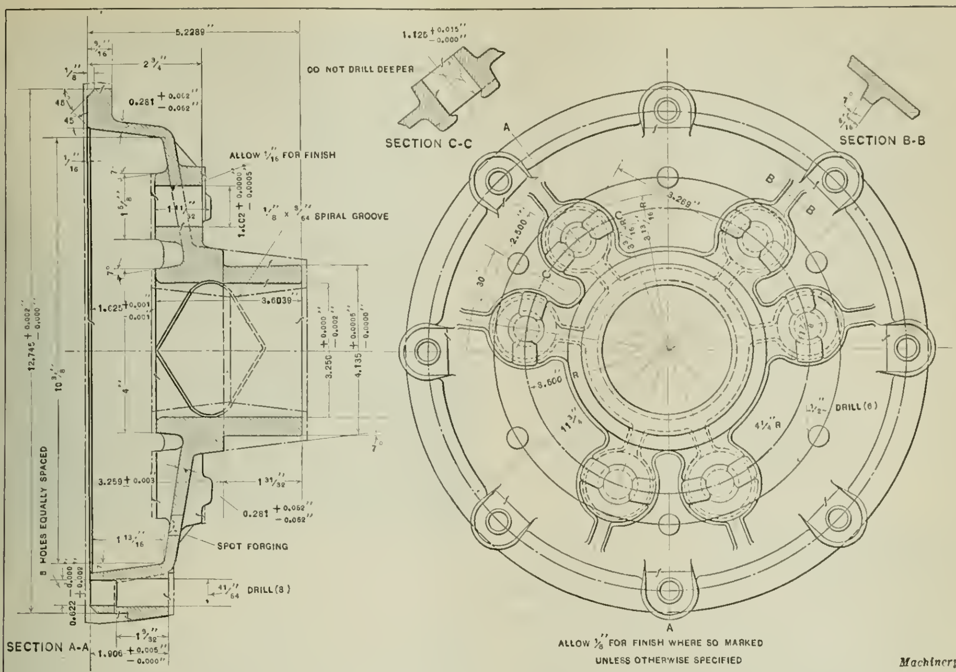


Fig. 1. Differential Gear-case for Motor Truck, which is produced by drop-forging

and arranged in a row with the tong-end protruding, in such order that they may be conveniently handled. If the forgings are made from bars, these are arranged on the furnace hearth in such a way that the one nearest to the hammer will always be the one to be withdrawn first and handed to the forger. After the forging has been made, the hammer man passes the remainder of the bar back to the furnace man, who places it at the head of the row and passes the next one on the opposite end to the hammer man. In this way, each bar will be heated equally, and there will be slight chance of the furnace man becoming confused and drawing a bar from the furnace before it has reached the proper forging temperature. On large work, which is hot-trimmed, three or more men constitute a gang instead of the two usually employed for handling small work, there being helpers in addition to the hammer man and furnace man. If the forgings are made from blanks cut to a predetermined size, there will not be room on the hearth for more than three, or possibly four of these at a time. These large blanks may be conveniently arranged to have the blank which is ready to be drawn nearest the hammer the same as in handling bars, or they may be reversed if the furnace man finds this to be handier.

The piece to be forged should be heated evenly throughout. There should be enough bars or blanks placed in the furnace at a time so that they will become thoroughly soaked with the heat before being withdrawn. If opposite ends of a large forging blank are unequally heated, the strength of the drop-forging is greatly lessened, and if this is frequently done, the dies will wear unevenly which will result not only in an inferior product, but may also lead to the hammer being seriously damaged. During the process of forging a quantity of parts, the impressions of the dies should be swabbed from time to time with crude oil to prevent the work from sticking in the impression.

If the forgings are of comparatively plain design and have no high or irregular projections, it is frequently possible to realize a production of 15,000 drop-forgings before it becomes necessary to resink the impressions. If the forgings are of rather intricate design, this quantity will probably not exceed 5000 forgings per impression. This data applies to dies having faces not greater than 14 inches square. Production on dies larger in face area than this, but of the same classification, will, of course, be proportionately less.

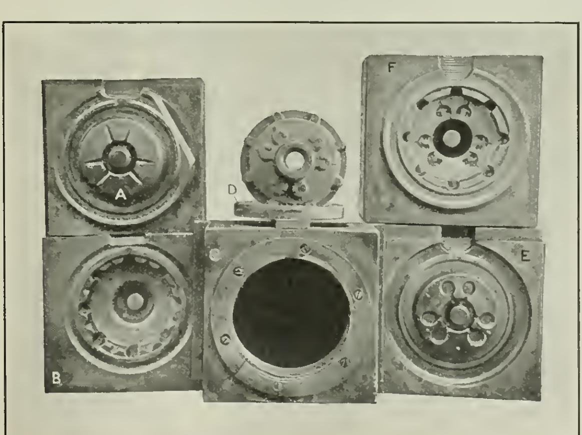


Fig. 2. Dies for producing the Differential Gear-case shown in Fig. 1

The life of drop-forging dies can be prolonged by working them while heated to a temperature between the hardening temperature of the die steel and the atmospheric temperature. Various methods may be used

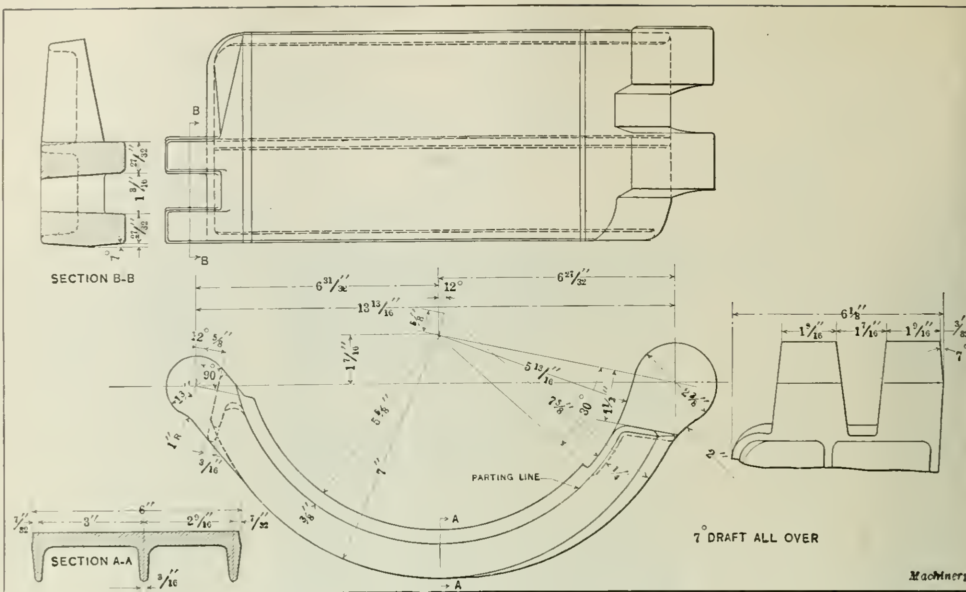


Fig. 3. Emergency Brake-shoe drop-forged from Low-carbon Steel

for heating the dies, one of which is to apply a jacket to the outside of the die-block, which is tightly packed with a suitable layer of infusible earth or fine molding sand, the packing being heated by the most convenient means available. For this purpose gas burners or an electric current may readily be utilized. Molten baths of lead or lead and tin alloy may be used if the die does not need to be heated over 600 degrees F., or use may be made of an oil bath if that is more convenient. For controlling the heat of the die-block, a heat-indicating instrument is set either into a recess in the block, into the packing, or in the bath.

For heating carbon steel blocks, the recommended temperatures vary between 300 and 1100 degrees F., but for certain grades of alloy steels, a higher temperature may be necessary, provided this is well below the hardening temperature. The heating temperature depends, of course, upon the composition of the die steel which can be determined from the manufacturers.

Straight carbon steels having a hardening temperature between 1400 and 1475 degrees F. will be given a high degree of resistance to wear if heated from 400 to 500 degrees F. while in use; and the lighter the falling weight of the drop-hammer (or the more easily the steel can be forged) the nearer can the lower limit—that is, 400 degrees F.—be approached. Dies made from alloy steels, such as chrome-nickel, carbon-chromium, chrome-vanadium, cobalt-chromium, tungsten or molybdenum require a considerably higher temperature than carbon steels. Heavy forging and trimming dies made of tungsten high-speed steel require a temperature of about 100 degrees F. which in some cases practically doubles the life of the dies, and for alloy die steels containing no tungsten a working temperature of about 850 degrees F. should be used.

Examples Illustrating Drop-forging Procedure

The automobile towing hook shown in Fig. 8 of the article "Design and Making of Drop-forging Dies," previously referred to, is made from a piece of 4- by 1¼-inch steel, 8 inches long, in two forging operations followed by a bending operation in an upsetter. The steel contains from 0.30 to 0.40 per cent carbon, and from 0.50 to 0.80 per cent manganese. On this job the waste of stock is great, the entire area between the arms being webbed before the trimming operation, in addition to carrying a heavy flash. The trimming operation could be performed cold, although the actual practice in manufacturing this hook is to trim it hot. This saves transporting the work to the cold-trimming department and back again to the upsetter for bending, which, of course, cannot be done until after the flash has been removed.

It is possible to produce parts such as wide yokes by drop-forging. In such work the die impressions are made so that the two arms of the yoke are parallel

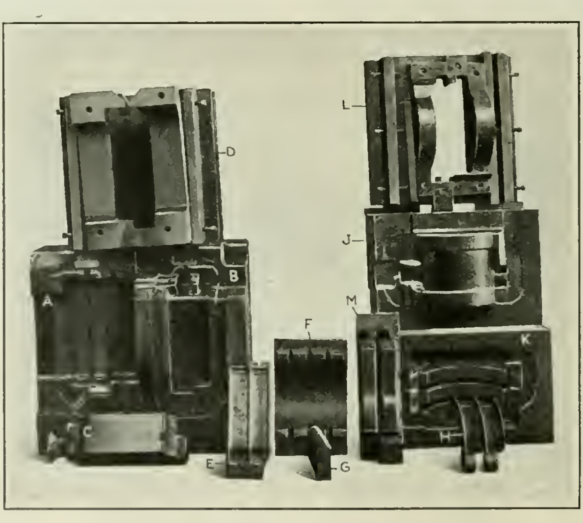


Fig. 4. Dies for Drop-forging the Brake-shoe shown in Fig. 3

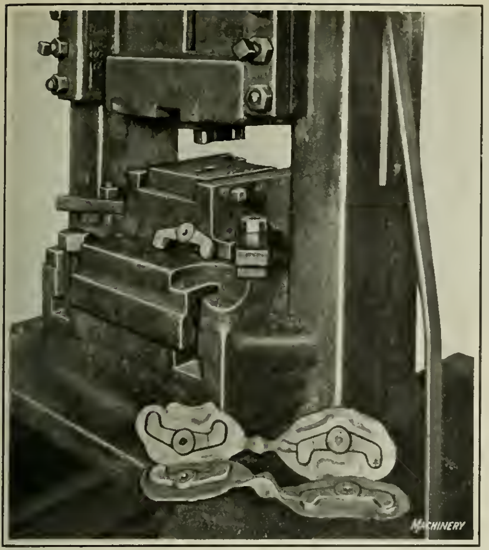


Fig. 5. Power Press equipped with Cold-trimming Dies

and close together; after the forging has been made from this impression, the arms are spread to the proper width, and if necessary, restruck in finishing dies. This permits a much smaller die-block to be used, and also enables the blank from which the yoke is to be forged to be of smaller size, which results in a considerable saving of material. This, in fact, is common forging practice, where the pieces are of such a nature that they can be drop-forged in one form and subsequently shaped to another by bending.

Another excellent example of drop-forging practice is that of the differential gear-case for a motor truck shown in Fig. 1. This illustration shows the rough forging on which there is 1/8 inch allowance for machining, wherever finish is required. The gear-case is made from a piece of open-hearth steel, 0.20 to 0.30 per cent carbon, high in manganese, the dimensions of the blank being 1 3/4 inches thick by 11 inches square. This piece, with its many bosses and projecting hub, shows the possibilities of the drop-forging process for producing parts that are of intricate shape.

Two operations are required to complete the job, exclusive of trimming. It is first blocked or broken down on a 5000-pound steam drop-hammer, and then after being reheated, is finish-forged in a 6000-pound steam drop-hammer. Both trimming operations are performed hot. The entire collection of dies, including trimmers and punches, is shown in Fig. 2. *A* and *B* are the upper and lower break-down dies, respectively, and *E* and *F* are the finishing dies. The trimming die is shown at *C*, and the punch (on which will be seen the finished forging) at *D*. The finishing dies are plug dies, designed to produce the hole in the hub. By employing this construction advantage is taken of the tendency for the hot metal to shoot up, in order to form the hub.

Still another example of what can be accomplished by drop-forging is shown in Fig. 3. This is a motor truck emergency brake-shoe, weighing 26 pounds. The forging is made from low-carbon open-hearth steel, and three operations are required to produce it. The blank from which it is made is 5 inches wide, 2 inches thick, and 15 inches long. It is first blanked, and then trimmed hot and bent, all these operations being done without reheating. The bending die is attached to the outside of the frame of the hot-trimming press, where the shear blades are ordinarily attached. The bending operation can then be done without much loss of time or heat. The forging is next reheated and finished in a double-impression die, after which the flash is trimmed hot. The blanking operation is done on a 3000-pound steam drop-hammer; the finishing on a 5000-pound steam drop-hammer; and the bending and trimming on a heavy back-geared press.

In Fig. 4 is shown the set of dies with which these machines are equipped to produce the brake-shoe. It will be noticed that the breakdown dies *A* and *B* are of comparatively plain design. The first-operation trimming die is shown at *D* and the punch at *C*. The drop-forging, as it comes from the first-operation trimmer, is shown at *E*, although the sprue has been knocked off the piece shown. The bending die *F* is a plain cradle member, and the bending punch *G* simply bears on the work at the center as it lies on the die *F*, contacting on the rounded end. The dies *J* and *K* produce the finished forging, which when trimmed by die *L* and punch *M* has the appearance shown at *H*.

Examples of Trimming Work

Examples of cold- and hot-trimming operations are shown in Figs. 5 and 6, respectively. The press shown in Fig. 5 is equipped with dies of the ordinary power-press type such as used for punching operations, although this type of die is not always used for cold-trimming. The function of the punch is simply to push the cold forging through the die opening, as in hot trimming. The small levers which are to be trimmed are made from open-hearth steel of low-carbon content and are shown in detail in Fig. 7. The forgings are produced in double-impression finishing dies, but the trimming must necessarily be performed singly, as will be understood by an inspection of the punch, the trimmed forging shown resting on the press, and the untrimmed work. The untrimmed forgings are likely to become bent at the gate, which makes it difficult to trim both parts simultaneously.

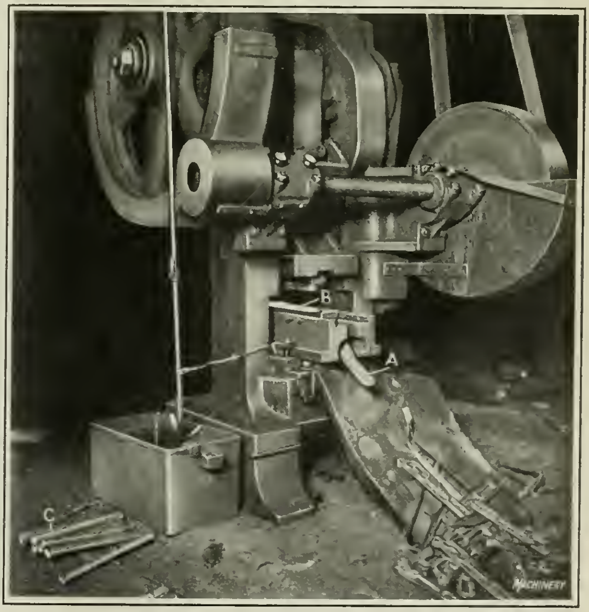


Fig. 6. Geared Press engaged in a Hot-trimming Operation

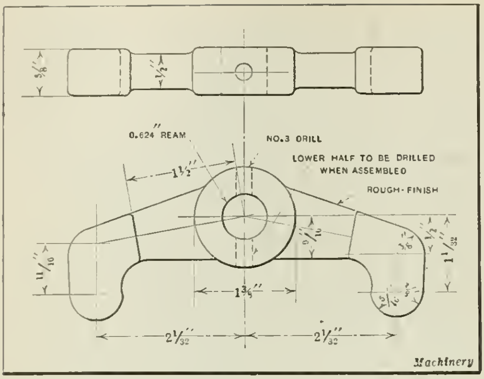


Fig. 7. Drop-forging trimmed with the Equipment shown in Fig. 5

In Fig. 6. a hot-trimming operation is shown in process and the work being trimmed is a small carbon-steel forging. The illustration shows the hot drop-forging *A*, with the flash removed, after being pressed through the die opening, and an untrimmed forging *B* resting in the die opening. There are also a number of trimmed pieces shown lying on the floor. This drop-forging is a latch cylinder locking link for railroad switch work, and is made from open hearth steel, 0.15 to 0.20 per cent carbon. The size of the blank is 1⅝ inches in diameter, and 18 inches long. A number of these blanks, which are cropped from regular bar stock, are shown lying on the floor at *C*, preparatory to being heated.

MACHINERY is indebted to the Union Switch & Signal Co., Swissvale, Pa., and to J. H. Williams & Co., Brooklyn, N. Y., for much of the information contained in this article. The concluding installment of this series of articles will describe modern drop-forge plant heat-treating equipment, heat-treating processes, and types of furnaces and fuels suitable for this work.

* * *

DELAMATER-ERICSSON MEMORIAL TABLETS

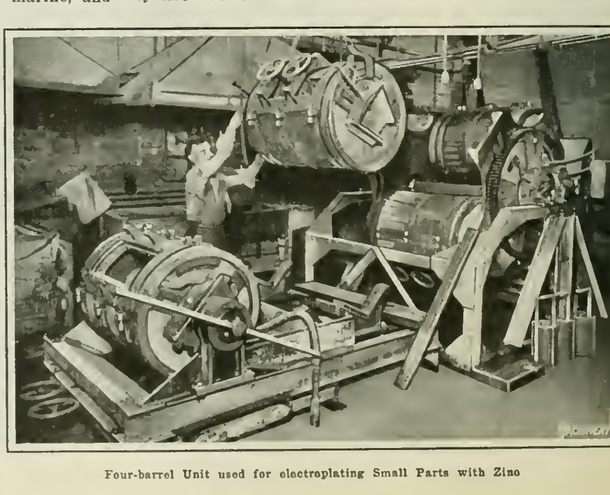
On March 9, 1922, which will be the sixtieth anniversary of the battle of the *Monitor* and *Merrimac* at Hampton Roads, Va., which demonstrated the merits of the turret battleship, invented and designed by Captain John Ericsson, tablets will be unveiled at four different places in New York City to commemorate the work of Cornelius DeLamater and Captain John Ericsson, who for fifty years—from 1839 to 1889—were pioneers in developing the naval, marine, and industrial interests of this country, and who at the time of the Civil War, without thought of personal reward, turned their mental and financial resources to account and applied their energy and experience to accomplishing what the Government had failed to do. One of the tablets will be erected where the Phoenix Foundry was located, at 260 West St., where the first iron boats in this country were built and where John Ericsson first introduced screw propellers for river and ocean steamers. A second tablet will be erected at the DeLamater Iron Works, at the foot of W. 13th St., where the first self-propelled torpedo, the first torpedo boat, the first submarine boat, and the engines for the original *Monitor* were built. A third tablet will be erected at the Continental Iron Works, Greenpoint, Brooklyn, where the hull of the original *Monitor* was built; and a fourth tablet will be placed at 36 Beach St., where Captain John Ericsson worked, lived, and died.

ZINC ELECTROPLATING UNIT

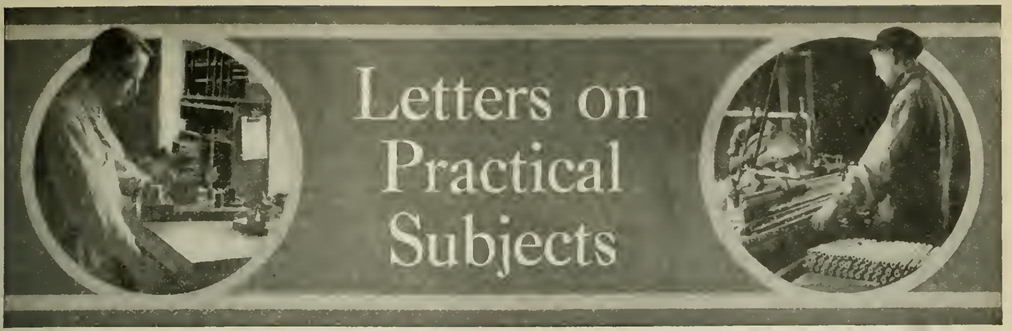
Confronted with the problem of increasing the output of zinc-plated parts used in electric controlling devices, the Cutler-Hammer Mfg. Co., Milwaukee, Wis., developed and patented the electroplating unit shown in the accompanying illustration. The apparatus consists mainly of a structural steel frame and a rotating member on this frame in which four wooden barrels are mounted. These barrels are filled with the zinc solution and the parts to be plated. They are stationary on their own axes, but, of course, revolve with their supporting member. The latter is driven by a 1-horsepower motor through two gear reductions, the first of which is a worm and worm-wheel, and the second a spur pinion and gear. The barrels are turned at the rate of three and one-half revolutions per minute. The electric current connections to the solution in the barrels are made by means of the V-shaped castings on their ends, these castings being copper-faced. The placing of a barrel into position in the carrier automatically makes the electrical connections.

It has been found desirable not to load and unload the four barrels at one time, but rather to replace one, run the machine a certain period, replace another, and so on. An extra barrel is provided so that little time is lost in changing barrels, the change being effected in one and one-half minutes. Each barrel remains on the apparatus for forty minutes, and as there are four barrels, this requires the changing of a barrel every ten minutes. During the removal and replacement of a barrel the current is not cut off from the other barrels; therefore, the plating is continuous. When a barrel is removed, it is placed on supports over an open bin at the left of the unit, and then the barrel with the unplated parts, which has been resting on vees at the front end of the bin structure, is lifted into place. An air hoist is employed to facilitate the shifting of the barrels.

After the apparatus has again been started, the operator removes the cover from the barrel over the bin and then revolves this barrel about 180 degrees so as to permit its contents to drop into the bin. Screens at the bottom of the latter allow the solution to drain off, after which the parts are dumped into suitable receptacles. The drained solution is used over again. When the barrel is empty, it is placed on the vees, filled with unplated parts and the plating solution, and after the cover is replaced, it is ready to be mounted on the apparatus once more. Approximately 300 pounds of parts can be loaded into a barrel, and so an average production of 6 tons per nine-hour day is obtained. The barrels are about 30 inches long and 24 inches in diameter. They are made of oak timber, and are secured on the unit by hook bolts. O. L. J.



Four-barrel Unit used for electroplating Small Parts with Zinc

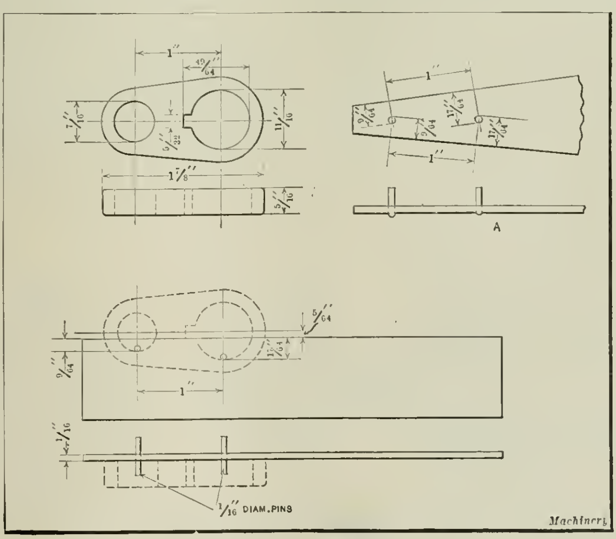


TEMPLET FOR LAYING OUT KEYWAYS

The accompanying illustration shows a templet that may be used advantageously for laying out keyways which must be symmetrical relative to a center line. A typical example of work on which a templet of this kind may be used is shown in the upper left-hand corner of the illustration. Ordinarily, in laying out the center line in tapered pieces such as this, considerable trouble is experienced, it being necessary to use plugs and resort to considerable calculation if a templet is not used. For accurate work, the outside of the part is seldom suitable to use as a locating surface.

The templet used for laying out the keyway in the work, and its method of application are shown in the lower part of the illustration. The templet is made from a strip of 1/16-inch sheet steel, in which two 1/16-inch pins are assembled. In laying out the centers of these pins, it is only necessary to locate from one edge of the templet, and make the center distance equal to the center distance of the holes in the work. The only calculations required are those for obtaining the 9/64- and 17/64-inch dimensions. It will be seen that these are the differences between the radii of the two holes in the work and one-half the width of the keyway. For example, 11/32 — 5/64 = 17/64 inch.

In use, the templet is placed on the work, as shown, so that the pins will seat snugly in the lowest part of the bores, and it is held in this position while a line is scribed along the upper edge of the templet to locate the lower side of the keyway. The pins in the jig project equally on each side of the 1/16-inch plate, so that by turning the templet over it may again be used for locating the other side of the keyway, the pins then being diametrically opposite the position occupied when scribing the first side of the keyway. After these two parallel lines have been scribed, an 11/64-inch plug is inserted in the hole and a strip of steel, 5/64 inch thick, is laid tangent to it and perpendicular to the center line, so as to furnish an approximate location for scribing the depth to which the keyway is to be cut.



Templet for laying out Keyways in Work which does not have Parallel Side

Perhaps the greatest time-saving feature of this simple templet is the provision for using both sides by simply permitting the pins to extend through the plate. Referring to the view at *A*, it will be seen that if this method of assembling the pins is not followed, a tapered templet is required so that the pins may be located perpendicularly and equidistant from both angular sides. The calculations involved in laying out the center distance of the templet would also be more complicated. A templet of the type described will be found to effect a considerable saving in time in laying out a keyway, as it requires only about thirty seconds per piece.

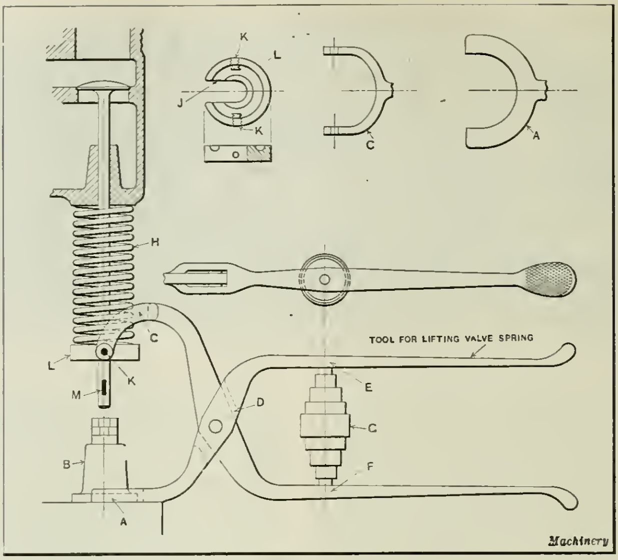
Wilkinsburg, Pa. WILLIAM S. ROWELL

TOOL FOR LIFTING ENGINE VALVE SPRINGS

The valve spring lifter shown in the accompanying illustration has proved useful in removing the valves from gasoline engines. It is easily made and differs somewhat from the conventional type of valve spring lifter, which is often found to be more cumbersome than convenient. The tool consists of a pair of tongs, the two halves of which are forged from steel. A fork *A*, which will straddle the valve tappet guide *B*, is forged at the end of one member. The other member is also made with a forked end *C*. It will be clearly seen from the illustration that this half, owing to the forked end, will not pass through the slot at *D*, and must therefore be made in two pieces and welded after the tongs are riveted together. After assembling, the handles are filed and checked at the ends as indicated in the illustration.

Pins are fitted into the handles at *E* and *F* which position the spring *G*. A steel pad *L*, grooved to fit the end of the valve spring *H*, and slotted as shown at *J* in the detail view, is placed in fork *C*, where it is held by two pins *K* which allow it to swivel. To remove a valve it is only necessary to compress the handles and insert the tongs under the valve spring H as indicated. When the handles are released, spring G causes the tong ends to be forced apart, thus compressing spring H. This permits the valve cotter-pin M to be easily removed, as both of the workman's hands are left free for this work. By assembling pad L in the fork so that it can swivel, it will automatically align itself with the valve spring H, so that there is no danger of the tongs slipping or flying out of position due to the pressure exerted by the spring. It is a simple matter to release the tongs and remove the valve spring after the cotter-pin has been removed. By the use of this tool, valves can be quickly and conveniently removed.

Cleveland, Ohio C. F. GEORGE



Tool for lifting Valve Spring to permit Removal of Valve

WORK-HOLDER FOR THREAD-MILLING OPERATION

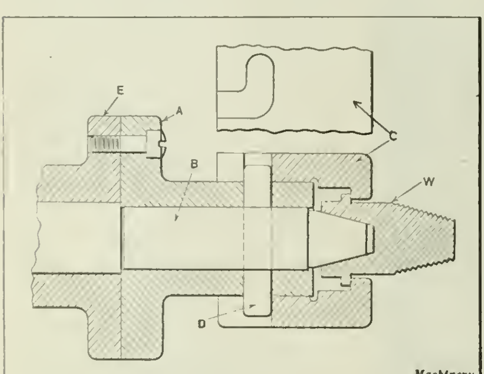
The work-holder described in the following was designed as a special holding means for the brass plug W which is shown located in the holder in the accompanying illustration. The operation performed on this brass plug was the milling of taper threads, the holder being attached to a thread-milling machine, although the design lends itself to application to other machines. In the present installation it was impossible to make use of the tail-center as a support, so that other means had to be employed to chuck the work securely. Consequently in the design of this special holder advantage was taken of the surfaces which were previously finished true with the portion on which the threads were to be milled, and these surfaces are those by which the work is shown located in the illustration.

The spindle of the thread-milling machine is indicated at E, and the adapter or body of the holder, which is attached to the spindle by means of fillister-head screws, at A. This adapter extends out from the head of the machine a sufficient distance to to allow clearance for the operation of the cutter-head of the machine. The construction also provides a rigid support for the tapered plug B which locates and helps to drive the work. Pin D is a driving fit in the adapter and plug, and holds them together. The projecting ends of this pin form lugs which engage bayonet lock slots in ring C. By this construction the locking ring C can be readily slipped in place, and brought up against the collar on the work, a slight turn securely holding it on the tapered end of plug B. The bayonet lock slots in which pin D engages are so machined that they have a slight angle relative to the face of the ring, and so enable the ring to be drawn in and securely bind on the collar of the brass plugs W. All that is necessary, then, in chucking work with this special holder is to first place the work on plug B and slip the locking ring over the work until the slots engage the ends of pin D, after which by a slight rotation of the ring, the work is securely held by the pressure exerted on the flange of the work.

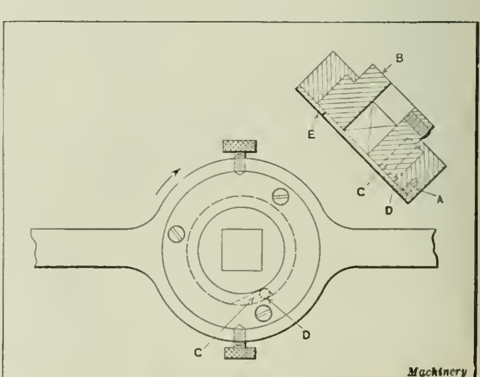
B. S.

REAMER WRENCH

There is a tendency for boys and semi-skilled men, especially if they have ever performed any hand-tapping work, to back a reamer out of a finished hole the same as they would a tap. It is, of course, known to all mechanics that a reamer should be rotated in the same direction, both in reaming the hole and in withdrawing the reamer from the work. If this is not done, the reamer quickly becomes dull, and the surface which has just been finished is likely to become scratched. A reamer wrench which was designed to prevent this occurrence, and which is extremely simple in construction consists of a die-stock in which a suitable



Work-holder for Thread-milling Operation



Slip Wrench for Hand Reaming

holder A is held by means of two thumb-screws. The holder is bored to fit a bushing B which is provided with a square hole for about two-thirds of its length and with a round hole for the remainder, so that it may fit the end of the hand reamer. The reamer is secured in bushing B by a headless set-screw. The periphery of the bushing contains a tangential slot C which is milled to a sufficient radial depth so that roller D may be housed between the bushing and the holder A and be free to revolve when located in the deepest part of this cut-out. The holder is provided with a plate E, screwed to the face to hold the parts together. The wrench is designed to operate similarly to a roller clutch, it being at once evident that after the wrench has been slipped over the end of the reamer and the set-screw which holds it to the shank tightened, rotation in a clockwise direction will cause the roller to bind in holder A and drive the reamer; also, reversal of direction of rotation will result in the roller becoming pocketed in the cut-out section of holder A and thus prevent movement of the reamer. The device is simple and fool-proof, it being absolutely impossible to back the reamer out of the hole when roller D is not wedged against the bore in the holder.

Rosemount, Montreal, Canada — HARRY MOORE

PATTERN CORRECTIONS

While it is impossible for the patternmaker to foresee all the difficulties that the molder may encounter, it should, nevertheless, be possible to minimize these difficulties by encouraging closer cooperation between the molder and patternmaker. An effective method of promoting such cooperation, even when the foundry is situated at a considerable distance from the pattern shop or even in another city, is to see that all pattern changes made at the foundry, and all reasonable suggestions that the molder can make to improve each pattern, be recorded on the pattern drawing and given to the patternmaker. By this practice the patternmaker will obtain a more intimate knowledge of actual foundry practice, and as a result, be able to construct better and more practical patterns. Where this practice has been followed, excellent results have been obtained, and the possibility of making the same mistake twice is eliminated.

Kenosha, Wis. — M. E. DUGGAN

DIMENSIONING SPLINE MILLING CUTTERS

Cutters used for milling splines must be very accurate in order to yield the required results. To furnish a toolmaker with dimension A, at the left in Fig. 1, and the included angle of the cutter teeth is not sufficient, since the usual gaging equipment does not make it possible to measure these accurately. The simplest way for a toolmaker to measure the cutter teeth is to use a vernier gear-tooth caliper and work to dimensions B and C, these dimensions being, respectively, the greatest width and depth that the cutter mills to. The method of computing these figures trigonometrically will be given in the following. As a check on the calculations it is advisable to lay out half a spline and space as shown in Fig. 2, either ten or twenty times actual size.

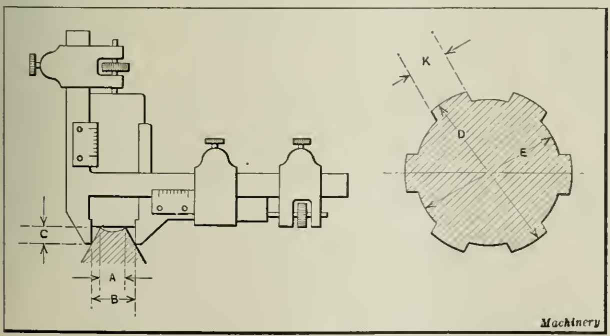


Fig. 1. Dimensions which should be furnished on Drawings of Spline Milling Cutter, and Part to be milled

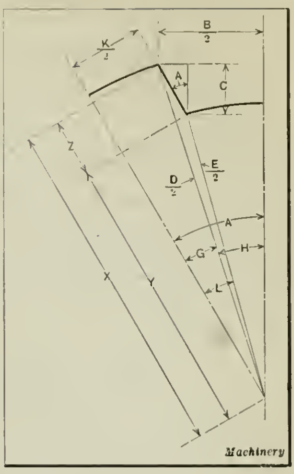


Fig. 2. Diagram used in computing Dimensions B and C, Fig. 1

From reference to Fig. 2 it will be evident that if N = the number of splines to be cut on a part, $A = 360 \div 2N$. Also,

$$\sin G = \frac{K}{D},\ \sin L = \frac{K}{E},\ \text{and}\ H = A - G.\ \text{Therefore,}$$

$$B = D \sin H.\ \text{Again,}\ X = \frac{D}{2} \cos G,\ Y = \frac{E}{2} \cos L,\ \text{and}$$

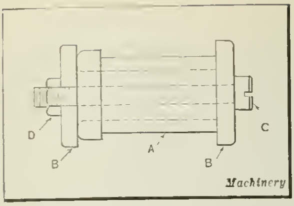
$Z = X - Y$. Thus, $C = Z \cos A$. While this computation involves a little more work for the drafting-room, it will be much appreciated as a time-saver by the toolmaker. The data given on the drawing of the part for which a cutter is intended should consist of the dimensions D, E, and K, on the sectional view shown at the right in Fig. 1, and the number of splines.

Detroit, Mich. — H. P. LOSELY

SHRINKING DRILL BUSHINGS TO DECREASE SIZE OF HOLE

Every toolmaker has undoubtedly had the misfortune to grind or lap the holes in a set of drill bushings to a size larger than was intended. In most cases this means that new bushings must be made to replace the ones having over-size holes. This, of course, results in a loss of time and material. The general procedure in making a drill bushing is to drill, and ream or bore out the hole; then rough-turn the outside diameter. The bushing is next hardened and put through a grinding and lapping process, which usually consists of first lapping the hole and then grinding or lapping the outside to the right size, care being taken to keep the outside concentric with the finished hole. If it should happen that too much stock is removed during the inside grinding or lapping operation, and this is discovered before the final outside finishing operation is performed, there is still a way to save the work if the error is within reasonable limits.

The method is to shrink the bushing to a size which will permit the grinding and lapping tools to be used again for finishing the hole to the correct size. The accompanying illustration shows the method of preparing the bushing for the shrinking operation. The bushing A is covered at both ends with thick washers B, which are tightly clamped to the ends of the bushing by means of screw C and nut D. The whole assembly is next brought to a red heat and then plunged in a cold bath. The cooling liquid is prevented from entering the hole in the bushing by the



Drill Bushing Ready for Shrinking

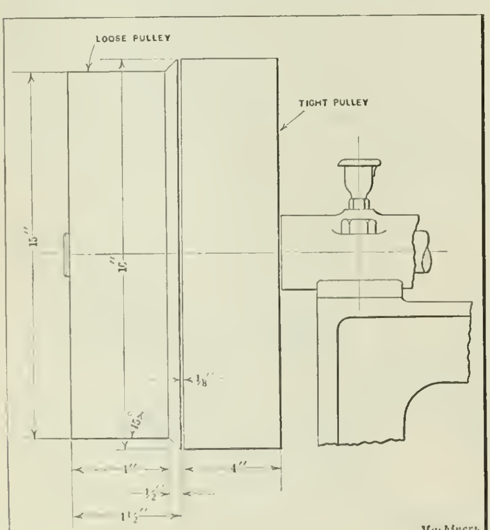
washers. As a result, the inner portion of the bushing shell, while still hot and soft, is contracted by the outer portion of the shell which is more quickly cooled and contracted by the cooling liquid. If required, this operation can be repeated, but the washers must be tightened each time. Bushings 1/4 inch in diameter and up may be shrunk in this way so that the holes will be 0.002 inch smaller in diameter.

New York City C. G. Youngquist

LOOSE PULLEY DESIGN

Belt-driven machines equipped with loose pulleys are seldom in operation all the time that the power is on. Under the most favorable conditions of continuous production, the idle time of the machine is usually in excess of 10 per cent of the total working day. Certain machines, which, from the nature of the operation, must be frequently stopped and started, are often idle 50 per cent of the working day. Under the best conditions, then, the drive belts of nearly all machines are running on the loose pulleys for a considerable part of every day.

Loose pulleys have long been recognized as necessary evils. Their bearings run hot, wear bell-mouthed, and quickly become a loose fit on the shaft. They are difficult to oil, and are generally avoided when an installation will bear the expense of a good friction clutch. A few manufacturers, recognizing these troubles, have adopted the pulley design shown in the accompanying illustration. It has the advantage of relieving the belt tension while the belt is on the loose pulley, thereby saving, not only the belt, but the bearing as well. The bearing pressure is lowered to such an extent that overheating is rare with this type of pulley, and the oil film is more readily maintained. A reduction in diameter of the loose pulley of 1 inch ordinarily reduces the belt tension about 150 pounds per square inch for a 25-foot belt. The resulting bearing pressure is usually low enough to permit the use of the so-called "oil-less" bushings of impregnated wood on pulleys which have previously been considered to be subjected to too severe service for this type of bushing.



Loose Pulley Design that relieves Tension on Belt

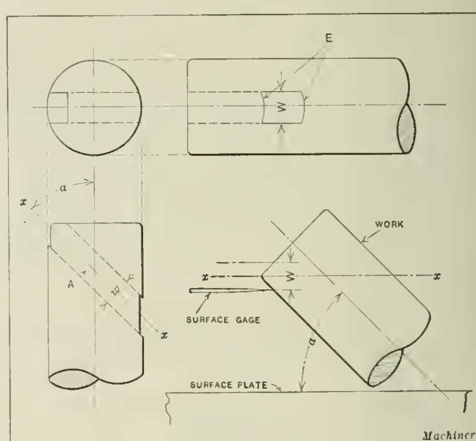
The difficulty of belt shifting is but little greater with this type of pulley than with straight-faced pulleys of equal diameter. To aid in shifting the belt, the conical portion of the pulley face should be inclined at an angle not greater than 45 degrees. Some designers use angles as small as 30 degrees, but the difference is hardly noticeable. The increased pulley face necessary to procure the lesser angle is not warranted by the results.

The loose pulley here described and illustrated is not new. It has been used for many years on the Universal Winding Co.'s machines and doubtless on many machine tools. Its adoption, however, has not been as general as its good features would seem to justify. A reminder of its purpose may result in its more general use on many machines now equipped with loose pulleys of the regular type, and thereby eliminate much of the trouble common to this type.

Philadelphia, Pa. John L. Alden

FILING SQUARE HOLES IN BORING-BARS

When a square hole such as indicated in the accompanying illustration at *A* is required in a round boring-bar for



Method of filing a Square Hole in a Round Boring-bar

the purpose of holding a square tool bit at an angle with the axis of the bar, it becomes necessary to file the hole square by hand if a slotter or some other suitable machine is not available. In filing holes or slots of this kind where the holes are held at an angle *a* with the axis of the bar, unsatisfactory hit-and-miss methods of procedure are often employed which can be eliminated if proper guide lines are scribed.

The view in the lower right-hand corner shows how the elliptic guide lines *E* can be easily scribed. Clamp the work to an angle-plate, with the axis x–x of the hole for the tool bit held horizontal and parallel to the face of the surface plate. Next set the scribing point of the surface gage at a point 1/2 W below axis x–x and scribe the lower lines. The scribing point should then be set at a distance of 1/2 W above axis x–x and the upper lines scribed in a similar manner. Care should be taken to keep the base of the surface gage in contact with the surface plate while scribing the lines. It will be noted that the upper line, in one instance, will be scribed on the end of the bar, while the lines on the opposite side will be located as shown at *E* in the upper view.

Cincinnati, Ohio J. F. Thornton

Industrial Conditions in Germany

From MACHINERY'S Special Correspondent

Berlin, November 9

GERMANY today presents a picture of millions of people working hard in consequence of the peace treaty and the London ultimatum, apparently with the aim of building up a great German market in competition with all other manufacturing countries. This aim is being realized due to the trade advantages offered by the continual lowering of the exchange value of the mark, which is seriously hampering the industries of surrounding countries and aiding the disposal of German-made products. In Holland there is practically no industry that is not suffering greatly because of the impossibility of competing with German manufacturers, and in some cases, notably in the machine-building line, the very existence of the industries is threatened. The number of working hours per week is generally less than in Germany, while the wages of employes are approximately three times as much. Recently the Dutch Indian colonies ordered materials for bridge and railway construction from German dealers. Conditions in Belgium and Switzerland are the same as in Holland. Swiss exports have dropped to one-half what they were a year ago, the watch, machine, and metal industries being particularly affected.

Italian and Russian Trade Relations

The Italian Government, in order to protect home manufacturers, has adopted a new high tariff. Of especial interest to machine tool builders is the fact that the tariff on machines weighing less than 10 meter-quintals (about 2200 pounds) is now 268 lire per meter-quintal (about 5 cents per pound, present exchange) instead of 9 lire per meter-quintal (about 0.17 cent per pound) as has been the case until recently. This increased tariff appears, at the present writing, to have put an end to German competition in Italy.

Arrangements made by the German Government with Soviet Russia have greatly improved business relations with that country. During 1920, Germany ranked second to Sweden in exports to Russia, but now Germany shows the strongest gains in that trade. Russian dealers and German manufacturers are cooperating to promote business between the two countries.

General Business Conditions

The manufacture of machine tools for home consumption is considerably less than for the export trade, although domestic demands have been satisfactory. Plants in the machine-building industries have orders for their products for months to come. However, production has been hindered by an insufficient supply of coal. American firms offered coal in September at 850 marks per ton F.O.B. Hamburg, while English coal was offered at 520 to 550 marks per ton F.O.B. Berlin. Iron and steel, automobile and railway car plants are all busy. Locomotive builders have sufficient work to last until January 1, but it is said that no orders are in prospect for completion after that date. It has also been reported that German locomotive builders have been underbid in South American countries by American concerns who also are able to extend credits for a longer period of time. Precision machines, optical goods and cameras are especially in demand in some countries.

Among the leading machine tool builders in Germany should be mentioned Ludw. Loewe & Co., Berlin, which firm has modernly equipped shops, and produces machinery well known not only in Germany but generally in the world's markets. This company is at present employing about 2600 workmen and 600 office employes. The plant has 3900 machines running, two-thirds of which are of the Loewe Co.'s own make. The total number of machines built in a year by the company is about 1600, and during the past year it declared a dividend of 24 per cent. Other plants reported as fully occupied are the Schubert & Salzer Ltd. of Chemnitz, which company paid 25 per cent dividends last year. The Wotanwerke Ltd. of Leipzig, specializing in shapers, paid dividends of 40 per cent, and the R. Stock & Co., Ltd. of Berlin-Marienfelde, twist drill manufacturers, have paid in the last three years, 25, 15 and 25 per cent dividends, respectively.

Owing to the large amount of business being done, the dividends paid out by machine tool builders generally vary from 8 to 25 per cent. Many concerns have increased their capital and some firms are combining their sales organizations. The Association of German Machine Tool Dealers has united with the Berlin Tools and Machine Tools Trade. In former days some antagonism existed between these two societies. The total amount of machine tools exported in 1920 reached 949,212 meter-quintals (about 104,632 tons) and was valued at 1,325,093,000 marks (about $5,300,400). About 190,500 meter-quintals were exported to Holland, 136,700 to France, 117,600 to Switzerland, 75,500 to Italy, 74,500 to Belgium, and 16,200 to Great Britain. The imports of metal-working machinery into Germany during the same year amounted to 10,105 meter-quintals (about 1115 tons).

The Labor Situation

Labor conditions have improved considerably. While the unemployed on the first of August amounted to about 358,000 workmen, this number was reduced to about 232,000 by September 1. There have been several strikes that interfered with regular production, but most of these have been settled without much difficulty. In a Dresden metal-working establishment a strike affecting 6000 workmen and lasting five weeks resulted in a failure for the employes. During that period the unions suffered a weekly loss of 5,200,000 marks (about $21,000) and the manufacturers, 65,000,000 marks ($260,000).

The Aluminum Industry

Experiments conducted during the war showed that aluminum could be obtained not only from pure clay, but from many inferior grades subjected to certain treatment. As a consequence the aluminum industry has been developed extensively in southern Germany where hydro-electric power is used in its production. Prior to the war the output of aluminum amounted to around 800 metric tons annually, while it is now about 32,800 metric tons.

Influence on Industry of Recent Fairs

The vast importance of the Leipzig fair is shown by the fact that more than 2,000,000 workmen are now occupied in filling orders obtained at this exhibit. The recent automobile exhibition in Berlin has also resulted in sales reaching into billions of marks. Some concerns received orders for more than 200 cars, and Belgian and Dutch dealers endeavored to reserve for themselves the entire production of a number of concerns. This industry employs about 150,000 workmen, and the total exports in 1920 amounted to between 21,000 and 22,000 cars and motorcycles.

Hanson-Whitney Semi-automatic Universal Thread Milling Machine

THE production of threads by milling has developed rapidly since 1900, and the single-cutter thread milling machine has become a standard tool, especially for external threads. Although the single-cutter type of thread milling machine has been used to a certain extent for internal work, it has not become as universal as the machine employed for milling screws. Even before the time mentioned, threads were made on gun work by a hob milling process; that is, a hob having concentric teeth corresponding in pitch with the screw to be milled was used in conjunction with a suitable lead-screw, and the screw was finished by setting the hob to the proper depth in the work and then feeding it endwise by means of the lead-screw; when the work had made one revolution, a thread was completed which was fairly accurate. There have been several developments along this line for such work as tap making and for cutting short threads on automobile parts, and also in places where a short thread only is wanted. Special machines have been made for internal as well as for external work.

The Hanson-Whitney Machine Co., Hartford, Conn., has produced a semi-automatic universal thread milling machine, designed to meet various conditions and to produce work of different types having external or internal threads especially when large quantities are required. Figs. 1 and 2 show front and rear views of this machine, which is of a very rigid design. The spindle is of a hollow type, and has a capacity for holding work up to 2 inches in diameter, but different headstocks can be used for larger diameters when necessary, and special holding devices are easily supplied to meet requirements. The illustrations show the machine with an ordinary cutting head, used especially for external work which can be held either between centers or in a chuck. Where the work is long and large in diameter, centers are used, and with the rapid adjustable footstock it is possible to hold the work very rigid.

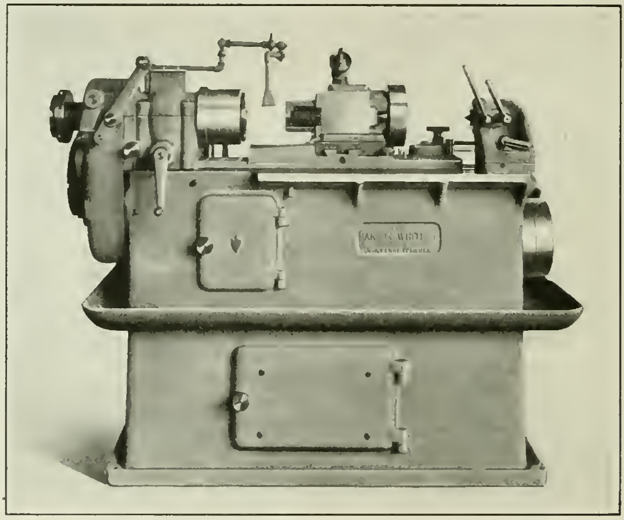


Fig. 1. Hanson-Whitney Semi-automatic Universal Thread Milling Machine

Operation of the Machine

The machine is partly automatic. The operator puts the work in the chuck and presses the button shown in front of the headstock; the carriage carrying the hob advances rapidly toward the headstock and then crosswise toward the work. When the hob almost touches the work, the motion is automatically changed to a proper feed motion; the spindle is revolving and the hob advances to the depth of the thread, and when the depth has been reached, the hob stays in the same position radially and advances according to the pitch desired. When cutting a right-hand thread, the hob moves axially away from the spindle, and when cutting a left-hand thread it advances axially toward the spindle. After the work has made a little more than one revolution, the hob automatically recedes a little more than the depth of the thread and traverses toward the tailstock a distance of about 3½ inches, leaving the work entirely free; then the machine stops automatically. The operator next releases the work and puts in another piece, and the machine repeats the sequence of operations. For internal work the hob has no outer support, but the process is the same. The hob automatically enters the hole, then feeds in to the proper depth; the work makes a little more than one revolution, the hob recedes, and traverses out of the hole, and the machine stops ready for the next piece of work to be milled.

General Features of Construction

Taper threads can also be produced by using taper hobs, and a compensating device can be employed for the taper desired. The capacity of the machine is for external diameters from 5 inches to ⅜ inch, and for internal diameters from 5 inches to 1 inch. All parts are well protected and well lubricated, and the slides are exceptionally long. The hob always rotates in the same direction whether machining internal or external work, or left- or right-hand threads. The direction is such that the hob tends to press the carriage down into the bed instead of lifting it. This prevents chatter, and is considered the principal reason for the smoothness of the work. On the right-hand end of the carriage, as shown in Fig. 1, is a knob handle by which the carriage can be adjusted longitudinally relative to the work. On the front of the headstock is a crank which can be used to operate the machine by hand when setting it up. Above the cutter-head there is a screw with a dial for adjusting the hob to the proper depth. The lead is controlled by a cam, and for different leads different sections are introduced into the cam. The cam is very accessible, being located behind the door on the upper part of the machine in the front. There are very few gears in the machine, and as the cams are cut with extreme accuracy, the lead of the milled thread is very accurate, especially when using a hob that has been finished after hardening. The lower door on the front has a tank attached to it for cutting lubricant, and the work is constantly flooded from a pump running at a constant speed.

Speeds and Feeds

The machine is driven by a single belt, and no slippage can take place that will alter the relation of the hob and the work. At the left in Fig. 2 is shown the speed-box for the hob, by means of which six speeds are obtained. At the right is another gear-box for the feed, and there are twelve feeds for each speed. This gear-box also includes the "hurry-up" motion, which is constant and is used for bringing the hob into engagement with the work, and also for withdrawing the hob. On the end of the machine there is a tappet disk which controls the slow and the fast feed. The slow feed, used while milling, is variable according to the material and diameter of the work. Where the thread is interrupted, as on a tap, the proper number of tappets may be applied to the disk, causing the spindle to move faster when crossing the flute, which saves considerable time, especially on taps of large diameter. All bearings in the transmission run in oil, and as ball bearings are used, very little power is required to run the machine.

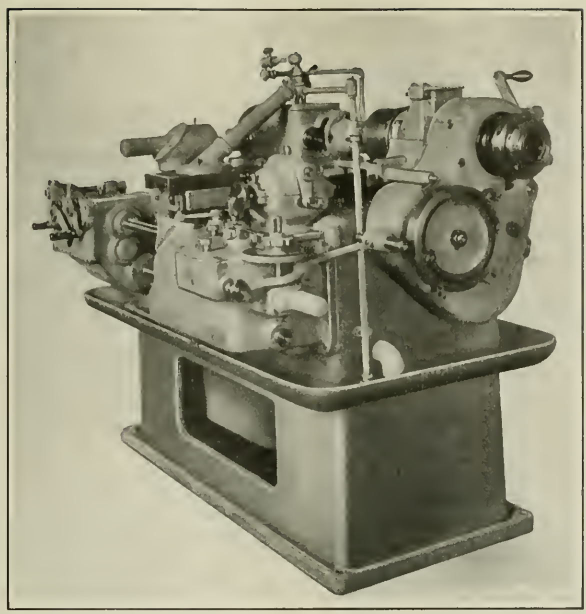


Fig. 2. View of Headstock End and Rear Side of Hanson-Whitney Thread Milling Machine

This machine is particularly adapted for threading parts such as are used in automobiles and airplanes, for cutting short threads on spindles, valve work, and for many other parts on which such threads are required. Excellent results have been obtained as to speeds and finish; for instance a machine steel bolt 2 inches in diameter with a thread 2½ inches long has been threaded satisfactorily in forty-eight seconds. The machine is also built with a simple method of changing the speed and the feed by so-called "selective change-gears." These are particularly useful when work is being produced in large quantities, and changes of work are not so frequent.

* * *

THE MACHINE TOOL SITUATION IN GERMANY AND HOLLAND

By H. DRESES, Dresee Machine Tool Co., Cincinnati, Ohio

The following paragraphs give some of the writer's observations during a visit to Holland and Germany this summer and fall, relating particularly to the conditions in the machine tool trade and industry in those countries. The most important dealer in Rotterdam, Holland, had an immense stock of American, German, Swedish, and Swiss machine tools on hand. The prices, size for size, of American and German machines were approximately as 3 to 1. While the quality of the German machines may have been somewhat inferior, the dealer stated that it was impossible to sell American machine tools against this competition. In Germany, especially in Berlin and Cologne, the principal dealers had large stocks on hand, but not a single American machine tool could be found, it being stated that all that had been on hand were sold during the war.

The general conditions in Germany are very peculiar. A machinist, when the rate of exchange was 1.25 cents to 1 mark, received about ten times the wages, expressed in marks, that he received before the war, his pay averaging, according to locality, from 8 to 10 marks an hour. At that time this would have amounted to from 10 to 12 cents in American money, but at the present rate of exchange of 0.4 cent to the mark, his hourly pay would only be from 3 to 4 cents an hour. The overhead expenses and the cost of raw materials are also in the same proportion, as compared with prices in the United States, except that bronze and copper cost about the same as in this country.

The German shops are still busy, and in addition to supplying the home trade, obtain business from the surrounding neutral countries, South America, and even from former enemy nations. However, the selling of German machines and goods at about one-third of the world's market price cannot last indefinitely, as it is a terrible drain on the national wealth, and it can be accomplished only with the lowest wage rate, the most frugal living, and small or no profits.

In some quarters it is believed that the German Government and financiers have forced this state of affairs to bring about a reduction in the reparation payment, but this would be a dangerous experiment, because the low purchasing power of the mark, with the consequent starvation of the people, may bring about a revolution or a Soviet Government, as in Russia. German business men, financiers, and economists all agree that the breakdown is unavoidable, and that the consequences will affect the whole world.

What the drop in the rate of exchange really means is clear to only a few people. Suppose that the German General Electric Co. had 10,000,000 marks in the bank with which to buy American copper. At an exchange rate of 1 cent per mark, this is only $100,000; but when the exchange drops from 1 cent to 0.4 cent a mark, which recently happened within a week, it means that the capital of this firm in the bank has shrunk to $40,000, and consequently, within a week, the purchasing power of Germany for American copper and the export possibilities for copper from this country have been reduced by more than half.

If Germany succeeds in passing through the present crises without a revolution, the people will still have to exist, and can do so only by producing and living so cheaply as to crowd everybody else out of the world's markets.

* * *

The American Drop-Forging Institute, with headquarters in Cleveland, Ohio, has entered upon a campaign of publicity and educational promotion relative to the use of drop-forgings. The purpose of the campaign is to impress upon buyers and users of all types of tools and machines the importance of knowing whether or not all the parts subjected to strain are drop-forged. A book has been prepared for distribution entitled "What is a Drop-forging?" which can be obtained without cost upon application to the American Drop-Forging Institute, Hanna Bldg., Cleveland, Ohio.

The British Machine Tool Industry

From MACHINERY'S Special Correspondent

London, November 14

FOR the first time in many months signs of returning activity are discernible in industrial circles. As a direct consequence prospects in the machine tool field are brighter. Several valuable orders have been received by machine tool makers, and important inquiries from both home and overseas sources are in an advanced stage of negotiation.

Small Tools

Small tool makers report a steady trade. One maker of machine tool accessories, in announcing substantial price reductions, received a flood of orders. To enable the reductions mentioned—an amount approximately equal to 45 per cent of what other makers are asking for similar articles—to be made, the firm has been engaged for the last eighteen months in developing a series of semi-automatic single-purpose machines, of a simple yet effective type. On putting these machines into commission, the immediate result was an enormous cut in productive labor costs, and this has been passed along to the consumer in due proportion, with the results stated.

Foreign Trade in Machine Tools

Among the overseas countries who are in the market for machine tools, India, Japan, Belgium, and Poland figure prominently, in about the order named. On the Continent British made goods stand high, and there is a strong demand for machine tools and machinery of all kinds. Customers have expressed themselves ready to buy, but, unfortunately, the demand is no measure of the capacity to pay.

As far back as 1919 legislation was passed designed to overcome this fundamental difficulty by the institution of a credit scheme whereby advances were made to the buying country. The total amount allowed for such advances was £26,000,000. The scheme has been disappointing in its results, credits amounting only to about £1,300,000 being advanced, chiefly to Czecho-Slovakia and Rumania. The scheme has now been considerably modified. All countries are to come within its scope, and instead of each transaction having to come up for consideration before an advance is made, a total credit sum is specified for any particular firm, after due investigation. The British Government holds the exporting firm responsible for 57½ per cent of the credit, the risk carried by the Government being 42½ per cent.

Exports and Imports

The reports of imports and exports of machine tools for this year show that imports fluctuate in tonnage at a low level, about equal to the pre-war level, but for the last three months they have dropped below that level. The exports fluctuate above the pre-war level and tend to keep above that level. Exports for September amounted to over 1200 tons, the value being about £175,000. Imports remained under 200 tons and £25,000 for the month. The ratio of total value of imports to exports is as follows: Pre-war imports, 100; exports, 290. Current year imports to end of September, 100; exports, 432. The export values for September included nearly £70,000 for lathes alone.

Labor Conditions

After lengthy negotiations the wage reductions proposed by the employers have been agreed upon, and the so-called Churchill award of 12½ per cent bonus is to be foregone by workers in three stages, which will complete the reduction by the new year. As a result, manufacturers have already been able to base their costs on a definite labor charge, and in some cases are prepared to supply machine tools based on these 1922 costs. There should now be no inducement to hold back orders in the hope of further price reductions, and it is generally expected that machine tool prices will remain stationary when demand revives. In connection with the voting by the men on this wage reduction it is interesting to note that where trade conditions have been better than the average the vote against acceptance was the heaviest.

Unemployment continues to be severely felt throughout the country, and in the engineering trades the total number claiming employment benefit at the end of September was very nearly a quarter of a million, the figure being but slightly less than for the previous month. In Johnstone—the Scottish machine tool center—distress among the employes is promptly dealt with by the firms themselves, who each contribute weekly to a special fund administered by a municipal official. Each case is dealt with on its merits, and in view of the small population it means that the position of practically every worker and the circumstances in which he is placed are known.

The working days lost through labor disputes have of late been relatively few; in September 150,000 days were lost, whereas for the same month a year ago over a million days were lost. How much a part unemployment has had in bringing about this result it is difficult to say, but the prospect of being without anything to do has no doubt presented itself forcibly to all classes of workers. Trade union restrictions still remain a great hindrance. To cite only one instance, on the Mersey, oxy-acetylene cutters cannot be used unless the job is large enough to necessitate twenty-five men being at work. As another instance of a shortsighted and disastrous policy, unions stipulate that in foundries the less skilled men who look after molding and other machines must be paid at the same rate as the skilled hand molder.

Prices of Material

Attention is being rapidly concentrated upon the vital question of the price of coal. Just now the coal market is in such a state of chaos that it is difficult to state a figure for the average price today. Reports are current that certain collieries are offering large spot lots at such prices as 10 shillings per ton (about $2, present exchange) or even less, while the price of coke in these districts has been reduced in a sensational manner from over 30 shillings ($6) per ton to 22s 6d ($4.50). Needless to say, all such prices must be regarded as abnormal, and due only to immediate lack of cash, since an average figure of the actual net cost of raising coal to the pit head would exceed them. However, the iron and steel smelting interests are very definite in stating that unless fuel can be obtained at less than 20 shillings ($4) per ton there can be no resumption of production on anything approaching an adequate scale. Taking these facts into consideration, there is no getting away from the fact that the miners' wages will have to come down again very shortly.

Iron and steel makers have announced drastic cuts in steel prices. Round bars 3 inches in diameter and over have been reduced from £14 ($56) to £12 ($48) a ton

Sheffield makers of high-carbon acid steel have reduced the price of billets, specially made for the file trade, from £19 ($76) to £16 ($64) per ton. This represents one of the biggest cuts recently made.

In finished steel products there is a brighter tone. Some crucible steel firms have considerable work on hand, and are running full time. It is stated that the Russian Soviet Government has placed large tool contracts in Sheffield, and an order for 200,000 saws has just been completed.

British steel works are again benefiting greatly by the condition of the industry on the Continent; it is extremely difficult to place orders for delivery before the beginning of next year with either Belgian or German works, and only a few French firms are prepared to sell for shipment before December. Therefore, taking into account the early delivery of British works, the prices quoted go a long way toward meeting foreign competition, and to many inland points, upon which heavy railway freight rates have to be paid, continental goods are at a disadvantage as regards price.

The associated makers of high-speed steel in Sheffield have reduced their prices considerably, and 18 per cent tungsten steel has fallen from 3s 9d (75 cents) to 3s 3d (65 cents) per pound, while 14 per cent tungsten steel has dropped from 3s (60 cents) to 2s 8d (53 cents) per pound. Foundries are feeling the present pinch to the extent that many are working practically at cost. As an example, identical castings for which £45 ($180) per ton was paid a few months ago now cost only £24 10s ($98) per ton.

Machine Tool Prices

The price of machine tools has been retarding sales, and even when big concessions are made on existing prices by firms who are badly in need of money and must realize on their stock, buyers will not accept the assurance that a special quotation has been put forward, and always decide to wait for a still lower figure. Stock machines are being offered at a reduction of 20 per cent on prices which are really necessary today.

The sales of government machine tools are still being held in various parts of the country. At the beginning of this month a sale was held in Birmingham, and some machines, particularly some of the highest grade American makes, were disposed of at prices lower than would be obtained if sold as scrap. A planer built by the G. A. Gray Co., of Cincinnati, with a 12- by 3½-foot table and three tool-holders, which was in nearly new condition brought only £150 ($600). Nine Pratt & Whitney plain hand milling machines, with a 16- by 3½-inch table and collet chuck, packed in the maker's case unopened, brought from £13 ($52) to £19 ($76) each, while eight Pratt & Whitney three-spindle vertical profiling machines, weighing 3500 pounds each, with 14- by 12-inch table, in the maker's case unopened, were sold at £20 ($80) each. A hexagon turret lathe, made by the same concern, taking 1½-inch stock, which was in practically unused condition, brought £30 ($120), while a nearly new Warner & Swasey No. 6 screw machine swinging 18 inches, with a 2⅝-inch hole through the spindle, was sold for £20 ($80). A No. 4 screw machine of the same make brought only £16 ($64).

The whole situation regarding the disposal of government machine tools is admittedly unsatisfactory, and calls for some concerted action on the part of machine tool makers and dealers.

* * *

We are not a nation of machines, and houses, factories, and railways. We are a nation of men, women, and children. Our industrial system and our commerce are simply implements for their comfort and happiness. When we deal with those great problems of business and economics we must be inspired by the knowledge that we are increasing and defending the standards of living of all our people. Upon this soil grow those moral and intellectual forces that make our nation great.—*Herbert Hoover*

INDUSTRIAL CONDITIONS IN FRANCE

By MACHINERY'S Special Correspondent

Paris, November 12

There is hardly any buying in the machine tool market. The dealers have their stock-rooms full of machines which they are unable to sell in spite of the many concessions they make and the very easy terms they offer. Some manufacturers find themselves in the same position. A large firm in the vicinity of Paris actually has in stock more than 60,000,000 francs worth of machine tools, principally large machines. During the first six months of this year France imported about 22,000 tons of machine tools, while during the whole year of 1920 31,600 tons were imported. The majority of these imports came from Germany.

The machine tool industry, of all French industries, is the one which will be most affected by the recent agreement of Germany to deliver material in lieu of money. The situation is aggravated by the fact that the Government is bringing pressure to bear on the industries to make them buy this German material.

Very few orders seem to be given out by the railroads at the present time. This is due to the indecision concerning the management of the railroads as well as to the existing financial situation. Furthermore, the French railroads will receive 6200 repaired railroad cars and 4500 new cars from Germany. Two thousand of the new cars will be 20-ton freight cars, two thousand, flat cars of 20 tons capacity, and five hundred, cars of 40 tons capacity. This will tend further to retard manufacture in railroad shops in France.

An important association has just been formed which includes such companies as Cail, Fives-Lille, and Ernault, to manufacture locomotives for Rumania, and large shops are to be built in that country for the purpose.

It is to be hoped that, because of the tremendous success of the automobile show and the numerous inquiries obtained there, metal-stamping factories will start up again. Nevertheless, it is evident, when the productive capacity of the various manufacturers is taken into consideration, that very large orders would be necessary to maintain the factories in active operation.

In the foundry field there is hardly any activity, and there seems to be no hope for improvement. The importation of castings has increased considerably during the first six months of 1921, as compared with the same period of 1920. This seems abnormal, when the very low prices quoted in France for castings are taken into consideration. Probably this is due to the fact that parts of machines have been listed as castings. On account of the very few orders, prices of castings continue to fluctuate.

* * *

CONVENTION OF THE AMERICAN FOUNDRYMEN'S ASSOCIATION

The American Foundrymen's Association will hold its next convention and exhibit in the city of Cleveland during the week of April 24, 1922. The headquarters of the association will be in the new Cleveland Public Hall at Lakeside Ave. and E. 9th St., which is rapidly nearing completion, and the exhibits will also be shown there. The Institute of Metals Division of the American Institute of Mining and Metallurgical Engineers will hold a joint convention with the association, as has been the custom in years past. The next meeting promises to be of unusual interest, as there never has been a period when economy in production was so important as now, and the exhibition will show the latest improvements and developments in foundry equipment.

* * *

A recent Commerce Report states that there are twelve factories in Austria engaged in the manufacture of tractors; but most of these factories are only partially devoted to this branch of the industry.

The Metal-working Industries

TO review conditions in the metal-working industries at this time without reference to general industrial conditions throughout the United States would be misleading. Of all the industries, those devoted to metal-working have without doubt felt the business depression most keenly and are among the last to return to a normal state. But every indication points to the fact that the lowest point of the depression in these industries was reached during the summer, and that there is a definite improvement at the present time. The iron and steel industry shows this gain to a marked degree. In the small tool field, the improvement noted in this review last month continues, and while the machine tool industry as a whole does not present so marked a change, many manufacturers report that sales during the last two months have been considerably above the average for the preceding months; still the activity is very slight, and active operation of the industry is not looked forward to for several months to come.

Taking the business situation as a whole into account, the progress toward recovery was somewhat interrupted a month ago by the theartened strike on the railroads. Nevertheless, from all parts of the country there are reports of slightly better conditions. There is a great deal more optimism, and while very few people are looking for a rapid improvement in the situation, the present rate of progress, if continued without interruption, will bring us back to a normal condition in a reasonable time. The Federal Reserve Bank of Cleveland in its November statement sounds a definite note of confidence in stating ". . . the time is near when business can safely throw away its crutches. Nearly all reports agree that the improvement shown last month is holding up well, and in some lines the production throttle has been opened another notch to meet the increase in demand. While there are still too many smokeless stacks in the steel section, the blowing in of furnaces is reducing the number. About this time last year the weakness in iron and steel was casting gloom over all kinds of business, this industry being regarded as the barometer of business. Then the cancellation of orders was a common occurrence. Today this barometer indicates a steady improvement.

"A year ago automobile and tire manufacturers were overstocked, and sales falling off. Recent reports indicate that sales are holding up well. Production is now being determined by demand. Last fall, building was hesitating in anticipation of lower costs. Labor troubles gave out a jarring note. The recovery this fall has been even more rapid than was expected. These developments are only a part of the transition—a transition not yet completed, but gradually working toward dependable business."

The Second-hand Market in Machine Tools

Many manufacturers have expressed a belief that the second-hand machine tool market will seriously affect the sales of new machinery for some time to come. It is generally supposed that there are available large quantities of used machinery, most of which is almost new or in very good condition. This view is not supported by the dealers in second-hand tools. Most of the machine tools offered today are so old or worn that the dealers will not consider putting them in their stock. Most of the good machinery from dismantled plants has already been offered and absorbed, and while occasionally a few good second-hand machines are available, the volume of this trade is not greater than it would be likely to be under normal conditions.

The second-hand machinery market seems large at present because of the very small business in new machinery. One dealer in used machinery says there are fewer used machine tools sold now than under normal conditions, because the market for used machinery, as well as for new machinery, is greatly reduced. Just as soon as reasonably normal conditions return, the influence of the used machinery market on the sale of new machinery will scarcely be felt—at least it will be felt no more than during normal times in the past.

There is very little government machinery still to be placed on the market; and while there are instances where firms which, in the past, would never consider anything but new machinery, have been induced to buy used machines on account of the saving at this time, it is not generally believed that those who have been accustomed to buying only new machinery will consider anything else in the future. Their buying habits will reassert themselves when their buying power is restored.

The Tool Equipment Business

A considerable change has taken place in the tool equipment business during the past months. Some of the concerns engaged in the designing and making of jigs, fixtures, gages, and special tools have discontinued altogether, which has lessened the very keen competition in this field during the last year, enabling firms established in the field to obtain business at figures which at least do not entail a direct loss. Taking the business of designing and building special tooling equipment as a whole, the last two months have shown a decided improvement, and at least one firm could be cited that is working at full capacity.

The number of concerns in this line that have gone out of business in some of the cities of the Middle West has thrown a considerable amount of machine tools on the second-hand market in those cities, which, for the time being, makes the supply of used machines exceed the local demand.

The Automobile Industry

Dealers in automobiles report that business continues well up to expectations for this season of the year, and in many instances the sales during October exceeded those in September. Further price reductions have been announced by some of the manufacturers of passenger cars and trucks. The reports from the different automobile manufacturers vary considerably, but on the whole production is showing the usual seasonal falling off. October shipments, according to the National Automobile Chamber of Commerce, were 11 per cent under those for September, and 4 per cent under those for October, 1920.

The Railroad Situation

Some of the western and southern railroads have requested the Interstate Commerce Commission to approve freight reductions averaging as much as 20 per cent. All classes of labor employed on the roads operating east of the Mississippi and north of the Ohio will soon be asked to accept wage reductions of 10 per cent. in order to make freight rate reductions in the East possible. One of the railroads in the Middle West has authorized the purchase of 55 locomotives, 127 steel passenger cars, and 7300 freight cars, while two other roads have purchased 3500 freight cars. This activity in buying will doubtless have a stimulating effect upon the industry in general.

Railroads in the Middle West have placed some orders for machine tools, but the buying of shop equipment is still limited to absolute necessities, and cannot be said to meet the actual requirements of the roads for the economical operation of their shops.

NEW MACHINERY AND TOOLS

THE COMPLETE MONTHLY RECORD OF NEW AMERICAN METAL-WORKING MACHINERY

Triplex Combination Bench Machine

A COMBINATION bench type of machine which may be used for all operations done on regular bench lathes, millers, and drilling machines, thus reducing the amount of equipment ordinarily required in tool-rooms, has been developed by the Triplex Machine Tool Corporation, 18 E. 41st St., New York City. One of the unique features of this machine is the method of mounting the spindle head. It will be seen from Fig. 1 that the spindle head is mounted on an arm *A*, which has the form of an arc and which is graduated in one-half degrees to facilitate setting the head in any angular position between the horizontal and the vertical. The head may be clamped in position by tightening a single nut, and is balanced by means of a counterweight within the hollow column. The spindle is driven by a motor, which is attached directly to the head, and which, consequently, maintains the same position relative to the head regardless of the position of the latter. The drive to the head is by means of a belt running on two-step pulleys. The motor has a rating of ¼ horsepower, is reversible, and of the constant-speed ball-bearing type, its speed being 1750 revolutions per minute. As the motor is reversible, either right- or left-hand tools may be employed.

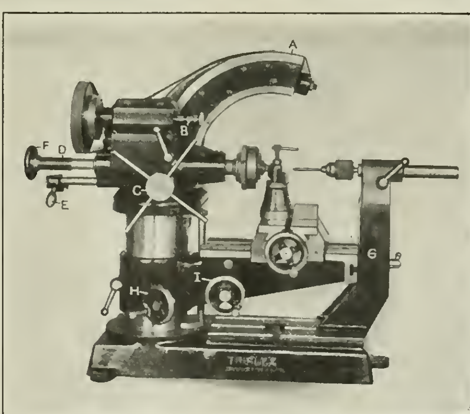


Fig. 1. Combination Bench Lathe and Milling and Drilling Machine brought out by the Triplex Machine Tool Corporation

Six spindle speeds are obtainable, the lowest of which is 90 and the highest 1150 revolutions per minute. These changes in speed are obtained by operating handle *B* which controls three shifting gears. The spindle can be fed a distance of 3 inches by turning the spider wheel *C*, and can be locked at any point by means of a clamping handle located above the spider wheel. The possibility of extending the spindle is particularly advantageous when some difficult milling and lathe work is being done.

The spindle is always fed by hand except when cutting threads, in which case it is fed by a master screw *D*, which engages a nut segment attached to handle *E*. The engagement is effected by swiveling handle *E*. The spindle is fed forward as it revolves, due to the engagement of the threads on the master screw and segment. At the completion of a cut, the nut segment is automatically disengaged by the beveled edge on the hub of handwheel *F*. Internal threads can also be cut in a similar manner when a proper threading tool is used. Either a faceplate, collet, or chuck may be attached to the front end of the spindle.

The bed of the machine swivels on the column, and may be swung to one side so that high work may be placed on the base, which is provided with three standard T-slots for bolting down the work. In Fig. 1 the outer end of the bed is supported by an upright member *G* which can be removed when not needed. This upright is provided at the upper end with a socket in which may be inserted a center for holding work between centers, or the shank of a chuck as shown. The bed is raised and lowered on the column by rotating handwheel *H*, and the carriage is fed longitudinally on the bed by handwheel *I*. The transverse feeding of the carriage slide is accomplished through the operation of the handwheel on the front of the carriage. The various handwheels are provided with dials graduated to 0.001 inch. The carriage can be clamped in any longitudinal position, and the bed in any angular position. By swinging the bed the required amount, any degree of taper, in either direction, can be turned on work. Graduations on the column bearing of the bed facilitate these settings.

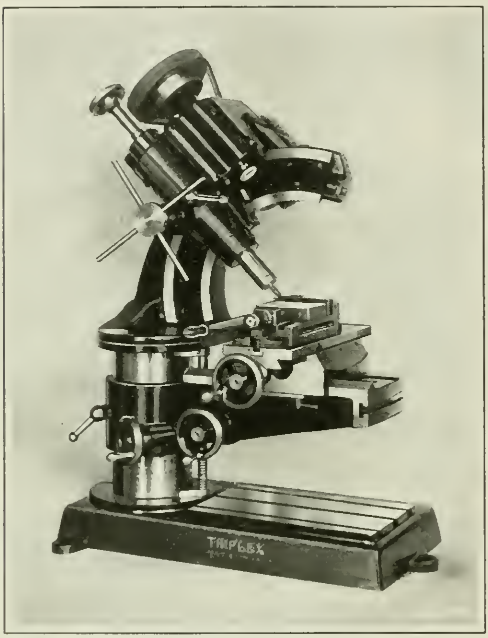


Fig. 2. Performing an End-milling Operation with the Spindle in an Angular Position

Milling operations can be performed by mounting a cutter on an arbor supported between the spindle and the tailstock center, or end-milling operations can be accomplished by inserting the cutter in a spring collet in the spindle, as shown in Fig. 2. The spindle head is shown in an angular position on its arm in this illustration. Fig. 3 shows the head in a vertical position, the machine being used as a bench drilling machine. A Jacobs drill chuck having a capacity for drills up to ½ inch in diameter is supplied. Some of the specifications of the machine are as follows: Longitudinal feed of carriage, 10 inches; transverse feed of carriage slide, 6 inches; vertical feed of bed, 4½ inches; maximum swing over carriage, 8 inches; maximum swing over bed, 14½ inches; maximum center distance, 14 inches; maximum height with spindle in vertical position, 43 inches; weight of machine, about 450 pounds; and bench space required, 16 by 25 inches.

COLBURN NO. 6 HEAVY-DUTY DRILLING MACHINE

The Colburn Machine Tool Co., 1038 Ivanhoe Road, Cleveland, Ohio, has recently added to its standard line of drilling and boring machines, a No. 6 heavy-duty drilling machine, designed especially as a production tool, a variety of work being accommodated due to the wide range of speeds and feeds obtainable. The machine is built with either a plain or a compound table in a single-spindle style, or with a plain table in gangs of two, three, or four spindles. Fig. 1 illustrates the single-spindle machine equipped with the compound table, while Fig. 2 shows a two-spindle machine having a plain table.

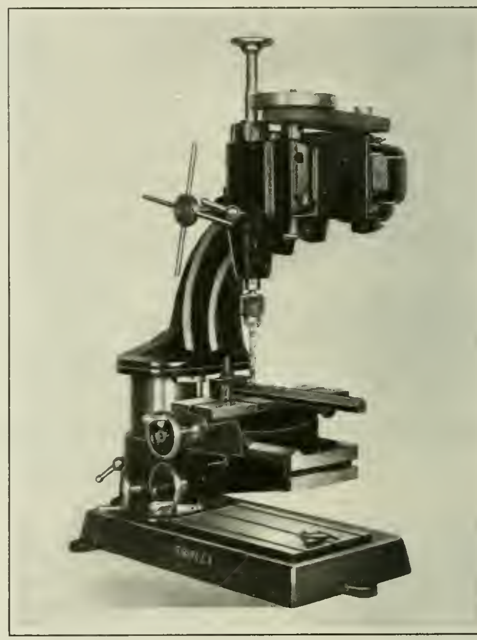


Fig. 3. A Drilling Operation in which the Spindle is placed in a Vertical Position

The machine has a column and base cast integral, to the top of which is bolted the head casting. The lower section of the column contains a storage tank for cutting compound, openings on each side of the column affording access to this tank. A flexible pipe returns the compound from the table to the tank. The head casting serves as an oil-tight box for the gearing. The speed and feed gearing run in oil, and all other gearing is lubricated by a splash system. All vertical bearings are lubricated by means of wicks. To suit work of such a height that it cannot be placed between the table and the spindle, a special extended base having two T-slots and a finished surface may be furnished. In order to place work upon this base the regular table must, of course, be removed from the machine.

The spindle has a No. 5 Morse taper socket, is double splined to equalize the working strain, and slotted across the lower end to provide a means for driving large boring tools. A small slot in the side of the spindle is employed for keying drills or other tools to prevent them from turning during an operation. The spindle is driven at its largest diameter and near the lower end, by a heat-treated chrome-nickel steel bevel gear. The spindle sleeve is bronze-bushed, and has rack teeth cut directly on its surface. A self-aligning ball bearing takes the thrust between the spindle and the sleeve.

The speed change-box is located on the left-hand side of the head near the back. It has an oil-tight cover which may be readily removed to enable the gears to be changed to give the desired spindle speed. Two speeds are obtainable with each pair of change-gears by transposing them on the driving and driven shafts, while two more speeds are obtained by means of sliding gears operated by a lever at the front of the machine. A set of change-gears may be furnished, which, with the combinations of change and sliding gears, will give forty-eight spindle speeds ranging from 30 to 375 revolutions per minute. The regular equipment consists of one pair of speed change-gears, giving four spindle speeds as described.

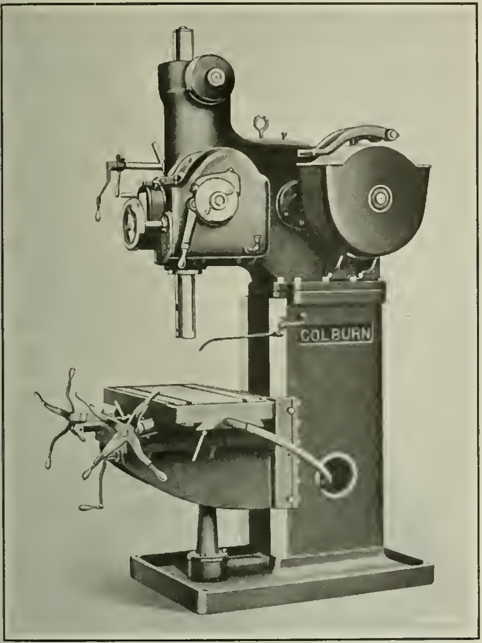


Fig. 1. Single-spindle Heavy-duty Drilling Machine made by the Colburn Machine Tool Co.

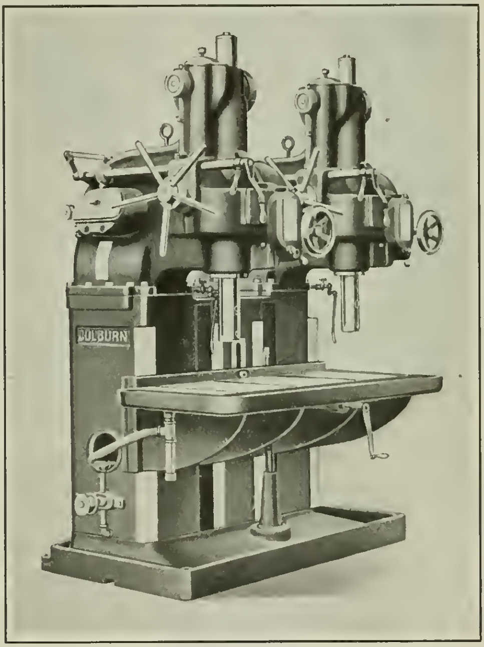


Fig. 2. Colburn Two-spindle Drilling Machine equipped with a Plain Table

The feed-box is located at the front of the head near the feed handwheel, as shown in Fig. 3. The various feeds are obtained in a similar manner to the different speeds, that is, by changing two gears in the feed-box. Two rates of mechanical feed are obtainable with each pair of change-gears by simply moving the handwheel either in or out. By moving the handwheel midway between the extreme inward and outward positions, the power feed is disengaged and the spindle may then be hand-fed by revolving the handwheel or the capstan wheel on the side of the head, the latter method being employed to obtain rapid movement of the spindle. With a complete set of change-gears, thirty-six feeds ranging from 0.005 to 0.134 inch per spindle revolution may be obtained. The feed mechanism is provided with a safety device, by means of which a pin is sheared, causing the feed to be stopped when the tool is operating under abnormal conditions, before any damage can result.

An interlocking device makes it impossible to change speeds while the machine is in operation, and this device also makes it impossible to start the machine until the sliding gears are fully in mesh. All control levers and handles are conveniently located at the front of the machine. An automatic tripping mechanism stops the feed when work has been drilled to the desired depth. The spindle is furnished with a spring counterbalance, the tension of which can be increased or decreased to suit the weight of different tools. The counterbalance also returns the spindle automatically after it has been tripped. A gear-driven tapping attachment having a ratio of 1½ to 1 is furnished when desired. This attachment is mounted on the driving shaft and driven by a pulley.

An oil-pan extends around the working surface of both the plain and compound tables. The elevating screw of the plain table is operated by a crank-handle, and is set off center to permit the boring of a hole through the table to accommodate boring-bar pilots. The compound table is mounted on a special knee and has rapid longitudinal and transverse movements, which are obtained through gearing actuated by the capstan handles. These are so arranged that the operator can readily manipulate the table in both directions while standing directly in front of the machine.

This machine may be equipped with a motor drive, provision being made for mounting the motor directly on the lower portion of the column at the rear. A motor of from 10 to 20 horsepower is recommended, the size depending on the work being done. The machine has a working capacity for driving 3-inch high-speed drills through steel. Some of its main dimensions are as follows: Distance from center of spindle to face of column, 14 inches; vertical adjustment of plain table, 13 inches; maximum distance between nose of spindle and plain table surface, 36 inches; compound table, 30 inches; and working surface of plain table, 20 by 24 inches, and of compound table, 18 by 30 inches.

On a machine of the gang type, each head forms a complete unit, this design permitting a number of heads to be mounted on a common column. All heads are interchangeable, a templet being used in drilling the bolt holes by means of which the heads are secured in place. Each individual unit is driven by a constant-speed belt from a lineshaft and connected with tight and loose pulleys on the head. Thus, any spindle may be stopped or started independently of the others. The machine may also be driven from a countershaft attached to the rear. The table on three- and four-spindle machines is elevated by means of two screws, one at each end. A large capacity pump supplies coolant to all spindles. This pump is attached to the side of the column, and is driven from either the lineshaft or the countershaft.

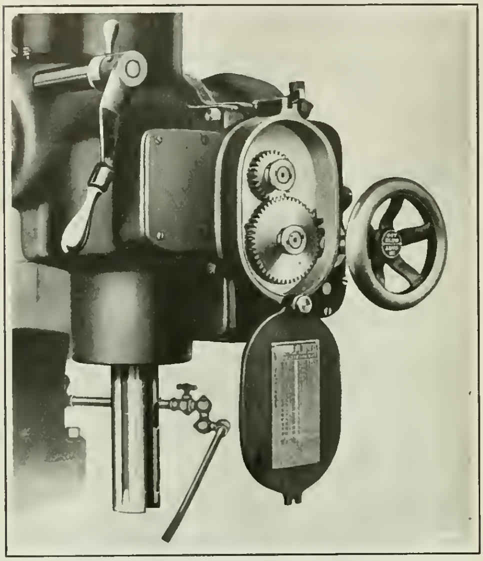


Fig. 3. Close-up View of Feed-change Box on Front of Spindle Head

The gang machine may also be equipped with a motor drive and tapping attachments. A ball-bearing countershaft is furnished with a motor-driven machine. The distance from center to center of spindles on gang machines is 35 inches The table is 20 inches wide, and, on a two-spindle machine, 59 inches long.

VAN NORMAN "RELIO" BENCH GRINDING MACHINE

To meet the requirements of garages and automobile repair shops, the Van Norman Machine Tool Co., 160 Wilbraham Ave., Springfield, Mass., has developed the bench machine shown in the accompanying illustrations, which is suitable for grinding pistons, valves, wrist-pins, etc., regrooving pistons, and for any other grinding or turning operation within its capacity. This machine is sold under the trade name of "Van Norman Relio." An individual motor drive is supplied for both the wheel- and work-heads, the wheel-spindle being connected to its motor by a belt, while the work-head spindle is driven through reduction gears direct-connected to the armature shaft of a motor mounted on top of the work-head. The wheel-spindle is equipped with ball bearings, and is located with its motor on a slide that may be moved transversely relative to the table.

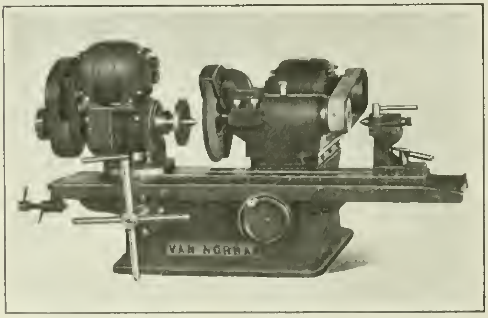


Fig. 1. "Relio" Bench Grinding Machine developed by the Van Norman Machine Tool Co.

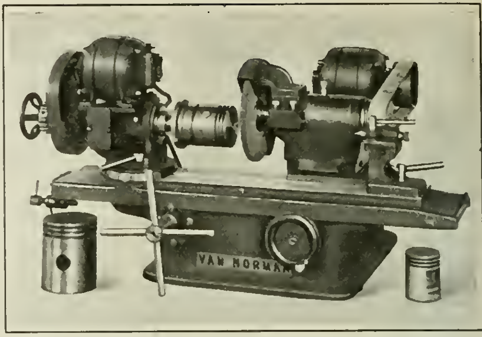


Fig. 2. Machine set up for grinding Automobile Pistons

The work-head spindle revolves in a taper bearing that may be adjusted to compensate for wear of the engaging surfaces. This head may be swiveled on the table and set at any angle from the center line of the table up to 50 degrees. Graduations on the base of the head facilitate these settings, and locating holes at 0, 30, and 45 degrees insure the same settings on subsequent pieces when grinding valves, reamers, etc. A tailstock is provided for holding work between centers when this method of support is desirable.

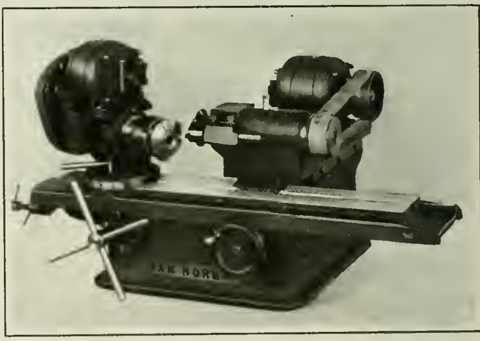


Fig. 3. Turning Angular Surfaces on the Van Norman "Relio" Bench Grinder

The table may be traversed past the grinding wheel through the rotation of a handwheel, and adjustable stops are supplied to limit this travel.

In Fig. 2 the "Relio" grinder is set up for grinding pistons, an attachment being mounted on the work-head spindle to enable the work to be quickly loaded and unloaded. Any standard piston with either straight or tapered sides can be accommodated. By removing the wheel and guard from the grinding head and inserting a special holder with a turning tool in a socket of the wheel-head in front of the wheel-spindle, the grooves for the piston-rings may be remachined. Another operation in which a turning tool may be effectively used on this machine is that of turning angular surfaces. This operation is illustrated in Fig. 3. The tool is fed over the face of the work by revolving the cross-

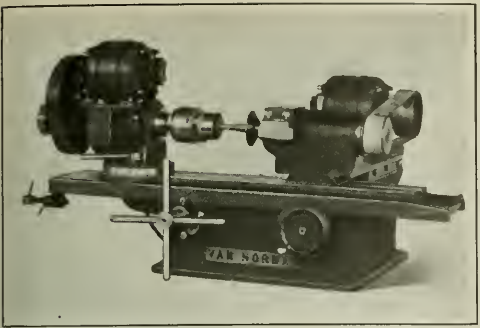


Fig. 4. An Internal Grinding Operation performed by attaching a Small-wheel Arbor to the Wheel-spindle

feed handwheel at the front of the machine. It will be seen that the work-head is placed at an angle to suit the angularity of the surface being machined.

Fig. 4 shows the machine set up for an internal grinding operation, a small-wheel arbor being attached to the front end of the wheel-spindle. Taper holes may be ground by setting the work-head to suit. Internal and external grinding can be performed at one setting of a piece of work by simply changing the grinding wheels. In the grinding of valves the head is set to the required angle and the valve stem is held in a draw-in collet chuck. It is stated that valves for standard cars are ground in less than one minute. Such an operation is illustrated in Fig. 5. Other operations readily accomplished on the machine are the grinding of wrist-pins, in which the work is held between centers and rotated by a key or pin inserted in the center of the work-head, provision being made for holding a wheel-truing tool on the tailstock; the grinding of tapers on valve cages;

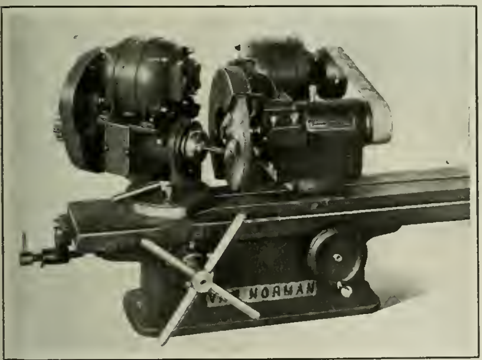


Fig. 5. Grinding an Automobile Engine Valve with Work-head set in an Angular Position

the grinding of valve reamers, in which a support finger is placed under the reamer teeth as they are being ground; and the repairing of armatures. In the last operation, the work is mounted between centers, and the worn parts may be finish-turned, scored or ground.

Some of the specifications of the machine are as follows: Size of grinding wheels, 8 by ½ inch and 1 by ¼ inch; swing of work-head, 8 inches; distance between centers, 12 inches; travel of table, 10½ inches; capacity of draw-in collet, ¾ inch; bench space required, 3 by 4 feet; size of wheel-head motor, ¼ horsepower; size of work-head motor, ⅛ horsepower. Low and high speeds of work-head spindle, 63 and 170 revolutions per minute, respectively; motor speeds, 1700 revolutions per minute; speed of wheel-spindle, 2800 revolutions per minute; and weight of machine, approximately 330 pounds.

ST. LOUIS POLISHING MACHINE

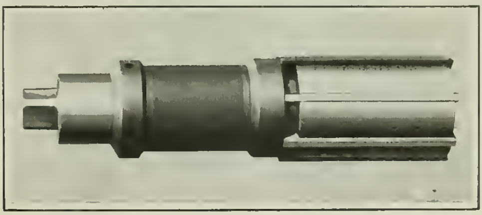
Another polishing machine known as the "Western" No. 10 has been added to the line of polishing and grinding equipment built by the St. Louis Machine Tool Co., 932 Loughborough Ave., St. Louis, Mo. The machine has a wide-face pulley and long bearings for the wheel-spindle, the bearings having large oil reservoirs and being amply provided for filling and draining. Circulation of lubricant is accomplished by means of chains. It will be seen that the lower half of the bearings is cast integral with the column. The arbor is made from 0.40 carbon steel, and has extra coarse-pitch

"Western" No. 10 Polishing Machine built by the St. Louis Machine Tool Co.

square threads. The machine may be furnished with taper-point arbors, either right or left, when desired. A few of the principal dimensions are as follows: Length of arbor, 48 inches; distance between wheels, 38 inches; and height from floor to center of arbor, 34 inches.

"RANSOME" PARALLEL-EXPANSION REAMER

An expansion reamer known as the "Ransome" has been developed especially for remachining automobile engine cylinders, by H. A. Hopkins & Co., Inc., 301 Laporte Ave., South Bend, Ind. It is made in five sizes to cover cylinders ranging from 2¾ to 4 inches in diameter. Each reamer is suitable for cylinders varying not more than ¼ inch in diameter, and has an extra expansion of 1/16 inch to allow for regrinding of the reamer blades. The tool consists only of a body, nut, and blades. The latter are anchored to the body by means of flanges that engage slots in the body. This construction eliminates chatter and always presents



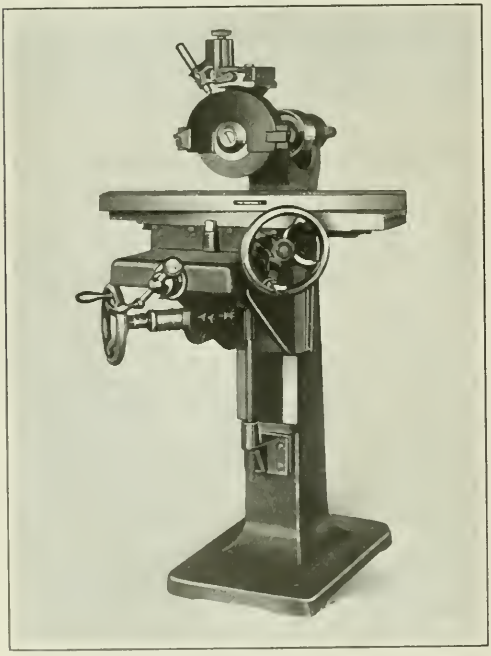
Parallel-expansion Cylinder Reamer made by H. A. Hopkins & Co., Inc.

an even cutting edge. The blades have a pilot end that permits them to be entered into the cylinder a short distance before any cutting is done, the reamer then being adjusted to the required size.

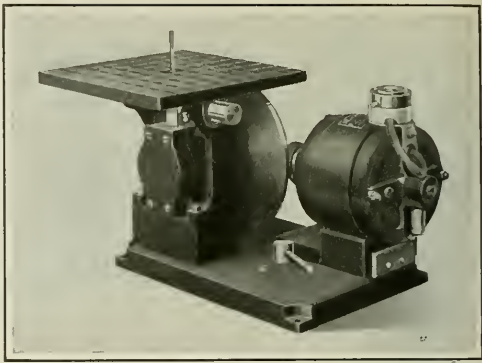
The actual cutting of the metal is done by a small corner of the blades, the reamer cutting from the end like a boring tool instead of scraping the cylinder surface. A micrometer dial facilitates accurate settings of the reamer blades. The reamer may be supported by a rope attached to the top of the shank, which is run over a pulley and provided with a counterweight at the opposite end. By such an arrangement the tool is permitted to feed at the desired rate and will enter the cylinder properly. A ratchet wrench is employed for revolving the reamer in a cylinder bore.

WILMARTH & MORMAN SURFACE GRINDING MACHINE

In November, 1909, MACHINERY was published a description of a No. 1 surface grinding machine developed at that time by the Wilmarth & Morman Co., 1180 Monroe Ave., N. W., Grand Rapids, Mich. This machine has since then been completely redesigned, and is now furnished with an adjustable swivel sub-table, as shown in the accompanying illustration, an improvement which provides a means of conveniently and accurately handling certain grinding operations. It particularly adapts the machine for grinding work of angular or irregular shape, as it is unnecessary to remove the work from the table and reset it in order to procure the proper angle. This is accomplished by swiveling the sub-table which has suitable graduations to enable close adjustments to be made. The sub-table is also provided with T-slots for attaching a headstock and a tailstock, or a dividing head, when grinding work held between centers. The wheel can also be trued without disturbing the work on the table, by means of a built-in truing device permanently located on the wheel hood. The machine is especially recommended for use in accurate gage or die work.



Wilmarth & Morman No. 1 Surface Grinder provided with a Swiveling Sub-table



Motor-driven Die-filing Equipment made by the R. G. Haskins Co.

HASKINS DIE-FILING MACHINE

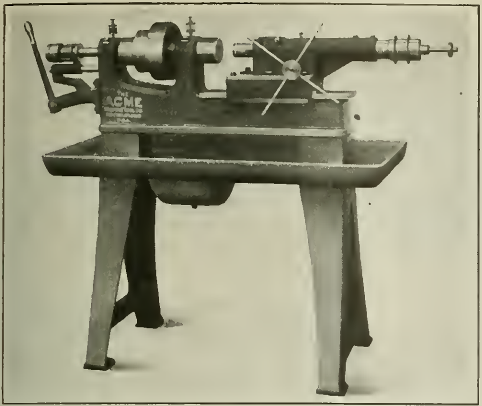
The accompanying illustration shows a motor-driven filing equipment built by the R. G. Haskins Co., 27 S. Desplaines St., Chicago, Ill., which is intended to eliminate the delay and expense of hand filing. The equipment is especially suitable for such work as machining templets, dies, tools, etc. The filing spindle is square in cross-section, and has provision for compensating for wear. Because of the construction it is possible to file sharp corners without play of the spindle. A reciprocating motion is imparted to the spindle by means of a hardened and ground tool-steel block and slide. This mechanism is entirely enclosed and adequately supplied with oil. The table is 9 inches square and may be locked in position for filing at an angle. A series of grooves in the top of the table prevents chips from accumulating on the surface and interfering with the rigid holding of work.

The motor is of 1/4-horsepower capacity, equipped with ball bearings, and is mounted on a dovetail slide. The drive from the motor to the spindle is through a friction wheel and plate. By pushing the motor either forward or backward on its base, the speed of the spindle may be varied from 300 to 700 revolutions per minute. A cam enables the machine to be stopped without stopping the motor. Standard machine files are furnished in sets of twelve, in various shapes and with 1/4-inch diameter shanks. The machine is light in weight, and so can be easily carried from bench to bench. All reciprocating parts are made of tool steel and ground.

ACME HORIZONTAL HIGH-SPEED DRILLING MACHINE

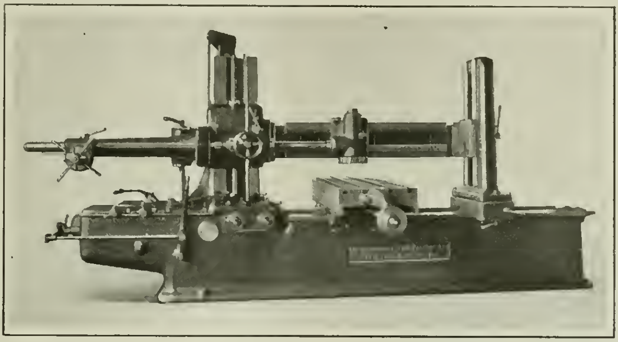
In the accompanying illustration is shown a horizontal high-speed drilling machine recently added to the line of machinery manufactured by the Acme Machine Tool Co., Cincinnati, Ohio. This machine is especially adapted for drilling small-diameter deep holes, such as grease-cup holes in king bolts, or similar work requiring quick operation. The design of the machine in general is similar to a hand screw machine, the spindle and chuck operation being the same as on that type of machine. The work is held in an automatic chuck that is opened and closed by operating a lever located at the head end of the bed.

On a turret-slide saddle is mounted a casting that carries the drill spindle. This arrangement permits the machine to be readily arranged for handling long or short pieces. The spindle is ordinarily run at approximately 3000 revolutions per minute, while the work-spindle is run at 500 revolutions per minute. The spindle is provided at the front end with a No. 1 Morse taper socket for holding drill chucks, and is driven from a flanged pulley on the rear end that is connected by means of a belt to a pulley on a countershaft. The spindle and its driving pulley are equipped with ball



Horizontal High-speed Drilling Machine developed by the Acme Machine Tool Co.

bearings, the bearings for the pulley being mounted on a separate stationary sleeve through which the drill spindle passes. This construction relieves the spindle from all belt pull, and permits it to be operated easily and quickly. The spindle is mounted in a sleeve which has rack teeth that mesh with the teeth of a gear on the turnstile shaft. Operation of the turnstile handle moves the spindle backward or forward, while a stop-collar on the rear end of the spindle may be set to stop the spindle movement when a drill has been fed to the desired depth.



Boring Machine built by the Blomquist-Eck Machine Co., equipped with a Vertical Milling Attachment

BLOMQUIST-ECK MILLING ATTACHMENT FOR BORING MACHINES

A vertical milling attachment, as shown in the accompanying illustration, has been provided for the horizontal boring machines built by the Blomquist-Eck Machine Co., 1146 E. 152nd St., Cleveland, Ohio. This attachment is supported by a cross-rail placed between the horizontal spindle saddle of the machine and the outboard bar support. The vertical spindle saddle of the attachment may be adjusted along the cross-rail by means of a rack and pinion, and is accurately located after placing in the approximate position, by binder screws. Motion is transmitted to the vertical spindle from the regular horizontal spindle by means of bevel gearing in the vertical spindle saddle. On all the boring machines made by the Blomquist-Eck Machine Co. the outboard bar support and the horizontal spindle saddle are machined so that this vertical milling attachment can be applied to any machine whenever desired.

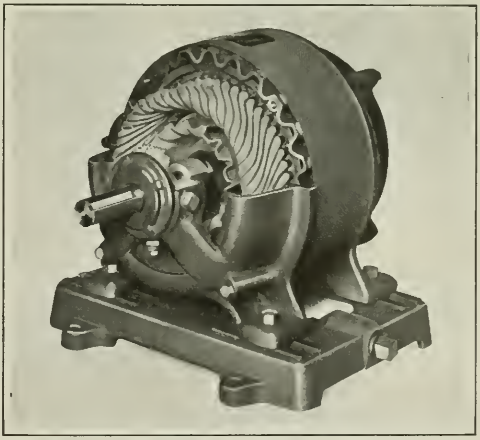
MYERS COMBINATION WORK-BENCH

In August MACHINERY appeared a description of a combination work-bench built by the Myers Machine Tool Corporation, Columbia, Pa., on which was mounted a geared automatic hacksaw provided with a vise, a 10-inch sensitive drilling machine equipped with a table and a 3/8-inch chuck, a grinder head supplied with emery and muslin polishing wheels, and a 4-inch machinist's vise having hardened steel jaws. The entire equipment was driven by a 1/2-horsepower motor running at 1750 revolutions per minute, which was mounted on a shelf supported by the table legs. A countershaft, mounted on the shelf with the motor, enabled individual or collective use of the different machines. Another work-bench similar to this, but equipped with a 10- by 45-inch engine lathe having a double friction countershaft, instead of the hacksaw, has now been placed on the market by the same concern. The new equipment is known as the No. 2 combination work-bench. The lathe is of standard design having a hollow spindle, power cross-feed, compound rest, thread-cutting mechanism, back-gearing, and three-step cone.

WOODS INDUCTION MOTORS

A line of general-purpose, polyphase, squirrel-cage, induction motors, one of which is here illustrated with one-half a head on one end, is now being introduced to the trade by the S. A. Woods Machine Co., Boston, Mass. These motors are enclosed in all sizes up to one horsepower inclusive, and semi-enclosed in larger sizes. They are ventilated by incoming air, which is screened as it enters the motor. The air then passes through gaps, is guided by a baffle plate over the windings, and exhausted through the bearing heads by the action of a fan. It is said that this system of ventilation insures that the motor will always be dry and free from oil-soaked windings.

The corrugated stator housing gives increased surface area for the radiation of internal heat. All motors have a temperature rise of 40 degrees C. when operated at full load, and the temperature rise does not exceed 50 degrees C. when an overload of 25 per cent is sustained continuously. Lubrication of the bearings is accomplished through the



New Type of Squirrel-cage Induction Motor built by the S. A. Woods Machine Co.

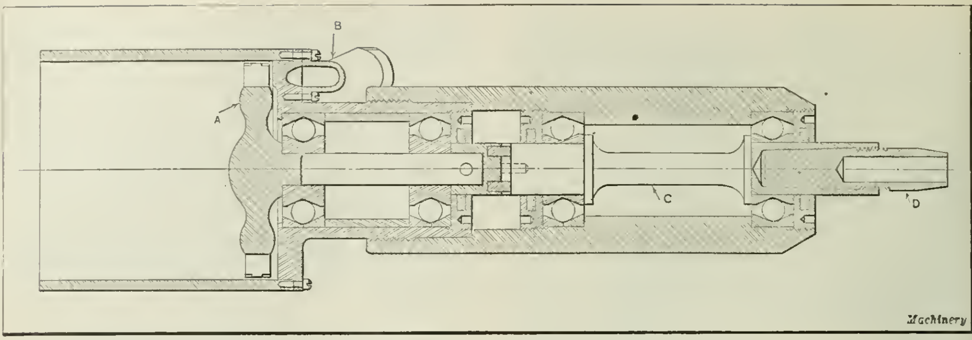


Fig. 1. Air-driven High-speed Grinding Spindle made by the Ex-Cell-O Tool & Mfg. Co.

use of wool waste. The stator windings consist of double cotton-covered enamel wire, while the rotor winding is of the cast unit type. Manufacturers who desire may simply purchase the stator and rotor, and supply their own shaft and bearing heads, enabling the motor to be built as an integral part of their product.

PARKER GRINDING SPINDLES

A high-speed grinding spindle adapted for use on various small-size internal and form grinding machines, and driven by an air motor which gives speeds up to 100,000 revolutions per minute, is shown in Fig. 1. This spindle is a product of the Ex-Cell-O Tool & Mfg. Co., 1214 Beaubien St., Detroit, Mich., sold under the trade name of Parker. It is said that the air drive affords a transmission free from vibration. The air is transmitted to a turbine rotor *A* through two nozzles *B* located diametrically opposite each other. The rotor is constructed of a steel of high tensile strength, and has thirty buckets on its periphery. It has a stem that is connected at the right-hand end to spindle *C*, to the outer end of which a quill *D* is attached. Thus as air is admitted against rotor *A*, it is caused to revolve due to the air being exhausted through its buckets. Air is usually supplied at pressures of from 40 to 60 pounds per square inch, the pressure depending upon the desired speed of rotation. Quill *D* is tapered at its inner end to fit snugly the taper socket in the end of the spindle.

It will be seen that the device is adequately provided with ball bearings. These bearings are of special construction, the outer races consisting of two rings, each of which has a different angle for the surface with which the balls make contact. The angularity of each of these surfaces corresponds with that of the face diagonally opposite on the inner races. In this design, the point of contact of a ball on one race is farther from the axis of rotation than on the other, and this condition causes the balls to revolve about their own axes as well as about the axis of the entire device. The result is a uniform wear of the balls and the elimination of lateral thrust. The angularity of the surfaces of the ball races is such that each ball revolves about its own axis approximately once to every 365 revolutions of the bearing. It is only necessary to oil the bearings every fifty hours of continuous rotation. The construction of the entire unit is such that it can be readily mounted on a machine.

Another grinding spindle intended for internal grinding operations, made by the Ex-Cell-O Tool & Mfg. Co., but which is driven by belt, is shown in Fig. 2. This spindle is equipped with the same type of ball bearings as the air spindle, and both equipments can be furnished to suit any make of grinding machine.

BARR PNEUMATIC DROP-HAMMER

Through a recent improvement in the valve control of the pneumatic high-speed hammer built by H. Edsil Barr, Erie, Pa., which has hitherto been mainly adapted for light forging and tool dressing operations requiring continuous rapid blows, the machine has been made suitable for drop-hammer work in which it is desired to form or straighten pieces completely at one blow. With this improved control, the hammer is always in the raised position when air is turned on. After a piece has been placed on the dies and the foot-lever is depressed, the hammer strikes a quick powerful blow without rebounding, and is returned instantly to the raised position. Rebounding of the hammer is eliminated by admitting air under the piston before a blow is struck. The hammer is also held in the raised position by air, and should the air be accidentally turned off, the ram will slide gently to the bottom position. The stroke of the hammer is 10 inches, and the potential blow, with air supplied at a pressure of 80 pounds per square inch, is about 442 pounds. With an air pressure of 100 pounds per square inch, the blow is about 540 pounds.

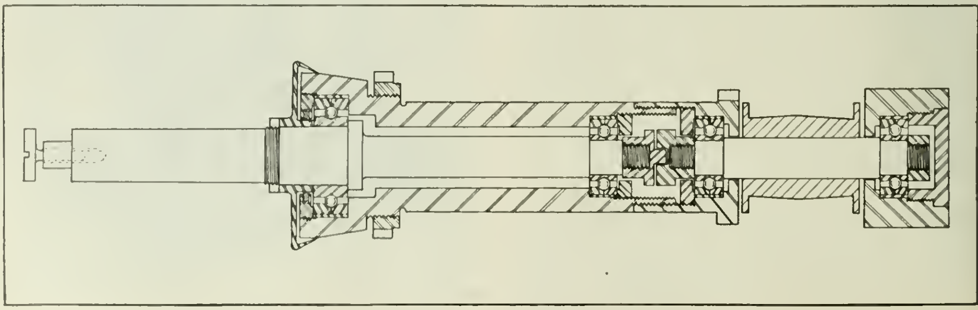
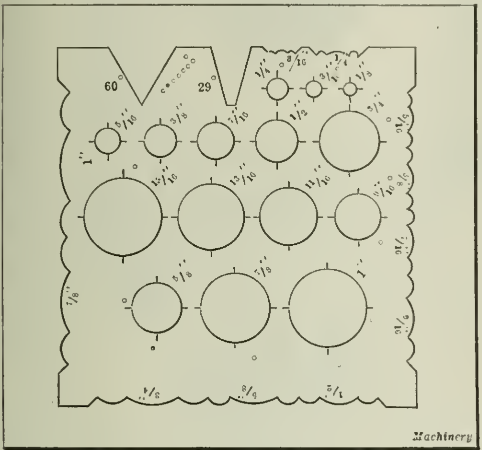


Fig. 2. A Belt-driven Grinding Spindle intended primarily for Internal Grinding

LOPEZ "DRAFTSQUARE"

An instrument intended to simplify the work of draftsmen by making more convenient the drawing of circles, arcs, fillets, nuts, and screw threads has been brought out by the Lopez Mfg. Co., 425 S. Wabash Ave., Chicago, Ill., under the trade name of "Draftsquare." This instrument is transparent, 0.055 inch thick, and 4¾ inches square. Its four edges have a series of arcs in sets of three, each set corresponding to the arcs used in drawing a three-sided view of a nut. The three arcs for any particular nut are identified by the nut size, which is marked on the square for each set. The



Engineers' "Draftsquare" placed on the Market by the Lopez Mfg. Co.

thickness of a nut is determined by marking the drawing through a small hole provided in each case, which is located the proper distance from the top of the arcs.

In drawing 60-degree V-threads, it is only necessary to draw lines representing the outside and root of the thread and then use the sides of a vee cut in one edge of the square for drawing the threads. A second vee facilitates the drawing of Acme threads. Holes ranging from ⅛ to 1 inch in diameter are provided for drawing circles and arcs. A series of holes 1/16 inch apart and a single hole 1/32 inch above these may be used for drawing guide lines for lettering. Angle lines for the same purpose may be quickly drawn by using the sides of the vees provided for drawing screw threads.

BLACK & DECKER PORTABLE DRILL

A new portable electric drill intended for drilling holes up to ¼ inch in diameter in steel has been added to the line of portable drills made by the Black & Decker Mfg. Co., Towson Heights, Baltimore, Md. The drill has an aluminum alloy housing and weighs only 5 pounds. It is of the same general design and construction as other drills made by the same concern, including the pistol grip and trigger switch. Through double reduction gearing the no-load speed is 1600 revolutions per minute. The gears have stub teeth, are made from chrome-nickel steel and heat-treated, and run in oil. All bearings are renewable. The switch mechanism is arranged in the grip in such a way that the tool is particularly adapted for close work, it being possible to drill within an inch of any obstruction.

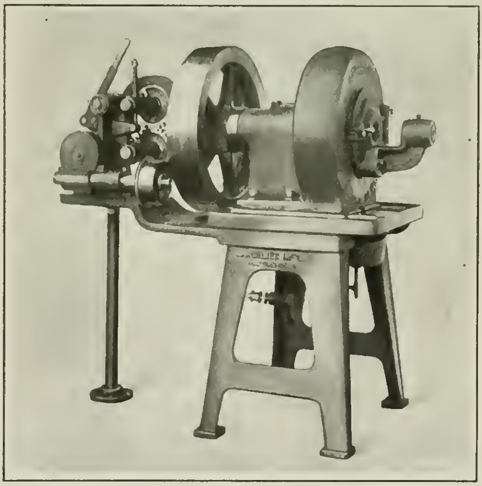
The brushes can be replaced from the outside of the case, and by removing four screws, the commutator, switch mechanism, field leads, and cord terminals may be exposed. The commutator end bearing of the motor armature is carried in a spider that is integral with the motor case. It is thus impossible for the armature to get out of alignment. The commutator may be inspected and cleaned while the drill is running. The drill may also be used for grinding operations, a base, clamp washers, and a grinding wheel being furnished for this purpose. The base can be mounted on a work-bench, and when the device is to be used as a bench grinder, it can be quickly attached to the base and an emery wheel secured to the spindle.

LANGELIER ROLLER-CAGE SWAGING MACHINE

A roller-cage type swaging machine, known as the No. 3½ AT4, is now being built by the Langelier Mfg. Co., Arlington, Cranston, R. I. This machine differs somewhat from the standard machines made by this concern in which the rolls are inserted directly in the head proper, the new type having a hardened steel ring driven into the head, which receives the revolving cage carrying the rolls. Other features of the mechanism are practically the same as on the fixed-roll machines.

The spindle head is slotted for the reception of the hammer blocks, which are bored at their upper ends to accommodate the hammer block rolls. The lower ends of the hammer blocks are slotted to receive the dies. The hammer blocks, rolls and dies are made of a special tool steel, and hardened. A spindle plate screwed to the front end of the spindle retains the different working parts, and limits the opening of the swaging dies during the operation of the machine.

When the machine is operating, as the spindle rotates, the centrifugal force tends to throw the hammer blocks out from their center, thus enabling the dies to open. The head rolls in the revolving cage project toward the center beyond the path of the hammer block rolls, and as they contact, they produce an intermittent rotation of the cage, retarding

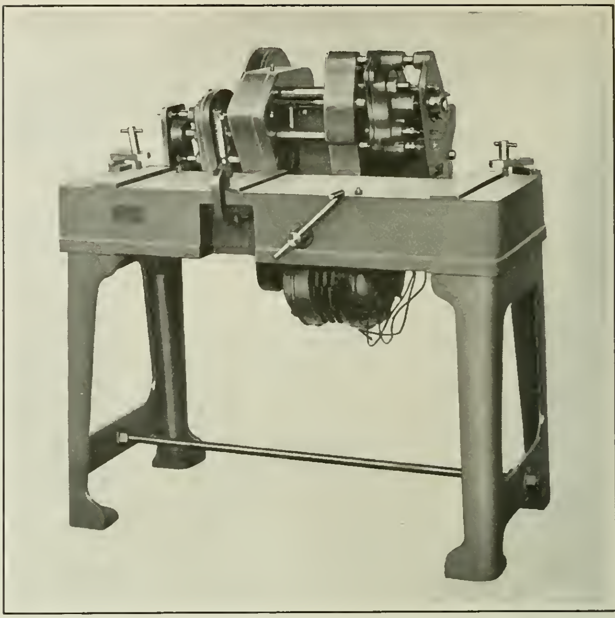


Swaging Machine of the Roller-cage Type which has been developed by the Langelier Mfg. Co.

the blow and resulting in a sliding or squeezing action. This action differs from that on the standard type of machine manufactured by this concern, in which the blow is direct and much more sharp. It is said that slow blows are better adapted to solid work, as more time is given for the stock to flow.

The machine has a roller attachment by means of which the stock is withdrawn after swaging, with a steady and smooth motion that insures a maintenance of the straightness of the work. This attachment is mainly used in light swaging or sizing work. It can be moved to and from the end of the spindle, over a distance of 5 inches, by means of an adjusting screw beneath the baseplate. The surface speed of the rolls may be changed from 30 to 45 inches per minute. These rolls, with their driving gears, are mounted on crank-arms fulcrumed on the upright casting of the attachment. The lower arm is held stationary by means of a set-screw. The upper roll is pressed against the lower roll by the manipulation of the lever, and tension is maintained by means of an adjustable spring. A bushing on the end of the machine spindle guides the stock into the center of the rolls and prevents it from catching on the gear teeth. The rolls can be opened instantly by means of the lever, and changed quickly by loosening a nut.

CRANKCASE DRILLING AND BORING MACHINE


Horizontal Machine for drilling and boring Automobile Crankcases, which has been brought out by the Manufacturers' Consulting Engineers

A machine that simultaneously drills three holes and bores another for a starter or generator, in each end of an automobile crankcase, is shown in the accompanying illustration. This machine is a recent development of the Manufacturers' Consulting Engineers, McCarthy Bldg., Syracuse, N. Y. It is designed to enable the completion in one operation of work usually accomplished in three operations. The machine consists of a bed supported on legs, on which are mounted a driving motor and two sliding heads. Each head carries three drills and a boring head, although the number can be altered to suit other operations. The heads are fed in opposite directions through the manipulation of a hand-lever, the arrangement being similar to that employed in effecting the feed on sensitive drilling machines.

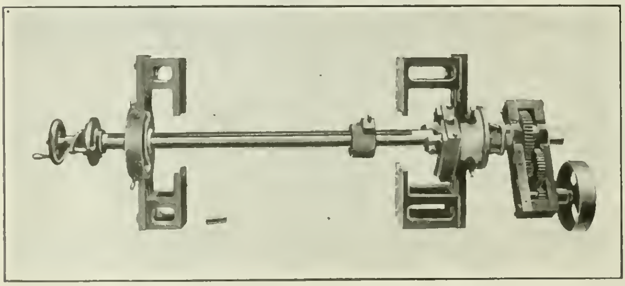
CLEVELAND "MEZZO" TWIST DRILLS

A new line of twist drills which are made from a special steel and given a special heat-treatment to adapt them to drilling conditions under which carbon or high-speed steels do not render satisfactory service, has been introduced on the market by the Cleveland Twist Drill Co., Cleveland, Ohio, under the trade name of "Mezzo." This term was selected to imply that the drills are intended for conditions midway between those under which carbon and high-speed drills are most satisfactory. Many shops, not being properly equipped to obtain maximum results from high-speed drills, are forced to reduce the speed at which they are used, and, if rigidity is lacking, also the rate of feed. These reductions, of course, affect production considerably.

For maximum efficiency, a high-speed drill must be run fast enough to keep it fairly hot, and if the equipment does not allow this, a reduced speed frequently results in breakage. Costly breakage forces many shops without proper equipment to use carbon tools with a subsequent reduced production. Thus it is evident that a saving in expense can be made as well as an increased production obtained in such cases by the use of a drill which will run at speeds and feeds above those of carbon drills and still stand up under the work. The "Mezzo" drills are designed to fulfill these requirements. They are intended for use at approximately double the speeds under which carbon drills work satisfactorily. In order to make them readily distinguishable, the new drills are given a blue-black rust-resisting finish.

PEDRICK PORTABLE TAPER BORING-BAR

A portable boring-bar designed primarily for taper-boring operations, but which may also be used for straight boring and facing, is a recent product of the Pedrick Tool & Machine Co., 3639 N. Lawrence St., Philadelphia, Pa. The special features of the bar are the possibility of taking it to the job and its adjustability to suit any degree of taper. The boring-bar is supported on the part being machined by means of cross-heads having four set-screws that enable the bar to be finally and accurately aligned after it has been roughly centered in the hole to be machined.


Portable Taper Boring-bar made by the Pedrick Tool & Machine Co.

A conical rotation of the bar is produced through a cross-slide and yoke to which the bar is attached. The degree of taper is controlled by the distance that the slide is moved from its central axis. The lower end of the bar, to which the feed-case is attached, describes an orbit and thus necessitates the provision of a spherical-shaped bearing in its cross-head. By preventing the handwheel of the feed-case from turning, the feed becomes constant and automatic. The gearing of this device may be driven by belt, electric motor, or air drill. When a facing arm is used with the boring-bar, the latter is held by spiders inserted in the bore of the work.

PARKER GRINDING, DRILLING AND TURNING MACHINE

Such operations as the grinding of valve reseating tools, valve cages, commutators, and gears, the sharpening of milling cutters, the drilling and regrooving of pistons, the milling of keyways, and other small machine operations can be readily accomplished by the use of a new bench grinding, drilling and turning machine, which has been brought out by the Ex-Cell-O Tool & Mfg. Co., 1214 Beaubien St., Detroit, Mich., under the trade name of Parker. From Fig. 1 it will be seen that the upper or grinding spindle is driven by belt from a $\frac{1}{4}$-horsepower motor, mounted on the same arm as that which supports the spindle on the column. The grinding spindle can be adjusted to various positions to suit angular operations, the motor swiveling with the head. The motor can be furnished to run from any lighting current. A small lever on the right of the grinding spindle head is employed for reciprocating the grinding wheel back and forth across the work.

The lower spindle, or work-spindle, is shown equipped with a 4-inch universal scroll chuck, but a 6-inch faceplate is also provided. The work-spindle may also be swiveled to any desired angle, as will be apparent by referring to Fig. 2, in which the upper spindle is in a vertical position and provided with a chuck and drill for drilling holes at an angle through the wall of an automobile piston. Both the swiveling members of the upper and lower spindle heads are graduated to enable accurate adjustments. In Fig. 2 it will also be seen that a large pulley has been mounted on the upper spindle instead of the small pulley seen in Fig. 1. A larger pulley is necessary in drilling and milling operations for reducing the speed of the spindle to suit these classes of operations. The lower spindle may also be revolved by a handwheel which is driven by a V-shaped belt, the handwheel being provided with a groove around its periphery for this purpose. This V-shaped belt is connected to the small pulley mounted on the shaft extending from the lower end of the motor, previously referred to in connection with Fig. 1. The proper tension is maintained on this driving belt by means of a double idler pulley fastened to a spring on an adjustable rod secured to the motor support. This arrangement is not illustrated.

The upper spindle is equipped with ball bearings, while the work-spindle has a straight bearing which extends its full length and also has a $\frac{1}{4}$-inch 45-degree angle thrust bearing. Both external and internal grinding operations can be performed on the machine, and an idea of its grinding range can be obtained from the fact that it is used for grinding the outside cylindrical surfaces of automobile pistons and for grinding holes as small as 5/16 inch in diameter. The regrooving of pistons and the turning of small armatures can be accomplished by mounting a tool in the lug at the left of the grinding spindle bearing. An overhanging center bracket can be furnished. The lower spindle head has a horizontal travel of 7 inches and a vertical movement of $8\frac{3}{4}$ inches. The machine has an over-all height of 24 inches, and weighs about 135 pounds.

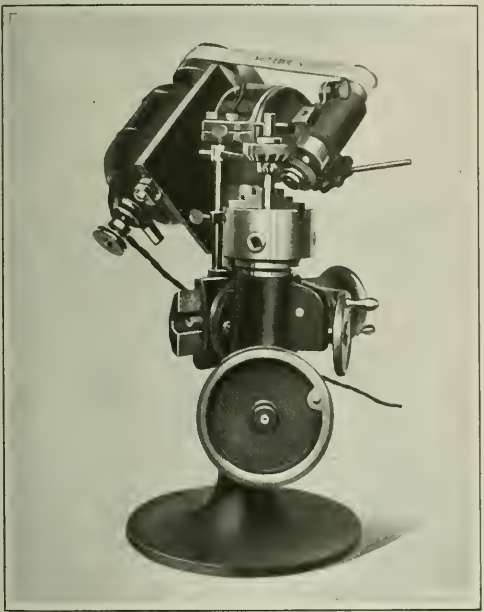


Fig. 1. Grinding, Drilling and Turning Machine placed on the Market by the Ex-Cell-O Tool & Mfg. Co.

Fig. 2. Machine set up for Drilling Operation, the Work-spindle being at an Angle and the Upper Spindle Vertical

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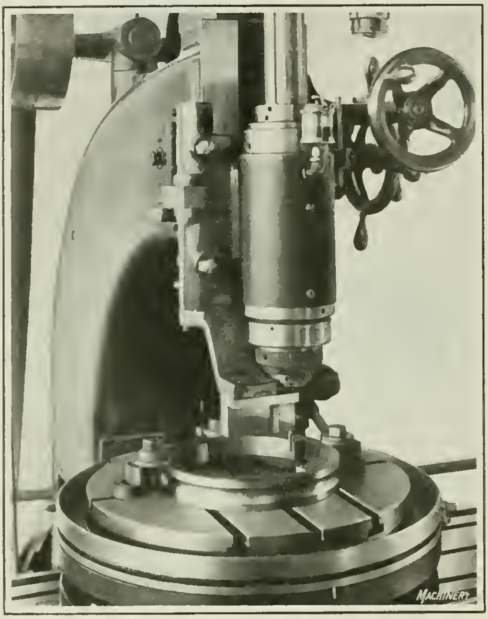
TURNER GASOLINE-KEROSENE BLOW-TORCH

The Turner Brass Works, Sycamore, Ill., have recently brought out a new style blow-torch using either gasoline or kerosene for fuel. On this torch the shut-off valve is located below the orifice. This construction prevents enlarging of the orifice through shutting off tightly when hot by forcing the point of the needle in, or through fuel corroding the needle point when the torch is cool. An adjusting needle in the orifice permits all gases to escape. It can be regulated so as to obtain any size flame without destroying the orifice. A cone-shaped tube on the burner siphons the correct amount of air regardless of the adjustment. The feed-tube is placed on the outside of the tank so as to prevent any possibility of heating the fuel in the tank to such a degree that it would create gas pressure and cause an explosion. The leather on the plunger of the air pump is loose in the cylinder, decreasing wear and allowing air to pass freely on the upward stroke. On the downward stroke the leather flares out and forces a large volume of air into the tank.

BECKER MILLING MACHINE ARRANGED FOR HIGH SPINDLE SPEEDS

Light milling operations must sometimes be performed on work so large as to require a large size machine having a large table space and throat clearance, when a much smaller machine would be preferable because of the higher spindle speeds obtainable with small cutters. To meet such requirements the Becker Milling Machine Co., 677 Cambridge St., Worcester, Mass., has arranged its No. 5-C vertical milling machine so that on special order, spindle speeds up to 1400 revolutions per minute may be obtained and cutters as small as 7/32 inch in diameter successfully used. The normal range of speeds for this machine is from 13 to 500 revolutions per minute. The high speeds do not interfere with the regular speeds, so that the machine may be used for all usual jobs and also be promptly available for high-speed work.

A special three-speed countershaft, with one shipper for obtaining the regular speeds and another for the high speeds, is employed. In the job shown in the illustration a groove 7/32 inch wide and 1/4 inch deep is milled tangent to the circular wall previously milled and about 1 inch below the top face of the work. Because of the necessary extension from the spindle face of the frail cutter employed for the operation, a special bracket is bolted to the spindle head, to which is attached a bushing which supports the cutter close to the surface being milled. This particular job does not require a large throat clearance, the machine set-up being primarily intended for other sizes of work which necessitate the use of a large machine.



Operation performed on the No. 5-C Vertical Milling Machine built by the Becker Milling Machine Co.

CONSOLIDATED SCREWDRIVER SET

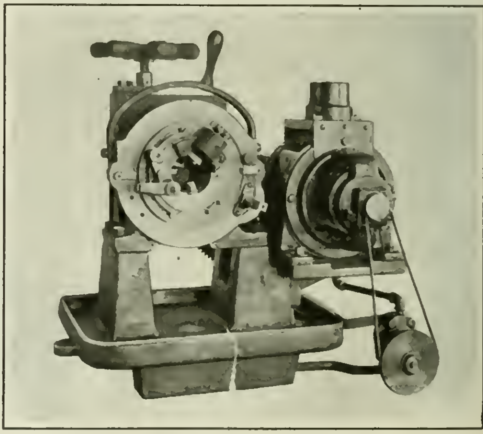
A screwdriver set consisting of one handle and four blades, any of which may be inserted in the handle to suit the slot in the head of the particular screw that it may be desired to drive into place or remove, is now being placed on the market by the Consolidated Tool Works, Inc., 296 Broadway, New York City. Two blades of the set fit into one end of the handle, and the other two into the opposite end. The blades are made of tool steel, ground and tempered, while the handle is turned from cold-rolled steel and knurled. The ends of the blades are 1/8, 3/16, 1/4, and 5/16 inch wide, respectively, and the length is 3 1/8 inches. When a blade is inserted into a handle, the over-all length of the screwdriver is about 6 1/2 inches. The blades are held in a positive manner in the handle and may be quickly interchanged.

Four-blade Screwdriver Set placed on the Market by the Consolidated Tool Works, Inc.

CURTIS MOTOR-DRIVEN PIPE-THREADING MACHINE

A No. 430 motor-driven pipe-threading machine has been designed by the Curtis & Curtis Co., 324 Garden St., Bridgeport, Conn., to meet the requirements for a portable outfit equally adaptable for use in the shop or in the field. The pipe is held stationary in a vise which forms part of the machine, and the dies, which are contained in a die-head, are screwed on the pipe, power being supplied by the motor through rawhide, steel, and cast-iron reduction gears.

The die-head is equipped with an automatic release which opens the dies at the completion of a threading operation while the machine is still running, so that the pipe may be removed without backing off the thread or stopping the machine. By turning a small lever, the dies are reset and the machine made ready for the next cut, which is identical with the preceding one, both as regards the length and diam-



No. 430 Pipe-threading Machine built by the Curtis & Curtis Co.

eter of the thread. The die release is adjustable to enable either long or short threads to be cut. The machine is equipped with a cutting-off attachment that cuts the pipe square without leaving a burr. High-speed steel tools and an oiling system with a pump are furnished with each outfit. The rating of the motor is 1 horsepower, and it may be run on ordinary lighting current. The machine, complete, weighs approximately 350 pounds.

DAVIS-BOURNONVILLE WELDING OUTFIT

A welding outfit contained in a substantial fiber case to facilitate transporting it to a job, which is said to be suitable for any welding operation, is shown in the accompanying illustration. This outfit has recently been brought out by the Davis-Bournonville Co., Jersey City, N. J., and includes a torch, three extension tubes, five welding tips, decarbonizing tube, oxygen regulator, acetylene regulator, 12 feet of oxygen hose and connections, 12 feet of acetylene hose and connections, spark lighter, pair of colored glasses, and torch and regulator wrenches.

The gas tubes are silver-soldered into both the head and rear ends of the torch. The needle valves are quick-opening,

Welding Outfit placed on the Market by the Davis-Bournonville Co.

and are also silver-soldered in place. The mixing chamber in the head end of the torch is so constructed that the gases are correctly mixed before entering the tips. Some sizes of the tips are made of copper and others of brass. The tip nut is made with a fine thread on the inside to fit the brass sleeve, and threaded on the outside to fit the head of the torch. Thus the tip can be made gas-tight in the head by hand pressure alone. Numbers are stamped on the handle of the torch showing the pressures of acetylene for use with the various sizes of tips in order to give a strong welding flame. The copper extension tubes can be furnished in any length desired. The tubes are flexible so that it is possible to weld in places otherwise inaccessible.

COATS-LEONARD RENEWABLE PLUG GAGES

Plug gages on which the gaging ends are renewable to make replacements possible at a minimum cost are now being placed on the market by the Coats Machine Tool Co., Inc., 110-112 W. 40th St., New York City. The gages are made of hardened steel and are ground within an accuracy of 0.0001 inch. They are put up in two sets in wooden cases. The No. 1 set comprises fourteen sizes from 1/4 to 1 1/4 inches in diameter, the sizes increasing by increments of 1/16 inch

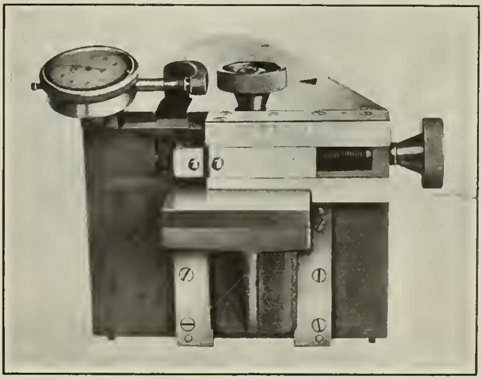
Case of Renewable Plug Gages placed on the Market by the Coats Machine Tool Co., Inc.

up to 1 inch, and by 1/8 inch increments from 1 to 1 1/4 inches. Any special combination of sizes can be supplied to order. The four smaller sizes are made solid with the handle. The No. 2 set comprises sizes from 1 3/8 to 2 1/4 inches in diameter, increasing by increments of 1/8 inch. Renewable limit plug gages are also supplied by the same concern to meet the demand for limit gages which can be furnished from stock. Each gage consists essentially of three parts, a "Go" end, a "Not Go" end, and a handle. The handles are interchangeable, and one size will fit a range of plug sizes. Stocks of hardened ends in both English and metric measurements are always carried on hand.

TOLEDO THREAD-LEAD GAGE

Imperfect lead of threads is largely responsible for the loose fit of screws in machines, because if the lead is inaccurate only two or three threads of the screw may bear against the threads of the tapped hole which the screw engages, with the result that when the members held together are stressed, the screw stretches a sufficient amount to produce a loose fit. In order to check closely the lead of all taps and accurately machined studs, the Toledo Tap & Die Co., Clinton St., Toledo, Ohio, designed the lead gage here illustrated, and has now placed it on the market. By means of this device on which patents are pending, the lead of threads can be quickly checked.

This gage has an arm 8 inches long that is pivoted on adjustable angle bearings and carries at its outer end a hardened and ground conical point. The arm also has a hardened button which comes in contact with the plunger of

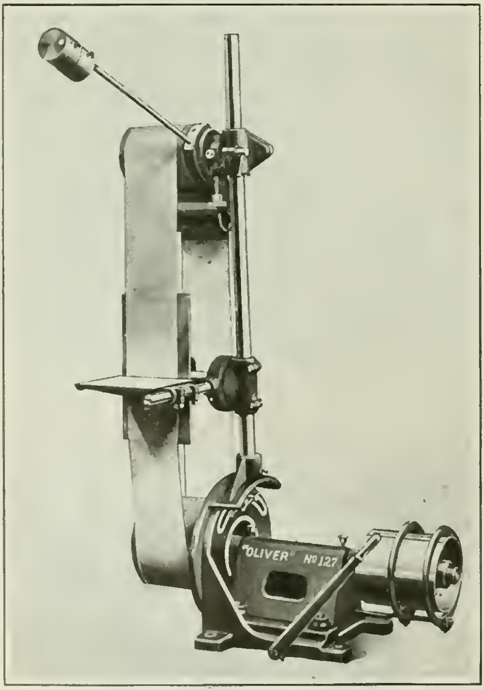


Gage for checking Lead of Threads, which has been developed by the Toledo Tap & Die Co.

the dial gage and registers, positively, any variations between a master thread gage and the work being inspected. There is a second hardened and ground conical point mounted on a slide which may be operated horizontally, so as to vary the distance between this point and that on the pivoted arm. The distance between the two points may be varied from ½ to 2 inches. In employing the device, a master gage is first laid on the table after the latter has been elevated until the center line of the gage coincides with the conical points. Then the latter are made to engage with two threads of the gage the desired distance apart, and the slide is adjusted until the dial indicator registers zero. The threads of work to be tested are then pressed firmly against the conical points and any difference in lead from the master setting will be indicated accurately on the dial. The dial may be furnished to show variations of either 0.001 or 0.0001 inch. The arm and pivot points are fully enclosed so that they cannot be tampered with.

OLIVER NO. 127 BELT SANDER

The No. 127 variety belt sander here illustrated is now being built by the Oliver Machinery Co., Grand Rapids, Mich., for pattern shop use. It is suitable for sanding concave and convex surfaces and the various irregular shapes met with in the manufacture of patterns, performing work usually done on disk and drum sanders. The table may be tilted to suit angular surfaces or draft on work. The machine is driven from a pulley mounted on a countershaft located on the base. On this base is mounted a frame that swings about the center of the countershaft and carries a supporting arm. On the latter are mounted two brackets,



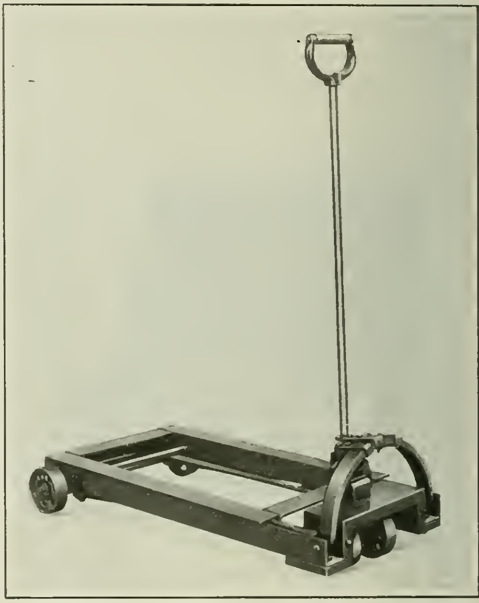
No. 127 Variety Belt Sander built by the Oliver Machinery Co.

one of which supports the main idler pulley and tension idler, while the other supports the table and backing plate, forms, or flexible pads.

The machine will take belts up to 10 inches wide and 14 feet long. The backing plate is 10 inches wide and can be adjusted in and out to produce a suitable tension on the belt. It has holes drilled in it for attaching flexible pads. The main idler is leather-faced and adjustable up and down the entire length of the idler arm to suit different lengths of belts. The tension idler is also faced with leather; it fulcrums on the center of the main idler, and is balanced by weights to give the correct tension to the belt. A fork idler may be mounted on the machine in place of the table, for doing oval sanding. This machine may also be motor-driven, in which case a motor of two-horsepower capacity is provided.

WESTERN LIFT TRUCK

The "Champion" lift truck here illustrated is a product of the Western Tool & Mfg. Co., Springfield, Ohio. This truck is constructed entirely of iron and steel parts, many of which are hand-forged. The front wheels swivel on thrust

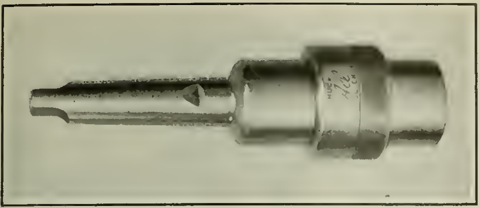


Steel Lift Truck made by the Western Tool & Mfg. Co.

ball bearings, and all wheels are provided with cage roller bearings. Weights up to 2000 pounds can be raised easily by one man. The truck turns in its own length. The over-all length is 46 inches and the over-all width 26 inches. The platform dimensions are regularly 23 by 38 inches, but platforms may also be supplied in any other lengths desired. The truck will raise a load through a distance of 1½ inches.

"SAVE-ALL" QUICK-CHANGE DRILL CHUCK

A positive safety quick-change chuck for drills or other tools with taper shanks is now being placed on the market by the Save-All Tool Co., 59 River St., Waltham, Mass. The drill or other tool is held in a collet which may be slipped into the chuck when the sleeve on the latter is raised. By lowering this sleeve, jaws are made to engage the taper end of the collet and hold it in place. This chuck has a device which prevents the breaking and burning of tools by shearing a pin that drives the collet whenever the cutting tool is overloaded. This pin is held in place by a pointed screw which seats in a groove in the pin, and, after a pin has been sheared, it can readily be removed by loosening the screw.

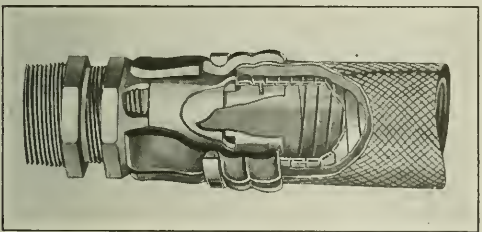


Safety Quick-change Drill Chuck made by the Save-All Tool Co.

The construction of the collet and chuck body is such that the members do not stick when tools are changed. A compensating collet lock automatically takes up wear and eliminates end motion, while a "Bristo" hollow set-screw prevents the tool from pulling out. Tools can be changed while the machine is in motion. The release of a tool from the collet is effected by striking a light blow on an ejector in the small end of the collet. The chuck illustrated accommodates drills having Nos. 1, 2, 3, and 4 Morse taper shanks. All parts are hardened, except the shearing pin.

"KNORR" DETACHABLE COUPLING

The "Knorr" metal coupling, which is readily detachable, leak-proof, and suitable for hose used with pneumatic tools, is placed on the market by the Barlow Mfg. Co., 108-114 Park Place, New York City. This coupling is also suitable for hose employed in conveying gasoline, etc., and is capable of withstanding pressures of over 450 pounds per square inch. Three or more arms of stamped steel closely embrace the end of the hose of any given outside diameter, these

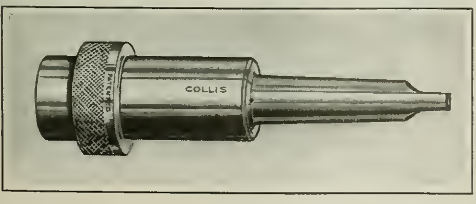


Coupling for Metal-lined Hose which is placed on the Market by the Barlow Mfg. Co.

arms being held in place by a steel ring. The arms are made to grip the hose through a wedge or spreader-nut threaded on the shank of the coupling, which forces out the arms at the other end. This lever combination enables the user to exert an easily adjusted pressure upon the hose and to remove the latter quickly by revolving the spreader-nut several times. Slight variations in the thickness of hose do not interfere with the attachment of the coupling. The shank or body is thin at the hose end and threaded, so that it can be screwed into the interior lining of the hose.

COLLIS QUICK-CHANGE DRILL CHUCK

The "Wonder" quick-change drill chuck here illustrated has been designed by the Collis Co., Clinton, Iowa, for use in the spindle of lathes, drilling machines, screw machines,



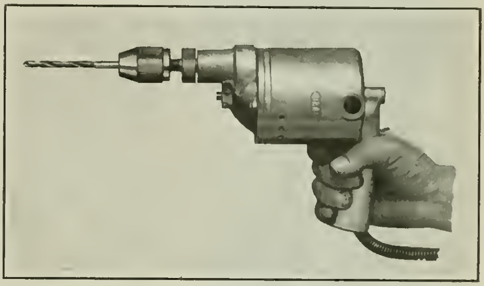
"Wonder" Quick-change Drill Chuck manufactured by the Collis Co.

and other machines having rapidly rotating spindles. The chuck can be operated by one hand, and collets inserted or released while it is revolving at speeds up to 1500 revolutions per minute. The ease with which a tool can be replaced adapts the chuck for use in the performance of several operations without removing the work.

The collets have taper shanks and may be used either in a horizontal or a vertical position. By the use of different collets either taper or straight shank drills and hand taps can be accommodated. A special style of collet known as the "Use-Em-Up" enables drills with twisted or broken shanks to be used, it being only necessary to grind a flat on the remaining portion of the shank. The chuck is made in six sizes.

"CYCLONE" ELECTRIC DRILL

A small portable electric drill having a capacity for drilling holes up to 5/16 inch in diameter in metal, has been brought out by the United States Electrical Tool Co., 6th Ave. and Mt. Hope St., Cincinnati, Ohio. This drill has an aluminum alloy housing, weighs about 5½ pounds, and has an over-all length of 9 inches. The gears are made of chrome-nickel steel, and are hardened and run in grease. The electric switch is located in the handle so as to be con-

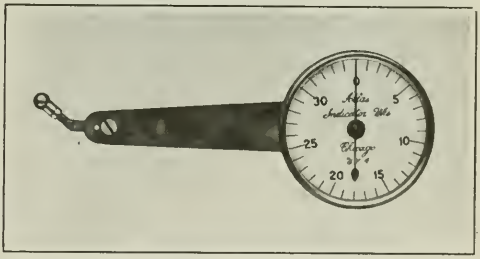


Portable Electric Drill manufactured by the United States Electricel Tool Co.

veniently controlled by the thumb at all times. The motor is of the universal type, air-cooled, and wound for operation by 110- or 220-volt current. It operates on from 25- to 60-cycle, single-phase, alternating current or direct current, and may be attached to any lamp socket. This drill is especially suitable for corner drilling, as it may be used within ¾ inch of walls.

ATLAS DIAL INDICATOR

A small indicator reading over a range of 0.055 inch, known as the "Junior," is being sold by the Atlas Indicator Works, 160 N. Wells St., Chicago, Ill. The indicator dial



"Junior" Indicator made by the Atlas Indicator Works

is carried on a swivel mounting that offers a convenient means of attaching the instrument to suit the various jobs on which it may be employed. After adjusting the contact point on the work, the dial may be revolved so as to bring the zero mark in line with the indicator hand. The reading of the indicator may be magnified or diminished by adjusting its contact point, this feature being of value when the instrument is employed by inspectors to detect the presence of errors on work, but not to measure their magnitude. The contact point may be locked in any desired position by means of a threaded collar on which patents are pending.

BLACK & DECKER CLEANING MACHINE

An equipment designed for cleaning small parts such as ball and roller bearings, gears, motor and generator parts, drills, milling cutters, and other tools has been produced by the Black & Decker Mfg. Co., Towson Heights, Baltimore, Md. The device consists of a cast-iron pedestal at the top of which a bowl is mounted. This bowl is 13 inches in diameter, 12 inches deep, and has a fine-mesh brass screen supported at about 5 inches from the bottom. The housing of a plunger pump is cast integral with the bowl. The latter has a safety cover so arranged that it cannot be left open. The cover is lifted by means of a convenient handle that operates the pump each time the cover is raised. A gallon of gasoline, kerosene, or other desirable liquid cleanser is poured into the bowl of the machine and the operation of the pump forces a stream of this fluid toward the center of the bowl from one side. The part to be cleaned is held under the stream of cleansing fluid so that dirt and chips are washed from the part and deposited on the screen below, the fluid passing through the screen and returning to the sump to be used again.

Apparatus for cleaning Small Work, made by the Black & Decker Mfg. Co.

SHEPARD ELECTRIC HOIST

A new electric hoist known as the "Liftabout," which is manufactured by the Shepard Electric Crane & Hoist Co., Montour Falls, N. Y., is shown in the accompanying illustration. The motor furnished with this equipment is of the fully enclosed type, with interchangeable frames for direct and alternating current. The motor is especially designed for hoist service and carefully insulated and impregnated to protect it from moisture. A standard series-wound interpole motor is furnished for direct current, and when the motor is running without load, its speed is approximately twice its full-load speed. The hoisting speed with an empty hook is, therefore, about twice that of the full-load speed. The induction motor furnished for alternating current may be of either the squirrel-cage or slip-ring type, the squirrel-cage motor being used with a single-speed control and the slip-ring type with a variable-speed control.

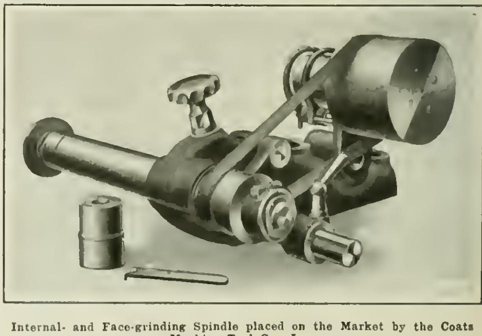
Either variable- or single-speed controllers are furnished, depending on the service in which the hoist is to be employed The variable-speed control for direct current offers eleven or thirteen running speeds, the number of speeds depending upon the size of the motor. Eight running speeds are possible with alternating current. The operating parts of the controller are fully enclosed from dust and moisture, but are readily accessible. The entire mechanism including the resistance may be removed from its case without disconnecting a single wire, and, likewise, the contacts and brushes may be removed without disturbing other parts of the controller. A single-speed control is afforded through a switch, the only function of which is to start, stop, and reverse the hoist mechanism. The hoist gearing consists of a double train of spur gears having either two or three speed reductions.

New Electric Hoist manufactured by the Shepard Electric Crane & Hoist Co.

A mechanical brake of the multiple disk type automatically holds the load when the motor is at rest, and prevents excessive speed in lowering, while an electric brake, also of the multiple disk type, brings the motor promptly to rest when the current is cut off or accidentally interrupted. An automatic limit switch prevents over-running of the load hook.

"FORTUNA" GRINDING SPINDLES

A line of spindles known as "Fortuna" designed especially for use in shops in which no grinding machine is installed has been placed on the market by the Coats Machine Tool Co., Inc., 110-112 W. 40th St., New York City. This line consists of a spindle intended for internal grinding, a second spindle for both face and internal grinding, and a third for vertical internal and face grinding. The spindles may be driven from a pulley similar to that illustrated, or by means

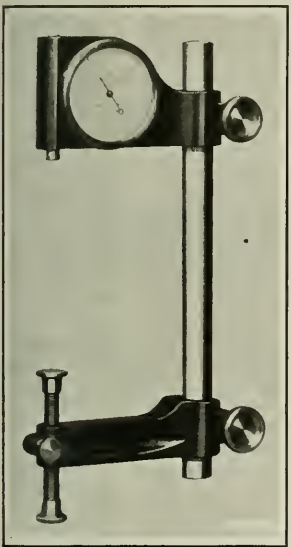


Internal- and Face-grinding Spindle placed on the Market by the Coats Machine Tool Co., Inc.

of a motor mounted on the clamping block. This block may be attached on the slide of a machine for feeding the grinding wheel across the work, it being especially suitable for use in connection with a lathe. The spindles are equipped with "Norma" ball bearings, and all attachments are readily interchangeable. The clamping block permits a quick reversing of the countershaft or the motor so as to enable work to be revolved to the left as readily as to the right. The construction of the attachment permits grinding wheels to be run at their maximum speeds.

HORSTMANN INDICATING CALIPER

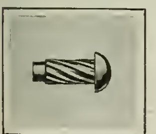
The extension-beam indicating caliper shown herewith is a modification of the indicating caliper placed on the market several years ago by the F. W. Horstmann Co., 196-210 Coit St., Irvington, N. J. The rear surfaces on the arms of the new instrument are machined flat, so that it may be used while lying on a flat surface. The device is employed for ascertaining the exact amount that work varies from a desired size. It is set by placing a piece of the desired length between the plunger of the indicator and the adjusting screw, and advancing the screw until the pointer of the indicator registers zero. Variation in the length of pieces can then be observed by noting the amount that the indicator pointer moves from the zero mark when pieces are placed between the screw head and the plunger. The distance between internal surfaces may be measured by reversing the arms on the beam. The beam is 6 inches long and ½ inch in diameter, but any necessary length can be substituted. Two of the classes of work for which the instrument is especially valuable are gaging across the face of large-diameter work in a lathe, or across wide pieces being machined on a planer.



Indicating Caliper made by the F. W. Horstmann Co.

PARKER NAMEPLATE "DRIVE-SCREW"

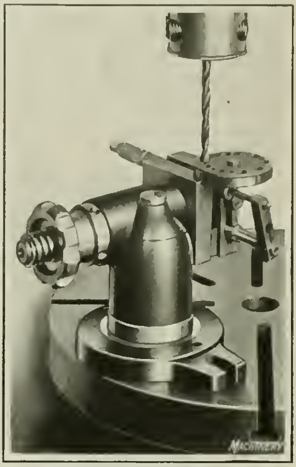
The "drive-screw" shown in the accompanying illustration was designed to present an easy and inexpensive method of permanently attaching nameplates, trademark plates, etc., to machine tools. The screw has a round head which is not slotted, threads of a very coarse lead, and a cylindrical pilot. In attaching a plate, holes slightly larger in diameter than the screw pilot are drilled into the part to which the plate is to be attached, and the screws are driven into place with a hammer. Owing to the fact that the screws are hardened and heat-treated, the threads readily cut their way into iron castings, and as the heads are not slotted, the screws cannot be easily removed in order to substitute another nameplate. This nameplate "drive-screw" is made by the Parker Supply Co., Inc., 793 E. 135th St., New York City.



Parker Nameplate Drive-screw

W. B. U. COMBINATION VISE, DRILL JIG AND MILLING FIXTURE

The W. B. U. Tool Co., 104 Harding St., Worcester, Mass., has recently brought out the combination vise, drill jig, and milling fixture here illustrated, which has been designed to hold work with accuracy. The vise is adapted for holding work on which two or more cuts are to be taken at different angles, and such operations can be accomplished without resetting the work. Both the jaw and swivel base are graduated through 360 degrees to facilitate angular settings. The equipment is especially suitable for use on machines where work can be tested with a square, directly from the work-table.

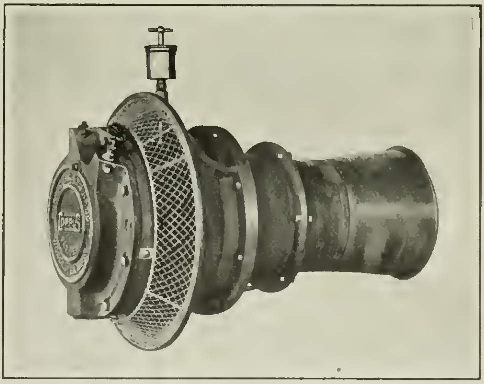


Combination Vise, Drill Jig, and Milling Fixture made by the W.B.U. Tool Co.

Part of the equipment is a solid drill bushing plate having eighteen holes ranging from 7/64 to ⅜ inch in diameter. The vise may be set for the drilling of round stock from 5/16 to 1 inch in diameter, which is held in a vee. By reversing the bushing plate, flat or square stock can also be drilled. The device is quickly adjusted by turning the screw. In filing work held in the vise, it is unnecessary for a toolmaker to remove the work frequently in order to ascertain whether it is being filed square.

COPPUS SCREW-BLADE PROPELLER BLOWER

A screw-blade propeller blower suitable for a variety of applications is being sold under the trade name of "Vano" by the Coppus Engineering & Equipment Co., Worcester, Mass. In the accompanying illustration this blower is shown arranged with a turbine drive, although an electric motor drive may also be supplied. Air is delivered from this blower in the same direction as that in which it enters. The principal feature is a stationary guide vane beyond the

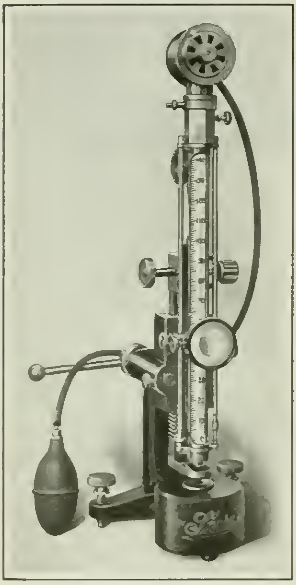


Screw-blade Propeller Blower brought out by the Coppus Engineering & Equipment Co.

propeller, which has individual blades that radially subdivide, without shock, the air current leaving the propeller. These blades, which have a curvature that increases in the direction of the propeller rotation, concentrate the air current and give it a further acceleration inside the stationary guide vane, so that a considerable portion of the pressure is produced in the latter. A large part of the end thrust is thus taken up by the stationary guide vane casing. The air streams into which the flow of air is subdivided by the blades rotate slightly as they leave the guide vane casing, and converge toward the axis so that the smallest section of the air flow is beyond the casing.

SHORE IMPROVED SCLEROSCOPE

A number of improvements have been made to the Model C scleroscope which has been manufactured by the Shore Instrument & Mfg. Co., Van Wyck Ave. and Carll St., Jamaica, N. Y., and the improved instrument is now known as "Model C-1." Among the new features is the provision of a special fine screen at the top which prevents dust from getting into the operating mechanism. A tungsten steel piston has been substituted for the leather piston previously supplied, the metal piston being unaffected by temperature and moisture and thus insuring a more uniform operation. The former rigid adjustments for the hammer hook mechanism have also been replaced by a flexible adjustment which greatly prolongs the life of the glass tube. The hammer hooks have also been provided with shock shoulders to eliminate breakage or misalignment of the parts. The improvements largely eliminate the disintegrating effects on the various members due to repeated shocks in testing and reduce the wear of parts.

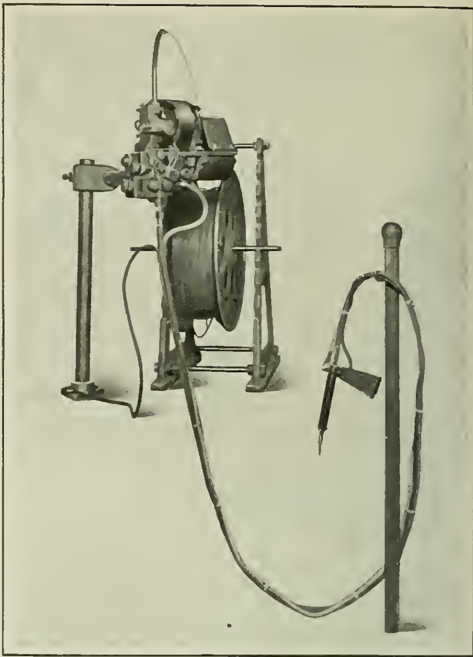


Improved Model C-1 Scleroscope made by the Shore Instrument & Mfg. Co.

GENERAL ELECTRIC SEMI-AUTOMATIC ARC-WELDING TOOL

A semi-automatic arc-welding tool has just been developed by the General Electric Co., Schenectady, N. Y., for use in conjunction with its automatic arc-welding head which was described in March, 1920, MACHINERY. This new device enables the operator to direct the arc as required by the conditions of the work. It is held by the operator, and acts as a guide for the electrode wire. The handle of the tool resembles that of an automatic pistol, and contains a switch for operating the control on the panel of the automatic welder, to start and stop the electrode wire movements.

Attached to the tool is a 10-foot length of flexible steel tubing, having an adapter on the other end for attachment to the automatic welding head. The electrode wire passes from the feed-rolls into the flexible tubing, and thence to the arc through a guide nozzle in the welding tool. With this new device, the automatic welder functions as usual, tending to hold the arc length constant, but the operator directs the arc as required by the particular job in hand.

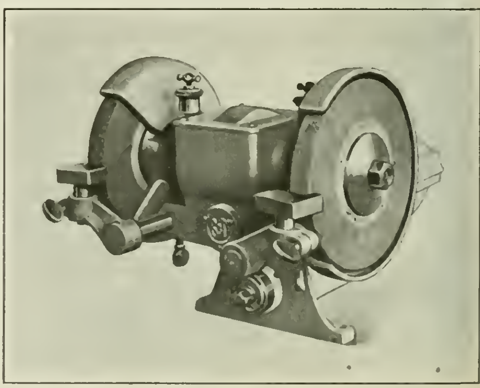


General Electric Arc-welding Equipment with Semi-automatic Lead

The field of application for this tool is work in which the seams to be welded are of irregular contour, or large work where the travel mechanism and clamping necessary for the full-automatic welder would be complicated. In many cases the edges of seams are not accurately prepared, so that there are gaps in some places and tight fits in others. The automatic welder cannot compensate for these conditions by varying the speed or by manipulation of the electrode, but with the semi-automatic arrangement this is taken care of.

BLACK & DECKER BENCH GRINDER

The 8-inch electric bench grinder shown in the accompanying illustration, which is a recent product of the Black & Decker Mfg. Co., Towson Heights, Baltimore, Md., is driven



Black & Decker Eight-inch Electric Bench Grinder by a ¾-horsepower motor of the universal type, similar to that supplied in portable electric drills manufactured by this company. The motor operates on either alternating or direct current. The grinding wheels are set well away from the motor casing and arranged to overhang the bench. This construction makes it possible to grind long pieces and odd shapes, and also enables the grinding wheels to be worn down to the clamping washers. The motor is air-cooled, the intake for the air being located 12 inches from the grinding wheels, a sufficient distance to eliminate the danger of grit being drawn into the machine. Grease is used as a lubricant throughout. This machine is supplied with one coarse and one fine grinding wheel, 8 inches in diameter and ¾ inch in width. Wheel guards, adjustable tool-rests, and an electric cable are also furnished as regular equipment.

NEW MACHINERY AND TOOLS NOTES

Nut Chamfering Machine: William H. Haskell Mfg. Co., Pawtucket, R. I. A machine made in two sizes for chamfering cold-punched square and hexagonal nuts, from ¾ to 2 inches. The nuts are placed in a chute at the front of the machine from which a feed-finger takes them, one at a time, and places them on a hardened steel die. Here they are chamfered and ejected into a truck or other receptacle.

Balancing Machine: Precision Balancing Machine Co., 3020 E. Franklin Ave., Minneapolis, Minn. A balancing machine adapted for a wide variety of work, including automotive crankshafts, flywheels, and parts readily mounted on arbors. It will receive bodies up to 24 inches in swing and 32 inches in length between bearings. The machine will give dynamic and static balance by two single corrections, individually measured and located near the ends of the body.

Portable Electric Grinding Machine: Arva Stroud, 327 Broadway, New York City. A portable electric grinding machine intended for use on any type of machine tool or in a vise for the accurate grinding of hardened parts. The machine is furnished in two models which are driven by ½- and 1-horsepower motors, respectively. The motors are of the universal commutator type operating on alternating or direct current. Grinding wheels 5 inches in diameter are supplied. The net weight of the machine is 22 pounds.

Cylinder Refinishing Machine: Bridgeport Cutter Works, Inc., 50 Remer St., Bridgeport, Conn. A portable electrically driven machine for reboring and refinishing automotive cylinders, which consists essentially of a sliding head supported on a guiding way carried on the top of the cylinder block by means of brackets. The guiding way may be adjusted in line with the center of the cylinder by means of an indicator. The sliding head carries a cutter-bar which is centered over each cylinder by the aid of an indicator.

* * *

RAILROAD RATES AND WAGES COMPARED

Data prepared by the Bureau of Railway Economics show that since 1915 the average increase in freight rates has been 78 per cent, while the total increase in wages of all classes of railroad employes has been 119 per cent. The figure given for the increase in freight rates is an average of all the schedules increased. It does not mean that the receipts for moving a given amount of freight actually increased by 78 per cent. On the contrary, the average receipts of the railroads per ton-mile increased from 0.722 cent in 1915 to 1.052 cents in 1920, or only 46 per cent, this being due to the fact that the rates were raised proportionately less on the classes of freight that are handled in the largest bulk by the railroads. The wage increase, on the other hand, was actually 119 per cent—the average annual compensation per employe having been increased from $830 to $1820 per year between 1915 and 1920. Hence the comparison should actually be based on a 46 per cent increase in ton-mile receipts by the railroads and a 119 per cent increase in wages.

INDUSTRIAL NOTES AND COMMENT

There have been considerable fluctuations in the iron and steel business during the past weeks, one week indicating a slightly increased output, partly due to an expectation of a reduction in freight rates, and another showing a slight falling off; but sufficient orders are on hand to keep the mills going at the present rate of production. There has been a much better demand from the railroads, orders for rails and cars demanding an increased output of the mills. The tinplate and sheet mills are particularly active. The ingot production during October was more than double that of July, according to reports from thirty companies to the American Iron and Steel Institute. Some of the independent companies in the Mahoning Valley are operating at 65 per cent capacity, the U. S. Steel Corporation averages 50 per cent, and the industry as a whole may safely be said to operate at from 40 to 45 per cent capacity. Several blast furnaces are preparing to resume operation in the Pittsburg district, and the export demand for steel, though still small, is better than at any previous time during the year.

The rumor of a merger of independent companies is becoming more persistent, and it is said that preparatory conferences have been held. The foreign trade in iron and steel and its products is mainly with non-European countries, Japan buying railway materials, sheets, and tinplate, while Argentina has placed large orders here for locomotives and other railway rolling stock and equipment.

Activity in the Automobile Industry

A very keen competition is expected in the automobile field next year, as the productive capacity is above the probable demand. The Department of Commerce reports improved outlook for exports of automobiles. A canvass made of the automobile industry indicates that it is now operating at from 30 to 50 per cent of normal capacity in the Detroit district, with the exception of the Ford plant, which is reported as operating at 80 per cent of its highest peak production. Reports indicate that farmers are buying more freely, both in the grain producing states and in the South.

During the first nine months of 1921, fifty-two passenger cars were reduced, on an average, nearly 20 per cent in price. The greatest reductions averaged 39 per cent for cars below $1000. For cars over $4000, the average reduction was 17 per cent. The average peak price of the fifty-two cars was $2344, and the average present price is $1890.

Railroad Traffic Indicating Increased Business

As is generally well known, the net earnings of the railroads have been quite satisfactory during recent months, due partly to the fact that the roads have spent less for maintenance than during the corresponding period of 1920. It is stated that nearly 200,000 freight cars are in need of repairs. On the whole, railway freight traffic has been quite satisfactory, and during one week in October, for the first time in 1921, the loadings of merchandise and miscellaneous freight (the group which includes manufactured goods) were heavier than in the corresponding week of 1920. The volume of traffic as a whole is now only about 10 per cent less than during corresponding periods in 1920.

Labor Conditions

A report of the Department of Labor and Industries in Massachusetts indicates better industrial conditions in New England, with unemployment from all causes reduced during three months from 25 to 20 per cent, and the amount of unemployment directly traceable to lack of work from 20 to 14.6 per cent. All the unemployment is not due to the industrial depression. The United States Department of Labor estimates that strikes and lockouts in the first half of the present year cost, in wages alone, $1,179,000,000. On the other hand, it is estimated that the direct wage loss due to unemployment because of lack of work amounts to about $4,000,000,000 a year.

STANDARDIZATION WORK OF THE GEAR MANUFACTURERS

In November MACHINERY in referring to the fall convention of the American Gear Manufacturers' Association, the comprehensive standardization program of the association was outlined. In addition to the standardization details there given, the association has formulated a program for the standardization of gearing materials and their treatment, electric railway and mine gearing, transmission gearing, and differential gearing. In order that the cooperation of engineers everywhere may be obtained, the details of this standardization program are given below. It is essential for any real standardization work in the gearing industry that the cooperation of the entire mechanical engineering field is obtained. Those who may desire to communicate with the association in connection with the standardization program should address B. F. Waterman, chairman of the general standardization committee, American Gear Manufacturers' Association, Brown & Sharpe Mfg. Co., Providence, R. I.

Standardization of Gearing Materials and their Treatment

(1) Carbon and alloy steel specifications—chemical and physical; (2) non-ferrous alloy specifications for the following purposes: bronze for spur and bevel gears, bronze for worm-gears, bronze for bushings, and brass for flanges of composition gears; (3) steel casting specifications—chemical and physical—in several carbon ranges for steels for use in casehardened, heat-treated, or untreated state; (4) gray-iron casting specifications—for gears only; (5) specifications of hardness limits which will be acceptable when purchasing bars, forgings, or castings of various chemical specifications; (6) consideration of burnt or badly overheated forgings; (7) recommended practice as to the hardening of hubs and bores to take ball and roller bearings; (8) recommended practice as to the combining of two gears or a gear and a clutch, in one piece; (9) recommended practice on under-cuts and reliefs to clear grinding wheels, and on the use of fillets and elimination of sharp corners; on the prevention of hardening trouble arising from keyways and oil-holes; and on obtaining clean threaded holes in hardened work; (10) recommended practice as to the hardening of bores and fork grooves of gears which slide on splined shafts; (11) recommended practice as to the prevention or control of shrinkage and warping in hardening; (12) report on methods of preventing scale, especially hard and adherent scale; (13) report on the economic factors governing the choice of bar stock, open-hammer forgings, drop-forgings, or upsetter forgings; (14) recommended practice for the inspection of forgings and castings—consideration of defects that call for rejection and those that call for a rebate; (15) recommended practice as to recording of heat numbers and the stamping of these numbers on gears to give the maximum of information without excessive complexity—proposal of standard A. G. M. A. system; (16) report on the design, construction, and operation of furnaces for the heat-treatment of gears; (17) report on pyrometry as applied to the gear industry, with recommendations; (18) report on microscopic examination of metals, as applied to the gear industry, with recommendations; (19) report on the testing of hardness; (20) recommended practice on the selection, test, and use of carburizing materials, and the design and use of carburizing pots; (21) recommended practice on "local" hardening as applied to gear work: (a) local carburizing, (b) local heating, (c) local quenching; (22) report on quenching mediums and quenching apparatus; (23) recommended practice as to depth of casehardening for different classes of gear work, giving consideration to the kind of steel, the tooth dimensions and the hardness; (24) report on researches on the relation of durability and wear of gears to hardness and other factors; (25) a standard nomenclature.

Standardization of Transmission Gearing

(1) Investigate the effects of Hotchkiss drive on transmission with and without slip joints on propeller shafts. Cooperate with Differential Committee on this work; (2) cooperate with other interested organizations to reduce to a minimum the number of bell housing sizes for unit power transmissions. In connection with this, the committee should work with the motor builders and the S. A. E. to establish reasonable manufacturing limits of parallelism and concentricity between flywheel, motor housing and transmission unit, power flange or clutch housing; (3) recommend proper center distances, width of face, pitch and pressure angles of gear teeth for a range of motor torques. Also cooperate with the Spur Gear Committee and the Metallurgical Committee in recommendation of steels; (4) investigate with all concerns who build transmissions, either for themselves or for the trade, any troublesome features in connection with either past or present construction, and report findings for the benefit of the A. G. M. A. in order to eliminate poor designs, either from trouble in the field or from manufacturing difficulties; (5) study and make recommendation for proper lubricants and proper methods of lubrication; (6) recommend proper shapes of gear blanks to reduce to a minimum manufacturing difficulties and heat-treating distortions; (7) recommend case wall thickness for the various types of transmissions and kinds of material; (8) work with the Tooth Form Committee in experimenting with and testing of any tooth form under consideration; (9) inspection.

Standardization of Differential Gearing

(1) Investigate effects of the Hotchkiss drive on differentials with and without slip joint on propeller shafts. Cooperate with Transmission Committee in this work; (2) investigate with all concerns who build differentials, either for themselves or for the trade, any troublesome features in connection with either past or present constructions and report findings for the benefit of the A. G. M. A. in order to eliminate poor designs either from trouble in the field or from manufacturing difficulties; (3) study and make recommendations for proper lubricants and proper methods of lubrication; (4) recommend proper shapes of gears to reduce to a minimum manufacturing difficulties and heat-treating distortions; (5) study the merits of close fitting differential inside gears and pinions, to reduce backlash to a minimum, tending to aid in reducing noise in rear axles, and establish limits based on a good manufacturing basis, in conjunction with the Spur and Bevel Gear Committees; (6) recommend properly designed mountings for differentials to insure load-carrying capacity to keep drive pinion and gear in proper mesh and correct alignment; (7) study effect of thrust on bevel drive pinion and also on bevel ring gear and recommend remedies to overcome any of the objectionable features, in conjunction with Bevel Gear Committee; (8) work with the Tooth Form Committee in experimenting with and testing of any tooth form under consideration; (9) possibility of the use of this committee in consulting way for the members of the A. G. M. A. who may require aid in solving some of their differential problems; (10) inspection in conjunction with the Inspection Committee; (11) cooperate with other interested organizations to reduce to a minimum the various types of differentials for automotive trucks, tractors, passenger cars, etc., to make for less models and greater production on those standardized.

Standardization of Electric Railway and Mine Gearing

(1) Nomenclature, symbols and formulas; (2) design of railway and mine gears in conjunction with other interested organizations; (3) tooth form in conjunction with Tooth Form Committee; (4) materials and treatments in conjunction with the Metallurgical Committee; (5) design of mountings; (6) lubrication.

PERSONALS

Walter E. Heibel, who for the last two years has been eastern district manager of the Wilmarth & Morman Co., Grand Rapids, Mich., has become connected with the New York office of the B. F. Sturtevant Co. at 52 Vanderbilt Ave.

Clyde E. Dickey, 233 Broadway, Woolworth Bldg., New York City, has been appointed sales representative for the Metropolitan District of New York City for the Peerless Drawn Steel Co., of Massillon, Ohio, manufacturer of cold-drawn screw stock, shafting and alloy steels.

C. H. Hobbs has been appointed assistant general manager of sales of the Detroit Seamless Steel Tubes Co., Detroit, Mich. Mr. Hobbs was connected with the Lackawanna Steel Co. for more than fourteen years, and for the last five years has been district representative in charge of the Detroit office.

Arthur G. Hertzler, who has been sales manager of the Bearings Co. of America, Lancaster, Pa., and connected with that firm in various capacities over a period of eighteen years, has left Lancaster, and will make his home in Salt Lake City, Utah. He has not yet announced his plans for the future.

F. T. Coup has been appointed district manager of the Cincinnati office at 20 E. 9th St., of the Wagner Electric Mfg. Co., St. Louis, Mo. Mr. Coup is well acquainted with the Wagner line of products, as he has been connected with the company for many years and was until recently in charge of its Milwaukee office.

Frank W. Trabold, for twenty years associated with J. H. Williams & Co., Brooklyn, N. Y., has terminated his connection with that company. Since 1909 Mr. Trabold has been successively sales manager, works manager, general manager, and vice-president. He is at present located at 30 Church St., New York City, but has not yet made definite plans for the future.

Henry R. Towne, chairman of the board of directors of the Yale & Towne Mfg. Co., and honorary member and former president of the American Society of Mechanical Engineers, has been elected honorary president of the Taylor Society. Mr. Towne is said to be the first engineer-executive to appreciate the genius of Frederick W. Taylor, the creator of scientific management.

J. H. Wilhelm, Lloyd E. Larson and John Cetrule, consulting engineers, 18 E. 41st St., New York City, have been elected president, vice-president, and secretary-treasurer, respectively, of the Triplex Machine Tool Corporation of New York, manufacturer of the Triplex line of combination machines. The new connection will not interfere in any way with their consulting engineering practice.

Fred E. Holtz has been appointed Milwaukee district representative of the W. A. Jones Foundry & Machine Co., Chicago, Ill., manufacturer of power transmitting machinery. Mr. Holtz assumes his duties immediately, making his headquarters in the First National Bank Building of Milwaukee. He has been associated with the company for the last two years, having been calling on Jones' customers in all lines of business throughout the United States.

Ernest Reich, formerly vice-president of the Hill Pump Valve Co., Chicago, Ill., and general manager of plant of the Chicago Pressed Steel Co., has recently returned from a seven months' survey of industrial conditions in Europe, and is now engaged in marketing domestic and foreign patents. Mr. Reich has also established connections for exporting novel manufacturing equipment, and would like to receive catalogues and quotations for such equipment, at his office 11 S. La Salle St., Chicago.

Leonard W. Kearns, for many years associated with the leather belting industry, has become affiliated with the sales organization of the Chicago Belting Co., Chicago, Ill. Mr. Kearns has been active in the leather belting business for twenty-two years, eighteen of which he was in the service of one company. He has been branch manager at Atlanta, Ga., Charlotte, N. C., and Chicago, Ill., and has sold belting throughout the United States and Cuba. He has a knowledge of the practical side of the industry, being a belting engineer, and has specialized in the belting requirements of saw mills, steel mills, woodworking plants, flour mills, and machine shops.

Stanley P. Rockwell, 65 Highland St., Hartford, Conn., has engaged in business for himself as a consulting metallurgist. Mr. Rockwell is a graduate of the Yale Scientific School and has had wide experience in the work which he is now undertaking, having been general foreman of heat-treatment and metallurgist of the New Departure Mfg. Co., Bristol, Conn., metallurgist with the E. F. Houghton Co., Philadelphia, Pa., district metallurgist and Captain of Ordnance of the United States Army, vice-president and general manager of the Weekes-Hoffman Co. of Syracuse, N. Y., and metallurgist of the Whitney Mfg. Co., Hartford, Conn. He will continue his association with the last-named company in an advisory capacity. Mr. Rockwell hopes to be able to serve the small concerns whose limited production does not warrant the continual attendance of a metallurgist. He is the inventor of the Rockwell hardness tester, and is also the author of a series of articles published in Machinery in 1920, under the title of "Carburizing and Casehardening," as well as other articles relating to heat-treatment.

OBITUARY

CHESTER L. LUCAS

Chester L. Lucas, advertising manager of Machinery for the Central West, died in Syracuse, N. Y., on November 3, following an operation for appendicitis, in the forty-first year of his age. Mr. Lucas became a member of Machinery's editorial staff in 1911, changing into the advertising department in 1918; and in both of these fields, differing widely, he achieved a marked success, due not only to his winning personality and sterling qualities of heart and mind, but to his unceasing efforts to serve his advertisers in practical ways. From all parts of the country have come to us letters showing the high regard in which he was held by his business friends.

Mr. Lucas was born in 1881 in Middleboro, Mass., educated in the public schools there and in Providence, and in 1899 moved to Bridgeport and entered the employ of the Schwerdtle Stamp Co. to learn the trade of engraving and die-sinking. After finishing his apprenticeship he went to work for the John Robbins Mfg. Co. of Boston, and afterward for the General Electric Co. in Lynn. While working at the General Electric plant he contributed a number of articles to Machinery on the subject of engraving and die-sinking. He was married in 1903 to Miss Ella M. Barnesa. His father and brother constitute the firm of J. L. Lucas & Son, Inc., of Bridgeport, in which firm he was financially interested. He was a 32nd degree Mason.

Mr. Lucas leaves a widow and three children, the eldest of whom is in the Exeter Preparatory School. To those with whom he was closely associated in Machinery's organization, who knew him so well and valued him so highly, his loss is a personal bereavement.

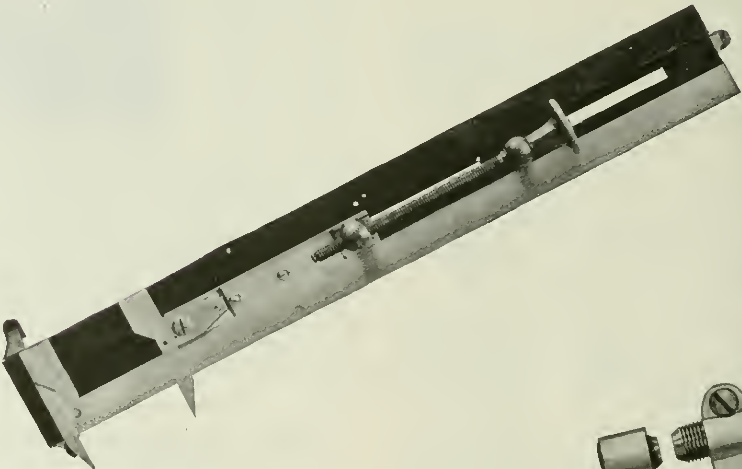
CIVIL SERVICE EXAMINATIONS FOR ENGINEERS, PHYSICISTS AND TECHNOLOGISTS

The United States Civil Service Commission announces open competitive examinations to fill vacancies in the Bureau of Standards. These include examinations for engineers, physicists, and technologists with salaries of from $2800 to $4000 a year; for associates with salaries of from $2000 to $2800 a year; and for assistants with salaries of from $1500 to $1800 a year. Applicants may qualify in electrical engineering, mechanical engineering, civil engineering, chemical engineering, ceramic engineering, radio engineering, engineering of materials, and any other specialized line of engineering. Those desiring to take the examination should apply for Form 2118, stating the title of the examination desired, to the Civil Service Commission, Washington, D. C. Examinations are also announced for junior engineers and junior technologists on January 11, March 8, and May 17. The salary for these positions is from $1200 to $1500 a year, and applicants should apply for Form 1312 to the Civil Service Commission, Washington, D. C.

THE FIRST PRECISION TOOLS IN AMERICA—1851

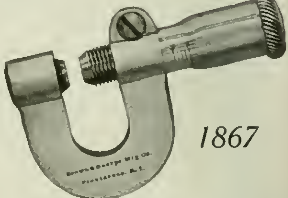
WHEN Joseph R. Brown of the Brown & Sharpe Mfg. Co. gave the world the invention of the Vernier Caliper, he established, 70 years ago, a World-wide Standard of Accuracy. In 1867, Mr. Brown and Lucian Sharpe introduced, in America, the first Micrometer Caliper.

The steadfast and satisfactory performance of these fine tools is a tradition maintained and protected by the conscientious efforts of skilled workmen.



1851

The first and original Vernier Caliper, so far as is known, invented by Mr. J. R. Brown in 1851—over 70 years ago.



1867

"The Pocket Sheet Metal Gauge." The first Micrometer Caliper in America—over 50 years ago—a Brown & Sharpe Product.

BROWN & SHARPE MACHINISTS' TOOLS

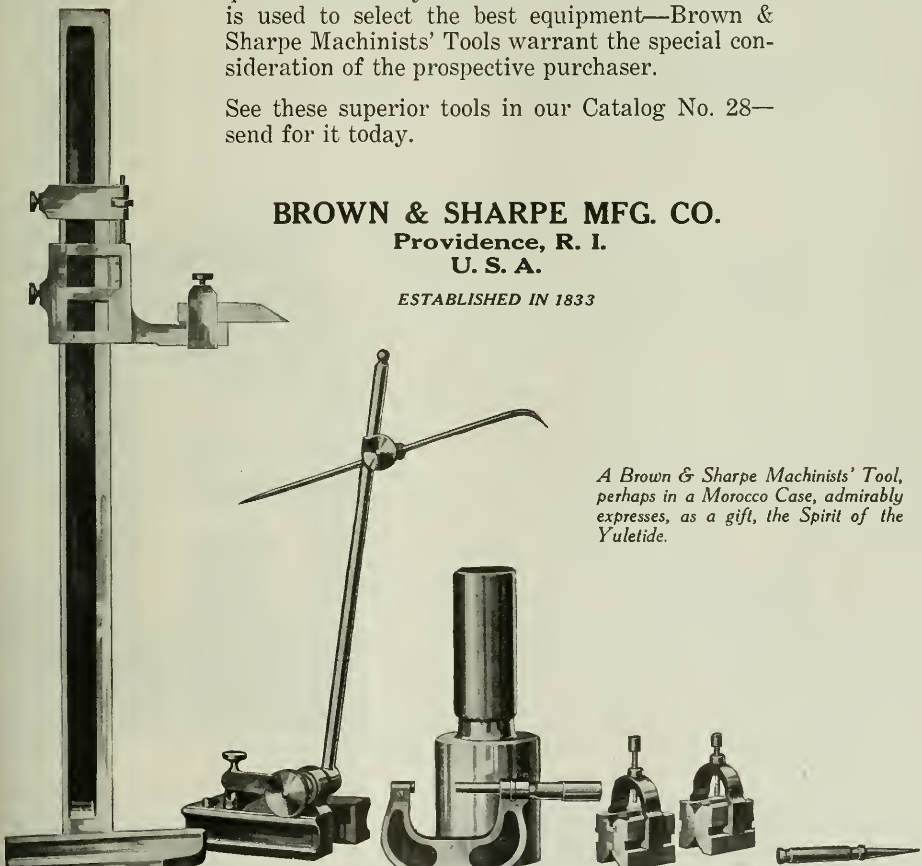
represent the accuracy and fine workmanship which only pride in product and experienced master craftsmen can accomplish.

When productive and efficient accuracy are as requisite to industry as now—when extreme caution is used to select the best equipment—Brown & Sharpe Machinists' Tools warrant the special consideration of the prospective purchaser.

See these superior tools in our Catalog No. 28—send for it today.

BROWN & SHARPE MFG. CO.
Providence, R. I.
U. S. A.

ESTABLISHED IN 1833



A Brown & Sharpe Machinists' Tool, perhaps in a Morocco Case, admirably expresses, as a gift, the Spirit of the Yuletide.

B.S
TRADE MARK

NEW BOOK ON BEARINGS

Bearings and Bearing Metals. 120 pages, 6 by 9 inches; 44 illustrations. Published by The Industrial Press, 140-148 Lafayette St., New York City. Price, $1.

Few subjects related to the design or construction of machinery are of greater importance than the subject of bearings. All classes of mechanisms have bearings of some kind, and bearings that are properly designed and constructed are a necessity. As every experienced mechanic knows, a poor bearing may tie up a machine or even cause an entire plant to shut down temporarily. Owing to the importance of this subject, designers and mechanics in general should understand the fundamental principles governing bearing design and should know what approved types are in common use on different classes of machinery.

This treatise deals exclusively with plain bearings, ball and roller bearings being covered in another book of this series. The types of plain bearings illustrated were selected to show how designs are modified to suit different conditions, and also practical methods of arranging bearings to insure adequate lubrication and thorough protection against the entrance of foreign material liable to injure the bearing surfaces. The designs illustrated were taken from actual practice and have proved satisfactory when properly constructed and applied. This treatise contains, in addition to the features mentioned, condensed information on compositions of various bearing metals, their properties, the classes of service to which different bearing alloys are adapted, and the general methods of procedure in designing plain bearings to meet different service conditions.

The book is divided into four separate chapters, the first one covering bearings of different types used in machine construction. The second deals with bearing metals, explaining the characteristics of different alloys and giving the composition of those most commonly used. The third chapter takes up the methods of lubricating bearings, and the last chapter deals specifically with the design of plain bearings.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912

of Machinery, published monthly at New York, N. Y., for October 1, 1921.

State of New York }
County of New York } ss.

Before me, a Notary Public in and for the state and county aforesaid, personally appeared Matthew J. O'Neill, who, having been duly sworn according to law, deposes and says that he is the treasurer and general manager of The Industrial Press, Publishers of Machinery, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, The Industrial Press, 140-148 Lafayette St., New York; Editor, Erik Oberg, 140-148 Lafayette St., New York; Managing Editor, None; Business Managers, Alexander Luchars, President, 140-148 Lafayette St., New York, and Matthew J. O'Neill, Treasurer and General Manager, 140-148 Lafayette St., New York.

2. That the owners of 1 per cent or more of the total amount of stock are: The Industrial Press; Alexander Luchars; Alexander Luchars, Trustee for Helen L. Ketchum, Elizabeth Y. Urban, and Robert B. Luchars; Matthew J. O'Neill; Louis Pelletier; and Erik Oberg. The address of all the foregoing is 140-148 Lafayette St., New York.

3. That there are no bondholders, mortgagees, or other security holders.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

MATTHEW J. O'NEILL, Business Manager

Sworn to and subscribed before me this 27th day of September, 1921.

(SEAL) WILLIAM E. BACON,
Notary Public, Kings County No. 444
Kings Register No. 3109
New York County No. 79
New York Register No. 3047
(My commission expires March 30, 1923.)

COMING EVENTS

December 1-3—Annual meeting of the Taylor Society in the Engineering Societies' Bldg., 29 W. 39th St., New York City. Secretary, Harlow S. Pearson, 29 W. 39th St., New York City.

December 6-9—Annual convention of the American Society of Mechanical Engineers in the Engineering Societies' Bldg., 29 W. 39th St., New York City.

January 11-14—Annual meeting of the Society of Automotive Engineers in New York City. Secretary, Coker F. Clarkson, 29 W. 39th St., New York City.

April 19-20—Annual meeting of the National Metal Trades Association in New York City; headquarters, Hotel Astor. Secretary, Homer D. Sayre, Peoples' Gas Bldg., Chicago, Ill.

April 24-29—Annual convention and exhibit of the American Foundrymen's Association in Cleveland, Ohio; headquarters, Cleveland Public Hall, Lakeside Ave. and E. 9th St. Secretary, C. E. Hoyt, 140 S. Dearborn St., Chicago, Ill.

May 8-11—Spring meeting of the American Society of Mechanical Engineers in Atlanta, Ga. Assistant Secretary (Meetings), C. E. Davies, 29 W. 39th St., New York City.

NEW BOOKS AND PAMPHLETS

Time Study and Job Analysis. By William O. Lichtner. 397 pages, 6 by 9 inches. Published by the Ronald Press Co., 20 Vesey St., New York City. Price, $6.

This work, dealing with time study and job analysis, is a timely one, in view of the present general interest in the question of reducing costs and increasing production. The aim of the book is to explain the practical application of time study and job analysis in simple non-technical terms. Special emphasis is placed upon the relation of standardization work to problems of management. The author shows how job standardization will increase productive ability, decrease labor turnover and enable manufacturing plants to earn greater returns. He shows how the work of standardization can be handled by training the clerical force already employed, and explains how to make the preliminary study, how to take the time study data, how to determine the rates on operations, and how to apply standardization. He also discusses job standardization in relation to industrial problems. There are six appendixes to the book, in which are given concrete examples of job analyses.

Drawing-room Practice. By Frank A. Stanley. 253 pages, 6 by 9 inches. Published by the McGraw-Hill Book Co., New York City. Price, $2.50.

The making of drawings, from the simplest constructions to complete assembly and working drawings of various classes, is dealt with in this book. Because of the difficulty often experienced by students in visualizing the parts to be drawn, use has been made of photographic views of different classes of machine parts, together with actual working drawings. Besides material for the beginner, chapters are included for experienced draftsmen regularly engaged in the production of working drawings, as, for example, the chapters dealing specifically with tool drawings and limit dimensions on working drawings. The thirteen chapters in the book treat of the subject under the following headings: Drawing Instruments and their Uses; Projection; Practical Applications of the Principles of Projection; Development of Surfaces—Intersections; the Helix and its Applications; Screw Threads in their Conventional Forms; Showing Detail Parts—Sections; Parts and Sections in Assembly Drawings; Working Drawings; Working Drawings of Small and Medium Sized Parts; Tool Drawings; Limit Dimensions on Drawings; and Isometric and Oblique Drawings—Shop Sketches.

Machine Drawing. By Carl L. Svensen. 214 pages, 6 by 9 inches; 388 illustrations. Published by the D. Van Nostrand Co., 8 Warren St., New York City. Price, $2.25.

This book has been prepared as a text book for technical students and draftsmen who have had previous instruction in mechanical drawing but who desire to take up advanced work. It is intended to serve as a guide for the development of an understanding of the relation of machine drawing to engineering. The text is made as brief as a clear presentation of the subject matter permits. A chapter on elementary principles is given as an introduction to the course and for review purposes. Working drawings, drafting-room practice, and idiomatic expressions of the engineering language are discussed, following which there is a chapter on the principles and practice of dimensioning. A study of the common machine details, empirical machine design, jigs and fixtures, etc., is included. About two hundred problems are presented to be worked out by the student, and these are conveniently grouped in the last chapter. The necessary instructions and references to the text are given to enable the student to work out any of the problems. The problems are presented by lay-outs or other specifications so that the instructor is relieved of the preliminary details which ordinarily arise in assigning machine drawing studies.

Waste in Industry. 409 pages, 6 by 9 inches. Published by the Federated American Engineering Societies, Washington, D. C. Sole Selling Agent, McGraw-Hill Book Co., Inc., New York City. Price, $4.

This book comprises a report of the Committee on Elimination of Waste in Industry appointed by the Federated American Engineering Societies to investigate causes of waste in industry. The report is the result of five months of intensive study. It covers an analysis of waste in six typical branches of industry, as follows: Building industry, men's clothing manufacturing, shoe manufacturing, printing, metal trades, and textile manufacturing. The report on the metal trades industry, which is of particular interest to the machine tool field, was written by Fred J. Miller, assisted by William B. Ferguson, and covers present unemployment, extent of the industry, and major causes of waste. It was found that the principal causes of waste are instability of labor employment; inefficient management; restrictive labor organization rules or customs; waste of materials through the lack of a well organized inspection system or lack of training of workers; and lack of thorough research work. In compiling the material covering the metal trades' industry, thirty-two plants were visited and field reports were made out for seventeen plants. In addition to the field reports made in the six industries mentioned, general reports are included on unemployment, strikes and lockouts, legal machinery for settling disputes, industrial accidents, health of industrial workers, eye conservation, and purchasing and sales policies. These general summaries were made from available information compiled by statisticians, economists, and others.

NEW CATALOGUES AND CIRCULARS

New Departure Mfg. Co., Bristol, Conn. Sheet 140 FE for loose-leaf binder, showing application of New Departure ball bearings in can seamers.

R. G. Haskins Co., 27 S. Desplaines St., Chicago, Ill. Circular outlining the constructional features of the Haskins die-filing machine, which is designed to eliminate the delay and expense of filing dies, templets, tools, etc., by hand.

Truscon Laboratories, Detroit, Mich., are issuing a monthly publication known as "The Maintenance Engineer," treating of such maintenance problems as rustproofing steel, protecting concrete against moisture, waterproofing processes, etc.

Sebastian Lathe Co., Cincinnati, Ohio. Catalogue 26, illustrating and describing the Sebastian line of engine lathes which includes two types, the Type S lathe being made in sizes of 13, 15, and 18 inches, and the Type M in 13- and 15-inch sizes.

Benjamin E. Jarvis, Inc., Newark, N. J. Pamphlet entitled "Right to the Line," illustrating the Jarvis portable motor-driven bench band saw for use in automobile body factories, pattern-making shops, manual training schools, and other places requiring a wood-cutting saw.

E. Horton & Son Co., Windsor Locks, Conn., is publishing a series of drill chuck circulars containing descriptive material covering the Horton-Morrow hand-operated ball bearing drill chuck, Horton geared drill chucks with hardened bodies, and Horton two-jaw drill chucks.

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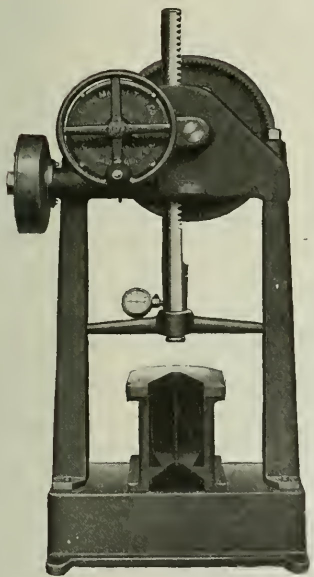

Illustrated Circular
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LUCAS MACHINE TOOL CO. NOW AND ALWAYS OF **CLEVELAND, OHIO, U.S.A.**

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry. Societe Anonyme Belge, Alfred Herbert, Brussels. Aux Forges de Vulcain, Paris. Allied Machinery Co., Turin, Barcelona, Zurich. Benson Bros., Sydney, Melbourne. V. Lowener, Copenhegen, Christiania, Stockholm. R. S. Stokvis & Zonen, Rotterdam. Andrews & George Co., Tokyo.

Ilg Electric Ventilating Co., 2850 N. Crawford Ave., Chicago, Ill. Circular entitled "Correct Ventilation—That's What Our Men Needed," showing the application of Ilg electrically driven blowers and fans for the ventilation of factories, offices, laboratories, etc.

Smalley-General Co., Inc., Bay City, Mich. Circular containing a number of time studies showing the time required for producing six different parts on the Smalley-General No. 23 thread milling machine. A time study is also given of the threading of a rotary tool joint on the Smalley-General No. 1 thread miller.

Ingersoll Milling Machine Co., Rockford, Ill. Circular illustrating and describing a special heavy Ingersoll adjustable-housing milling machine designed for large and heavy work, the main bed of the machine being 27 feet long, the width over all 31 feet 10 inches, the over-all height 15 feet 4 inches, and the weight 150,000 pounds.

Pawling & Harnischfeger Co., 38th and National Aves., Milwaukee, Wis. Bulletin descriptive of the P & H No. 6 radial wall drill, which has been designed to meet the demand for a simple machine for drilling, reaming, and countersinking large unwieldy pieces, such as structural shapes, boiler plates, long beams and similar bulky objects.

Oilgear Co., 60 Twenty-seventh St., Milwaukee, Wis. Catalogue treating of variable-speed hydraulic power transmissions and illustrating installations of these drives on different types of machines. The Oilgear feed control system comprises a variable delivery oil-pump driven from any available source of power and an oil-motor driven by pressure from the pump.

Whiting Corporation, Harvey, Ill. Catalogue 158 (superseding No. 151) illustrating and describing Whiting standard crane designs, including electric traveling cranes, bucket-handling cranes, gantry cranes, jib cranes, pillar and bracket cranes, and lifting attachments. Tables of clearances for electric traveling cranes and for hand-power cranes are included.

Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. Leaflet 3665, containing data on motors for elevator service, including formulas for selecting motors for this class of service. Leaflet 1732, illustrating and describing enclosed floating switches used on motor-operated pumps for automatically maintaining a water level in open tanks. Leaflet 1950, discussing the advantages of electric drive for power pumps.

Davis-Bournonville Co., Jersey City, N. J. Circular illustrating and describing the Davis-Bournonville new garage and small machine shop welding torch and carrying case outfit. This equipment affords the small shop a convenient means for repairing broken steel, cast-iron, aluminum, copper, brass, and other metal parts. Instructions for setting up and adjusting the apparatus for welding are included.

Stanley P. Rockwell, 65 Highland St., Hartford, Conn., consulting metallurgist and specialist in the heat-treatment of steel, has published a circular containing questions and answers intended to give prospective clients an idea of the work in which he is engaged, and his previous experience. The circular also reproduces a number of letters of recommendations from firms in the metal-working and allied industries.

Chicago Pneumatic Tool Co., 6 E. 44th St., New York City. Bulletin 710, describing the details of construction of the Chicago pneumatic dry vacuum pumps which are made in steam-, belt-, and motor-driven styles. Tables of capacities, speeds, and general dimensions are given for the different classes of machines produced. Special publication No. 674, giving complete specifications for pneumatic hammers, drills, grinders, rammers, and air hoists.

Vanadium-Alloys Steel Co., Latrobe, Pa., is distributing to the trade a reference card containing suggestions for the tool hardener. The card is 8½ by 11 inches in size, made of heavy cardboard and is provided with a cord so that it can be hung on the wall of the hardening room or the tool-room. On the front of the card are given thirty-seven "tips" for the tool hardener, and on the back are listed the various grades of tool steel made by the company.

Gardner Machine Co., Beloit, Wis., manufacturer of disk grinding and polishing machinery and accessories, has published a new sixteen-page booklet containing complete instructions for the proper setting up and use of the Gardner improved abrasive disk. This pamphlet will undoubtedly prove of use to all who are using this improved disk. Two-color circular entitled "The Gardner Improved Abrasive Disk," treating of a heavy abrasive disk manufactured by this company.

Smith & Mills Co., Cincinnati, Ohio. Catalogue 2, containing specifications of the different sizes of pillar type shapers made by this company. The plain crank shapers are made in three sizes of 12, 14, and 16 inches; the back-geared cone drive crank shapers in 16-, 20-, and 25-inch sizes; and the back-geared single-pulley drive shapers in sizes of 28 and 32 inches. The pamphlet also contains a detailed description of the various parts of the machines, and the attachments supplied.

Precision & Thread Grinder Mfg. Co., 1 S. 21st St., Philadelphia, Pa. Circular describing in detail the method of setting and operating the precision thread lead variator, which is used on lathes in conjunction with the multi-graduated precision grinder of this company's manufacture for producing threads with precision leads. By the use of the variator, leads can also be elongated sufficiently to compensate for shrinkage in hardening, and metric threads or threads of unusual lead can be cut.

Vacuum Oil Co., 61 Broadway, New York City. Booklet containing information compiled by the technical department of the company, covering the principle, construction, operation, and lubrication of the surface-ignition type of oil engines. Booklet containing technical data on the mechanical principles, construction, operation, and lubrication of stationary steam engines, as well as information on boiler plant and steam production. Copies of these books will be sent to those interested upon request.

National Acme Co., Cleveland, Ohio. Calendar for November 1921-November 1922 containing on each page, calendar for the current month and the preceding and following months as well as a view of the machines and tools made by this company, including Acme multiple-spindle automatic screw machines, "Namco" self-opening die-heads, Gridley single-spindle automatic turret lathes, "Namco" plain and castellated milled nuts, screw products, "Namco" collapsing taps, and Gridley piston and piston-ring machines.

Collis Co., Clinton, Iowa. Bulletin A, illustrating and describing the "Wonder" quick-change chuck for drilling and tapping machines. Price lists of the chucks, collets, and bushings are included. Bulletin E, containing price lists and capacities of Collis drill chuck arbors which are made to fit any size drill chuck requiring an arbor, and which are furnished with standard taper shanks, Brown & Sharpe, straight, or special tapers. Catalogue 10, containing dimensions and price lists of "Use-em-up" drill sleeves and sockets, drill drifts, lathe centers, lathe bushings, and arbors.

Garrison Machine Works, Dayton, Ohio. Catalogue illustrating and describing the construction and workmanship of the Garrison precision pitch-line control gear chucks, by means of which spur, helical, internal, sprocket, and bevel gears are automatically chucked true with the pitch diameter, thus insuring concentricity of the gear, regardless of errors in turning or mounting on the arbor of hobbing or generating machines. Specifications are given for the different styles of chucks. Circular of Garrison gear chucks, showing how the use of these chucks enables production to be increased and reduces the size of the scrap pile because of the precision control.

Simmons Method-Hob Co., Second St. and Duncannon Ave., Philadelphia, Pa. Catalogue containing tables of sizes and prices for Simmons method-hobs, which are provided with generated teeth of different forms for hobbing gears of various types. The tables give data for hobs used on Adams-Farwell machines, Barber-Coleman No. 12 machines, Lees-Bradner main cutter-arbors, Lees-Bradner fast cutter-head machines, Gould & Eberhardt machines, and Schuchardt & Schutte machines. Tables are also given of dimensions for B & S standard 14½-degree gear tooth parts, gear shaper 14½-degree system, gear shaper stub tooth system, and gear tooth and hob tooth parts for the Simmons standard involute system.

National Tube Co., Pittsburg, Pa. Bulletin 13, treating of National hammer-weld pipe. This circular contains a detailed description of the manufacture of lap-weld pipe 24 to 96 inches in diameter by hammer-welding illustrated with views showing the various steps in the process. Following the article on manufacture is an outline of the characteristics of hammer-weld pipes, including physical properties, bursting and collapsing strength, carrying capacity, and comparative discharge rates. The bulletin also discusses installation advantages, protective coatings, joints, and uses of hammer-weld pipe. Complete specifications of the different sizes are given, as well as tabular material and formulas relative to the flow of water in pipes.

Garrison Gear Grinder Co., Dayton, Ohio. Circular describing the features of construction of the Garrison gear grinder, which is designed for generating and grinding the teeth of hardened gears. By the use of this machine, tooth contours of any pressure angle can be generated, the correct contour and size being automatically produced after the diamonds are set and the wheel dressed to grind teeth of the desired size and pressure angle. The advantages claimed for this machine are use of only one wheel; elimination of precision adjustments; economy and strength of wheel; generation of teeth of correct contour and size; elimination of heat; accurate indexing of work; simplicity of operation; durability; and elimination of finishing cuts ordinarily taken on gear-cutting machines.

Eastern Machine Screw Corporation, 23-43 Barclay St., New Haven, Conn. Catalogue descriptive of the H & G self-opening die-heads, containing 96 pages of material, completely indexed, and approximately 51 illustrations. The book is wider in scope than a regular catalogue, containing also data which should be useful to the man working out threading problems. It describes in detail the features of construction of the H & G die-heads, and gives sizes and capacities of the four types, which comprise the Style A rotating die-head, the Style B "Ford Special," the Style C non-rotating type, and the new Style D die-head for use on Brown & Sharpe automatics. The single-spindle and double-spindle H & G threading machines are also described. A special section is devoted to the chasers for H & G die-heads, and information on ordering the heads and chasers is included. Operating instructions are given, as well as complete instructions for grinding chasers, the latter being a new feature of this edition of the catalogue. Another of the products illustrated and described is the H & G chaser grinder. The last section of the book entitled "Useful Information" contains data pertaining to standard threads, decimal equivalent tables, and tables giving weights of cold-drawn steel screw stock, and cutting speeds.

TRADE NOTES

Seneca Falls Foundry Co. has recently rented the foundry of the Seneca Falls Mfg. Co., Inc., Seneca Falls, N. Y., manufacturer of "Star" engine lathes and "Short-cut" lathes.

Peerless Machine Co., 1611 Racine St., Racine, Wis., announces that a substantial reduction has been made in the price of Peerless high-speed saws, effective October 20. Revised price lists have been issued.

William S. Walker Co., Park Bldg., Pittsburg, Pa., advertising agent, has opened an office at 340 Leader-News Bldg., Cleveland, Ohio, which will operate for the present as a sales office and by the first of the year will be used as a service office.

Cincinnati Hy-Speed Machine Co., Cincinnati, Ohio, has made an exclusive selling arrangement with the Niles-Bement-Pond Co., 111 Broadway, New York City, covering the full line of "Hy-speed" products. Circulars of "Hy-speed" drilling and automatic tapping machines are now ready for distribution.

Joseph T. Ryerson & Son, Jersey City, N. J., have moved their general offices from 30 Church St., New York City, to their plant office building, West Side Ave., Jersey City, and request that all correspondence be sent to that address. The company will continue to maintain its sales and export offices at 30 Church St.

Loy & Nawrath Co., 21 Runyon St., Newark, N. J., manufacturer of power brakes, squaring shears, miter presses, and forming and miter dies, has opened a New York office in the Hudson Terminal Bldg., 30 Church St., Room 1922. The telephone number is Cortland 6297. All correspondence should be addressed to the New York office.

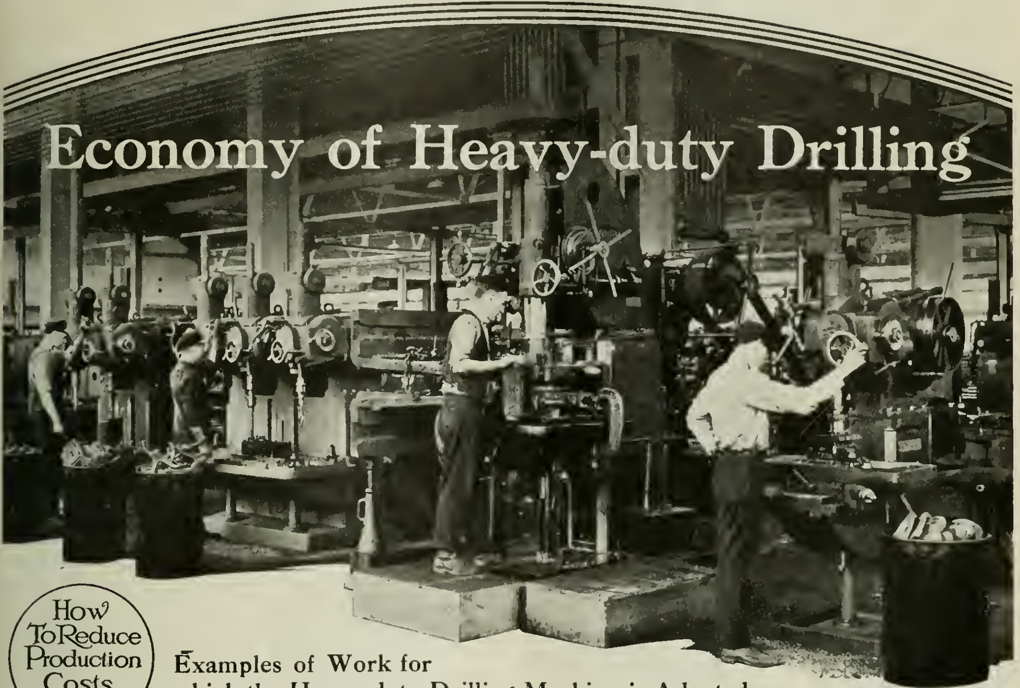
Coats Machine Tool Co., Inc., World's Tower Bldg., 110 W. 40th St., New York City, has obtained the exclusive agency in the United States for the original Hirth minimeter and "Fortuna" internal and face grinding spindles. The supply of Hirth minimeters in this country was discontinued at the outbreak of the war in 1914, and users will be glad to know that they can now obtain these instruments in the United States.

Timken Roller Bearing Co., Canton, Ohio, was one of the exhibitors at the National Exposition of Mines and Mining Equipment, held in conjunction with the recent convention of the American Mining Congress in Chicago. The Timken exhibit showed the application of tapered roller bearings in the mining industry. Mine car axles equipped with Timken tapered roller bearings were features of the exhibit, and samples of bearings were also shown.

Arrow Machinery Co., 234 N. Third St., Philadelphia, Pa., has been organized to deal in machine tools, shop equipment, and small tools, and would like to receive catalogues, price lists and dealers' discount sheets from manufacturers. W. A. Heilprin, head of the company, has been a manufacturer of sheet-metal specialties for many years, and was maker of the "Columbian Safety" air gun. He was also manager of the Metalform Tool & Stamping Co., manufacturer of jigs, fixtures, tools, and dies.

Rockford Tool Co., 2400 Eleventh St., Rockford, Ill., has appointed the Crane Machinery Co., 501 Morgan Bldg., Buffalo, N. Y., exclusive distributor of the Sundstrand 9-inch manufacturing lathe in the Buffalo territory. The Crane Machinery Co. will also represent the Rockford Milling Machine Co. in Buffalo. The Aumen Machinery Co., 107 E. Lombard St., Baltimore, Md., has been appointed exclusive distributor for the products of the Rockford Milling Machine Co and the Rockford Tool Co. in the Baltimore territory.

Wetmore Mechanical Laboratory Co., 129 Michigan St., Milwaukee, Wis., which was organized in 1915 by Charles P. Wetmore and P. B. Rogers is again actively engaged in engineering and manufacturing work. This company designed and manufactured the Wetmore inserted-blade expanding reamer which was used in the production of shells during the war, and later developed commercial reamers of this type. The company will now devote its efforts to developing mechanical devices and to perfecting manufacturing methods, including jigs, fixtures, and tool work; it is also handling contract manufacturing work, as well as die and screw machine work. The president of the company is Charles P. Wetmore, and the secretary and treasurer, P. B. Rogers. Mr. Wetmore will be in charge of the mechanical work.



Economy of Heavy-duty Drilling

How To Reduce Production Costs ?

Examples of Work for which the Heavy-duty Drilling Machine is Adapted

By FRED R. DANIELS

THE heavy-duty manufacturing type of drilling machine is especially useful as a production machine when accuracy is one of the main considerations. In this type of machine the work is located on a substantial foundation so that it will withstand the thrust produced by the powerful drive. The present article deals with the use of The Colburn Machine Tool Co.'s heavy-duty drilling machine for work where heavy cuts are required. This machine is built either in single units or in gangs, and the examples here given include both types.

The two-spindle machine is particularly suited to machining work such as motor-truck axles, on account of the possibility of adjusting one spindle unit so that the center distance will agree with the spacing of the holes in opposite ends of the work, thus eliminating the necessity of reversing the work. One operator can handle the work alone. Fig. 1 illustrates the application of a two-spindle Colburn heavy-duty drilling machine for machining truck axles in the plant of the Timken Detroit Axle Co., Detroit, Mich. The operations consist of drilling and reaming the 1⅛-inch diameter holes at each end and counterboring a large hole in the lower arm of the steering-knuckle yoke. These axles are produced at the rate of four per hour. The arrangement for adjusting the center distance in these machines, when handling work of this class, is illustrated in Fig. 3. The dotted outline at the base shows the position when the minimum center distance of 44 inches is obtained. This may be increased to a maximum of 63 inches by simply turning the handwheel that actuates the right-hand unit through the medium of worm-gearing.

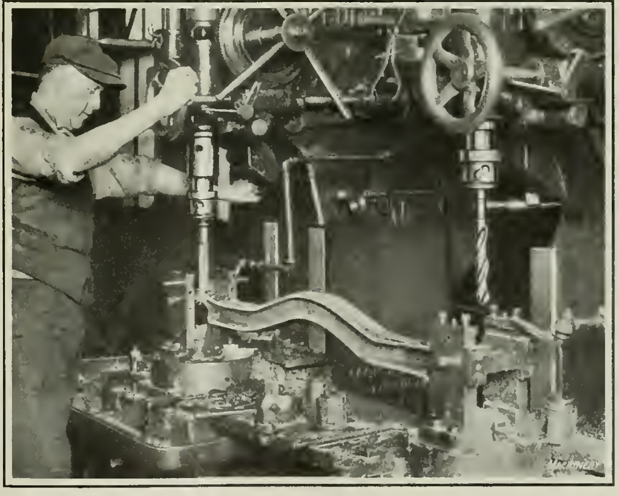


Fig. 1. Two-spindle Drilling Machine machining Motor-truck Axles

The three-spindle No. 2 Colburn manufacturing drilling machine illustrated in Fig. 5 is employed by the Tokheim Oil Tank & Pump Co., Fort Wayne, Ind., for machining cast-iron pump cylinders. The operations consist of boring, reaming to 3¾ inches

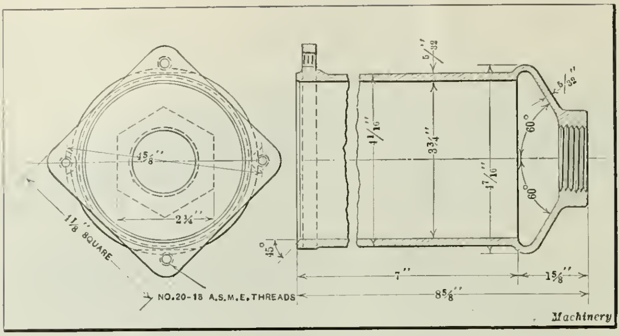


Fig. 2. Pump Cylinder machined with Set-up illustrated in Fig. 5

diameter, and facing the open end of the cylinder. A detail view of this cylinder is shown in Fig. 2, from which the nature of the work performed may be better understood. From Fig. 5 it will be seen that the cylinders are chucked in special sliding fixtures so that after the hole has been bored under the first spindle, the fixture may be slid forward to an auxiliary table, which carries it to the right, and it is then slid back under the second spindle for reaming. This arrangement enables the operator to keep the three spindles constantly at work and to so time the feed of each spindle that as soon as the work has been faced under the third spindle it can be removed and replaced with a rough casting, which is transferred to the first spindle to undergo the same series of operations. The track on which the fixture carriages ride extends at the end of the machine a sufficient distance to permit the end carriage to clear the end spindle entirely when unloading, so that the fixture carrying the reamed casting may be advanced for facing.

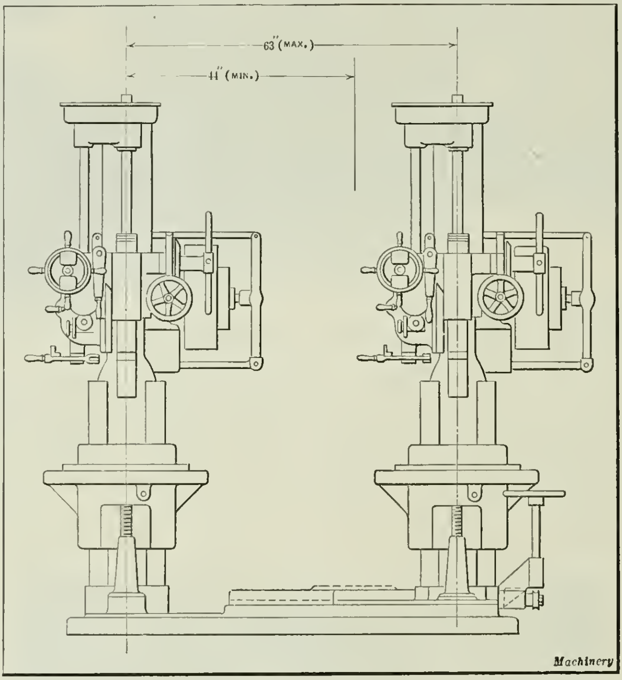


Fig. 3. Diagram showing Provision for adjusting Center Distance of Spindles

For driving large boring-bars, reamers, and other tools where a powerful drive is employed and the tools are run at their maximum recommended speed, the noses of the spindles are slotted to accommodate a driving lug on the shank of the tools. The spindle speed employed for the operation described in the foregoing is 80 revolutions per minute, and the feed 0.012 inch per spindle revolution. This special equipment enables a production of eight castings per hour to be attained. This job is not primarily a drilling machine operation; therefore, the increase of the output per operator by the use of this special drilling machine arrangement, lends considerable interest to the job from the aspect of reducing manufacturing costs through greater production.

Cutting Acme Threads

The elevating screw nut used in the construction of the Colburn boring mill has a left-hand Acme thread, four threads per inch, which was formerly produced by chasing on a lathe. The work is now being performed on a drilling machine, using an angle-plate fixture to which the work is strapped, as shown in Fig. 6. These nuts are made of cast iron, and they are first drilled and reamed to 1.3125 inches in diameter, after which three taps (two roughing and one finishing) are run through the reamed hole to produce the Acme thread. The outside diameter of this thread is 1 9/16 inches. For drilling, a speed of 240 revolutions per minute is used, with a feed of 0.016 inch per revolution. For reaming, the speed is 45 revolutions per minute, and the feed 0.035 inch per revolution. The production time by this method of machining is six pieces per hour; whereas when the work was done on a lathe only seven castings were produced in a nine-hour day.

Machining Lever Brackets

For machining cast-iron lever brackets, such as those shown on the table of the machine in Fig. 7, a box-type jig is used which is designed to accommodate both right- and left-hand castings and also to permit the use of a box-tool for turning the end of one bearing on this casting. A plan view of this fixture showing the position of the casting, as well as the provision for handling opposite-hand castings is shown in Fig. 4. The work is located against one of the studs *A*, and is fastened to the side of the fixture by two hook-bolts *B* which reach over the foot of the casting and secure it in position after the set-screw at the end of

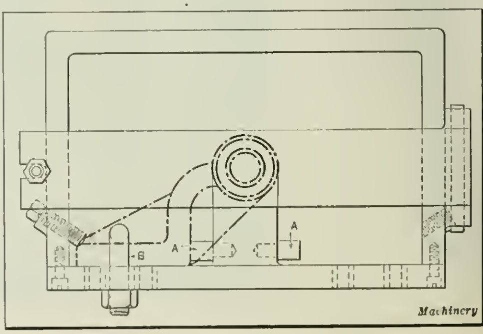


Fig. 4. Box Jig used in Operation illustrated in Fig. 7

the jig has been tightened against the end of the casting, locating it firmly against stud *A*.

With the work thus located and the cover fastened down, a hole 1⅛ inches in diameter is drilled and reamed through both bearings of this bracket, after which the cover is thrown back and a box-tool is employed to rough- and finish-turn the outside diameter at one end of the casting. This is the operation illustrated in process in Fig. 7. The diameter of this turned end is 2¼ inches, and the length 1¼ inches. The next operation is that of spot-facing the inside of each bearing, using a double facing tool which is fastened to the cutter-bar after it has been run down through the two reamed holes, so that the cutter is located between the two surfaces to be finished. The cutter is first fed up and then down, and its use assures parallelism of these two faces.

With the work still in position, the jig is turned on its side and four 17/32-inch holes are drilled and spot-faced in the foot of the casting. The jig is open at the back, so that as it is turned over, the chips fall out, thus overcoming the objection commonly raised to the use of box fixtures. For the 1⅛-inch hole, the drill speed is 300 revolutions per minute and the feed 0.018 inch per spindle revolution; for reaming, the speed is 45 revolutions per minute and the feed 0.035 inch. For turning the 2¼-inch diameter, a spindle speed of 160 revolutions per minute is employed with a feed of 0.018 inch per revolution. For the 17/32-inch holes in the foot, the drilling speed is 430 revolutions per minute, and the feed 0.15 inch. The production time is five brackets per hour.

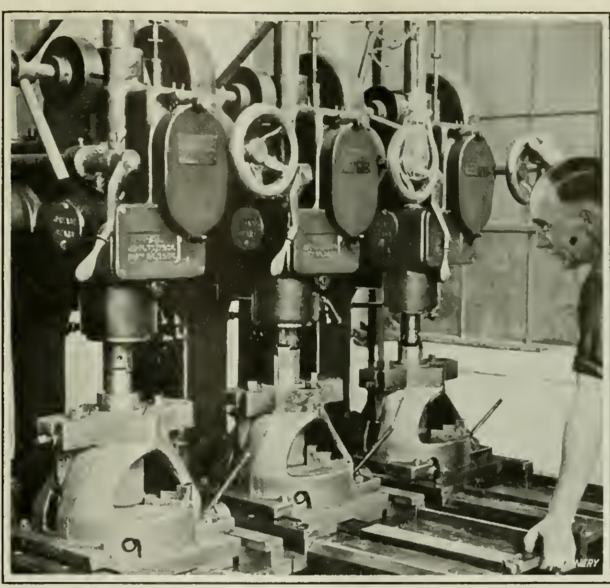


Fig. 5. Three-spindle Heavy-duty Drilling Machine with Track for moving the Jigs from Spindle to Spindle

Special Tooling for Multiple-spindle Drilling Machines

The three-spindle heavy-duty Colburn drilling machine illustrated in Fig. 8 is equipped with a special auxiliary table, which is fastened to the regular table and carries a parallel against which the jigs are guided as they are traversed from station to station. The jigs are provided with rollers for advancing them to the various spindle positions,

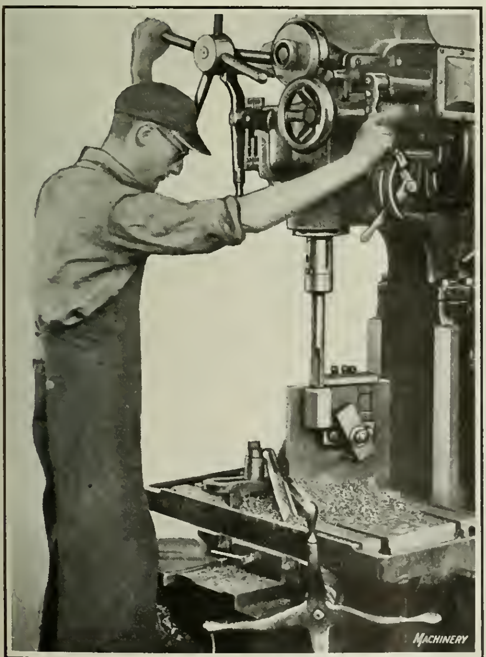


Fig. 6. Tapping Acme Threads by the Use of Three Taps

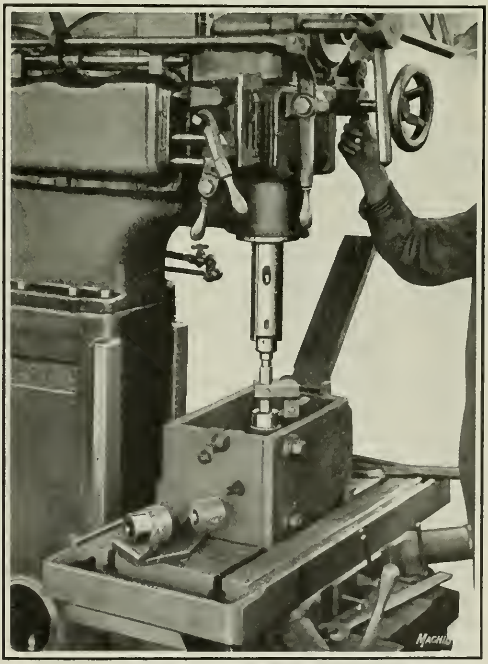


Fig. 7. Turning Hub of Cast-iron Bracket with Box-tool

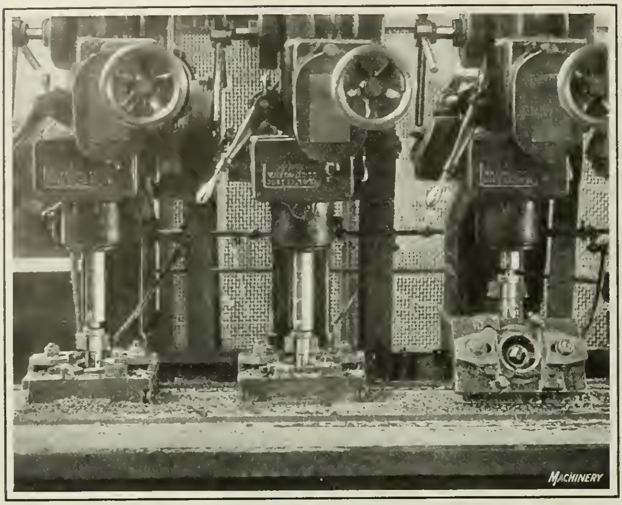


Fig. 8. Three-spindle Drilling Machine with Auxiliary Table and Tracks for sliding the Jigs from One Spindle to Another

as well as with rollers set at right angles to these, so that at the completion of the longitudinal travel of the jig it may be rolled forward on tracks running to the front of the table and at right angles to it, for convenience in loading. These tracks are not shown in the illustration. This method of moving the jig from one end of the table to the loading position at the opposite end makes it unnecessary for the operator to exert any manual effort, and also saves time.

The construction of the jigs will be understood by reference to Fig. 9, which is a plan view showing, by heavy broken outline, how the work is located in pairs, so as to form a complete circle. The work is located by V-blocks, and is clamped in this position by set-screws, being held down by large clamps *A*. The operations performed on this multiple-spindle drilling machine are rough- and finish-boring a 2.44-inch hole formed by two castings, as shown in Fig. 9, to limits of plus or minus 0.003 inch, and counterboring with a 2⅞-inch diameter tool to a depth of 1/16 inch. These steel castings are first disk-ground on the back surface to enable them to be properly seated in the boring jig. Four jigs are used for this work, the extra one being loaded while the operations are being performed on the first pieces. The spindle speed is 80 revolutions per minute and the rate of feed 0.006 inch per revolution. The production time is forty pairs or eighty machined castings per hour.

Drilling Spindle Sleeves

The spindle sleeves used in the construction of the Colburn heavy-duty drilling machine are drilled with the equipment illustrated in Fig. 10, which consists of a four-spindle No. 2 manufacturing type machine, on the table of which four jigs are mounted. The design of these jigs is shown in Fig. 11. The body *A* is mounted on trunnions which are carried in supports bolted to the face of the jig. The body is made of cast iron, and there are two serrated steel strips *B*, 120 degrees apart on the inside, which act as a cradle for holding the sleeves to be drilled; the work is secured in place by two set-screws, one at each end of the body.

There is a locating member *C*, which is assembled midway between the ends of the body, and on this member a flat milled on the side of the spindle sleeve rests, which takes the thrust during the drilling operation and also locates it centrally in the body of the jig. For loading and unloading, the body is swung into a horizontal plane, in which position latch *D* drops down and engages a slot in the end of one trunnion, as indicated by the dotted outline. The index-pin which locates the body in a vertical position during the drilling operation is operated by a small lever, which withdraws the pin against spring pressure and permits the body to be revolved. In Fig. 10 the operator is shown loading the first jig, from which the advantage gained by designing the jig to swing to a horizontal position is apparent. The drill bushings are knurled and slabbed, and are prevented from turning by a pin in each end of the body.

These spindles are made of 0.35 per cent carbon steel, and are 17¼ inches long with a 1 7/16-inch hole extending through them. In drilling this hole, the drills are fed half way through the sleeves, and the jig is then indexed through 180 degrees so that a hole may be drilled in the opposite end of the piece to meet the first one. It has been mentioned that a flat milled on the side of the sleeves is used to locate them in the jig. This flat is afterward milled off in finishing the outside of the sleeve, and rack teeth are cut on the exterior. When the space between the end of the bushing and the adjacent end of the work becomes filled with chips the bushing is lifted to allow the chips to escape, but there is no liability of inaccuracies resulting from this, because the body is held firmly and the drill is free from vibration. The production on this operation is one sleeve every 2½ minutes, that is, 24 per hour, floor to floor. This rate depends on the spindles being kept in continuous operation, and no time being lost in loading and unloading the jigs.

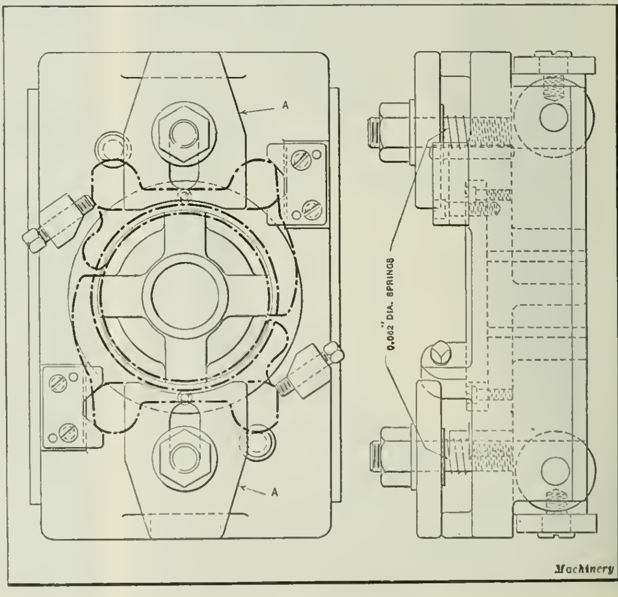


Fig. 9. Detail View of Jigs used in Operation Illustrated in Fig. 8, showing how the Work is located

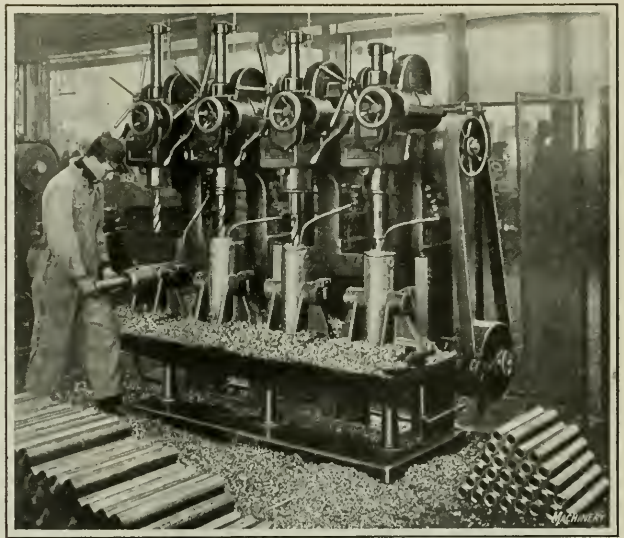


Fig. 10. Drilling Spindle Sleeve Holes 17¼ Inches Long by 1 7/16 Inches in Diameter

Drilling Bottle-filling Machine Gage Bodies

A cast-iron gage body for bottle-filling machines is illustrated in Fig. 12, in position on the Colburn heavy-duty drilling machine used in boring and reaming this piece. The jig used to hold the casting while machining the eight holes in each end is shown attached to the special base of the machine, which, in this case, is used as a table. This construction is employed when there is an unusual distance between the spindle nose and the locating surface. The jig is bolted to this special base, and is supported at the top by a bracket attached to the vertical ways on which the regular machine table is usually mounted. A combination boring and reaming bar is used in this operation, carrying two boring heads and two reamers and an extending pilot which enters the base of the jig.

The jig is of the indexing type, and two boring-bars are provided, one of which is in use while the other is placed in the next hole to be machined, so that as the work is revolved this boring-bar is brought into alignment with the spindle and connected with the quick-change collet chuck. The work is so long that if this were not done it would be necessary to rotate it to remove the boring-bar, then turn it again in order to permit the same bar to be passed through the holes, and finally turn it backward to bring it into alignment with the spindle of the machine. When indexing, a circular clamp at the top of the jig is loosened, a strap at the bottom is released, and the index-pin withdrawn by means of a cam-lever shown at the front of the jig.

The work seats on a cast-iron shoulder of the jig and is clamped down by a slotted washer at the top. A plug on the shoulder of the jig locates the gage centrally. The sixteen holes are 4⅝ inches in diameter and 5 inches deep, and the production time is thirty minutes per casting, as compared with 3 hours and 20 minutes by another method.

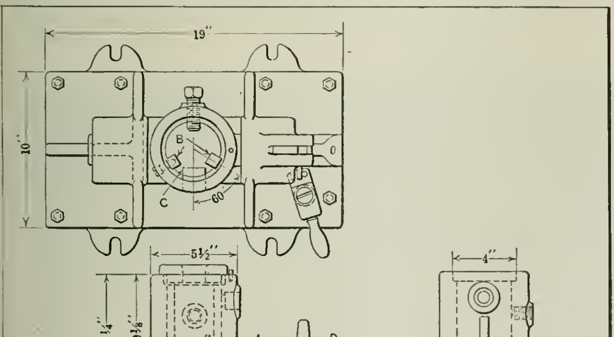


Fig. 11. Revolving Fixture in which the Spindle Sleeves are located while drilling

Boring Hole in Dredge Saddle

The boring of a saddle for a dredge is illustrated in Fig. 15. This is a steel casting the design of which is shown in Fig. 13. The machine used is a D-8 Colburn heavy-duty drilling machine, and the operation consists of rough- and finish-boring a 12-inch cored hole to 13 inches finished diameter. This hole is 10 inches long, and three cuts are required to complete the operation. For each of these cuts it takes fifteen minutes to feed the boring-bar through the work, so that the entire operation consumes 45 minutes. The rotative speed of the spindle is 23 revolutions per minute, and the feed is 0.030 inch per spindle revolution. While this is not a production job, it illustrates very well the capability of this type machine for handling work where heavy cuts in tough material are required.

Handling Large-diameter Work

It often happens that work of large diameter, which would be exceedingly awkward to handle unless some special provision were made, may be machined by employing some such arrangement as is illustrated in Fig. 16. Here a No. 14 Colburn drilling head is mounted on a boring mill table in which a post is located around which the work may rotate during the drilling and reaming of the various holes in this casting. The work to be machined is a cast-iron can tester wheel which is used in testing cans by means of compressed air. A partial plan view and section of this wheel are shown in Fig. 14. There are forty-two 1¼-inch holes drilled and reamed on a circle of 31 inches radius, and the same number of 1-inch holes on a circle of 35 inches radius. All these holes are drilled and reamed with the set-up illustrated in Fig. 16.

The stationary post on the table, previously referred to, carries a slotted index-wheel at the top by means of which the work is indexed for drilling each hole. A radial arm is also carried on this vertical post under the index-wheel in which there are two bushings, one for the inner circle of holes and one for

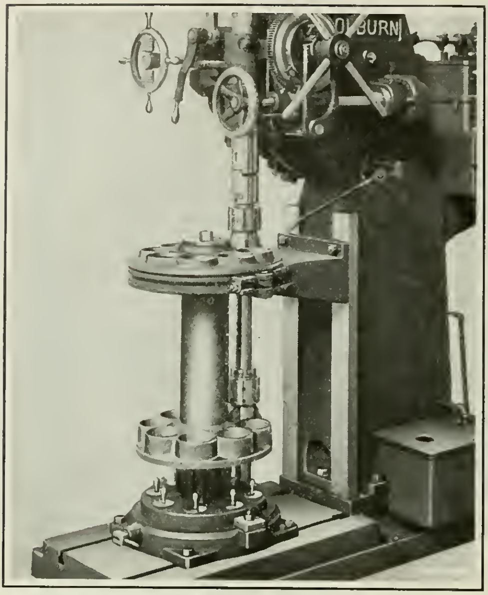


Fig. 12. Use of Extended Base and Indexing Jig for boring and reaming Long Work

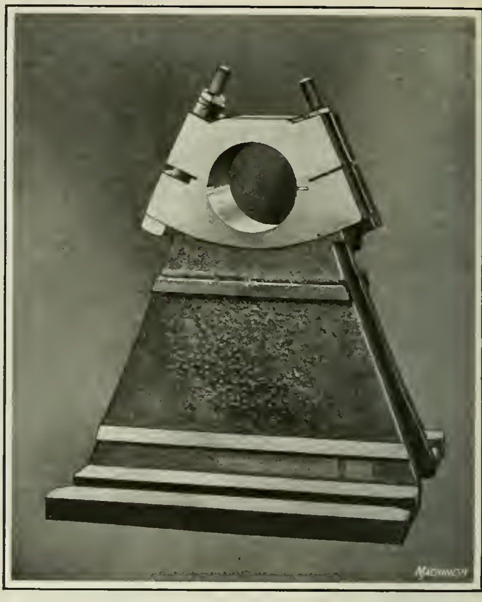


Fig. 13. Saddle for Dredge, showing Hole bored on Machine illustrated in Fig. 15

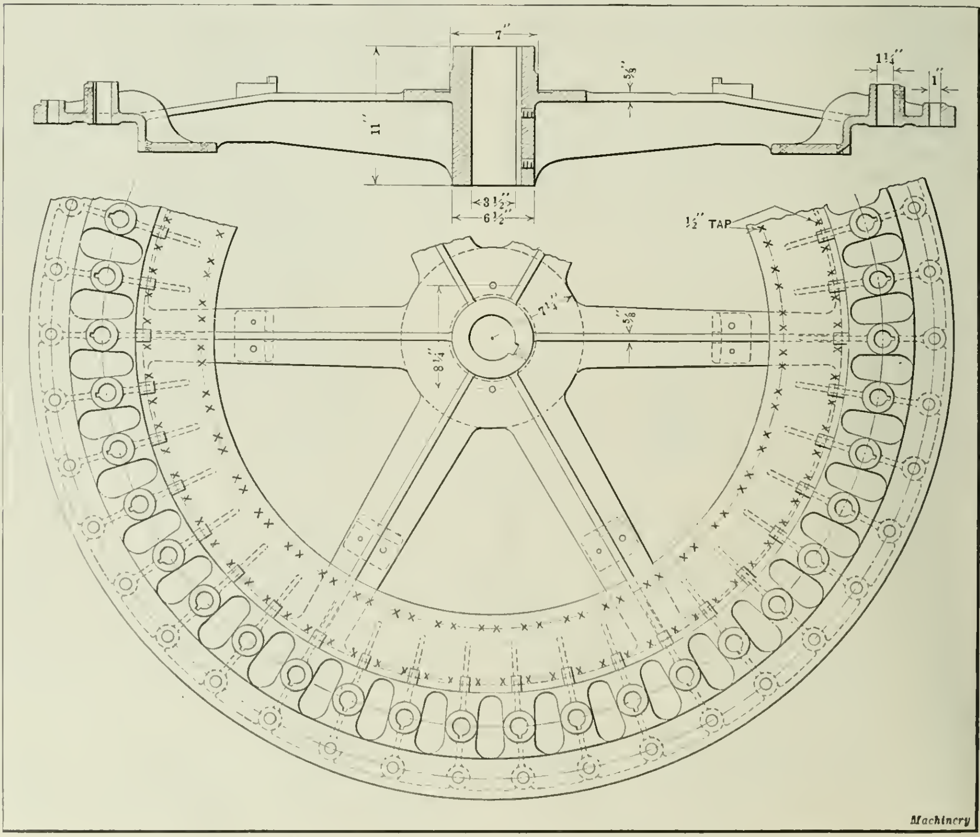


Fig. 14. Can Tester Wheel in which Eighty-four Holes are drilled with the Equipment illustrated in Fig. 16

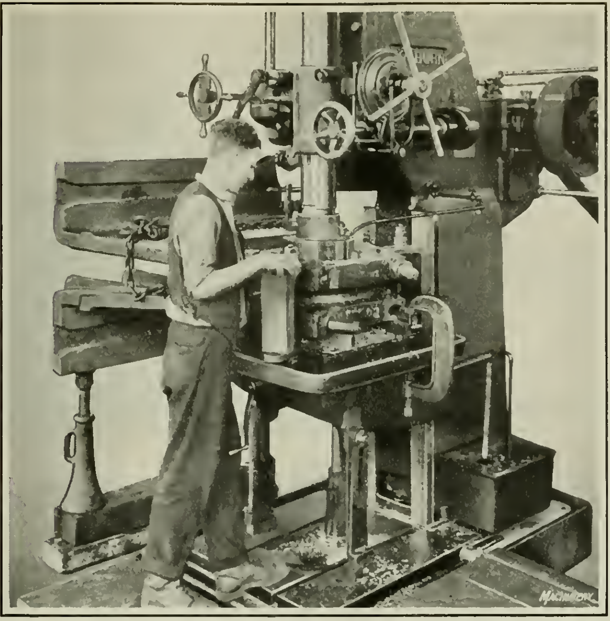


Fig. 15. Boring a 13-inch Hole in a Saddle for a Dredge

the outer circle of holes. After the larger holes are drilled and reamed and the work has made two complete revolutions, the post is moved outward in the T-slot of the table in which it is clamped to obtain the correct radial distance for drilling the outer circle of holes. Then a plug is used in the larger bushing hole in the radial arm, and is passed down through one of the 1¼-inch holes so that the smaller holes are kept in radial alignment with these. A limit of 0.001 inch is allowed on the location.

The 1¼-inch holes are drilled and reamed through 3¼ inches of metal, using a drill speed of 160 revolutions per minute and a reamer speed of 45 revolutions per minute. The drill feed is 0.015 inch and the reamer feed 0.038 inch per spindle revolution. The 1-inch holes are drilled and reamed through 1¾ inches of metal, the drill speed being 300 revolutions per minute and the reamer speed 45 revolutions per minute. The feed used is 0.018 inch per spindle revolution for both drilling and reaming. The production is two wheels per eight-hour day.

* * *

ANNUAL MEETING OF THE TAYLOR SOCIETY

At the annual meeting of the Taylor Society, held in the Engineering Societies Bldg., New York City, December 1 to 3, the program covered many problems of management. Some of the papers read are given in the following: "The Technique of the Appraisal of the Efficiency of an Industry" comprised a critical examination of the evaluation sheet devised and used by the engineers of the Committee on the Elimination of Waste in Industry. The discussion on this paper was opened by C. E. Knoeppel, C. E. Knoeppel & Co., New York City. A report of the Committee on Sales Engineering was made by Willard E. Freeland, Winchester Repeating Arms Co., New Haven, Conn. A paper on "Reflections of a Production Manager" was presented by Charles F. O'Connor, Universal Winding Co., Providence, R. I., and a paper on "The Necessity of the Quota for Proper Sales Cost Accounting" was presented by Charles P. Staubach, Burroughs Adding Machine Co., of Newark, N. J. Another paper "The Application of the Principles of Scientific Management to the Office" was read by William H. Leffingwell, Leffingwell-Ream Co., Chicago and New York, and a paper on "The General Control of a Business" was presented by John H. Williams, Day & Zimmermann, Philadelphia, Pa. The subject "Combination Routing" was brought up by D. J. Walsh, Jr., and a paper on "The Formula for an Efficient Workman" was presented by Boyd Fisher, Lockwood, Greene & Co., Boston, Mass.

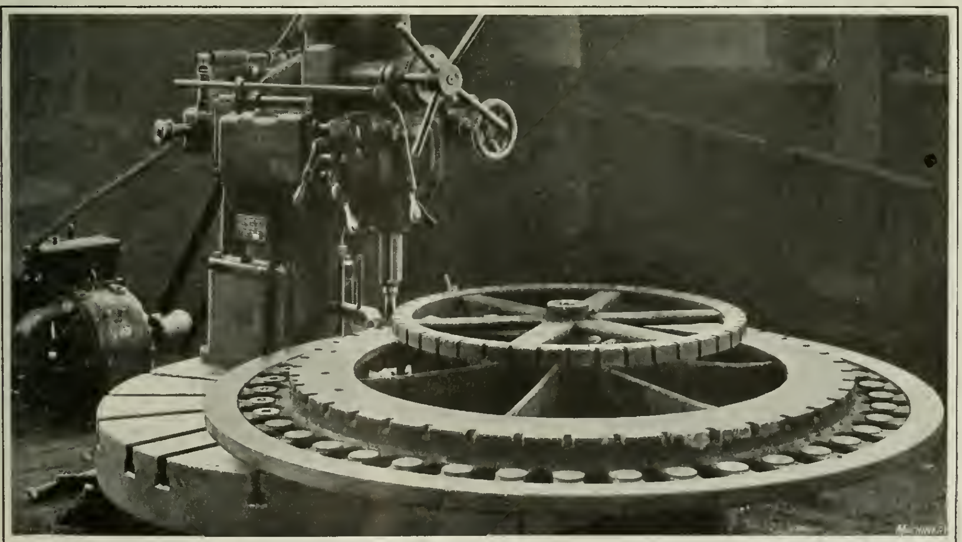
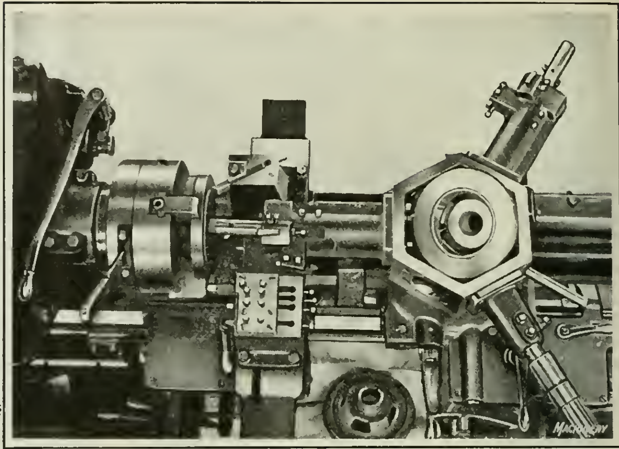


Fig. 16. Drilling Head mounted on a Boring Mill Table for handling Work of Large Diameter

Turret Lathe Tooling

Equipment for Machining Differential Gear Housings on Foster Turret Lathes

By I. F. YEOMAN



THE illustrations accompanying this article show the tooling lay-out for machining a differential gear-case on a turret lathe. Before describing the various operations and equipment employed a brief review will be given of the way in which production problems for the Foster turret lathes are handled at the Foster Machine Co.'s plant in Elkhart, Ind.

When the blueprints are received from the customer, the head tooling engineer makes a study of them, and after ascertaining the surfaces to be machined and the limits required on these surfaces, notes on the blueprints the cutting speeds and the number of cuts required, together with the various feeds to be used in performing the machining operations. He also indicates the preferable method of holding the work in the chuck. The next step consists of making a rough sketch of the work to be machined, on which certain methods of finishing are indicated. For example, in Fig. 1 the details of both members of a differential housing are shown. It will be noted that the finished dimensions for the various surfaces to be machined are given; and also that the method of machining certain of these surfaces is indicated.

How To Reduce Production Costs

Sketches are then made showing the recommended type and location of the tools required in performing the operations for each chucking of the work, as well as the best method of chucking the part to be machined. If, as in the present case, two chuckings are required in finishing the work, one of these tooling lay-out sketches will be made for each operation. Figs. 2 and 3 show the general tooling arrangement provided for machining the differential gear housing, in the first and second chucking, respectively. After the preliminary sketches of the proposed tooling lay-out are completed, these and the engineer's suggestions regarding the machine to be used are submitted to the assistant tool designer who computes the floor-to-floor time estimate for each series of operations.

After the time study has been made, a copy of this and the lay-out made by the engineering department are sent to the prospective customer, who is given a complete explanation of the proposed method of machining the parts and is also advised regarding certain other details which have been observed in studying the job and in making the time study. As soon as an order has been received on the strength of the preliminary investigation, the design of the tools and all calculations pertaining to the machining of the work are carefully rechecked before the finished tool drawing is made. Blueprints of these drawings, accompanied by any necessary explanation, are then sent to the foreman of the special tool department, where the tools and designs are made.

Tooling for First Chucking on Differential Housing

All equipment used in machining the differential housing shown in Fig. 1, including chucks, expanding reamers, and special tool-holders are manufactured by the Foster Machine Co. and applied to a 2-B universal turret lathe of this company's manufacture. In the first chucking, it is considered advisable not to use the turret of the machine, a special arrangement being employed in its place, with the result that a substantial reduction is made in the cost and time required to machine the part. This arrangement consists of a multiple tool-holder, shown in Fig. 2, which is mounted on the cross-slide of the lathe in the position shown in Fig. 4, so that the tools may be brought successively into engagement with the various surfaces to be machined, by simply operating the cross-slide screw and feeding the carriage along the bed until it comes in contact with a positive stop.

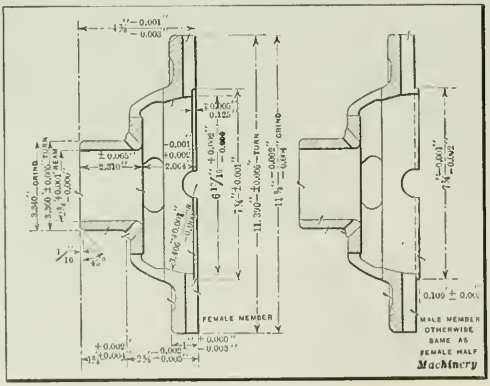


Fig. 1. Sketch giving Dimensions of Differential Gear Housings

In the first chucking, the housing is chucked on the inside, using a special 16-inch, three-jaw Barker wrenchless chuck, having corrugated and hardened steel jaws, carried in a heavy steel body. The first operation is that of rough-turning the outside diameters of the hub and flange. With the aid of the dial index of the cross-slide screw, the multiple tool-holder is traversed transversely to bring tools *B* and *C* into the proper position for turning the hub, which results in similarly positioning tool *E*, used in rough-turning the outside diameter of the flange. The cut required to machine the hub is divided between the two tools *B* and *C*, so that the operation will be completed in the same time that the flange is rough-turned. Tool *C* also turns the fillet at the base of the hub and rough-faces the adjacent surface *C'*. All surfaces finished are indicated by the same reference letters used in designating the tools employed in machining. For example, tools *C*, *D*, and *E* are used in machining surfaces *C'*, *D'*, and *E'*.

Fig. 4 shows the tools near the completion of the rough-turning operation. The traverse of the carriage is automatically terminated by means of a positive stop as soon as the rough-turning cuts are completed. This brings the tools *A*, *C*, and *D*, Fig. 2, into the proper position for rough-facing the three surfaces similarly designated, during which operation the carriage is fed radially outward, as the feed diagram in the lower right-hand corner of the illustration indicates.

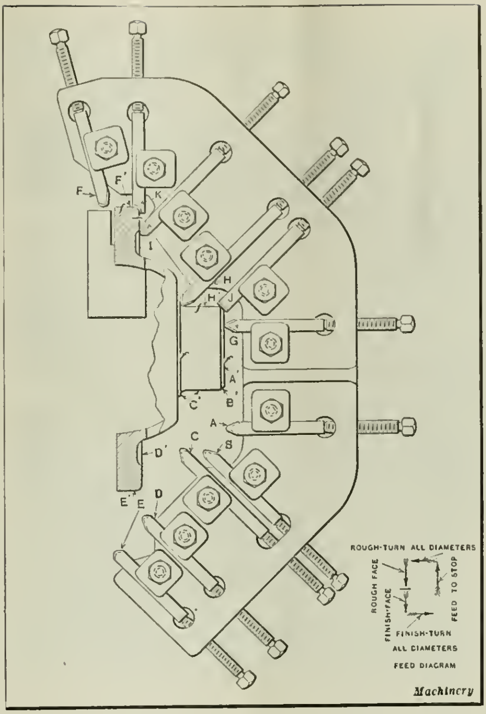


Fig. 2. Multiple Tool-holder which carries all the Tools used in the First Chucking

This completes the roughing operation, and the finish-facing cuts are immediately taken by continuing the cross-feed, which results in finish-facing the end of the hub with tool *G*, finish-facing the flange with tool *I*, finish-facing and forming the fillet at the base of the hub with tool *H*, as well as chamfering the end of the hub with tool *J* and forming a radius on the flange with tool *K*. This brings tools *F* and *H* to the proper position for finish-turning the outside diameter of the flange and the hub, respectively, and this is the position which the tool occupies in Fig. 2. In finish-turning these two surfaces, the carriage is simply fed longitudinally back to the starting position. This completes the operations performed in the first chucking, and the casting is then removed from the machine preparatory to performing the second series of operations. During the test made at the Foster plant, the floor-to-floor time for completing the first chucking on these malleable iron castings, was from 4½ to 5½ minutes.

Tooling for Second Chucking

In the second chucking, a combination of cutting tools is used in which both the turret and the cross-slide are employed. The casting is located in the three-jaw Barker wrenchless chuck, with the previously faced surface of the flange seating on three pins *A*, Fig. 3. The chuck, which holds the work by the periphery of the flange, is provided with special soft jaws, the gripping surfaces of which are corrugated as shown at *K*.

The surface *B'* surrounding the inner end of the hub and the corresponding outer surface of the casting are first rough-faced, the two facing operations being performed simultaneously. Tools *B*, *C*, *D*, and *E* are carried in a tool-block on the cross-slide so that after the tools have been properly adjusted by first positioning tool *B* for finishing the inner surface of the hub, the other tools will be in position for starting the facing cut on the flange.

The two tools *D* and *E* divide the cut, and so enable the flange to be rough-faced at the same time that surface *B'* is machined. The illustration shows the tools in the position that they occupy at the completion of this operation, at which time tool *C* produces the circular recess in the female member of the differential housing. (See Fig. 1). In machining the male member, it will of course be understood that the position of this tool will be such as to rough-face the annular projection corresponding to this recess. In these facing operations, the proper depth of cut is obtained by the use of a positive stop for the carriage, after which the surfaces are faced by feeding the cross-slide forward to a stop.

The hole in the hub is next rough-bored and the radius connecting the hole with the inner face of the hub formed, the tools being carried in the boring-bar mounted in the first side of the turret. This boring-bar also carries two radius-forming tools *F* for rough-forming the inner concave surface, and a tool *L* for taking a second cut in the female recess. The cutters *F* are located 180 degrees apart and are designed with chip clearance grooves as shown. When the male member is machined, tool *L* used in machining the female member is not, of course, required. The boring-bar mounted in the second side of the turret carries tools for finish-boring the hub, finish-facing surface *B'*, and for finish-forming the female recess and establishing the relation between the depth of this cut and the finished surface *B'*.

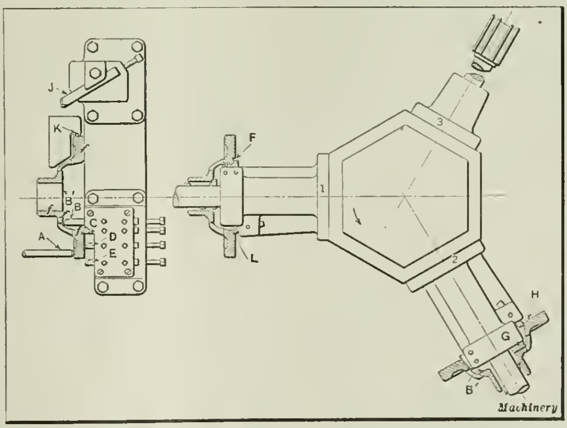


Fig. 3. Tooling Lay-out for the Second Chucking

When machining the male member, the recessing cutter is set at the proper angle for finish-turning the outside diameter of the annular projection. It will be observed that cutter *G*, used in finish-facing the inner end of the hub, is different in design from tools used in other facing operations, owing to the fact that it must take a sweeping cut. During the finish-boring operation, tool *J*, carried in a tool-block at the rear of the cross-slide, is fed across the flange of the housing to finish-face that surface. In the heading illustration, this operation is shown near its completion, the tool *J*, Fig. 3, having not quite completed its cut. The final operation in machining the casting is that of reaming the hole in the hub, using an expanding reamer carried in the third side of the turret.

It will be noticed that in both tooling set-ups the tools are designed with provision for adjusting the cutters by the use of adjusting screws. The radius-turning cutters *F* are also designed so that they may be adjusted in various directions. The time required to complete the second chucking operations, during the test of tools conducted in the Foster shop, was 7¼ minutes per casting.

It may be of interest to add, in connection with the description of the engineering service described in the opening paragraphs, that fifteen days after the receipt of the order for the tools described and illustrated in the foregoing, the equipment was thoroughly tested and delivered to the shipping department, ready for the customer's use. As the entire equipment was made in the plant of the Foster Machine Co., duplicate parts or tools can be supplied to the customer from the original drawings without delay.

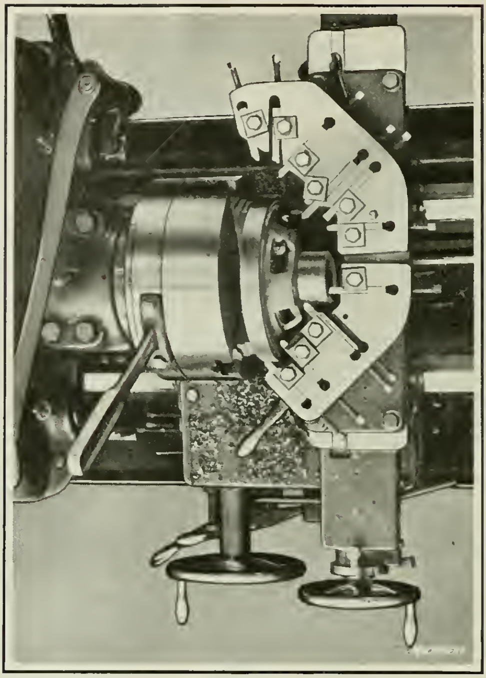


Fig. 4. Turret Lathe with Equipment used in the First Chucking Operation on the Differential Housing

* * *

TENSION IN BELTS

By N. G. NEAR

Some means of determining the tension in a belt while it is on pulleys is often desirable. The tension can, of course, be determined by means of a dynamometer, but as this method is a rather cumbersome one and takes considerable time, it is seldom used. When the belt drive is horizontal or nearly so, the writer has found it possible to determine the tension quite accurately by basing his calculations on the amount of sag in the belt. In employing this method, use is made of the following formula:

$$S = \frac{WL^2}{8T}$$

in which

S = sag, in feet;
W = weight of belt, in pounds per cubic inch;
L = span of belt, in feet;
T = tension in cross-section of belt, in pounds per square inch.

Applying this formula to leather belts, the writer computed the values given in the accompanying table, which will be found convenient for quickly determining belt tensions. To use the table, it is simply necessary to measure the span of the belt in feet, the distance between shaft centers, and the sag in inches, and then locate the columns in the table corresponding to these measurements. The tension can then be read directly in pounds per square inch. For example, if the span is 30 feet and the sag 5 inches, the tension will be 112 pounds per square inch. In some cases, it is possible to measure the sag, both on the tight and slack sides, while the belt is in motion. This cannot be done satisfactorily, however, unless the belt runs smoothly.

* * *

HOOVER CONFERS WITH TRADE JOURNAL EDITORS

The monthly conferences between Mr. Hoover and the editors of engineering and trade journals inaugurated shortly after Mr. Hoover became Secretary of the Department of Commerce are being continued, and the cooperation between the Department and the industries through the medium of the engineering and trade press is thereby facilitated to a marked degree. The problems of the industries may be transmitted to Mr. Hoover in this manner, and he, in turn, has a channel to which he can easily turn for information on any subject relating to the whole industrial field. The close cooperation with the industries that Mr. Hoover is endeavoring to establish is probably the greatest step ever taken in making the Department of Commerce of real value to commerce, trade, and manufacturing interests. The greatest help the industries can render is to make definite suggestions as to the assistance the Department can give.

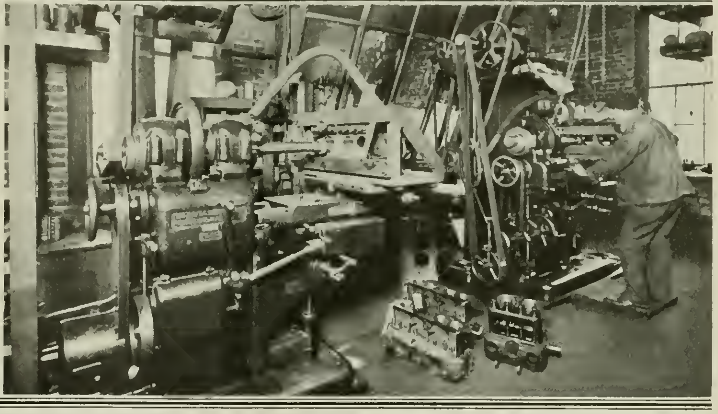
TENSION OF BELT IN POUNDS PER SQUARE INCH

Distance between Shaft Centers in Feet	Sag of Belt in Inches											
	1	2	8	4	5	6	7	8	9	10	11	12
5	16.5	8	5.3	4	3.2	2.7	2.3	2	1.8	1.6	1.5	1.3
10	64	32	21	16	12	10	9	8	7	6.4	5.5	5
15	140	70	46	35	28	24	21	18	15	14	13	12
20	250	125	82	62	50	42	36	32	28	25	23	22
25	380	190	130	100	80	66	57	50	44	38	35	33
30	560	280	180	140	112	94	82	72	64	56	52	48
35	780	390	250	190	150	130	110	97	86	78	70	64
40	1000	500	320	240	200	170	145	125	113	100	92	85
45	1280	640	400	300	250	210	180	157	142	128	117	107
50	1580	790	530	400	300	250	225	195	175	158	145	131

Machinery

Automobile Repair Shop Practice

First of Three Articles Describing Methods and Equipment Commonly Employed in Automobile Repair Shop Practice



THE greater part of automobile engine overhauling is confined to cylinder work; this includes, besides the resizing of the bores, refitting of pistons, rings, and wrist-pins, and aligning connecting-rods. When the pistons are loose, an automobile engine wastes power, due to the pumping of oil and the reduced compression. These troubles can be eliminated quickly and without much expense by regrinding and refitting, and this fact, coupled with the growing need for repair work of this general type, has led to the establishment throughout the country of repair shops for handling engine work exclusively.

Some shops do not have the equipment for handling parts other than cylinders, pistons, and rings, while others are fully equipped for repairing crankshaft bearings by welding or by grinding down the crankpin and main bearings; reseating cylinder valves; straightening, rebushing, and fitting connecting-rods.

The methods followed in different repair shops vary somewhat, although the results obtained are essentially the same. It may be that the practice in one locality would not be practical in another place due to the local demands, which of course would also affect the equipment used. In this series of articles the procedure followed in a number of repair shops for performing work of like nature is described.

Common Engine Troubles

When an engine is dismantled, it is often found that there is an excessive clearance between the piston and the cylinder. The piston-rings often have large black spots on their outer periphery indicating that the rings have not been bearing on the cylinder wall, and through the space thus left the expanding gas has been escaping, resulting in a loss of compression and efficiency of the engine. It is sometimes found that the cylinders and pistons are rough or scored, due to insufficient lubrication, so that it is impossible for the rings to prevent the escape of gas.

It may be that a wrist-pin is discovered to have worked loose and to have cut a groove in the cylinder wall, a condition which will also allow gas to escape. Even though the cylinder wall is perfectly smooth, it may he found upon investigation, that the part of the cylinder in which the rings travel has been worn larger, permitting the rings to expand and the gas to escape at the joint. If the cylinders are worn to this extent, the gas also usually escapes around the circumference of the ring even more than at the joint. The cylinder bore may be worn oval-shaped and be from 0.005 to 0.010 inch greater across one axis than the other and, of course, no ring can be made that will conform to such a condition. The wear in the region of the ring travel, which is only about half the length of the cylinder, is commonly encountered, but this can be readily remedied by regrinding.

Another phase of general automobile engine repairs has to do with the crankshaft. When the crankshaft has sprung out of alignment and when its journals are worn out of round, the result is excessive vibration, noise, and an unbalanced and uneven running engine. In overhauling an automobile engine, special attention should always be given to the crankshaft. If the crankshaft bearings need regrinding, this should not be neglected, as the cost of doing this work at the time when the engine is being overhauled is small. If this is not done and an attempt is made later to fit a set of bearings to a shaft which is not perfectly true, much more time will be consumed and a far less satisfactory result obtained. The practice of filing, lapping, and polishing a crankshaft is practically obsolete, as it is not only slow but almost impossible to obtain accurate results.

Cylinder Regrinding

If an engine has been dismantled and it is found that the cylinder bores are in need of resizing, a series of operations is necessary in order to put the piston back into proper running condition. First, each cylinder bore in the block must be accurately reground to the same diameter until all marks are removed, which sometimes necessitates the enlarging of the bores an average of 0.015 inch on the diameter. If the bores are deeply scored, it is often better practice to weld the worst places and then grind to size. New pistons must then be fitted to these ground cylinders, and for this purpose it is necessary either to keep a supply of rough or partly machined over-size pistons on hand or, if the establishment is large enough and the practice of finishing replacements from rough castings followed, a full line of patterns is required.

Over-size pistons may be procured commercially to meet almost any condition. They must then be machined to fit the cylinder bore; the outside diameter is usually finished by grinding, although in some cases the pistons are finish-turned. The pistons must be fitted with over-size rings, and these may be bought in sizes varying by certain increments, such as 0.005 inch on the diameter. The variation in diameter of the piston-rings has an effect upon the practice followed in regrinding the cylinder bores; for example, if the

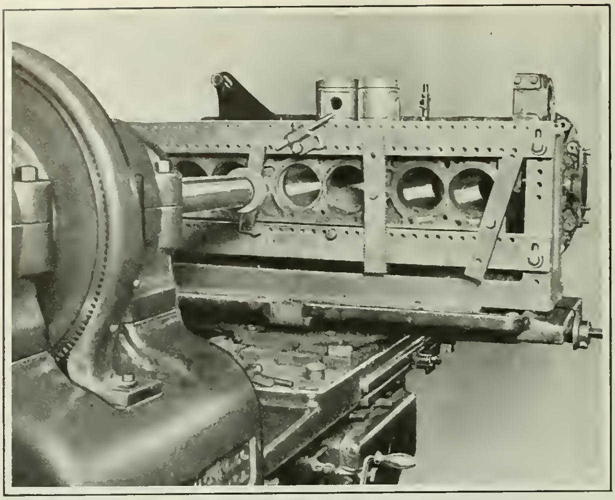


Fig. 1. Cylinder Grinder set up for regrinding the Bores of a Six-cylinder Marmon Sleeve-valve Engine

diameters are increased by increments of 0.005 inch (even although more metal may be removed than is absolutely necessary to clean up), the finished pistons may be fitted without any additional machining.

If it has been found, in disassembling the connecting-rod, that the wrist-pin is badly worn, it is, of course, necessary to furnish a new set of wrist-pins and in some cases, perhaps, provide new bushings in the connecting-rods. Wrist-pins may also be purchased to meet almost any desired condition. After the connecting-rod and piston have been properly fitted, the assembly should be tested for alignment and straightened so that the cylindrical surface of the piston will be at right angles to the crankpin bearing of the connecting-rod. An auxiliary repairing operation is regrinding the seats on the exhaust and intake valves, and this should not be neglected. This can be done with a special bench type of equipment to which reference will be made later.

Regrinding the Bore of a Sleeve-valve Engine

At the plant of Frostholm Bros., Syracuse, N. Y., all classes of automobile engine repair work are done. Fig. 1 shows a No. 55 Heald cylinder grinding machine on the table of which a Marmon sleeve-valve aluminum cylinder block is mounted. The cylinder regrinding work on a sleeve-type aluminum engine is the same as on a cast-iron block except that the factor of overheating must be taken into consideration. The block is attached to a regular angle-plate type of cylinder fixture similar to that furnished by the manufacturers of this grinder. This is a six-cylinder block, having a bore 3¾ inches in diameter, and it is ground with a No. 303S carborundum wheel. It is generally practicable in cylinder regrinding to take at least two cuts. For roughing, about 0.005 inch of metal is removed per table travel, and for finishing about 0.0015 inch, both these figures varying according to the judgment of the operator. This block is to be fitted with "Kant-Skore" aluminum alloy pistons, two of which are shown on top of the fixture.

In this fixture two steel parallels are bolted to the vertical side of the angle-plate, in which a number of holes are drilled. This enables the block to be bolted in place readily and also permits cylinders of any size or type to be mounted on the same fixture. It is recommended that the wheel be trued up before starting the finishing operation, and for convenience in doing this a diamond wheel-dresser is attached to the upper parallel of the fixture. The dust is removed from the cylinder by an exhaust fan to which a flexible tube is attached, with the open end resting in the outer end of the cylinder bore.

Regrinding an Overland Cylinder

The operation illustrated in Fig. 2 is that of regrinding an Overland four-en-bloc cast-iron cylinder, having a 4⅛-inch bore. This work is also done on a No. 55 Heald type machine equipped with a cast-iron angle fixture of similar design to that previously referred to. This machine is in use at the plant of the Nixon Tool & Broach Co., Syracuse, N. Y. This illustration shows the method of mounting the cylinder more clearly than Fig. 1. Four universal plates are provided for clamping the work to the fixture, two of which are carried at opposite ends of each parallel. These may be assembled in any of the holes in the parallel and may be tipped at any angle to suit the holes in the cylinder block. In this case, the lower left-hand plate was tipped so the bolt at this corner would reach through the hole in the plate.

The lower parallel has a T-slot in which the bracket which carries the wheel-dresser slides. In mounting the cylinder in the fixture, it is necessary to use an indicator at each corner in order to make the block perfectly horizontal. In setting up the job, the operator locates each bore centrally, relative to the grinding wheel, by setting the spindle eccentric, successively, at 90-degree positions by hand, until the trial spark produced at each quarter appears to be about the same. The experienced grinder can detect very accurately any variations in central position by either watching the spark or by the sound, although watching the spark is the more reliable way. While this work is being done the eccentric is not revolved, except as it is turned by hand, and the spindle is driven by power in the regular way.

Method of Setting and Adjusting Wheel Positions

The cylinder which appears to be the most deeply scored is first cleaned up and the other bores ground to this diam-

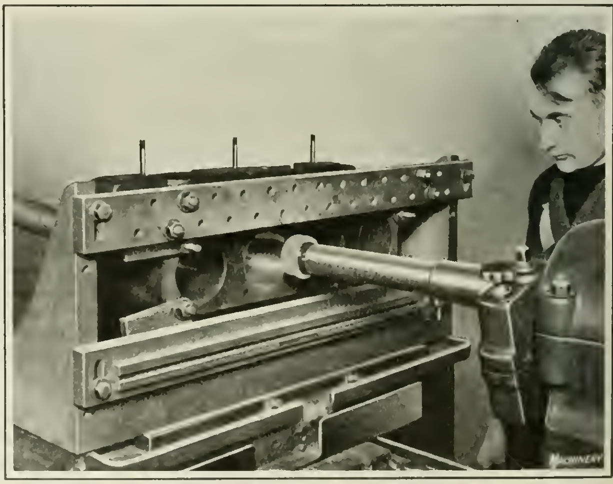


Fig. 2. Regrinding an Overland Four-en-bloc Cast-iron Cylinder

eter. For average work it is necessary to increase the cylinder bores about 0.020 inch, according to the experience of the Nixon Tool & Broach Co., and it has been noticed that rarely is it required to remove more than 1/32 inch from the diameter. A No. 36-H Norton wheel is used and about 0.005 inch of metal is removed in the first operation. If it is found that this does not clean up the bore, another 0.005 inch of metal is removed in the second travel of the table, and so on by increments of 0.005 until the cylinder is free from any score marks. This method is necessary in this plant on account of the practice of using over-size piston-rings varying by 0.005 inch.

After the first hole has been ground to the required size, the graduated dial for the radial feed of the wheel is set at zero, and the eccentric turned back so as to move the wheel in from the ground surface. This will enable the wheel to enter the second cylinder bore before starting this operation; in setting up, the same procedure of hand adjustment and observation of the spark, previously described, is followed. A 24-inch diameter exhaust fan is used to remove the cast-iron dust from the cylinder bore. The time required to grind a four-en-bloc cylinder of this size bore averages about 3½ hours.

Regrinding Large-bore Stationary Engine Cylinder

The cylinder regrinding operation illustrated in Fig. 3 is performed in the plant of Frostholm Bros. and consists of resizing a stationary engine cylinder, 8 inches in diameter, having a 20-inch stroke, on a Brown & Sharpe No. 23 cylinder grinder. This machine has a special tapered spindle, which is designed to eliminate wheel chatter. The general practice of this company is to use a No. 303S carborundum wheel for soft cast iron, and a 36-J Norton wheel on hard cast iron or semi-steel. On the job illustrated a No. 303S carborundum wheel is used. For the roughing cuts, from 0.002 to 0.003 inch of stock is removed on the diameter, but for finishing, the depth of cut is not over 0.0005 inch.

This regrinding job is an example of large work, which is very near the maximum limit. A 6-inch diameter wheel is used, running at 500 revolutions per minute, and it requires about fifty travels of the table to regrind the bore to the proper condition and with the degree of accuracy required. In the course of these fifty travels of the table, the diameter of the cylinder is increased about 1/32 inch. The diameter is tested by means of a special block with beveled edges, on which an Ames indicator is attached, and this test-block is slipped into the bore; the bearings of the two beveled edges of the block and the indicator point furnish a ready means for inspecting the parallelism and uniformity of diameter of the hole.

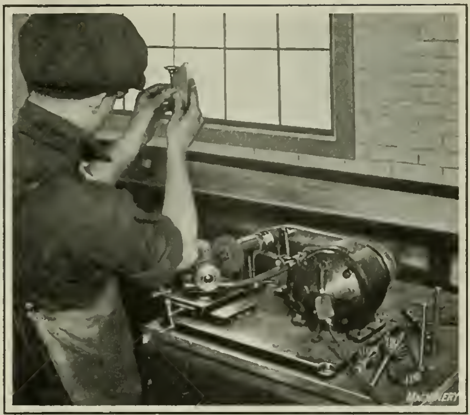


Fig. 4. Grinding Valve Heads to reseat in Exhaust and Intake Ports

Variations in Regrinding Practice on Cylinder Work

In the repair shop of Saucke Bros., Rochester, N. Y., Heald No. 60 cylinder grinding machines and the regular equipment are used, two of which are shown in the heading illustration. The block shown mounted on the first machine is a four-cylinder block taken from a Republic truck, the bore being 4⅛ inches in diameter and 10½ inches long. On the table of the other machine is mounted a six-cylinder Hudson block, 9½ inches long, with 3½-inch bore. In this shop it is the practice to first measure the blocks and determine which of the cylinders is scored the deepest. The bore that is scored deepest is ground first and all others are then ground to the same diameter. The most severely scored cylinder encountered in this shop required the removal of 1/16 inch on the diameter. Both the 303S and 30R carborundum wheels are regularly used for cylinder regrinding work in this shop, and the practice in the actual operation of the machine is to remove about 0.001 inch per traverse of the table until within about 0.002 inch of the finished diameter size. The wheel is then squared up and 0.0005 inch removed per cut until the finished diameter is obtained.

For the roughing operation the highest table feed is used, and for finishing, the lowest table feed. The work-head feed usually employed is the second feed provided on the machine. The recommended wheel speed is from 6100 to 6700 revolutions per minute for a 3-inch diameter wheel, which is equivalent to a surface speed of from 4825 to 5050 feet per minute. The approximate adjustment of the table crosswise when locating the work for successive cylinder bores is obtained by adjustable dogs, and the finer adjustments by the micrometer dial on the cross-feed screw. In actual practice, however, it has been observed that the operator depends more upon his observation of the spark than upon any mechanical means for obtaining the table location when aligning the cylinder bore with the machine spindle.

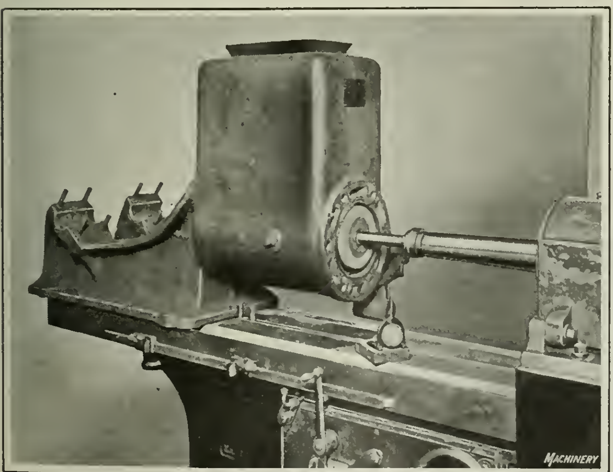


Fig. 3. Stationary Engine Cylinder set up for regrinding the Bore

Grinding Valve Stems

In grinding valve stems in the Frostholm Bros. plant, a Franklin Machine & Tool Co.'s grinding equipment is employed. This equipment is illustrated in Fig. 4 in which the operator is shown using the gage for testing the angularity of the seat relative to the stem. The gage has a semicircular groove in which the valve stem fits while the angularity is being gaged. A 46K Norton wheel is used with this motor-driven bench grinder, and the stem is chucked in a special draw-in collet chuck. The cutters shown on the bench are also ground with this equipment; they are mounted on an arbor and held in the draw-in collet chuck similarly to the valve stem. These tools are used for remachining the seats for these valves in the cylinder blocks.

Coming installments in this series of articles will deal with the practice of machining pistons and crankshaft repair work.

* * *

INDUSTRIAL STANDARDIZATION IN GERMANY

Standardization is playing an important part in Germany's industrial reconstruction. The German industries are carry ing out a far-reaching program of standardization as a necessary step in building up the industrial structure necessary to reduce production costs in order to gain extensive foreign trade. In no other country, except in Great Britain, is standardization work carried on upon a larger scale than in Germany. American industrial leaders must sooner or later take note of this standardization work, because our ability to compete in foreign markets with German goods will depend largely upon the manner in which we are able to produce standardized goods cheaply.

Scope of Standardization Work

Prior to 1917, a great deal of standardization work was done in Germany by individual companies, engineering societies, and industrial associations; but the work was not unified along national lines. Noting, however, the success of Great Britain, which organized its national standardization body in 1901, Germany formed a central standardization bureau in 1917, the membership of which consists of engineering societies, industrial organizations, government departments, and 700 leading industrial firms. In the four years since its formation, 144 approved data sheets of standards have been issued, and over 500 additional standard sheets of data have been so far developed that they have been published in tentative form. These standards are issued under the general designation of "German Industrial Standards." The data sheets are published in loose-leaf form, and generally so arranged as to make each sheet independent of the remainder. These sheets are bought by interested firms in any required quantity, and issued directly to their designers, draftsmen, and foremen. This plan is now also followed by the Austrian, Dutch, Swedish, and Swiss standardization bodies. The sale of the German data sheets of standards is said to amount to over 1,000,000 a year.

The standardization bureau has an extensive information service on standardization work in Germany and other countries which is available to the industries. A similar information service has been started by the American Engineering Standards Committee. In this connection it should be noted that the German and Japanese industries appear to study foreign developments much more closely than do the industrial leaders and engineers of other countries.

Methods of Standardization

The standardization work done on the continent of Europe in engineering, looked at broadly, indicates that these countries are going much further into dimensional standardization than has been done in England and America. The object is to secure interchangeability of supplies and machine elements, so that parts of similar apparatus made by different makers may be used without difficulty for similar service. By far the greater part of the German standardization work has been devoted to machine parts, screw-threads, bolts and nuts, standard diameters, systems of limit gaging, etc.—in other words, to purely engineering matters. The Anglo-Saxon mind takes more interest in matters having to do with purchases and contracts, such as specifications for materials and for the performance of apparatus, methods of tests, etc. The German bureau has as yet done very little of this kind of work, although it has been highly developed by some of the German industrial associations, as for example, in the electrical industry. Greater dependence is placed in continental Europe upon theoretical and basic engineering considerations, while the Anglo-Saxon standardization is guided by expediency in adjusting commercial considerations.

Comparison between American, British and German Standardization Work

According to a statement published by the American Engineering Standards Committee, German manufacturers will go much farther in yielding apparent temporary commercial advantages for the sake of advancing their national industry as a whole than American or British manufacturers. This is doubtless due to one of the fundamental German traits, that of planning definitely for the future—often for a future far ahead—while the Anglo-Saxon prefers rather to take the step that seems most expedient at the time, sometimes without very careful consideration of the effects of that step in the long run.

It appears that the work done in Germany is woven very intimately into the industrial fabric. In the work of standardization, the central organization has 5000 firms as cooperating members. There seems to be a striking analogy in the present standardization there and the research work of a generation ago. Whatever estimate one may place on the role played by German industry in general, everyone agrees that research was fundamental to the marked success of the German chemical industries. Apparently the Germans are expecting standardization to prove equally important in their general industrial development.

A complete copy of the report on industrial standardization in Germany, prepared for the American Engineering Standards Committee by its secretary, will be sent to anyone interested upon application to the committee, 29 W. 39th St., New York City.

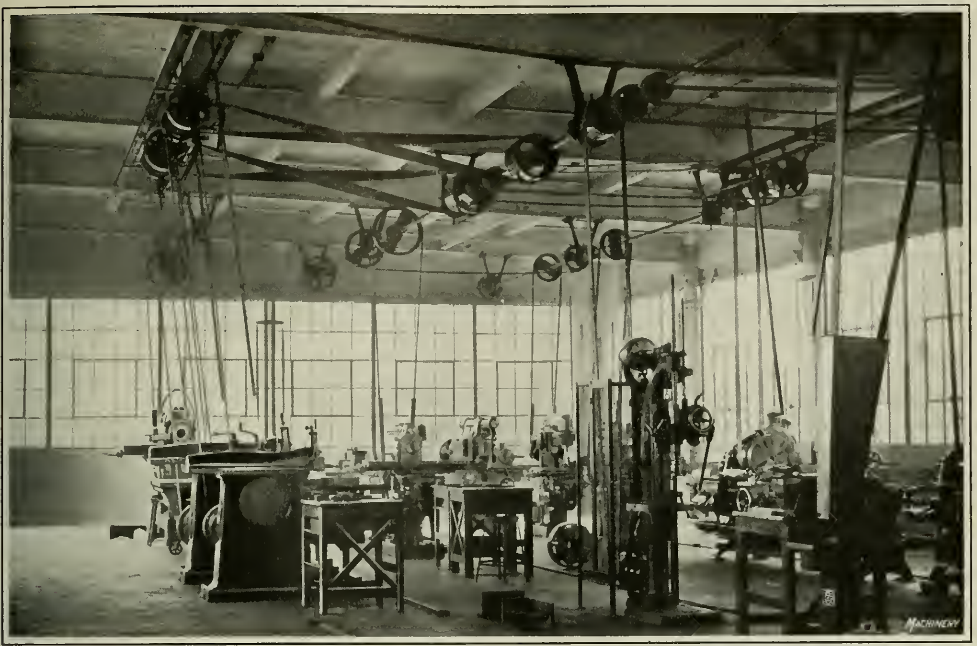
* * *

REPORT ON AMERICAN MACHINE TOOLS IN GREAT BRITAIN

According to a special report recently received by firms in this country who are members of the American Chamber of Commerce in London, the market in Great Britain for American machine tools, once a very good one, now scarcely exists. The factors responsible for this depression are carefully gone into, and interesting comments are made regarding the likelihood of a decreased market for American tools even when trading conditions shall once more have become normal. The report also reviews the state of the British machine tool industry, and discusses the effect of German competition both in Great Britain and in Europe. Hints as to marketing American machine tools are given, and manufacturers in the United States who are considering the British market are advised to consult the American Chamber of Commerce in London, which is always ready to give the benefit of its experience in these matters. Full details are available only in the report which has been sent to members, but concerns interested can obtain copies by writing to the American Chamber of Commerce in London.

* * *

The Latvian Government has adopted a law effective for a period of five years (until April 1, 1926) whereby all industrial machinery and equipment intended for the reconstruction of Latvian industries or the establishment of new industries will be admitted into the country free of duty.



Reclaimed Leather Belting

Use of Salvaged Leather Belts Reinforced with Woven Cotton Fabric

OLD, stretched-out, oil-soaked leather belting can be freed from grease and dirt, and, with proper treatment, can be reclaimed for efficient service. This salvage work is being done commercially with satisfactory results. At an expenditure of 50 per cent of the original cost of leather belting, the life of a belt may be almost doubled without impairing its efficiency. The Syracuse Belting Co., of Syracuse, N. Y., manufacturer of reclaimed belting under the trade name of "Nu-Bilt," uses a process of reclaiming that is quite simple. The secret of the method lies in providing a suitable fabric as a backing to reinforce the scrap leather; the backing must be such that it will not produce an unequal amount of stretch between the leather and the reinforcing material. Solid woven cotton belting is the material used by this company as a backing. It is furnished by the manufacturers in coils of 500 feet, and is then stretched over rolls and held in tension while it is being coated on the side that is to be cemented to the leather with a specially prepared sizing cement. This is allowed to dry thoroughly and set the stretch before being removed from the rolls. It is then free from any further appreciable elongation.

In the process of reclaiming oil-soaked and discarded leather belts, the oil and the grease are extracted previous to applying the fabric backing of woven cotton belting. In treating ply belting, the original plies are separated and each thickness used separately, so that double or triple the amount of reclaimed belting is obtained. The old belting is cleaned in a bath of naphtha in which it is thoroughly soaked. It is then removed from the bath, artificially dried, and passed between rolls to squeeze out the grease that is not removed by the naphtha bath. The leather is next sized for uniform thickness on a leather belt machine, using a knife for scraping off the uneven surface. The belt is afterward hand-scraped to remove any dirt that might not have been scraped by the machine.

The edges are then squared up, or when making narrow belting from wide belting, cut into strips by drawing the belting over a knife. The winding and measuring machine in which this work is done has a straightedge for guiding the leather and producing strips having parallel straight sides. This is of the utmost advantage when making wide belts from narrow ones, which is commonly done by simply building out the width by laying the narrow pieces side by side on fabric backing of the desired width. Sections as short as one foot may be used to piece out a belt. After being treated, the leather is coated with high-grade cement, applied to the flesh side, against which the stretched and sized woven belting is laid while both are run through a press. After the cement between the fabric and the leather has thoroughly set, the edges must be finished to remove all unevennesses. This operation is similar to the edging of old leather, using a winding and measuring machine.

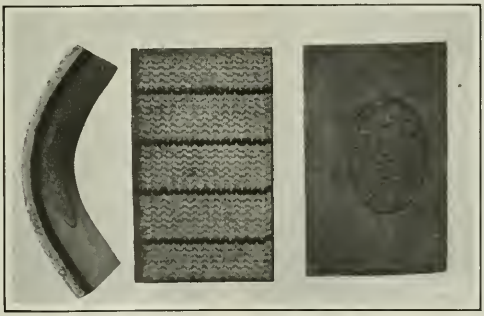


Fig. 1. Reclaimed Belting showing Face and Edge

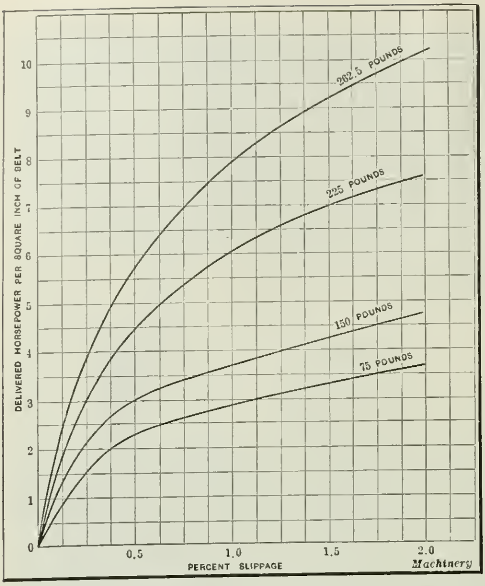


Fig. 2. Chart showing Horsepower of Reclaimed Leather Belting running at a Speed of 1000 Feet per Minute and having Different Initial Tensions

Efficiency in Power Transmissions

It will be realized that the finished product is practically free from further stretch, so relacing to take up slack is not often necessary. Some sections of reclaimed belts are shown in Fig. 1. The reclaimed belting is very pliable, enabling

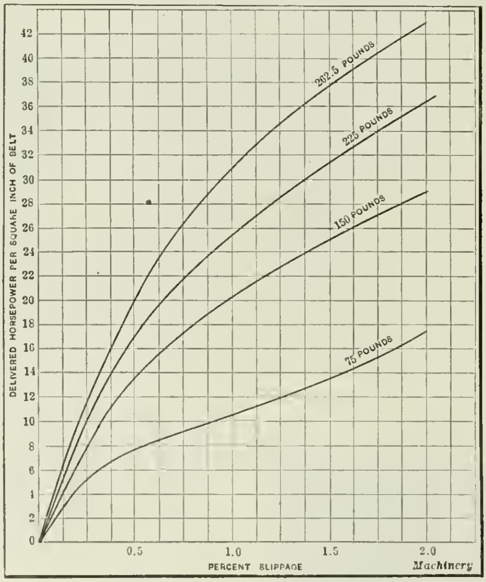


Fig. 3. Chart showing Horsepower of Reclaimed Leather Belting running at a Speed of 3000 Feet per Minute and having Different Initial Tensions

the belt to hug the pulleys closely and transmit horsepower effectively. When operating where oil is likely to get on the belts, the fabric backing acts as a wick and absorbs oil that would otherwise penetrate through a leather belt and ultimately cause slippage. Leather does not readily absorb mineral or vegetable oils. "Nu-Bilt" reclaimed leather belting is run with the hair side of the leather to the pulley, and the woven belting outward.

A series of tests conducted in the engineering department of Cornell University shows that reclaimed belting is efficient as a transmitter of power. Of course, varying humidities on different days affect the results of different tests, because climatic changes cause the initial tensions to change. This element made it desirable to conduct the tests for a sufficient number of days so that it would be possible to strike a fair average from the values obtained under various climatic conditions.

A 4-inch "Nu-Bilt" belt was used in making the tests, and three series of tests for determining the delivered horsepower at the surface speeds of 1000, 3000, and 5000 feet per minute were made, each at initial tensions of 262.5, 225, 150, and 75 pounds per square inch of belt section. The horse-

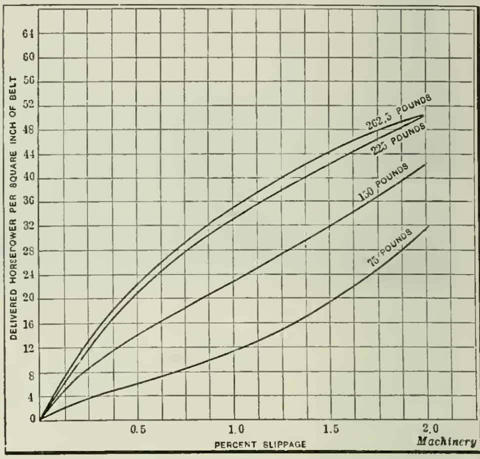


Fig. 4. Chart showing Horsepower of Reclaimed Leather Belting running at a Speed of 5000 Feet per Minute and having Different Initial Tensions

power developed and the percentage of slippage for each of these tests were plotted and curves drawn. The developed horsepower corresponding to slippages of 0.5, 1, 1.5, and 2 per cent was then taken from these curves, and these values

TABLE 1. HORSEPOWER TRANSMITTED BY RECLAIMED BELTING

Percentage of Slip	Initial Tension, Pounds per Square Inch			
	262.5	225	150	75
Test No. 1—1000 Feet per Minute Belt Speed				
0.5	5.72	4.45	2.98	2.28
1.0	7.90	6.04	3.71	2.87
1.5	9.18	6.97	4.23	3.30
2.0	10.14	7.57	4.73	3.69
Test No. 2—3000 Feet per Minute Belt Speed				
0.5	20.1	17.1	13.7	7.6
1.0	31.2	25.4	20.2	10.4
1.5	37.6	31.4	24.9	13.4
2.0	42.8	36.3	28.4	17.3
Test No. 3—5000 Feet per Minute Belt Speed				
0.5	22.5	21.3	13.8	5.9
1.0	35.1	32.6	22.4	10.9
1.5	44.25	42.5	32.1	19.3
2.0	50.1	50.3	41.9	31.4

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averaged, the results being presented in Table 1. These averages are shown plotted in Figs. 2, 3, and 4 for each of the three belt speeds. The curves are marked to show the tensions used in plotting the average in each case.

Slippage and Strength of Reclaimed Belting

The generally accepted Barth and Sellers formulas give certain horsepower values for different belt speeds and tensions. For a double-ply belt running at 1000 feet per minute, the Sellers formula gives 7.5 horsepower per square inch of belt section, and the Barth formula, 5.4 horsepower; at 3000 feet speed per minute, Sellers gives 18 and Barth 14.2 horsepower; at 5000 feet per minute, Sellers' rating is 22.7 and Barth's 13.6 horsepower. The higher values of Sellers are generally applicable to lineshaft belting, and the Barth values are those commonly used as a basis for machine tool belting from countershafts. These ratings were used to select the slippage values in the three charts shown in Figs. 2, 3, and 4, and this enables these data to be tabulated in the manner shown in Table 2. The values in the table are arranged so that a definite comparison of the amount of slippage for each of the four initial tensions under belt speeds of 1000, 3000, and 5000 feet per minute, may be made.

TABLE 2. SLIPPAGE PERCENTAGES OF RECLAIMED BELTING

Belt Speeds, Feet per Minute	Initial Tension, Pounds per Square Inch				Initial Tension, Pounds per Square Inch			
	262.5	225	150	75	262.5	225	150	75
	Sellers Rating				Barth Rating			
1000	0.89	1.93	....	....	0.45	0.77	....	....
3000	0.43	0.54	0.98	....	0.37	0.38	0.51	1.58
5000	0.51	0.55	1.00	1.66	0.28	0.27	0.48	1.32

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Although tests were run at an initial tension of 75 pounds per square inch, this low tension is not commonly used in practice except when the tension of the belt has dropped due to stretch. This initial tension would rarely be used with reclaimed belting owing to the fact that its stretch is negligible and it will maintain a high tension.

Tension Test for Breakage

Two breakage tests between two-ply leather and "Nu-Bilt" belting were made for the Brown-Lipe-Chapin Co., Syracuse, N. Y. In one test the reclaimed product broke at a stress of 4050 pounds per square inch, and the leather at 4900 pounds per square inch; in the second test the breaking points were 3900 pounds per square inch for "Nu-Bilt" and 4150 for the double leather. In the first test the elongation in reclaimed leather was 0.10 inch per inch of length, and for leather 0.215 inch; in the second test the respective elongations per inch of length were 0.095 and 0.21 inch. It will be noted that the stretch of the leather belting was more than double that of the reclaimed belting. The results of the second test indicate that there is but slight difference in the strength of the two belts.

Application of Reclaimed Belting

Reclaimed belting is used in a large variety of installations in many of the largest plants in the country, where it is reported to be rendering excellent service. Such machines as turret lathes, automatics, and milling machines are equipped with belting of this kind, and it is also said to be particularly satisfactory in connection with motors and grinders.

In Fig. 5 is shown the application of a 6-inch "Nu-Bilt" belt which is used for driving the top head of a 12-inch molding machine made by the American Wood Working Machinery Co. The machine is in operation at the plant of the Wilson & Green Lumber Co., Syracuse, N. Y. Another installation of this belting is shown in Fig. 6. This view was taken in the plant of the Endicott Forging & Mfg. Co., Endicott, N. Y., where the belting is being used for driving Bradley hammers. It will be seen that the belt is running from a flanged pulley to a pulley on the lineshaft. A belt guide is employed, but the edges of the belt are not curled or frayed to any extent.

One section of the plant of the Greiner, Semon, Lowry Co., Syracuse, N. Y., is shown in the heading illustration. This view shows the main drive motor, as well as shapers, drilling machines, engine lathes, and milling machines, all being driven from the lineshaft by "Nu-Bilt" belting.

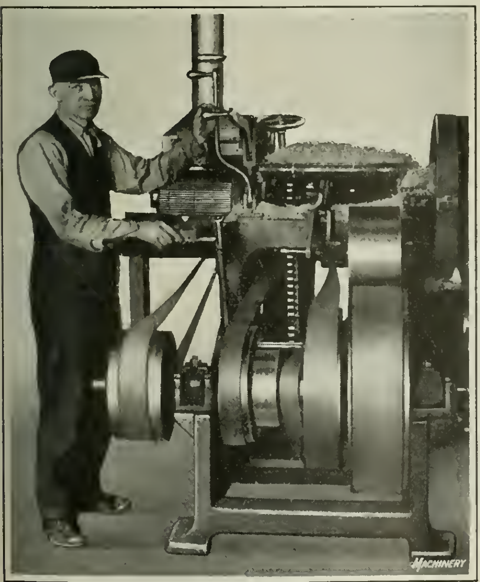

Fig. 5. Reclaimed Belting in Use on a Woodworking Machine

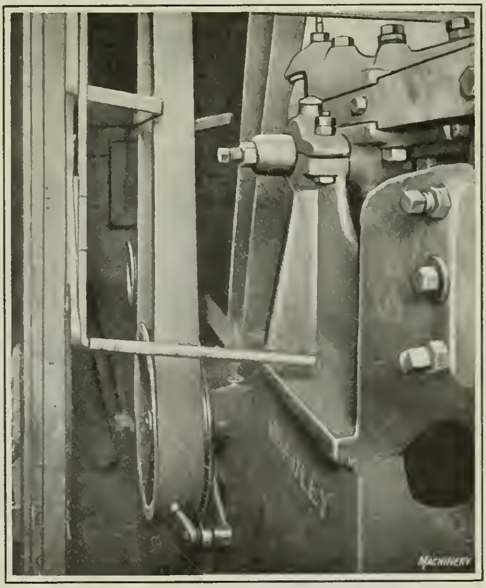

Fig. 6. Helve Hammer driven by Reclaimed Belting

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WHAT IS NORMAL BUSINESS?

During a recent trip through the West the writer asked a considerable number of machine tool manufacturers for their definition of "normal business." One said three times the amount (in value) of their sales for 1914; another two times; another 50 per cent more; another twice their average annual sales for 1910, 1911, 1912, and 1913; another suggested that if the sales curve were taken for the ten years preceding 1915 and continued through the six years following, not at the war prices or output, but at the average increase for the preceding ten years, the point reached by the curve at the present time would represent present normal business. For purposes of comparison it seems simpler in each case to use a value basis and to allow for the difference in price between the periods to be compared.

Now comes the Manufacturers' Association of Connecticut, which has worked out a method as follows: Each plant should determine the number of employes required to operate its present equipment and the number of regular working hours per week. The product of these two gives the number of man hours per week when the plant is in "normal" operation. To estimate the percentage of normal at which the plant is actually operating at a given time, the actual average number of employes at that time, multiplied by the actual number of working hours gives the total of man hours. The proportion this bears to the normal number of man hours will indicate the percentage of normal at which the plant is operating. Instead of "normal business" this is really capacity production, and we know that many plants have greater capacity, or more equipment than is required by any reasonable estimate of normal business.

Who has another method?

* * *

THE EFFECT OF HIGH FREIGHT RATES

The general belief that the high cost of transportation is one of the most potent factors in retarding business improvement is strengthened by a consideration of the effect of present freight rates upon the cost of machine tools, which, in common with many other manufactured articles, carry from three to six freight charges on the raw material and the various products that enter into their manufacture, thereby greatly increasing the cost to the purchaser.

The increased cost of transportation as it affects the machine tool business is shown by the following examples of freight charges on machine tools in 1914 as compared with 1921, and also freight charges on some of the principal materials used in the machine tool business—steel bars, pig iron, and coal—Cincinnati being used as a center.

The transportation of an 18-inch by 8-foot lathe to New York now costs $48 against $22 in 1914; a 24-inch by 10-foot lathe, $93 against $42; a 4-foot radial drilling machine, $120 against $48, and a carload of machine tools, $136 against $62. The rates from Cincinnati to Chicago are in about the same proportion, $31 against $14; $59 against $27; $78 against $30.

The effect of freight rates on the cost of material is even more marked. In 1914, a 50-ton carload of steel bars at the mill cost $1100; in November, 1921, it cost $1550, or approximately 40 per cent more; but the freight on this carload of steel had increased more than 110 per cent—from $158 to $334.75. A carload of coal cost at the mine in 1914, contract price, $37.50, and in November, 1921, $70; but the freight to Cincinnati, which was $50 in 1914, rose to $108.15 in 1921.

Freight rates must come down before prices can be reduced generally, and every help that the Government continues to give the railroads to reduce their operating expenses by abrogating unreasonable working rules and by reducing railroad pay to a level with wages paid in other lines of industry will help to benefit all classes of the people.

* * *

RUINOUS COMPETITION

Business conditions have caused the revival of some objectionable trade practices in the metal-working industry which have resulted in almost ruinous competition between manufacturers in various lines. In one instance, recently brought to our attention, four bids were submitted for the manufacture of certain metal products, the lowest bid being $2100 and the highest $2450. Nothing below the lowest bid could have been considered a fair price; yet upon being told the figures, the three highest bidders offered to reduce their quotations, virtually forcing the lowest bidder, in turn, to reduce his figure also, until finally the order was placed with him at $1500.

Through the operation of this pernicious practice the contract was finally awarded to the lowest bidder at less than actual cost, a price-cutting war was inaugurated in which all the manufacturers will inevitably lose a large amount of money, and a new price level was established below the point where there is any profit, the manufacturers having played into the hands of the purchasing agent, who in future will work his advantage for all it is worth.

Times of depression always bring out harmful and objectionable business practices which it sometimes requires years of normal business to eradicate. After much labor and research, manufacturers adopt mechanical standards which they would never think of discarding, and for their own protection they should not rashly discard standards of business procedure, especially in regard to competitive practices.

* * *

UNIONS HAMPERING PRODUCTION

One of the questions that must be settled in the railway shops is the extent to which unions shall continue to be permitted to restrict production. In a railroad shop in the Middle West, machinery was installed that produced from 3000 to 4000 parts a day of one article used in great numbers in railroad work. The makers of the machinery employed, devised an automatic machine capable of producing 20,000 parts a day, which was installed and proved its efficiency; but when it became evident that production would be increased at least fivefold, the unions protested so effectively that the use of the automatic machine was discontinued, and it now stands idle.

When the cost of railroad operation is increased because union labor refuses to permit the use of modern improvements and labor-saving machinery, we all suffer. The railroads increase their rates to cover the resulting loss, other costs rise, industry is hampered, unemployment in other industries increases, and even in the railroad shops themselves there is less opportunity for work, as present conditions show, and so it goes throughout the vicious circle.

While some of the most objectionable of the rules in the National Agreement between the railroads and the unions have been abrogated by the Railway Labor Board, many objectionable features have been retained.

Work and Thrift—Watchwords for 1922

THE New Year opens under clearing skies, national and international. The world is wiser, if chastened, and one thing it is now sure of is that the glory of war is one of humanity's great illusions, and there must be no more of it. And right here in America where the love of peace is a national characteristic and ideal, we have learned that we cannot have it, however much we cherish it, by merely holding aloof from our neighbors. So we have been talking things over with them and find them eager for our friendship and quite willing to reduce their armaments and sign up for universal peace, if assured of our continued interest and good will.

Nor can we trade with neighbors impoverished after a world war in which forty million men were under arms and whole populations enlisted for the production of war munitions. A great wild splurge it was while it lasted, and the bill has hardly begun to be paid yet. But the progress of mankind, political aud economic, since the guns were silenced and the trenches vacated, has been amazingly swift, considering what there was to be done and the debris, turmoil and confusion out of which the victorious no less than the vanquished had to lift themselves.

Serving the industries as MACHINERY does, it is exhilarating to note the marked progress in mechanical methods and devices during the past year or two. It is not the spectacular discovery, or even the application of some new force or element, that immediately and directly benefits the mass of mankind, but the thousand and one ideas and improvements developed in prosaic mechanical practice, which improve, multiply and cheapen the manifold products of industry and thus increase the measure of comfort among the people. Wonderful is the flying machine and great must be its future, but of greater direct benefit to the greatest number is a good washing machine made cheap enough for the poorest. Along this line the country is moving, and no industry shows greater progress in the details of design and construction which make for greater power and speed in production than the fundamental machine tool industry which it is MACHINERY's privilege to serve.

Following the great and unprecedented activity of the war period in which this basic industry was greatly expanded in order to accomplish its vital work for the production of munitions there have been nearly two years of stagnation. One of the last of the industries to recede from the peak, it is one of the last to turn toward prosperity again. Small tools and accessories, the vanguard of the metal-working industry in the forward march, are doing a better business, and in other lines of industry various branches are well along the road to prosperity. The machine tool industry serves them all, and when the turn has come for them the turn for this basic industry cannot be far away.

It is a fact that after every depression recovery in the machine tool industry has been more rapid than was expected. There is not a great deal of war machinery to be released, either government or private, and there is a great deal of "hold-back" in buying of shop equipment. The world never stands still; consumption goes on incessantly, and the purchase of machine tools as well as commodities of every description must follow the inexorable law of supply and demand. The year 1921 will stand out a heavy black mark in the annals of the machine tool industry, but that is behind us, and 1922 will unquestionably lay the basis for a period of prosperity in this industry.

The industry has its troubles like every other, but is operated by practical people who know how to work definitely for practical results. They are not much given to theory, except the theory that underlies and makes possible modern mechanical practice. They believe in work. A great many good people believe that religion will save the world; others think prohibition can, or did think so; socialism in all its varieties has many advocates; but MACHINERY believes with the Machine Tool Industry, that the sovereign remedy for social and economic ills is just plain hard WORK, plenty of it—and THRIFT. Evidences multiply that people generally are returning to these fundamentals. The year 1922 should be a great year for men and for nations endowed with horse sense.

New Type of Thread Plug Gage

A THREAD plug gage of a design embodying a number of new features, which is manufactured by the Hartford Tap & Gauge Co., Hartford, Conn., is shown in the accompanying illustrations. This gage can be supplied in a number of different combinations, as for example, with a standard thread plug gage on one end of the hollow handle, and an over-size thread plug gage on the other end, or with a thread plug gage on one end and a plain plug gage of the same diameter as the tap drill used in producing the hole in the work, on the other end. The handle may also be provided with only one gage and used as a single-end gage. The thread of gages generally wears first on the end that enters the hole in the work, and so provision is made for reversing the threaded plugs as they become worn so that they will have a longer life.

Each plug is mounted on a screw which has a head of approximately the same diameter as the bottom diameter of the thread on the plug. This screw fits into a nut held in the handle by means of a taper pin, as shown in Fig. 2. The threaded plug is rigidly attached to the handle by tightening the screw. The taper pin is first driven back so that its large end projects about 5/16 inch from the side of the handle; then the screw is tightened with an ordinary screwdriver, after which the taper pin is again driven into the handle until the large end extends approximately 1/16 inch. Thus the taper pin is driven a distance of about ¼ inch. The driving of the taper pin into place causes the nut to be drawn back into the handle and creates a tension in the screw so that the gage and the handle are held tightly against each other. A small pin driven into the ends of the handle projects into a small slot on the face of the gages. This locks the members together in such a way that they will not work loose.

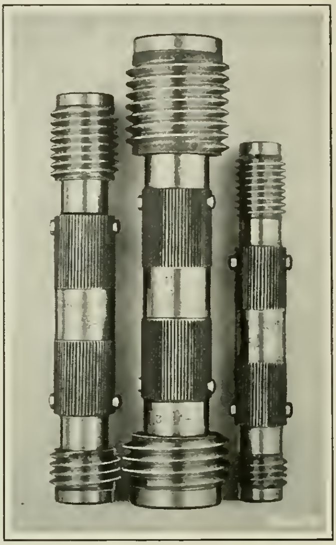


Fig. 1. Reversible-end Thread Plug Gages

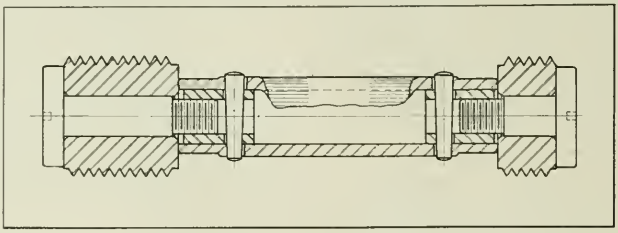


Fig. 2. Sectional View showing the Method of attaching the Threaded Plugs to the Hollow Handle

All parts of the gage, including the taper pins, are hardened. The thread on both ends of the plugs is milled off until a full form is reached. This will be seen by referring to the gages illustrated in Fig. 1. By this construction, any dirt that happens to be in a hole to be gaged will be scraped off by the thread of the plug as the latter is inserted in the hole. As the handle is hollow, the gage is comparatively light in weight, and by making the diameter of the screw heads approximately the same as the diameter of the bottom of the thread on the gage ends, it is unnecessary to provide a special pilot for the plug.

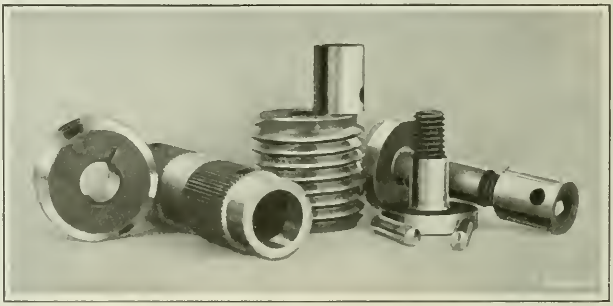


Fig. 3. Parts of the Hartford Tap & Gauge Co.'s Thread Plug Gage

Although the first cost of a gage of this design is more than that of a solid gage, the possibility of renewing the gage ends and using the handle, screws, nuts, and taper pins indefinitely is an economy in cases where a gage is subjected to severe use. The thread plugs are finished without lapping by means of a new grinding method known as the "Hanson process" producing a fine finish and threads of accurate form. The gage ends are manufactured in various sizes from ½ to approximately 6 inches in diameter, and with U. S., V, Acme, and Whitworth threads. This new type of thread plug gage was designed by B. M. W. Hanson.

The more rigid requirements in interchangeable manufacture which prevailed during the period of the war, and which since then are being more and more adhered to in many lines of manufacture for peaceful pursuits, have increased the demand for accurate gaging means, and mechanical men generally will be interested in the details of new designs.

* * *

On December 16 the Keller Mechanical Engraving Co., Brooklyn, N. Y., through its vice-president, Jules Dierckx, presented to President Harding a bronze medallion bearing on one side the portrait of the President and on the other side an expression of the sentiments of the times. The original of the medallion was modeled in wax by Frederick Kaupmann, Jr., and from a mechanical point of view the reproduction is unique in that the dies were cut on an automatic machine and not by hand, as is the usual practice. The occasion commemorated the twenty-fifth anniversary of the founding of the Keller Mechanical Engraving Co.

Reducing Costs by Continuous Milling

CONTINUOUS circular milling presents one method by which production costs can be reduced to the minimum in milling when the work lends itself to ready loading and unloading on a rotary fixture without stopping the machine, and when the operation may be accomplished as the parts are conveyed by the rotating table past the cutters. The efficiency of continuous milling as regards the average amount of time required for machining a part will be emphasized in this article, which illustrates a number of operations of this class performed on single- and double-spindle milling machines of the vertical continuous type, built by the Newton Machine Tool Works, Inc., Philadelphia, Pa. The distance between the spindles of double-spindle machines varies, but in each case it is sufficient to permit long pieces to be completely rough-milled before a finishing cut is begun on the same part. Owing to the fact that the work is turned on the axis of the fixture as it is presented to the cutters, a shearing action of the cutters is produced, which accounts for the high rates of feed obtainable.

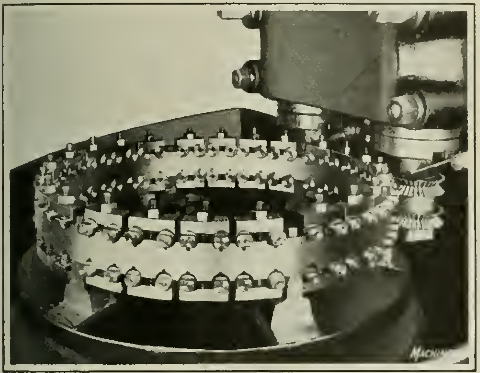


Fig. 1. Operation in which One End of Camshaft Thrust Blocks is flatted and beveled

Fig. 2. Fixture for holding One Hundred Connecting-rod Bolts on a Single-spindle Machine

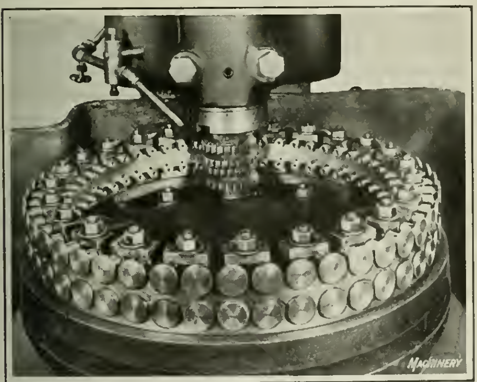


Fig. 3. An Operation on Valve Lifters, the Cutter-spindle heing located within the Work Fixture

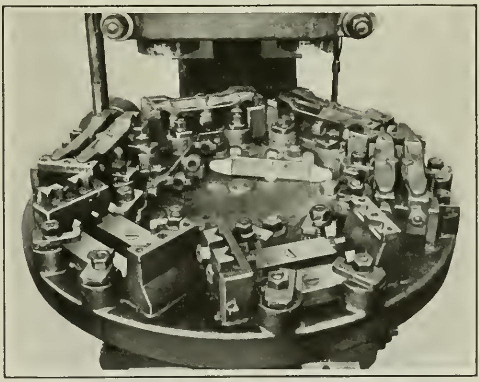


Fig. 4. First Operation on Valve Rocker-arm Brackets in which the Bottoms are machined

In the examples to be presented, the possible production per hour, the average production per day based on an efficiency of 90 per cent, and a piece cost based on a labor rate of 70 cents per hour will be given. An operation in which a double-spindle machine is employed to advantage is illustrated in Fig. 1; this consists of milling camshaft thrust blocks. The fixture holds ninety-six pieces at one time, and as they are traversed past the set of cutters on the first spindle, flats are machined on the top and bottom of the projecting ends. The second set of cutters bevels the front ends of these flats. In this operation the table feed is 5 inches per minute, so that 413 pieces may be machined per hour or 2973 per eight-hour day, based on the efficiency previously mentioned. The average labor cost per piece is 0.19 cent. It will be seen that four blocks are clamped in place by means of one bolt which controls two clamps. The pieces are seated in rounded grooves, and the shoulders on the opposite ends to those machined bear against the inside of the fixture, so that the work projects the required amount.

Automobile connecting-rod bolts have the head milled flat on one side and beveled on the other in the operation illustrated in Fig. 2, which is accomplished on a single-spindle machine equipped with four cutters. The fixture has a capacity for 100 bolts, and four pieces are held in place by two clamps and one bolt, as in the preceding operation. In this case the bolt heads register against the outside of the fixture. The table feed is 8 inches per minute, and a production of 625 pieces per hour is possible, or an average production of 4500 pieces per day, the labor cost being 0.13 cent per piece.

Another 100-piece fixture is illustrated in Fig. 3, which shows an operation on the small ends of valve lifters. In this case the milling cutters are inside the fixture, whereas in the preceding examples they were located outside. The table feed in this operation is 12½ inches per minute, so that a production of 1194 pieces per hour is obtainable, or an average of 8600 pieces per day. This brings the labor cost per piece to 0.065 cent.

An operation on cast-iron valve rocker-arm brackets is performed on a machine provided with the rotary fixture shown in Fig. 4 in which the ends of the pieces are clamped in V-blocks drawn together by means of a bolt, while other clamps bear against bosses on the work. The operation consists of milling the feet and a boss on the bottom of the brackets. There are six stations on the fixture, each of which holds two pieces. At a table feed of 15 inches per minute, the production per hour is 120 pieces or 864 pieces per day, the labor cost being 0.65 cent.

A second operation on the valve rocker-arm brackets, which is somewhat more complex than any of the others described, consists of machining the faces of three bosses. This set-up is not illustrated. The fixture accommodates twenty-two brackets, the pieces being seated on the surfaces machined in the operation illustrated in Fig. 4. While the three boss faces at one end are parallel with each other and those at the other end are also parallel, the faces of both sets are not parallel. On account of this condition only three faces can be machined in one traverse past the cutters, the other three being milled by reversing each bracket for a second traverse. By this method the twenty-two pieces are completed in two revolutions of the table, and with a feed of 4 inches per minute a production of thirty-five pieces per hour is possible. At the rate of 252 pieces per day, the labor cost per piece is 2.22 cents.

A fixture designed for holding cast-iron covers for a pump gear-box is shown in Fig. 6. The covers are surface-milled at the rate of 18 inches per minute, which gives a production of 114 pieces per hour or 821 pieces per day, at a labor cost of 0.68 cent per piece. The portion of the castings projecting into the fixture is forced against a steel plate by means of an adjustable steel plate, actuated by a screw.

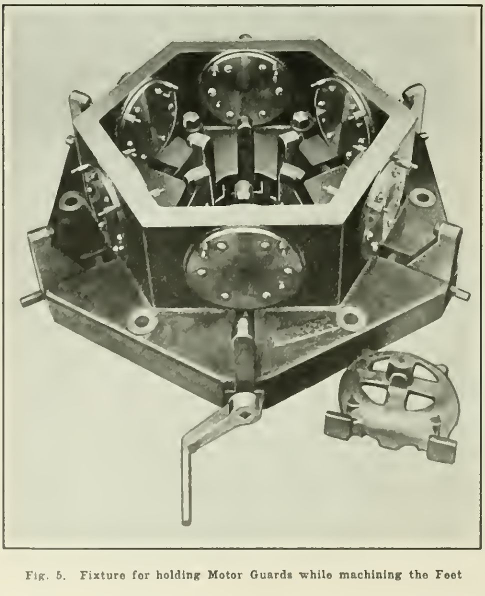


Fig. 5. Fixture for holding Motor Guards while machining the Feet

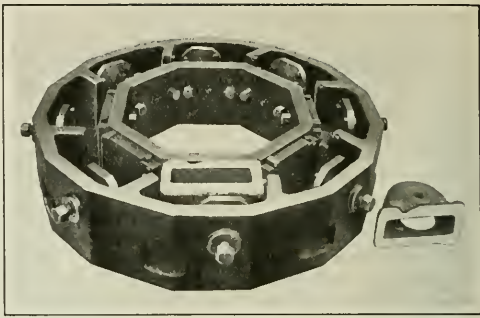


Fig. 6. Fixture designed for holding Covers for Pump Gear-cases

The fixture presented in Fig. 5 is employed in the continuous milling of end shields for electric motors, one of these parts being shown in front of the fixture. An internal surface of the work is machined to fit circular plates attached both to the outside and inside of the fixture, and at each station two parts are held on these surfaces by two clamps operated through a single screw that is turned by means of a crank-handle. The operation for which this fixture is employed consists of milling the feet of the shields, and this is accomplished at a feed of 30 inches per minute which gives a production of 313 pieces per hour or 2254 per day, at a labor cost of 0.25 cent per piece.

* * *

STANDARDIZATION AS A MEANS OF CUTTING PRODUCTION COSTS

Simplification is probably one of the most important means of cutting production costs, but it cannot be accomplished by the individual manufacturer without the wholehearted support of the financial, sales, and production executives. To obtain the greatest reduction in cost it is necessary, however, that such simplification be carried beyond the plant of the individual manufacturer to include the entire industry. Cooperative simplification between manufacturers, or standardization, can be carried out most advantageously through the medium of trade organizations.

In the automotive industry the Society of Automotive Engineers, functioning through its standards committee, has made possible this coordination of effort which has resulted in the application of standards and consequently the cutting of production costs to a great extent. Additional standards, each representing a possibility of reduced costs, will be acted upon at the standards committee meeting on January 10 in the Engineering Societies' Building, New York City. Sixteen divisions representing different fields in the automotive industry and parts or material manufacturers will present over thirty proposals for adoption as standards. The iron and steel division will submit a complete revision of the present iron and steel specifications. The revised report is based on a great number of laboratory tests carried out throughout the country. The following parts and materials are included in the various reports: Ball bearings, roller chains, sprocket cutters, generators, insulated cable, starting motors, carburetors, fan belts and pulleys, mufflers, running boards, iron and steel specifications, non-ferrous metal specifications, rod-ends, lock-washers, pressure gages, pneumatic tires, clutch facings, tire pumps, and three-joint propeller shafts.

* * *

The Danish Government is reported to have discontinued negotiations looking toward a trade agreement with Russia, while Sweden still continues to bargain with the Soviets in the hope of securing a satisfactory commercial treaty. Norway has concluded a commercial treaty with Soviet Russia.

Mechanical Engineers' Annual Meeting

THE keynote of the annual meeting of the American Society of Mechanical Engineers, held December 5 to 9, in the Engineering Societies' Building, 29 W. 39th St., New York City, was the prevention of waste in industry. A great many of the papers read before the society pertained to this subject. The address by the retiring president, Edwin S. Carman, dealt with the subject of industrial relations, and great stress was laid upon the necessity of paying greater attention to the human factor in industry. The engineer must not only concern himself with scientific and mechanical facts, but must broaden his views as to his position in industry, so as to aid in the solution of the greatest problem now requiring attention in the field of production. Some common ground must be found between employer and employe, and the engineer must fit himself to be able to aid in formulating the proper means whereby this can be accomplished.

Salvaging Industrial Waste

The machine shop division had prepared a program of three papers, all of which awakened a great deal of interest. The subject of salvaging industrial waste was dealt with by J. A. Smith, general superintendent of the General Electric Co., Schenectady, N. Y. Attention was called to the great amount of waste in ordinary machine shop operation, due to not taking care of metal and other material waste. Furthermore, a great deal of waste is due to negligence of repair and maintenance work. The author emphasized the fact that systems must be set up governing the distribution and repairs of the various classes of small tools so that the consumption of these will be regulated within certain defined limits of economy and efficient service, in accordance with production requirements in the shop.

It is good practice to make regular monthly inspections of machine tools and equipment, and make a record of these inspections, in order that repairs may be made promptly at a minimum of cost before the damage becomes more serious or breakdown ensues, with increased repair expense and added delay to production. The record is valuable as showing the relative cost of maintenance and the relative life of service of various makes of tools. It is often good economy to replace a tool showing high maintenance cost with a new tool of some other make, and thus save both expense and delays to production. In all cases of replacements and repairs, valuable parts should be salvaged and made use of on other jobs of repair work, wherever practicable.

In supplying small tools to the shop, much can be accomplished in the way of reducing expense by efficient methods of distribution and collection. A system of regular inspection of tool-rooms, tool cupboards, benches, and areas around machine tools should be established in all departments. Tools not needed for immediate or current use should be promptly returned to stock, and those needing repair put into shape for further requirements. This is particularly important in the case of high-speed-steel tools where the cost is relatively high by comparison, and a single idle tool may represent a good many dollars of tied-up capital. By a properly organized system of distribution and collection, the inventory of tool stocks carried may be greatly reduced, expenditures for new tools curtailed, and those in use in the shops kept more constantly in active service.

The author also laid emphasis on the fact that the question of profit should not always be a deciding factor in considering the saving of materials, but that operations must be conducted with a broader view of saving everything which may he of value whether immediate, direct profit is gained or not. The manufacture and supply of raw materials depends so often upon the supply of various kinds of scrap and waste that it is most essential that consideration be given to the country's needs as a whole and that efforts at salvage work be not limited to the desire for immediate profit. Indirectly benefit will be received through reduced cost of raw stocks, because of the abundance of original materials which are thus created.

Still another phase of salvage work which is distinct and apart from the field of salvaging metal scrap and other factory wastes, is the saving of time and human effort, and of mental and physical energy. Profitable manufacturing requires that we build up our organizations both in offices and in the factory with a view to concentrating directive effort, eliminating duplication of orders and instructions, establishing unity of purpose, system in method of procedure, and cooperative effort on the part of all employes, whether serving in official capacities or in the lower grades of mechanical and physical labor.

Waste in the Machine Industry

An address that aroused a great deal of enthusiasm because of its relation to the human rather than the engineering side of shop operation, was that by J. J. Callahan, general manager, Passaic Metal Ware Co., Passaic, N. J., on "Waste in the Machine Industry." In this address Mr. Callahan pointed out that if the management of any industrial undertaking desires the cooperation of its employes, this can be obtained by creating a spirit of mutual confidence and by arousing the interest of the employes in the success of the business enterprise by giving them an opportunity to take an active interest in the development and application of improved methods and facilities. He gave numerous examples of successful application of such cooperation both in the plant with which he is connected and in other manufacturing establishments. An article explaining in detail the plan that Mr. Callahan has installed in his own shop in Passaic, was published in November, 1919, MACHINERY, entitled "Representative Government in a Manufacturing Plant."

The Art of Milling

A paper giving particulars of an investigation undertaken at the University of Michigan for the purpose of finding a rational basis for the action of a milling cutter was presented by Professor John Airey, Ann Arbor, Mich., and Carl J. Oxford, mechanical engineer, National Twist Drill & Tool Co., Detroit, Mich. In this paper it is shown that metal is removed more efficiently with thick chips than with thin chips. It follows from this that, other conditions being equal, including speed and feed per minute, the cutter with the fewest teeth gives the greatest efficiency. However, it is evident that the efficiencies of two cutters with different numbers of teeth are equal, provided the table feeds be adjusted so that the same feed per tooth is effected. This gives a definite working theory on the influence of spacing.

It is definitely established that for a given material, tooth shape, and sharpness, thickness of chip is the sole criterion of the efficiency with which metal is removed in milling and that increase of spacing over that required for free cutting is a handicap. Present-day high-powered cutters have several times the chip space needed. Limitation of machine power has doubtlessly been the chief factor in giving a false bias to the influence of spacing. Formulas for determining the number of teeth for a known diameter of cutter and for determining the depth are included in the paper, as well as a geometrical construction for obtaining the best shape of tooth.

The authors pointed out that the industrial value of scientific analysis applied to basic shop processes appears to be little appreciated when that analysis is contrasted with investigations carried on to improve the design of the manufactured product. This is explained partly by the cleavage between the engineering department and the operating department in almost all plants. It is also partially explained by a shrinkage in the significance of the term "engineering" until it means "design" only, when used in a quantity-production atmosphere. This is either the cause or the effect of our engineering schools keeping out of touch with production proper, and consequently research energy is lavished on all features of design, each minor side issue usually having its full quota of devotees.

In contrast to this, research endeavor covering basic shop processes appears to be badly neglected. Taylor, in this country, and Nicolson, in England, have done classical work in the field of lathe-tool action. There is much to be done, and many fundamental shop processes are yet untouched. A plea is here made that our engineering schools devote the same intensity of attention to shop processes that they now devote to design. The economic results to industry would be greater though not so spectacular. If a hole can be drilled more quickly or a surface can be milled more rapidly, then the cost of practically all classes of finished products is affected. This is true of improvements in all basic shop processes, whereas improvements in design benefit only a limited field—just one class of finished product. The economy accruing from improvements in shop processes, being distributed over a larger territory, is less spectacular, and this, indirectly, may account for the decreased attention given to it.

In the art of milling, the only published investigations have been handled by machine tool builders. Attention has in consequence been focussed more on the machine than on the cutter. This paper describes an attempt to investigate the fundamental principles underlying the action of milling. The investigation described in the paper was instituted in May, 1920, by the National Twist Drill & Tool Co., and this company furnished the financial support throughout. Experiments have been conducted in the engineering shops of the University of Michigan, at the plants of the National Twist Drill & Tool Co., the Lincoln Motor Co., and the Hudson Motor Car Co. The greater part of the work was done at the University of Michigan. A complete copy of the paper may be obtained from the American Society of Mechanical Engineers, 29 W. 39th St., New York City.

* * *

PROPOSED BIG STEEL WORKS IN INDIA

According to information given out by W. H. Rastall, chief of the Industrial Machinery Division of the Department of Commerce, there has recently been incorporated in India by Bird & Co. of Calcutta and Cammell, Laird & Co., of Sheffield, a new concern known as the United Steel Corporation of India, Ltd., with a capitalization equivalent to $60,000,000 to $100,000,000 depending on the exchange calculated. It is believed that this development is of great importance to the future of the iron and steel industry in the East, it being proposed to establish, as soon as possible, works on a large scale near the deposits of iron, coal, and limestone in India. The cost at the works is said to be greatly below what has to be paid in other steel-producing countries, and for this reason it is believed that India will be able to produce the cheapest steel in the world. Cammell, Laird & Co., Ltd., are acting as advisors to the corporation, and are responsible for the design and erection of the works as well as of hiring employes. The plant is designed to produce 600,000 to 700,000 tons of pig iron, and the steel works and rolling mills are capable of producing 450,000 tons of finished steel a year. As a first step, however, it is proposed to erect a unit of half this capacity.

INDUSTRIAL CONDITIONS IN FRANCE

By MACHINERY'S Special Correspondent

Paris, December 10

The machine tool market is very quiet, and there is practically no buying. The only demand is for special machines, of which a few are being sold. Hence the production in the French machine tool shops is at a low level, and in the St. Etienne district, especially, a number of plants have reduced their working hours. The machine tool builders are particularly affected by the uncertainty of the policy which will be adopted by France in its dealings with Germany. Many French buyers of machine tools are deferring their purchases until German machines may be imported into France without difficulty.

At the present time, only special machines find a market, but some of these are selling steadily. This is particularly true of swaging machines, which have been placed on the market by three French manufacturers—Jouve, 3 rue de l'Orme, Paris; Chanay, 32 rue du Plat, Lyons; and Groslambert, rue de Vesoul, Besancon. These machines have given very good results.

The Allied Machinery Co. of France, 19 rue de Rocroy, Paris, has just installed in its Cail factory at Denain, one of the "Quickwork" shears built by the Quickwork Co., St. Marys, Ohio, which is said to be the only machine of its kind in France, and which has been arousing considerable interest among French engineers on account of the work of which it is capable.

The Norton Co. has built a large factory at La Courneuve, and is now supplying grinding wheels in all sizes from this plant. The quality of these wheels is exactly the same as that of the wheels formerly imported from America, the raw materials being imported from the United States. Fenwick Frères, 8 rue de Rocroy, Paris, because of the prohibitive exchange rates with America, have taken the agency of a Belgian manufacturer of grinding machines.

General Conditions in the Metal-working Field

In general, there is a slight improvement in the metal-working industries. Slowly but steadily the plants are starting up. There has been an increase in the demand for labor in the metal-working field in the vicinity of Paris. The scale of wages at present, based upon an eight-hour day, is as follows: Unskilled labor, 14 francs; machine operators and helpers, 22 to 24 francs; milling machine and lathe operators, 27 to 28 francs; blacksmiths, boilermakers, structural iron workers, 26 to 29 francs; highly skilled mechanical workers, 30 to 33 francs.

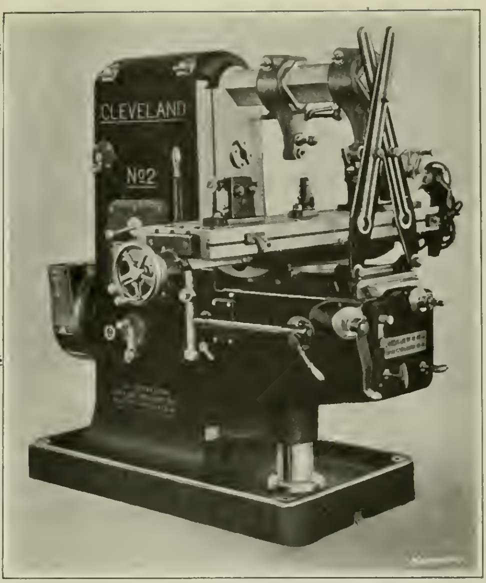
It is stated that a number of large French steel works have jointly opened negotiations with Italian works for delivery to Italy of large quantities of steel billets to be rolled into the finished product by Italian mills. The Italian Government approves of this arrangement, and a reduction is being considered in the custom duty for imports of this kind into Italy.

Considerable business is expected from the electrification of the railroads, some of the large railroad companies of France having already started to negotiate important orders in the electrical field. The Thomson-Houston Co. is figuring on a contract to manufacture 200 electric locomotives for la Compagnie d'Orléans. The same company is at present engaged in the manufacture of material for sub-stations for the Midi railroad, and is negotiating with the Paris-Lyons-Mediterranean road for similar material.

Construction Mecanique Francaise (Anciens Etablissements Cail) at Denain (Nord) is working on an order for 100 large locomotives to be completed and delivered in the course of the coming year. This company now employs 3500 men, and the production has reached 90 per cent of the pre-war output. The restoration work at Denain has proceeded rapidly, and when the new buildings have been completed the industrial plants of the city will have a larger capacity than before the war.

Design of the Cleveland Milling Machine

A Detailed Description Covering the Important Features in Design



THE efforts to produce machines to meet, in the best way possible, the demands for adaptability to a large variety of work, ease of operation, rapidity and accuracy of production, and length of service, have been largely responsible for the evolution of standard machine tools to the present-day designs. By these constant efforts the milling machine has advanced to its present stage of development. The heading illustration shows a modern machine of this type—the Cleveland milling machine built by the Clark-Mesker Co., Cleveland, Ohio. A patent covering the distinctive features of this machine has just been issued and, in view of this, it is believed that a description of the design will prove of interest to those engaged in machine tool design and to users of machine tools.

Construction of the Column and Over-arm

The column and base of the machine consist of a one-piece semi-steel casting adequately ribbed to give a rigid construction. As shown in Fig. 1, the lower portion of the column on the inside is formed into a chamber in which is kept a supply of coolant for the cutters, the coolant being conveyed to the cutters through the medium of the centrifugal pump *B* which is driven from the main driving shaft *A* through bevel gears and a vertical shaft. By driving the pump directly from the main shaft the supply of coolant to the cutters is automatically cut off when the machine is stopped. The bracket for the pump and its driving shaft is suspended from a rib which separates the coolant chamber from the compartment occupied by the main driving shaft and the speed-change gearing. A gasket is placed between the flange of the pump bracket and the rib so as to prevent oil leaking from the upper compartment into the coolant chamber. The pump forces the coolant to the cutters through piping which may be seen in Fig. 3, the coolant being later returned from the table to the chamber through a hose. The coolant chamber is filled through an opening in the right-hand side of the column which is provided with a suitable cover.

A feature of the machine is the square over-arm, the main advantage claimed for this design being that it provides a positive alignment of the arbor supports and the arbor with the other machine members. The over-arm is held snugly in the column by a cap having 90-degree V-grooves which mate with similar grooves in the column proper. The cap is aligned on the column through the use of a taper gib and dowel-pins, and the over-arm is clamped in place by binding members *C*, Fig. 1, each of which has two cylindrical parts connected by a screw that projects from the left-hand side of the column. These cylinders have beveled surfaces on the ends in contact with the square over-arm, and clamp the latter when the bearing surfaces are drawn against it by rotating the binding screw. The two arbor supports are clamped to the over-arm in a similar manner.

Lubricant for the various gears in the upper compartment of the column is supplied through opening *D*. The compartment should be filled to a level midway across a gage glass on the left-hand side of the column, which may be seen in the heading illustration below the main driving shaft. To fill to this level requires approximately five gallons of oil, but it is only necessary to do this about twice a year. A fine mist of oil is created in this compartment when the machine is running, due to the revolution of the gears.

The Spindle Driving Arrangement

Power to the cutter-spindle, the knee-elevating mechanism and the table feeds is transmitted through shaft *A*, Fig. 1, from the constant-speed pulley *E* which drives shaft *A* by means of friction clutch *F*. The pulley is mounted on the hub of the clutch-driving member, and this entire unit is supported by a bracket bolted to the rear of the column. Clutch *F* is controlled by levers *A*, Fig. 3, on each side of the column, located close to the table. The drive from the main shaft to spindle *G*, Fig. 1, is through a set of change-gears which ends in two gears keyed to the spindle. This arrangement furnishes sixteen speeds in geometrical progression, in either direction.

Power is transmitted from the driving shaft to the first gear *H* in the speed-change train, either direct through clutch *L* or through three bevel gears, *I*, *J*, and *K*, and clutch *L*. The clutch is keyed to shaft *A*, and when it is brought in mesh with the sleeve on which gear *H* is mounted, the latter is driven in a direction opposite to that in which it revolves when the drive is through the bevel gears previously mentioned. Clutch *L* is operated by a lever on the left-hand side of the column, which may be seen in the heading illustration adjacent to the oil-gage. With this arrangement only one speed, in either direction, can be transmitted to shaft *M*, Fig. 1, this being accomplished by means of the gear at the rear end of shaft *M* which meshes with gear *H*.

Two sliding gears *U* and *V* on shaft *M* and four gears which are held stationary axially on a sleeve *N* that revolves on a shaft enable any one of four speeds to be transmitted to the sleeve. From this sleeve power is transmitted to shaft *O* through two pairs of sliding gears *W* and *X*, which mesh with gears keyed to sleeve *N*. Sliding gears *W* and *X* have clutch teeth on both ends, and when gear *W* is pushed to the rear, the clutch teeth on this end engage similar teeth on gear *Q*, thus driving this gear directly.

When the sliding gear is brought to the front its teeth engage those of clutch *P* so that gear *Q* is driven through the clutch and the sleeve on which the clutch and gears are mounted. Similarly sliding gear *X* drives gear *R* either through the clutch teeth mounted adjacent to this gear or through clutch *P*. Gears *Q* and *R* mesh with gears keyed to the spindle, and as gear *Q* is mounted on a sleeve, and gear *R* really consists of a sleeve with teeth cut on one end, when either of these gears is transmitting the drive, the other rotates idly on shaft *O*. The sliding gears on shafts *M* and *O* are operated by ball-joint levers *A*, Fig. 4, located on the left-hand side of the column. The forks operating the sliding gears are made interlocking so as to prevent the engagement of both pairs of gears at one time.

Adjustment of the Spindle

The spindle is flanged at the front end, and the face of this flange has a keyway into which may be inserted hardened steel jaws for driving arbors and face mills. Wear on the front and rear spindle bearings may be compensated for by adjusting nut *S* (Fig. 1) at the rear end of the spindle. The spindle may be hand-operated by turning wheel *T*, which is a convenient feature when boring jobs and some milling operations are being performed. Positive locking of the spindle is effected through a small crank-lever on the left-hand side of the column near the rear, which may be seen in the heading illustration. This locking device cannot be operated while the machine is running, and neither can the main driving clutch *F*, Fig. 1, be brought into contact with its driving member when the spindle is locked. The positive locking feature enables the operator to remove arbor nuts without difficulty. The draw-in bolt *Y* provided for holding arbors or cutters in the socket end of the spindle may be rotated by applying a crank-handle on the rear squared end.

The Knee-elevating Mechanism

Reference to Fig. 2 will show that the gearing for elevating or lowering the knee and feeding the saddle and table is all contained in the knee, the latter consisting of a main casting gibbed to a dovetail slide on the column, and a casing *A* in which the major portion of the gearing is contained. This construction enables ready unit assembly and facilitates lubrication of the transmission members, as a sufficient quantity of oil can always be kept in casing *A* for some of the feed-gears to dip into. Power is transmitted to the knee-elevating and table-feeding mechanisms from shaft *A*, Fig. 1, through bevel gears *a* and *b*, and spur gears *c* and *d*, gear *d* driving the extremely wide faced spur gear *B*, Fig. 2. The extreme width of gear *B* is necessary on account of the vertical movement of the knee. Gear *C* also meshes with gear *B* and transmits power to shaft *D* through bevel gears, the drive being connected and disconnected by operating clutch *E*, which is controlled by a lever on the left-hand side of the knee. When clutch *E* is in engagement with bevel gear *F*, the rotation of shaft *D* is in the opposite direction to that in which it revolves when the clutch is in engagement with gear *G*. This arrangement enables the knee to be elevated or lowered, the saddle fed to the front or rear, and the table to the right or left.

From shaft *D* power for operating the knee mechanism is transmitted to sleeve gear *H* through trains of feed-change

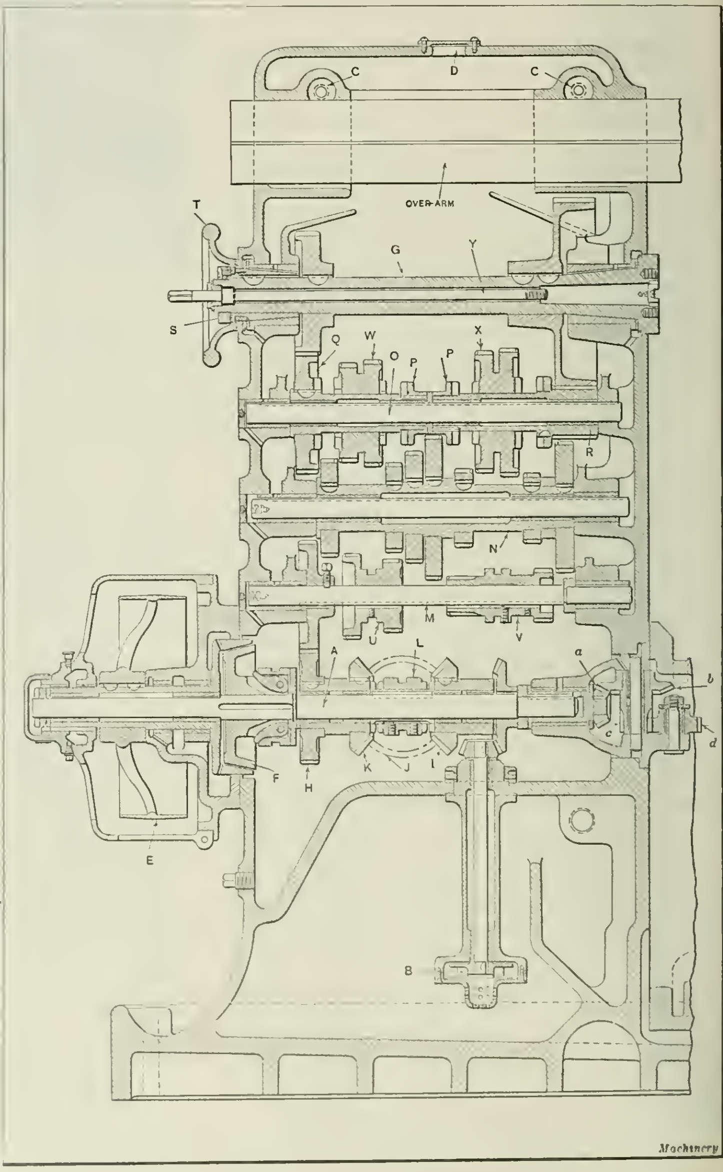


Fig. 1. Cross-sectional View of Column of Cleveland Milling Machine, showing the Main Drive and the Drive to the Spindle and Centrifugal Pump

gears which are connected by either of sliding gears I or J and which drive gear K mounted on a sleeve on shaft L. Power from gear K is transmitted to gear H by engaging the teeth of clutch M with those of the clutch member mounted on shaft L adjacent to gear K. Gear H drives its mating bevel gear V on the top of the elevating screw N. The threads of this screw engage those of nut O which is held in a post mounted on the base and is automatically lubricated. The knee is raised or lowered according to the direction in which the screw is rotated. The main knee casting has a bearing on the post in which the screw nut is mounted. Gear V has teeth on the upper side as well as on the lower, the upper teeth meshing with a pinion that may be rotated by hand by turning crank B, Fig. 3, when the power feed is disengaged.

Saddle and Table Feeds

Sixteen feeds to the saddle and table in geometrical progression are provided through the change-gearing in the knee; these are obtained by operating handles on the front of the knee as shown at C in Fig. 3. The saddle is adjustable on a dovetail slide on the knee, and is fed across the knee by means of a screw engaging a nut cast integral with the saddle, the screw being driven direct through the gearing in the knee or turned by hand when handle Q, Fig. 2, is revolved. This handle is applied to the square end of the screw which is located as shown at D, Fig. 3. The clutch for the power feed is operated by a handle on the right-hand side of the knee. Automatic operation of this clutch is also provided to stop movements of the saddle at predetermined points. The crank for feeding the saddle by hand is disengaged from the screw when this member is power-fed.

On the top surface of the saddle is mounted a swivel-head R, Fig. 2, and on the latter is mounted table S. The saddle and swivel-head are correctly assembled with reference to each other by means of a hardened annular ring which seats in a recess in the upper surface of the saddle and which furnishes a bearing for the head. Clamps are supplied to maintain the head in any desired angular position, and the base of the head is graduated to facilitate such settings. The drive from the feed-change gearing to the table is through a train of spur gears which drive shaft P, and then through bevel gears which connect shaft P to the table screw located at W. The vertical shaft U on which two of the bevel gears are mounted is located at the center about which head R swivels. The table screw engages a stationary nut on the swivel-head.

A clutch on the feed-screw engages and disengages the screw from the power drive. This clutch is actuated by lever T through a gear segment and forked lever. When the clutch is disengaged, the table may be hand-fed by revolving handwheel E, Fig. 3, or crank-handle F. The clutch can be disengaged automatically after the table has moved a desired amount, by an adjustable trip secured to the T-slot on the front side of the table, which strikes a projection on lever T, Fig. 2. The bevel gear on shaft P and those on shaft U are held in a bracket supported by the saddle, the gear on shaft P being free to slide so that it can follow the movements of the saddle. Easy traverse of the table is facilitated by means of rollers with which the swivel-head is equipped, and which keep the bearing surfaces amply lubricated.

Additional Features

Among the most important requirements of a milling machine are convenience and rapidity of operation, and in the Cleveland machine these are obtained by locating all control levers at the front and by having all mechanisms controlled either by a lever or a handle. The graduated dials provided on all adjusting screws are large in diameter. A rotary table can be mounted on the regular table, and in such an event the drive to the rotary table is supplied through an extension shaft and universal joints which connect this table to a train of gears on the right-hand end of the regular table, power being transmitted to this train of gears from the table feed mechanism. Although the machine illustrated is intended to be driven from a lineshaft by a constant-speed pulley, it may be arranged for motor drive in approximately two hours, the machine having been designed with this in view. A Morse silent chain transmits the power when the machine is driven by motor.

A machine equipped for cutting teeth in a rack is illustrated in Fig. 5. A special bracket A is attached to the face of the column, this bracket supporting a cutter-spindle at its outer end. This spindle is positioned at right angles to the machine spindle, and thus is parallel with the table, when this member is at right angles with the knee. The cutter-spindle of the rack attachment is driven from the machine spindle through spiral gears. A form cutter is used in cutting the rack teeth, and a tooth is produced each time the rack is fed transversely past the cutter by operating the saddle feed. After a tooth has been formed the rack is indexed longitudinally to suit the pitch through gearing B on the end of the table, which is connected to the table feed-screw. This gearing is actuated by operating handle C which has a plunger that engages a notch in a one-notch index-plate

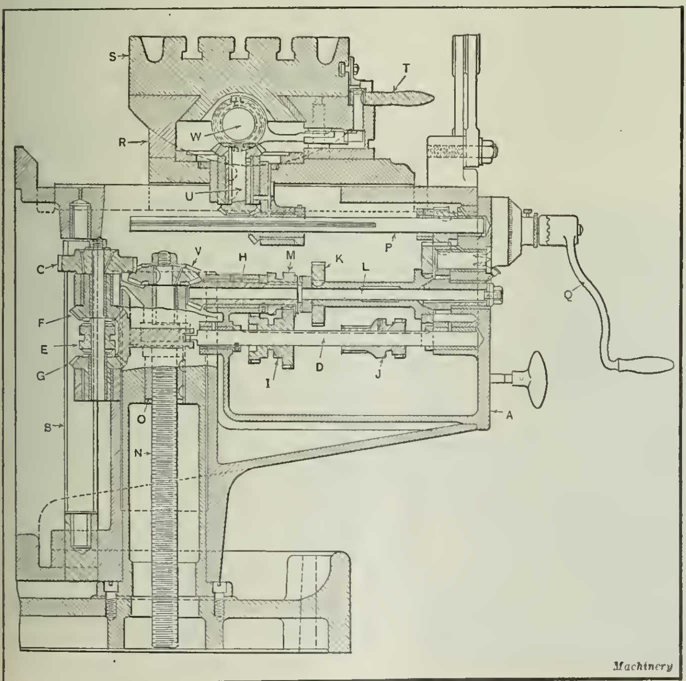


Fig. 2. Sectional View, showing the Important Mechanisms in the Knee

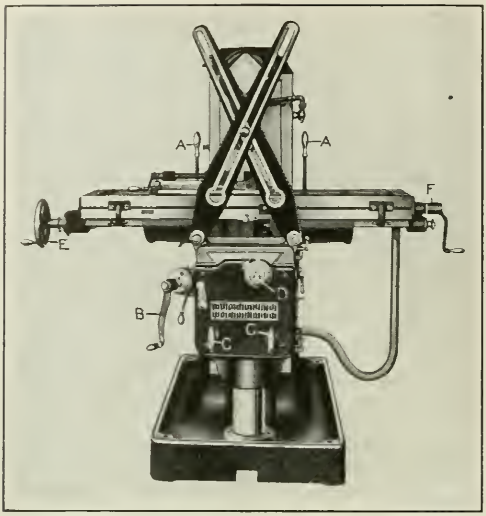


Fig. 3. Front View of the Machine, illustrating the Arrangement of the Arbor Supports

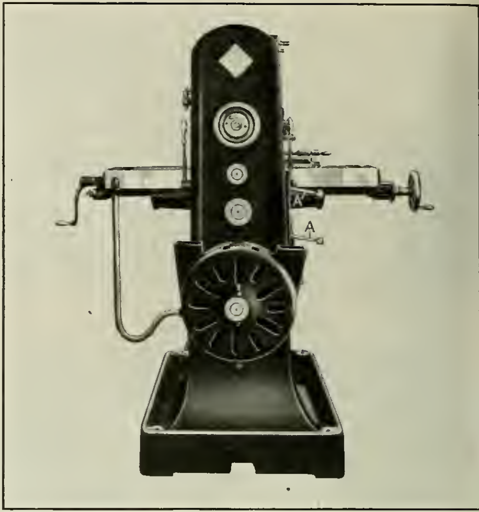


Fig. 4. Rear View of the Machine, showing the Bracket supporting the Driving Pulley

mounted on the same shaft as the top gear in the train. One movement of the handle causes the table and rack to be indexed the necessary amount.

Slotting Attachment

A slotting attachment may also be supplied to meet the requirements of diemakers and toolmakers and for use in shops where there is not sufficient work to justify the purchase of a regular slotting machine. This slotting attachment is firmly clamped to the dovetail slide of the column and located in position on the column by means of two pins at the top of the attachment base. The frame which carries the ram is graduated and can be swiveled through 180 degrees. This permits it to be used in the horizontal position without interfering with the stroke of the ram. The ram is of rectangular section and gibbed to provide adjustment for wear. Its stroke may be set for any length up to 4¾ inches. At the lower end of the ram is attached an adjustable tool-block made of hardened steel V-jaws, which will accommodate tools from ¾ to 1 inch in size. The drive to the crankshaft which actuates the ram is direct from the milling machine spindle through a coupling. Lubricant is supplied to the slide surfaces of the attachment by an oil-cup on the front of the ram and vees which convey the oil while the ram is in operation.

* * *

According to figures published in a recent Commerce Report, there were 558 plants in the United States in 1919 engaged in the manufacture of machine tools and metal-working machinery. The combined value of the products of these plants for that year was $248,573,000. The exports amounted to a value of $58,507,942, of which $22,627,477 represented machine tools.

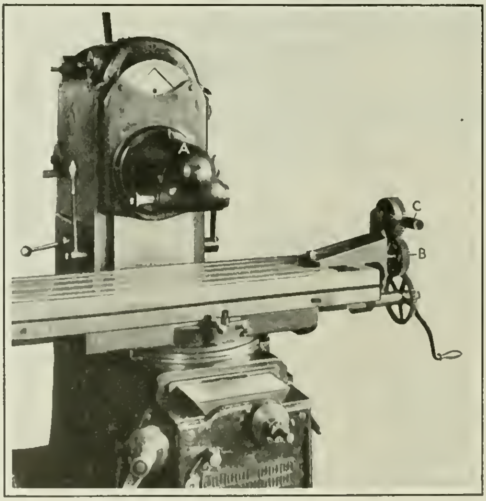


Fig. 5. Attachment for cutting Teeth in Racks

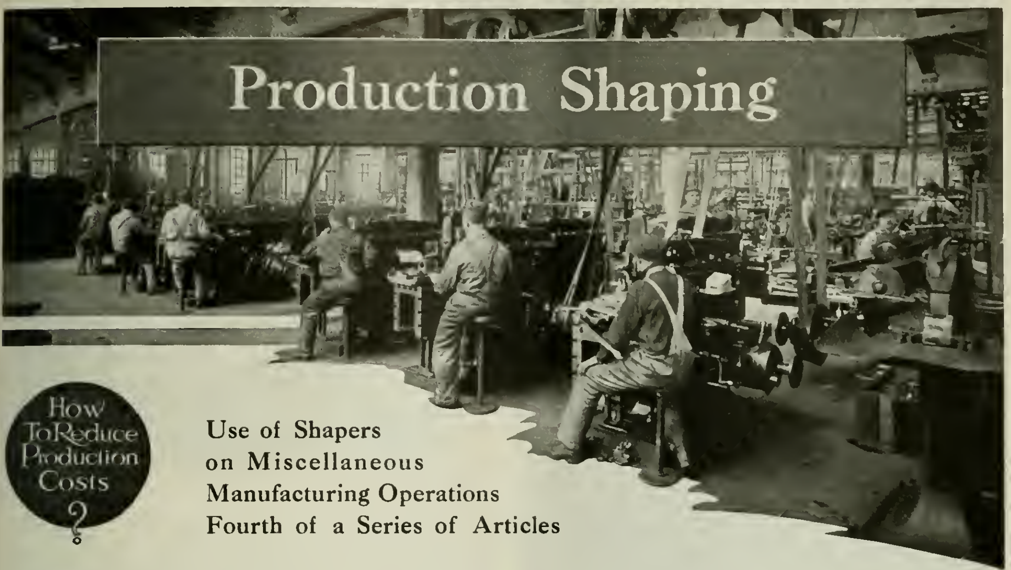
POLISHING FLUTES OF REAMERS

Flutes of reamers, taps, and other similar small tools are not usually polished in regular production work, but are ground with solid wheels. For this operation, according to *Grits and Grinds*, the Norton Co., Worcester, Mass., has found that alundum wheels 2 to 6 inches in diameter, by ¼ to ½ inch thick, grain 60 or 80, and grades O to Q, will give satisfactory results. Some manufacturers, however, polish the flutes of taps and reamers, and for this work a felt or leather wheel is generally used, unless the work is exceptionally large, when a canvas wheel is more satisfactory, since it will hold the abrasive better and give greater production. On the smaller sizes a leather wheel is considered best from the cutting standpoint, and it is also as good as other kinds for finish. Leather wheels are made from a good quality of oak tan leather, and they should be approximately 6 or 8 inches in diameter by ¼ or ½ inch thick.

Care should be taken to see that the polishing wheel is true, and if necessary it should be turned true before setting up with grain. When this is done, a sizing of good glue should be applied and left about two hours to dry. Then two coats of glue and abrasive are put on and left to dry over night. Before using, the grain on the sides of the wheel should be dressed off with a piece of broken grinding wheel.

The sizes of wheels and also the grain to use depend largely upon the sizes of the work to be polished. For large work a wheel of 60 or 80 grain will give good results, while for smaller sizes a wheel of about 120 or 150 grain is satisfactory. If a still better finish is required, grain 200 with Tripoli or oil can be used. This work is done free-hand.

Production Shaping



How To Reduce Production Costs ?

Use of Shapers on Miscellaneous Manufacturing Operations
Fourth of a Series of Articles

ALTHOUGH the principal field of application of shapers is in tool-room and experimental and repair shop work, machines of this type are now being used for many detail operations which must be performed in the manufacture of metal parts. For instance, one well-known maker of firearms has twenty-five crank shapers in the production departments of his plant, and this is but one of many examples that could be cited. The following article illustrates and describes the performance of miscellaneous manufacturing operations on the shaper, and will tend to emphasize the applicability of a machine of this type as a standard form of equipment for production work.

Application of the Tilting Table Flap for Shaping an Inclined Surface

Fig. 1 illustrates a typical application of the tilting table flap of the shaper built by the Potter & Johnston Machine Co., of Pawtucket, R. I. This construction provides for obtaining a specified angular relationship between the under surface of a piece of work that rests on the shaper table and the top surface that is being planed by the cutting tool. In this case, the piece to be machined is a cast-iron gear guard, the feet of which are bolted down to the table by means of clamping straps. By tilting the table flap, the top surface of the gear guard is finished at the required angle with the plane of the feet.

Use of Swiveling Table for Shaping Two Surfaces at an Angle with Each Other

Still another adjustment furnished on the Potter & Johnston shaper to provide for obtaining definite angular relationships between two surfaces of the work is illustrated in Fig. 2. The piece shown on the machine is a cast-iron bracket on which two surfaces are shaped at an obtuse angle to each other. The shaper table is carried on a pivotal support, so that after one surface has been finished, the table

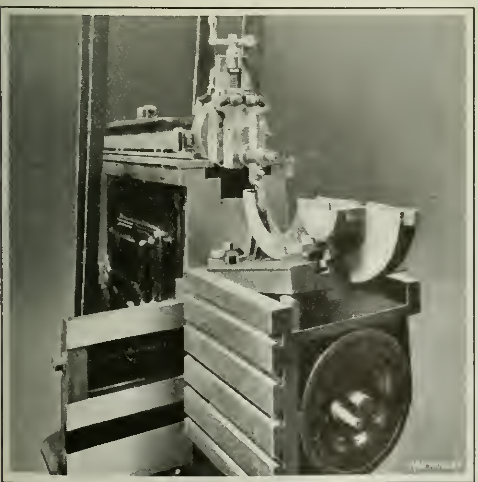


Fig. 1. Application of the Tilting Shaper Table Flap for obtaining a Specified Angular Relationship between Two Finished Surfaces on the Work

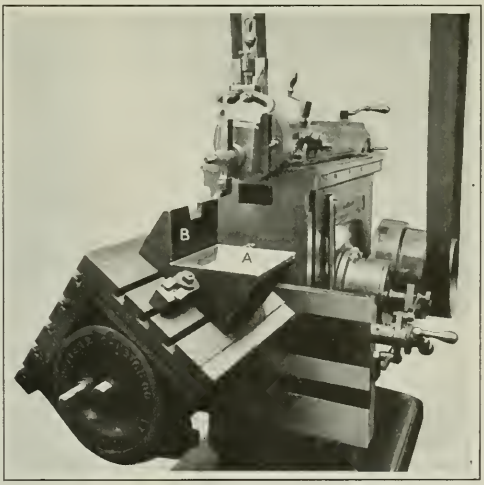


Fig. 2. Application of the Swiveling Table for obtaining a Definite Angular Relationship between Two Finished Surfaces on a Piece of Work

can be swiveled through any required angle for finishing a second surface at a specified angle to the one previously machined without resetting the work. In the present case, surface *A* was finished first, after which the table was swung over to the position shown for shaping surface *B* with a vertical downward feed of the tool. The shaper tool is forged with an offset in order to avoid any interference between the tool and the work. It will be seen that the casting is strapped down on the shaper table.

Shaping Both Sides of a Wide Slot Simultaneously

The piece of work illustrated on the machine in Fig. 3 is a sliding block used on a piston-turning machine. The operation consists of finishing the two vertical walls *A* of a wide slot, with a specified clearance between them, on a

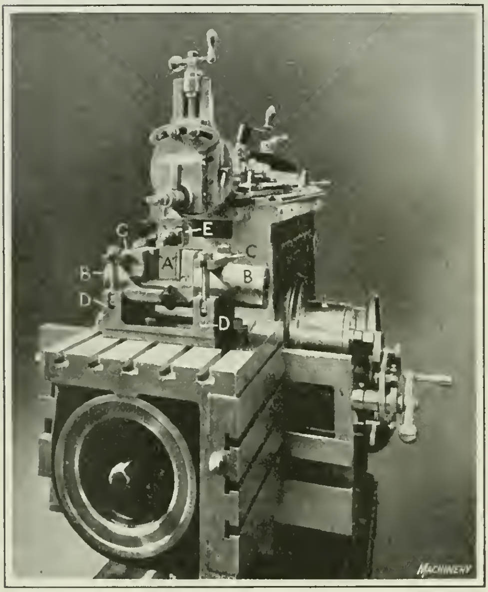


Fig. 3. Use of a Duplex Tool-holder for finishing Two Sides of a Wide Slot simultaneously

Potter & Johnston shaper. This job is interesting for two reasons. The two trunnions *B* have been turned before the piece comes to the shaper, and they are utilized as locating points by having a V-block fixture bolted to the table with straps *C*, which hold the trunnions down in the vees *D*. With the work located in this way, the two sides *A* of the slot are finished simultaneously by means of a tool-holder *E* that supports two cutter bits extending in opposite directions. The slots in which these bits are carried in the tool-holder, are inclined sufficiently so that the points of the tools will operate without interference between the tool-holder and the work.

Cutting Long Keyways on the Shaper

In cases where it is required to cut long keyways, or spline grooves, the shaper may often be employed advantageously. Such a case is shown in Fig. 4, where the shaft is held in a vise bolted to the table of a shaper built by the John Steptoe Co., of Cincinnati, Ohio. The work is done with a tool of the same width as the keyway or spline groove,

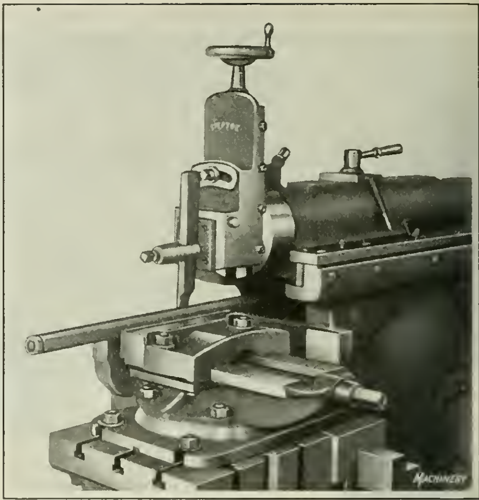


Fig. 4. How the Shaper is used for cutting a Long Keyseat

the latter being produced by feeding the work up to the tool until the groove has been sunk into the work to the required depth. If an exceptionally smooth finish is required on the sides, it may be found desirable to take a second cut with a slightly wider tool.

Many men of experience in the planning of machining operations would regard this as a job for which the milling machine would be peculiarly well adapted. Local conditions would naturally affect the results that could be obtained, but on either type of machine the setting up time would be approximately the same, and it is probable that there would be little difference between the actual time required to form the groove with either a milling cutter or a shaping tool.

Shaping Wobbler Rolls

An interesting operation showing the application of shapers on work other than machine tool parts is illustrated in Fig. 5, which is a close-up view of one end of a very heavy steel wobbler roll on which it was necessary to plane the semicircular grooves that are used for driving

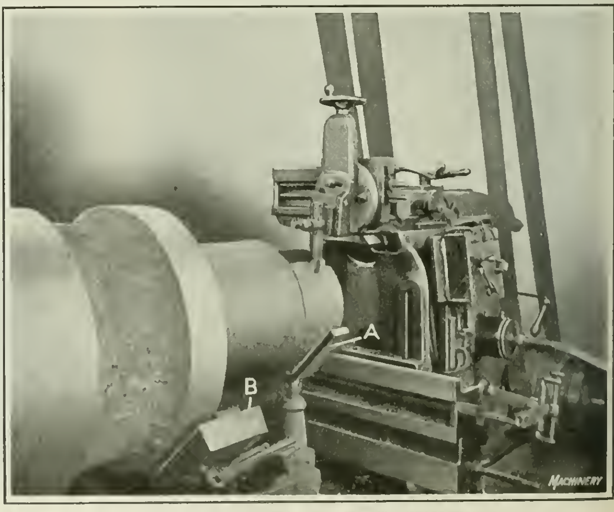


Fig. 5. How a Traverse-head Shaper is used for cutting Integral Key

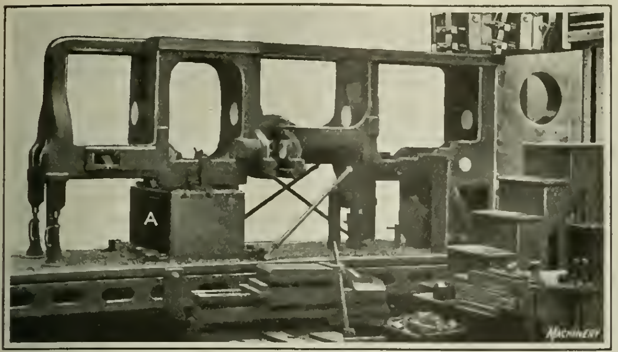


Fig. 1. Automatic Screw Machine Frame Casting set up for planing

the roll. The operation is practically impossible to perform except by using a shaper that is adapted for this work. In this particular instance, the roll was brought to the machine by a crane and set in the proper position with the inner end supported by a cradle *A*, which is mounted on an adjustable jack to locate the work. The cross-rail and table of the shaper were removed as will be seen in the illustration.

The shaper is provided with a traverse head having automatic horizontal and vertical feeds similar to a planer, and has sufficient adjustment to make it possible to plane the wobbler grooves without difficulty and in much less time than by any other method. In some shops where motor-driven shapers are used, it is found easier to transport the shaper to the work on account of the great weight of some of these rolls.

* * *

PLANING OPERATIONS ON PARTS OF NATIONAL ACME AUTOMATICS

Figs. 1 and 2 show the set-up of the frame casting for a National Acme multiple-spindle automatic screw machine on a Cincinnati planer. It will be seen that the casting is of rather unusual size and of such a shape that there would be considerable danger of distorting it by the pressure of the planing tools, unless adequate precautions were taken to avoid such trouble. Before starting to set up the casting, each of the bosses in which shaft bearings are subsequently to be fitted, has been carefully laid out, so that these fixed points on the work may be used in setting the planing tools, thus making sure not only that all planed surfaces on the casting will be properly cleaned, but also that these faces will be correctly located relative to the other fixed points.

The casting is first located by means of a supporting block *A*, which is secured to the table of the planer. This block is employed when the casting is inverted for planing the base; when standing on its own base, no special support of this kind is required, because there is a uniform flat face for the casting to rest on. However, regardless of whether the work is standing right side up or upside down, there are numerous points at which it is necessary to provide additional support to prevent springing the casting out of shape under the pressure of the cut; this is accomplished by the use of jacks, as shown in the illustrations. Adequate support is furnished by this means, and by the use of end-stops, straps, and packings usually employed in the performance of planing operations.

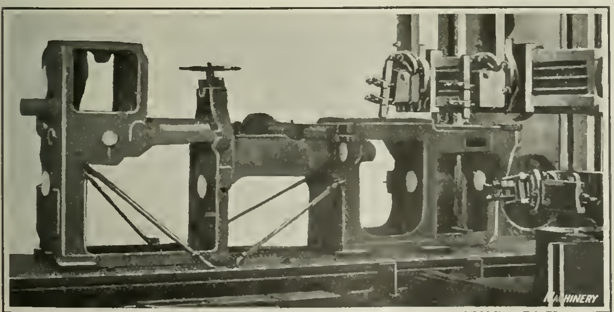


Fig. 2. Casting shown in Fig. 1, set up in the Reverse Position

Planing the Dovetailed Bearing in a Cross-slide Block

In Fig. 3 a finished cross-slide block for a National Acme automatic screw machine is shown at *A*, and this illustration also shows the way in which a string of these castings is set up on a G. A. Gray planer for planing one of the dovetailed bearings of these blocks. The castings are clamped against a parallel bar fixture by means of bolts and fingers. Sheet-metal guards *B* are placed over the ends of the clamping fingers to protect the finished surface of the work. In this operation, the point of interest is the provision which is made for finishing the angular under-cuts of the dovetailed bearings. This is accomplished by setting the tool-head at an angle so that the tool point can be fed down the inclined side of the work. The tool is forged with an offset point which enables it to operate without interference between the side of the tool and the work. In performing this operation, the method of procedure is to first cut a slot of rectangular cross-section, and then to perform the under-cutting operation as shown. The material is cast iron, and this job is performed with a feed of 1/64 inch per table stroke and a cutting speed of 36 feet per minute.

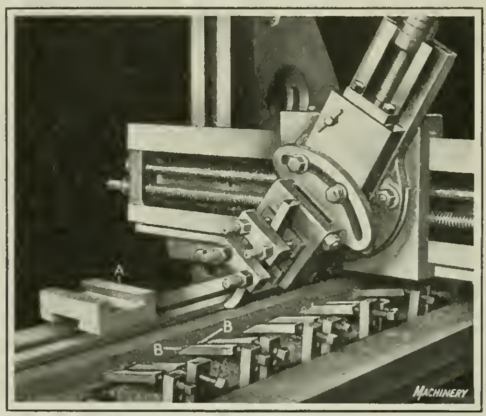


Fig. 3. Planing Dovetailed Bearing in Cross-slide Blocks for National Acme Automatics

* * *

Great improvements are being effected in the French railway system, according to an item in a recent Commerce Report, and the rolling stock now includes about 1000 locomotives and 50,000 cars more than before the war. Traffic has increased, and 40,000 cars, on an average, were loaded daily during September.

HOW THE MACHINE TOOL SALESMAN CAN SERVE THE INDUSTRY

By a Machine Tool Sales Manager

Rumors—good, bad, and indifferent—surge through all industries. Some of them are based on facts, many are not. At the present time there is a rumor circulating in many industries to the effect that manufacturers are trying to meet the demand for lower prices by lowering the quality of their products. It is impossible either to confirm or contradict this rumor, in so far as it concerns *all* the different industries of the country; but it is a matter of great consequence if such a rumor should be circulated in regard to the machine-building industries in general, and the machine tool industry in particular. Whether such rumors invade the industry and are allowed to circulate depends largely upon the viewpoint and activity of the salesman.

With all due credit to the efforts of catalogue and trade-paper advertising to create quality ideas in the minds of the buyers, it is the spoken word of the salesman that leaves the lasting impression. The machine tool salesman, of course, will always say that the particular machines that he represents have greatly improved; but he sometimes implies that the machines of his firm are the only ones about which this could be said. Then he is followed by another salesman who represents another machine, which is the "only exception." There can be only one effect upon buyers of such an attitude. The impression is created that there must be some ground for the untrue rumors, and this will prove injurious to the industry.

No salesman would want to plant favorable impressions which are likely to grow into orders for his competitors, but he should never forget that his firm is part of his competitors' industry, and that no permanent gain can be made by reflecting unfavorably in any way upon that industry. Suppose that he is selling lathes. He will make a much stronger impression by admitting that all lathes have made rapid progress within the last few years. They are all improving, for the machine tool industry can never stand still, and his own firm had to hustle to keep their usual place in the lead. To hold their lead they secured the best engineers and made improvement after improvement. It is true that another salesman will come along with another leading lathe, but is it not better to have several claiming to be the best builder, instead of having all condemn every machine except their own?

The Old-time Shop Mechanic

In one respect machine shop mechanics are like ball players of bygone days. Just as the old ball player likes to tell how much faster the old game used to be played, so the old-time mechanic likes to praise old-time workmanship, and tell how certain old-time machines "made as they used to make 'em" were better than those made today. This is a pitfall which the machine tool salesman must take care to avoid in these times. It would be easy at the present time to help spread the thought that machine tool workmanship really has not improved, or having improved, is now yielding to a different tendency. Yet, if the salesman permits himself to agree with these statements, he is showing himself ignorant of the remarkable advance of recent years, and by ignoring well-known facts is doing a great injury to the industry in which he is engaged.

It is true that machine tools have always been built with a great deal more care than a great many other lines of machinery, and old-time machines have some very good workmanship. But today the gears are made of steel—perhaps hardened steel or alloy steel—many of the parts are ground to size, and modern measuring tools have reduced the working limits and made perfect alignment the rule, whereas formerly it was an exception. The machines of today are heavier, they have more power, and they perform more and better work.

The Question of Lower Prices

For the last six months the great problem for all business men has been to establish confidence in business, and it may be said that this has been accomplished. As individuals we are all determined that prices are to be lower. We know that food, clothing, and other standard articles of consumption should and will come down in price, but for such articles there is generally a standard of quality, which for the same classes of goods is the same today as it was ten or twenty years ago. In the machine tool industry a different condition exists. Machine tools will continue to improve, and the machine tool salesman should impress that upon the minds of his customers. It is doubtful if there is another industry in which quantity is as subordinate to quality as in machine tool building. The first thing that is demanded of a machine tool is quality. The prices of machine tools will never recede to the pre-war levels, because of the improvements that have been made both in design and workmanship during recent years. The machine tool salesman who casts a reflection upon the workmanship of the product of any reputable machine tool builders whose products may compete with his is doing an injustice to the entire machine tool building industry.

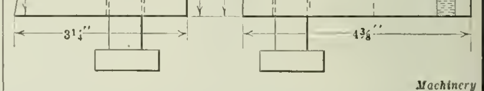
The best service that the machine tool salesman can render today is to give useful and accurate information as to the products of the entire industry. The impressions that he allows to remain in a prospective customer's mind will be passed on to others, and he should check any impressions that may create an unfavorable opinion of the industry.

* * *

CLAMP FOR PLANER WORK

By JOE V. ROMIG

A clamp or pinch-dog, which is intended for holding flat work on a planer table, is shown in the accompanying illustration. It will be noted that the 60-degree tooth of the clamping member *A* lies in a higher plane than the axis of the bolt *C*. When in use, the body *D* is clamped to the table in such a position that the 60-degree tooth of clamp *A* will be in contact with the side of the work. When screw *B* is elevated, a downward and inward pressure is exerted on



Clamp for Planer Work

the work by the point of the 60-degree tooth. In some cases it is advisable to cut a shallow notch in the work with a chisel for the reception of the clamping tooth. When used on work having finished surfaces, a smooth block of metal is placed between the tooth of the dog and the work.

It is obvious that clamps of this type are intended to be used in pairs, so that a clamp on one side of the work will be located directly opposite a similar clamp on the other side. The clamping-bolt slot in the base of the fixture is long enough to permit the dog to be attached to the planer table in almost any position. The device can be located on parallels in order to obtain the desired clamping action on high work. The body *D* may be made of cast iron, and the clamping member *A* of hardened and drawn tool steel.

Feeds and Speeds as Production Factors

By ALBERT A. DOWD, President, and FRANK W. CURTIS, Chief Engineer, Dowd Engineering Co., New York City

How To Reduce Production Costs ?

ALL manufacturers agree that correct cutting speeds and feeds of machines are essential to maximum production, but there are comparatively few who give the matter sufficient consideration. If the production and the establishment are large, the little losses here and there due to incorrect speeds and feeds may make a total loss of thousands of dollars in the course of a year, and even in a small factory, the loss in production will result in a considerable loss in money. Manufacturers often do not make any great effort to keep machines up to their maximum output, because it is thought that the changes necessary may interrupt production and cause a still greater loss. Also, past experiences in changing feeds or speeds may not have proved successful, due to the poor judgment of the man engaged on the work.

Importance of Recording Speeds and Feeds

There is in all probability no more important factor in production work than the use of correct feeds and speeds, and yet, admitting that each manufacturer wishes to keep his machines running at 100 per cent efficiency, he is not always willing to take the proper steps to insure such a condition. A lathe may be turning a piece of work at too slow a speed and a request may come from the foreman of the department to install a larger pulley on the lineshaft in order to obtain the desired increase of speed. A similar job may be in process in another part of the factory at a different speed and feed without the foreman knowing about it, because he has no supervision in the other department. He may not even know the correct speed at which the work should be revolved to insure the greatest efficiency, but realizes that the production is not what it should be.

An occurrence like this reveals the importance of keeping a record of machine speeds and feeds employed throughout the entire shop and those used on every piece of work which has been made. With a carefully kept record and proper supervision of the machines to see that they are producing as they should, there is no reason why one lot of parts being machined today, should be produced at a slower rate than another lot of the same kind made several months ago. In addition to this, there is always the possibility that production can be increased more or less if the man in charge of setting feeds and speeds conscientiously does all he can to obtain the highest production. This brings us to an important point in the discussion—the selection of a competent man to set all speeds and feeds.

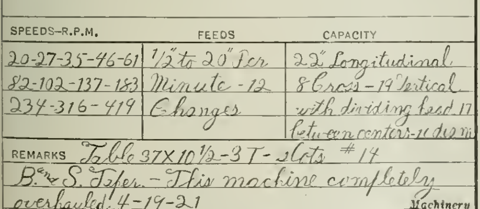
Selection of the Right Man to Set Speeds and Feeds

In determining a man's qualifications for the position, a number of matters must be taken into consideration in order that no mistake will be made by picking out a person likely to use poor judgment or antagonize the department foremen. Mechanical knowledge over a broad field is an essential item, and this knowledge should be of a thoroughly practical nature gained not only by actual shop practice but also by study and analysis. A clear-thinking man having a critical turn of mind, yet not hasty or of the egotistical type, will usually be found to be best for this kind of position. Another essential quality is the ability to determine whether a machine is at fault in not giving sufficient production or whether the loss is due to castings being too hard, or other conditions. In a shop of normal size, one man should have charge of all speeds and feeds, and none of these should be changed in any department without a written order from him. Naturally, this could not apply at first, as it would interrupt production and cause a great amount of trouble.

Installing a System of Recording Speeds and Feeds

In the installation of a system of this kind, the first step would be to make a list of all machines with complete data regarding speeds and feeds for each, their location in the factory, their factory number, etc. Much of this information should be easy of access through the tool engineer, other heads of departments, and factory records. It is advisable to file record cards according either to the type of machine or the department, as may be found most suitable for ready reference. A card suitable for this kind of record is shown in Fig. 1. If a machine is kept continually on a given piece of work, it may be found more convenient to incorporate all data about the speeds, feeds, and rate of production on the card record of the machine. However, as the majority of factories use machines on more than one piece of work, a record of each piece with the details of each operation may be found more useful. A great deal depends upon conditions in the factory, and the system should be devised according to their requirements.

Fig. 2 shows a card which can be used to record facts about the work itself, such as the machine on which a given operation is performed, the speed and feed used, and the rate of production obtained. A single card should be used for each operation, and complete details regarding the production should be given in such a form that it will serve

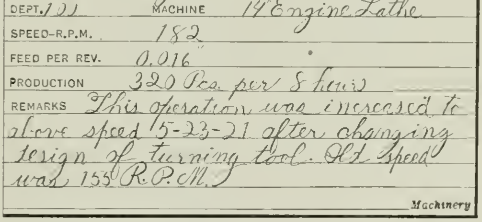

NAME Cincinnati Miller TYPE No. 1 M. Plain
FACTORY NO. 1431 BUILDING #8 DEPT. #14

SPEEDS—R.P.M.	FEEDS	CAPACITY
20-27-35-46-61	1/2" to 20" Per	22" Longitudinal
82-102-137-183	Minute - 12	8 Cross - 19 Vertical
234-316-419	Changes	with dividing head 17
		between centers - 11 diam

REMARKS Table 37 X 10 1/2 - 3 T-slots #14 B. and S. Taper. - This machine completely overhauled 4-19-21

Machinery

Fig. 1. Card for keeping Data Relative to Machine Tools, such as Speeds, Feeds, and Capacity


PART 188 Bearing Bracket
OPER. 3 Rough-turn hub diameter
DEPT. 101 MACHINE 14" Engine Lathe
SPEED—R.P.M. 182
FEED PER REV. 0.016"
PRODUCTION 320 Pcs. per 8 hours
REMARKS This operation was increased to above speed 5-23-21 after changing design of turning tool. Old speed was 155 R.P.M.

Machinery

Fig. 2. Work Record Card which gives Machine Tool used, Speed and Feed, and Production Rate

CHART SHOWING CONDITIONS WHICH GOVERN SPEEDS AND FEEDS

Machine Tool	Size: Heavy or Light Condition: Good or Bad Style: Old or New Right Machine for Nature of Cut
Material	Annealed, Hard, Medium, Soft Too Much Stock to Remove Shape of Work Proper Heat-treatment
Tool Used	Grade: Steel, Stellite Properly Ground Properly Held and Supported Properly Hardened Size: Large Enough to Carry off Heat Number of Pieces per Grind
Lubricant	Necessary or Not Composition Flowing Correctly Flow Large Enough

as a guide in setting up the machine and operating it when the same work is again placed in the shop. After these cards have been prepared, shop tests can be instituted gradually, each machine being tested according to the work it is doing in order to be sure that this is being accomplished in the best manner and in the least possible time. When making the tests a record should be kept of the old and new speeds and the resulting gain in production. Such records will be found of great value, as they not only show the gain in production, but also the method used to obtain the result. If the same job is put through the factory at intervals any deviation from the standard time originally set should be accounted for.

Factors to be Considered in Setting Speeds and Feeds

In analyzing the conditions that affect the setting of speeds and feeds, it will be found that the four following factors are particularly important: the machine tool used for the operation, the material to be cut, the cutting tools employed, and the lubricant used. Each of these factors should be carefully considered from several angles, and as any one of them often affects the others, the engineer should consider the problem in general in connection with each factor, if best results are to be obtained. The accompanying chart will assist a man new to the work to reach a decision regarding the various essential points. The order in which the different factors are mentioned is the logical sequence for a rapid analysis of conditions, although it is possible to start at almost any point, provided certain requirements are known to be correct.

Machine Tools—The machine tool for a given piece of work should be selected with care to make sure not only that it is the ideal type for the work, but also that it is in good condition. High production with the necessary accuracy cannot be obtained unless the equipment is in first-class shape, and a great deal of trouble is caused by an attempt to turn out a high-grade product with inefficient equipment. Modern machine tools are to be preferred to the older types for several reasons: They are more convenient to operate, and have more power and greater range; hence, they will turn out work more rapidly and with greater precision. The man in charge of speeds and feeds should recommend the substitution of newer types of machines for those which are obsolete and which, as a consequence of their condition, cause production to fall below normal.

Material to be Cut—After the machine tool selected for an operation has been found to be in suitable condition to perform its part of the work, the material to be machined should be considered. Steel, cast iron, and brass should not be cut at the same speed and feed. Cast iron may be chilled, hard, medium or soft, all of which conditions require a different rate of speed and feed. So also brass and aluminum vary in their composition and must be cut at suitable speeds and feeds. Tests should be made of the material to be cut, and if found far from normal it should be returned to the foundry or forge shop for proper treatment. If work comes through the factory with some pieces hard, others medium, and some soft, a machine cannot be expected to turn out a uniform product at established rates of speed and feed.

Certain kinds of material can only be brought into a uniform condition by annealing, and when this is the case care must be taken to see that the work is thus treated before it is placed in production. On some classes of work it may be found that the finish allowance is too great and that it would be better to change the pattern so that the cutting action will be less severe. The shape of the work also has some effect on the speeds and feeds which can safely be used, as a part which is very thin and fragile or one on which the cutting action is interrupted, will not permit the same speeds and feeds that might otherwise be employed.

Cutting Tools and Lubricant—The next step is to note carefully the cutting tools and lubricant used. These two items are shown separately on the chart, but they may often be considered together. Sometimes a heavier tool or one made from different material will result in an increase in production; for example, a stellite tool may be substituted for one of high-speed steel with an appreciable gain in production, although stellite would not always be found entirely suitable. On certain classes of materials and kinds of cutting, substantial gains can be made by the use of the tool best suited to the work. The length of time which a tool will run without grinding is a fairly reliable guide as to whether it is suited to its work or not; however, the most economical tool is not always that which stands up the longest, as it may be better to grind it several times a day if an increase in production will result. A common lathe tool, for example, may reasonably be expected to require regrinding oftener than a form cutter, which would perhaps need a special attachment in order to grind it properly. The latter may also require considerable time for setting up, while the former can be located and clamped readily.

A heavy tool carries away heat from the cutting point more rapidly than a light one; hence it is used where heavy cutting is required. The use of various kinds of lubricants often shows that a tool will stand up longer with one than with the other, and when this is the case, it is obviously more economical to use the compound which shows the greatest efficiency. In cutting threads, for instance, oil gives better results than soda water or other compounds. Some materials can be cut wet or dry, but usually one method is better than the other, and whichever it is, it should be used if circumstances will permit. A lubricant serves two purposes—it reduces the friction and cools the tool. Both of these functions should be considered in selecting a lubricant.

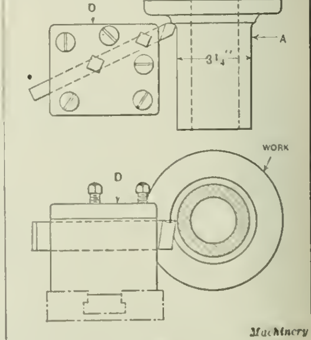


Fig. 3. Job on which Savings were effected by altering the Design of the Toolpost

Setting the Speeds and Feeds

After a number of tests have been made on different classes of work and kinds of materials, it will be found an advantage to make up tables of the results so that they can be used in the future for setting speeds and feeds on new work. It is essential to have these tables in such shape that they can be referred to readily; therefore, a cross-index which refers to a number of actual tests on cast iron, steel, brass, etc., is of value in connection with the tables. A great many points regarding speeds and feeds have been mentioned in order to bring out their value in relation to the general subject. We could easily go a step further and state that cast iron can be cut at a surface speed of 50 feet per minute, mild steel at 80 feet, and brass and aluminum at 200 feet, but such information would serve no useful purpose except to give an approximation of what can be accomplished under normal conditions, and we should then be obliged to determine what a normal condition is.

Cutting speeds for various materials can be found in any mechanical handbook, but any kind of rule of this sort must be flexible. Cast iron may be cut at speeds ranging from 30 to 150 feet per minute, depending on the quality of the material, depth of cut, finish desired, tool used, feed of machine, and other matters which have been mentioned. Other metals and alloys can also be cut at widely different rates of speed and feed, depending on the circumstances. The proper cutting speeds and feeds for a given piece of work are those which will produce it within the required limits in the shortest possible time and what these speeds and feeds should be must be determined to a great extent by tests and by the most careful supervision. The maximum speeds and feeds cannot be obtained by calculation, although comparative records are a great help in this connection. The highest and best production is obtained through a capable man who is always in the shop and who is never satisfied with results until assured that the limit has been reached.

Savings made Possible by Increasing Rate of Feed on a Lathe

A few specific examples of actual savings effected by giving attention to the speeds and feeds of machines will illustrate the value of proper supervision of this work. Fig. 3 shows a flanged cast-iron piece *A*, which is finished in a turret lathe, the flanged portion being held in chuck jaws. Tool *B* is used for turning the cylindrical surface of the piece, the length of the cut being 5 inches. The original method of holding the tool was by means of a standard tool-post *C*, and the depth of the cut was 1/16 inch, the feed 0.020 inch per revolution, and the speed 50 feet per minute. The length of time needed to make the cut was 4.54 minutes.

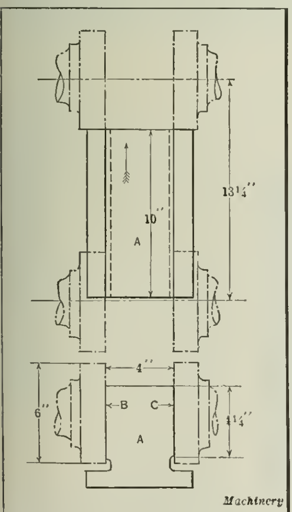


Fig. 4. Job on which a Reduced Speed and Increased Feed aided Production

The foreman of the department considered this satisfactory, as he had found that a coarser feed produced chatter, but the man in charge of the speeds and feeds considered the time too slow. In tests he tried a speed of 65 feet per minute, with the result that there was considerable chatter and the tool was soon ruined. He then decided that the method of holding the tool was largely responsible, as it was not suited to withstand heavy cutting, and so, a heavy special tool-post *D* was made which permitted a heavier feed to be taken without appreciable vibration. Now, a speed of 50 feet per minute is employed and a feed double that previously possible, or 0.040 inch per revolution. By this means, the time of the cut has been reduced to 2.27 minutes. The time required to make the change was thirty minutes.

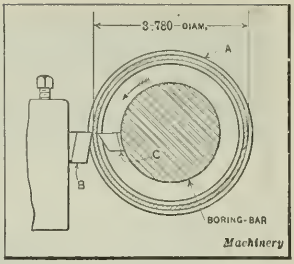


Fig. 5. Example in which Stellite Tools were substituted for High-speed Tools

Increasing Production on a Milling Job by Reducing Speed and Increasing Feed

Another example is presented by Fig. 4 which shows a steel billet *A* that is face-milled on two sides *B* and *C*. The amount of stock removed is 3/32 inch on each side; the length to be cut, 10 inches; the total traverse of the table, 13¼ inches; and the diameter of the cutters, 6 inches. The original speed of the cutters was 80 feet per minute, the table feed 0.100 inch per cutter revolution, and the time required for the cut 2.55 minutes. It was decided that the cutting speed was too great, as the cutters did not stand up as they should. Therefore, their speed was reduced to 60 feet per minute, and the table feed increased to 0.200 inch per revolution. The new time of production was 1.65 minutes, and the cutters kept sharp a much longer time. This example illustrates the savings possible in milling operations by a judicious selection of feeds and speeds. Generally slow speeds and coarse feeds are better for milling operations, but this is not always so. Chatter in milling may often be remedied by a suitable change in feed or speed or both. A little experimenting along these lines will prove of value, as chatter is fatal to good workmanship, and causes loss in production and injury to the tool equipment and the machine.

Savings Effected by a Change in Tools

Occasionally more suitable speeds and feeds can be set for a job by changing the tool or its general shape. This matter, however, should be approached with caution, and unless an analysis determines conclusively that the tool is at fault, it would not be found advantageous to change it. Fig. 5 shows a ring pot *A* that is simultaneously turned eccentric by tool *B* and bored by tool *C*. Both of these tools were formerly made of high-speed steel, but they did not stand up well on account of the hardness of the material. On an average only six pieces could be turned and bored before regrinding of the tools was necessary. The speed of the work was 37.1 feet per minute, the feed was 0.035 inch per revolution and the production per eight hours was 65 pieces. Some of these would not pass the inspector on account of the tools being slightly dull and, therefore, not producing the work within the required limits.

Stellite tools were substituted for the others, and the speed was increased to 39.6 feet per minute and the feed to 0.042 inch per revolution, with the result that the tools machined 140 pieces before regrinding was required. The production increased to 89 pieces per eight-hour day, the gain amounting to 36.9 per cent. From this example it is plain that a change in a tool may increase production in some cases. The great variety of conditions encountered make it impossible to give hard and fast rules for this kind of work, but great gains can be made if care is taken in the selection of the right man for the work, giving him the authority to make necessary changes in feeds and speeds and, in this way, making him solely responsible for the work throughout the factory.

Furnace Design and Fuels Suitable for Treating Drop-forgings

IN the articles published in November and December MACHINERY, a number of examples of modern drop-forging practice were illustrated and described, together with the dies used in producing them. In the present article, the practice followed in heat-treating drop-forgings and the equipment employed will be discussed, with special reference to furnace design and kinds of fuels commonly used.

As a general statement it may be said that annealing will improve the reliability of any forging, although it is not necessary to anneal all forgings; in fact, there are a great many that are never annealed and that give satisfactory service without such treatment. As a rule, small parts need not be annealed except, perhaps, to make them easier to machine. Low-carbon steel parts that are to be casehardened should first be annealed to overcome the tendency of the forgings to warp during the casehardening process. If they are not to be casehardened, straight carbon steel forgings of not more than 0.30 per cent carbon are rarely annealed unless by so doing subsequent machining will be facilitated.

Complications have arisen in connection with the heat-treating of steels during recent years due to the ever-increasing use of alloy steels of a great variety of compositions. These complications have been met by the advances which have been made in the metallurgical field, which have resulted in better control arrangements for the heat-treating department. The practice now followed in modern plants is to rely wholly on the directions issued by the metallurgist for handling steel in the furnace, and in quenching and tempering, to obtain the physical qualities desired in the finished forging.

When it comes to the actual heat-treating, it is necessary that the man in charge be capable and experienced in the operation of the furnaces, so that he can intelligently carry out the instructions of the metallurgical department. The human element enters into the process to a considerable extent, and hence the methods may vary somewhat from the recommendations of the technical expert. It is noticeable that rarely can two shops be found which carry out the identical heat-treating instructions in the same manner, which, of course, is due to the human element, and for this reason rather wide tolerances are permitted in the heat-treating specifications.

Fig. 1. Observing Conditions in Heat-treating Furnace

Refining the Grain Structure Preparatory to Hardening

As the steel leaves the hammer, the grain is large and it should be refined by annealing. Before dependable results can be assured, every precaution must be taken to obtain steel which will conform exactly to the specifications recommended by the metallurgical department for the particular service required. Working to specified temperatures is of little value unless the analysis of the steel is known. The temperatures for annealing and hardening and all data referring to the heat-treating of steel are furnished by the steel manufacturers in some cases, although the most satisfactory results are those obtained when the steel is made to the analysis furnished by the purchaser's metallurgist or chemical engineer.

The annealing process consists of heating the steel slowly and uniformly to a few degrees above the lower critical point (usually about 1600 degrees F.) and allowing it to cool without being unduly exposed to the atmosphere. This can be done either in the furnace or in suitable cooling pits. Perhaps the most satisfactory results will be obtained with the intermittent pusher type of annealing furnace. This is equipped with a mechanical device for intermittently advancing the plates on which the work rests into the heating chamber a few inches at a time. The heat in the chamber may be so regulated that as the work advances into the furnace it will be subjected to a gradually increasing temperature, and as it approaches the discharge end of the furnace the temperature will gradually decrease. The temperature in the center of the chamber is, of course, the proper annealing heat. By this means absolute uniformity is assured, and as the work is delivered from the discharge end it is dropped into baskets or other suitable receptacles where it is left until it has cooled completely.

Treatment after Annealing

If the steels are of the straight carbon class, they should be heated, after annealing, to the proper temperature for hardening and then quenched and drawn to the required hardness. In general, the heat-treatment of drop-forgings is based on the same principles as those that govern other steel parts, although there are a few special conditions that arise in handling steel in this form. The higher the carbon content, up to 0.90 per cent, the lower the quenching temperature should be. Likewise, nickel has a similar effect to carbon in lowering the upper critical temperature of iron. The method of heat-treating medium sized chrome-nickel steel forgings employed in a plant engaged in the manufacture of airplane motors is as follows: The forgings are gradually and uniformly heated to from 1425 to 1500 degrees F. and held at this temperature until thoroughly soaked. They are then removed from the furnace and quenched in warm water, maintained at a temperature of 115 to 120 degrees, for a period of twenty seconds. The forgings are drawn immediately at 1000 to 1200 degrees F., depending on the exact chemical analysis of the steel. The practice of drawing immediately after the quenching overcomes the tendency of the steel to crack. In some other plants the practice differs from that described in that chrome-nickel forgings are quenched in oil instead of in water.

Types of Furnaces

Of the three designs of fuel-burning furnaces—muffle, semi-muffle and car-bottom—it is probable that the semi-muffle type is the most economical to operate from the standpoint of fuel consumption. The muffle type furnace, although furnishing an even distribution of heat, requires more fuel consumption to penetrate the refractory lining of the furnace and reach the work. The car-bottom type of furnace is advantageous in charging and discharging, but in recharging, the bottom of the car becomes cold and must be reheated with each charge, resulting in the consumption of an increased amount of fuel. The car-bottom type of furnace is excellent for annealing large quantities of parts, for which work uniform results can always be had with this style furnace.

City gas is a satisfactory fuel for the muffle or semi-muffle type of furnace, and with this fuel the flame is short and the distribution of heat good. However, the cost of artificial gas is so high, that it is never used in localities where natural gas is procurable. Oil-burning furnaces are provided with burners and a low-pressure air line for atomizing the oil. By regulating the supply of air, the amount of oxidation which will occur, when burning oil, can be controlled and a soft flame obtained.

Anthracite coal as a fuel is still used in certain types of furnaces, but with varying results. The flame is not a highly oxidizing one, and in this respect the fuel has some advantages. Powdered or pulverized coal which has been passed through a fine 200-mesh screen and blown into the combustion chamber at low pressure may also give good results. The best success with pulverized coal will be obtained in small furnaces.

While oil- and gas-burning furnaces are used extensively in modern heat-treating departments, the application of electricity to the heating of furnaces is the most recent method in use, especially where the temperature must be under more absolute control than can be obtained in fuel-burning furnaces. Furnaces of this type are ordinarily of comparatively small size, so that there are certain limitations to their use for heat-treating large work. The electric furnace is best where results of an exacting nature are required, and in the continuous type of furnace electricity is almost invariably employed. The power cost, however, is high, and in some localities where large power companies do not exist, it is almost prohibitive. Control equipment must be used; this consists usually of a relay system, actuated by pyrometers, which produce electric contact with a switch or operating mechanism by means of which the

Fig. 2. Battery of Heat-treating Furnaces for Drop-forgings

supply of electricity is regulated. The pyrometer, of course, registers the heat only in that part of the furnace in which the thermo-couple is located, and is used by the furnace operator principally as an aid in judging the temperature of the other parts of the heating chamber.

Two methods of heating an electric furnace may be used —the electric arc and the resistor. For heat-treating purposes, the electric arc is not suitable, because the heat is not distributed properly, and the gases developed by the arc have a detrimental effect on the work. The resistor type of electric furnace is therefore invariably used, but it is limited by the amount of heat that the metal of the resistor will withstand. Under ordinary circumstances this temperature is about 2000 degrees F., so that for most commercial heat-treating purposes it is suitable, since a temperature as high as this is rarely required. A resistor of chrome-nickel alloy is highly satisfactory, although carbon and graphite resistors are being used considerably with some success. Resistors made of other materials than those mentioned are inferior and will not be found satisfactory.

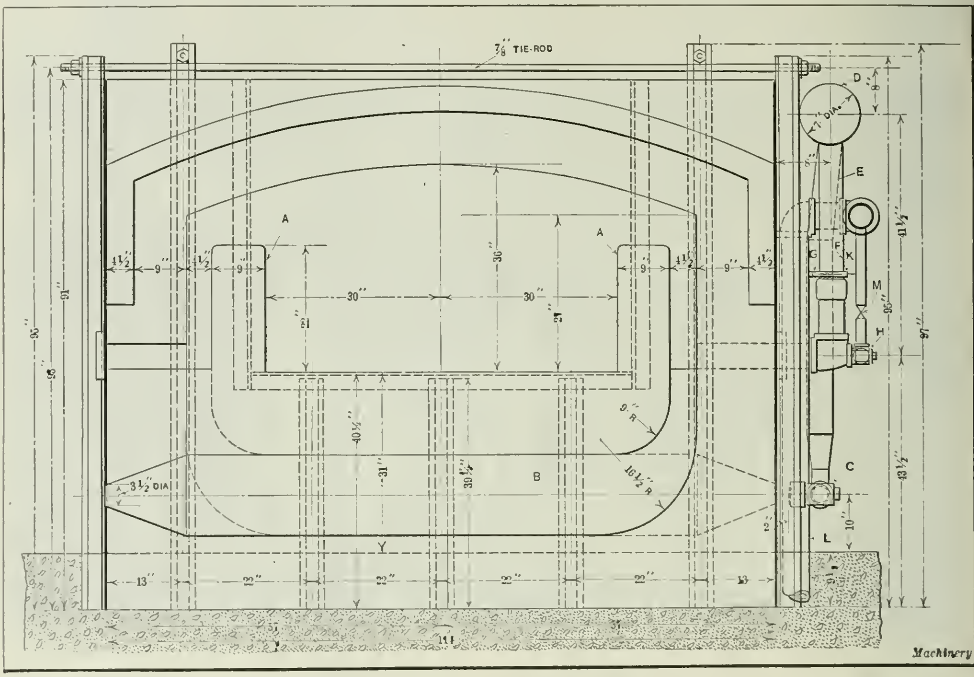


Fig. 3. Design of Combination Oil and Gas Furnaces shown in Fig. 2

Furnace Equipment and Design

In some plants where the work is small and is pot-annealed, the furnaces are installed in a pit so that the hearth is on a level with the floor of the heat-treating department. (See the heading illustration.) This facilitates the loading of the furnaces and the removal of the pots, and in such a case the arrangement is preferable to one where the hearth is elevated.

In designing a furnace, the kind of fuel which it is advantageous to burn should be kept in mind, this of course being influenced by local conditions. The heating chamber should be designed so that the radiant energy from the arches will fall on the work being heated, but not so that the flame will come in contact with the work. If large work is being heated and is laid directly on the hearth of the furnace, care should be taken to select a refractory material for the hearth, which will withstand the destructive effect of dragging the work back and forth. A cheap grade of firebrick, machine made, will be found suitable for this purpose, because it is hard and resists friction. The walls may be lined with any of the commercial furnace linings, but they need not be as hard as is required for the hearth.

The continuous type of furnace, in which a conveyor carries the work through, is especially suitable for handling small work. This same principle of automatic heating, when the parts to be treated are comparatively large, is incorporated in the intermittent type of furnace. This arrangement provides for advancing the work to a certain section of the furnace and after it has acquired the proper temperature, advancing it still farther, intermittently, until the work has been properly heated. Continuous and intermittent heat-treating furnaces may be heated by electric current, although a fuel fire is more commonly used.

A battery of heating furnaces used in the heat-treating department of a large drop-forging concern is shown in Fig. 2. This drop-forging plant has a rated monthly output of 1800 tons, and for handling this work there are eight of these large furnaces, the proportions and design of which are shown in Fig. 3. These furnaces are a combination gas- or oil-burning type of special design. The protective walls *A* are arranged so that the heat will radiate from the arched roof, thus providing a semi-muffle construction which affords ample protection for the work. There are four combustion chambers *B*, equally spaced under the furnace hearth. These are fed by gas burners *C*, two on a side, arranged alternately and connected directly with the supply pipe (not shown in the illustration). The blast line is located at *D* and runs the depth of the furnace. There are suitable valves for regulating the gas flame located along the gas line. The blast for the gas burner is regulated by dampers *G* in pipes *E*, and when gas is not used, is shut off and the air for the oil burners *H* admitted through dampers *K* located in pipes *F*. The oil supply pipes *L* are laid underground. The admission of oil to the burners is regulated by valves located at *M*.

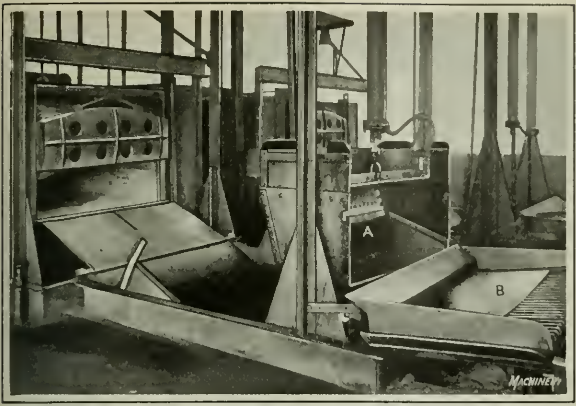


Fig. 4. Front View of Furnace, showing Chute leading to Quenching Tank and Air-operated Shovel

These furnaces are equipped with four pyrometers each, with leads to a central control station. The man in charge of the control station is required to notify the furnace men of the temperature of each furnace and the proper time for drawing the heats. This is done by means of a telautograph, so that as the temperatures are written down by the man in charge of the instrument, this reading will be duplicated at each of the stations which are located in different parts of the heat-treating room, as well as in the laboratory. This enables not only the furnace man but also those in the laboratory who are interested in the progress of any particular lot of forgings being treated, to keep in close touch with the heats. These readings are taken every twenty minutes so that the progress of the heating can be closely watched.

It will be seen that the furnace hearth is above the floor level, which is a desirable condition when comparatively large pieces are being heated. This arrangement makes it possible for the parts to be pushed out at the opposite end of the furnace on the floor where they can either be permitted to cool, or immediately picked up and placed in a convenient place for subsequent treatment. A portable hoist is provided for this purpose. The quenching tanks, which are located in front of the furnace, are equipped with gratings for holding the work. These gratings are operated by an air hoist as may be seen at the left in the extreme background of Fig. 2.

The facility with which work of this kind can be handled will be understood by reference to Fig. 4. Here a front view of a furnace is shown, with the door raised and a chute in position, down which the heated work slides into the oil quenching tank. The scoop or shovel *A* rides in a suitable framework, and is operated by compressed air. The air cylinder is shown in the illustration, as well as the supply hose for admitting the air to the cylinder. The construction of the shovel is such as to permit it to be swung on trunnions and scrape the bottom of the tank, like one-half of a grab bucket. The forgings are deposited from the shovel on the grating *B*, allowing the oil to drain back into the tank. The depth of the tank is about four feet.

In addition to these furnaces and their quenching tanks, this department is also provided with a number of small furnaces for casehardening and cyaniding small work and for various hardening requirements.

General Notes Relating to Heat-treatment

The variation in the compositions of steel makes it practically imperative to follow the fixed rules regarding time requirements in heat-treating the various types of steel. The experiences of the man in charge, in connection with the recommendations of the metallurgist, are usually followed. The work should be heated to about the same color as the refracted light from the furnace walls, which, in connection with the use of pyrometers, will enable the heating and drawing time to be closely approximated.

As a means of assisting in keeping a record of various parts which have been heat-treated so that a precedent for handling similar work may be had, the practice is followed in one shop of making a "prolong" on each forging to be subsequently cut off and used as a test piece. After the heat-treatment has been completed, the "prolong" is cropped off and numbered to correspond with the piece from which it was cropped. All or a portion of this is machined into various types of test pieces, and these are tested to see if the forging meets the tensile and impact requirements. The parts are not permitted to leave the heat-treating department until satisfactory results have been obtained from the tests. It has often been found necessary to reheat the forgings as a result of information obtained from the tests, in order to obtain the desired physical qualities in the forgings. These test pieces are filed away for future reference when similar work is being treated.

Accessories Required in a Heat-treating Department

In addition to the furnaces and quenching tanks, there should be included in the department a medium-sized open frame drop-hammer for use in correcting excessive distortions due to heating, particularly if the work is long like an axle or crankshaft. A hammer of this type will reduce materially the amount of subsequent straightening necessary, and for crankshafts is really essential. There is usually space enough in a corner of the heat-treating department to accommodate the accessory equipment. This equipment will include, besides the hammer, an air compressor which furnishes air for operating the grating hoist cylinder for the quenching baths (if this equipment is used), a blower for the furnace blasts, a straightening machine, and a machine for testing hardness.

Fig. 5 shows a Metalwood straightening machine used for the final straightening of such parts as camshafts and crankshafts. This machine employs an anvil which is operated by air pressure. The crankshaft is supported between centers on the table of the machine, so that it may be turned as required to locate the shaft when applying pressure. Fig. 6 illustrates the use of the Brinell machine for testing the hardness of a motor truck axle. The machine is enclosed in a closet, when not in use, so as to protect it from varying atmospheric conditions, which are so noticeable in a heat-treating department. By this means, a higher degree of dependability can be placed on the results obtained in making the test.

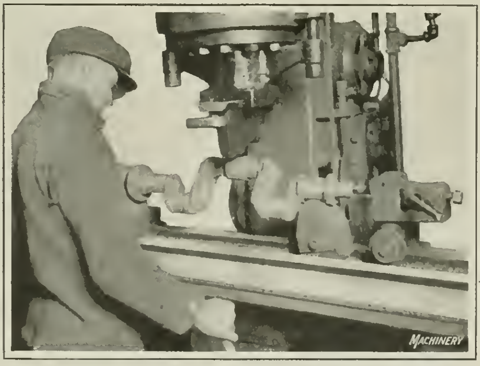


Fig. 5. Straightening a Crankshaft Forging

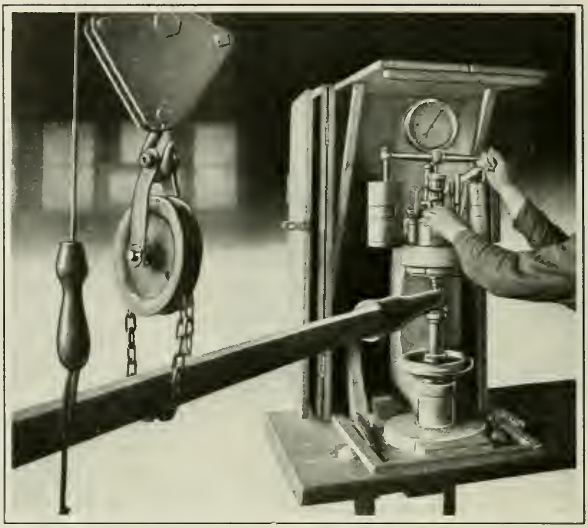


Fig. 6. Motor Truck Axle being tested by Brinell Hardness Testing Machine

After the drop-forgings have been heat-treated, they are transported to the cleaning department in which the tumbling barrels, pickling solution tanks, and sand-blasting equipment are installed. If the forgings are to be machined subsequently, they should be pickled in a dilute solution of sulphuric acid, or other suitable bath. Small parts may be cleaned by tumbling, which is an effective method of removing the scale and fins from the surface of the forgings. Large parts cannot, of course, be tumbled, and if a sand-blasting equipment is not available, the parts may be gone over with a wire brush to remove the scale. However, sand-blasting is the most effective method of handling all sizes of work.

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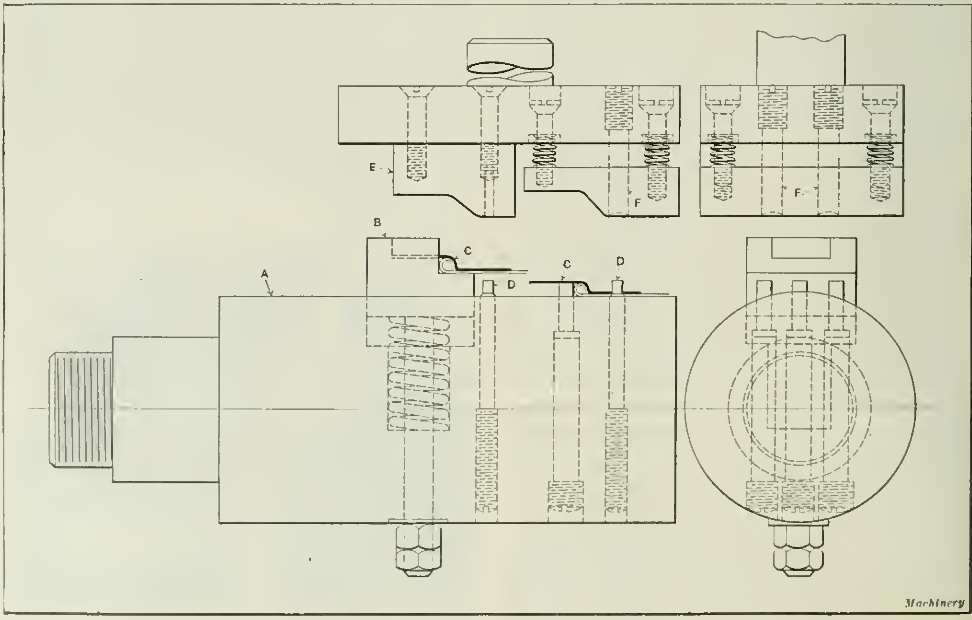
RIVETING DIE

By D. C. OVIATT

The riveting die illustrated is used for attaching ears to tin pails. The cylindrical horn *A* is attached to the power press, extending out horizontally so that the pail may rest on it while the ears are being riveted in place. The pail is abutted against the spring gage block *B* as shown in the illustration, and the ear *C* laid on it in the proper position for riveting. The rivets *D* are set in suitable depressions in the horn, these depressions being formed by special long screws which do not extend quite to the circumference on the horn. To permit the depth of depressions to be maintained regardless of wear produced in the riveting operation, it is merely necessary to adjust the screws to the proper depth. The upper member carries a punch-block *E* which, on the descent of the press ram, forces the gage-block and the work which it supports down until the rivets have pierced the pail and ear. The second position of the pail, with the ear partly assembled, is shown near the end of the horn. The ear is supported by spring pins during the riveting operation which takes place with the work located in the second position. The riveting punches *F* are protected by a spring-backed guard block which, when the press ram descends and the rivet is set down, rests on the ear and acts as a shock absorber.

Work of this kind is usually done on a regular horning press that is arranged especially for the performance of rivet-setting operations of this nature, but such a press is not required when dies constructed according to the general design illustrated are employed.



Die used on Power Press for riveting Ears to Pails

A Railroad Shop Organized for Efficiency

Equipment and Methods Employed in the Angus Shops of the Canadian Pacific Railway Co. Montreal, Canada—Second of Two Articles

By EDWARD K. HAMMOND

IN the first installment of this article, which appeared in the December number of MACHINERY, the general arrangement of the Canadian Pacific Railway shops at Montreal, Canada, known as the Angus shops, was described, and a plan of the shops was shown. It is the purpose in the present installment to show designs of jigs and fixtures used, and to outline some of the methods that have made it possible to reduce costs in the Angus shops.

Design of Multiple Jigs and Fixtures

With a view to bringing production conditions in a railroad shop as nearly as possible into line with those that obtain in the best manufacturing organizations, the jigs and fixtures in the Angus shops have been designed, wherever possible, to provide for a multiple set-up of engine and car parts. As a case in point, consider the equipment shown in Fig. 1, which is used for planing all flat external surfaces of locomotive cylinders. By using a fixture of this kind two castings can be set up at a time, and a number of pairs of cylinders, depending on the capacity of the planer, can be handled in a single operation, thus substantially increasing the rate of production.

The method of procedure is quite simple. The cones *A* are provided with steps to enter the finished bore of cyl-

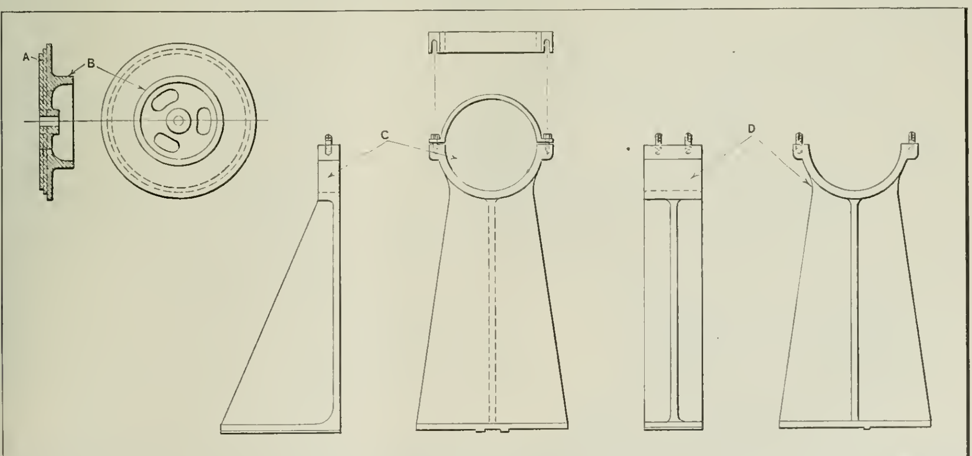


Fig. 1. Fixture used in planing Locomotive Cylinders, which is designed to hold Two Castings at a Time

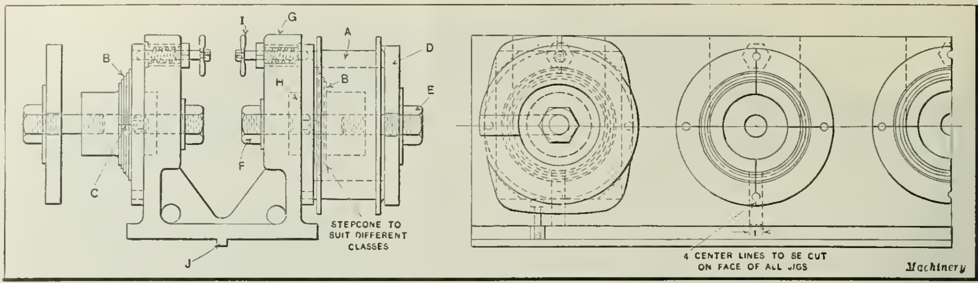


Fig. 2. A Multiple Planing Fixture for Use in machining Main- and Side-rod Brasses

inders of various sizes, and these cones have hubs *B* which enter sockets *C* in the supporting members. Each fixture consists of three parts, namely, two end pieces *C* and a center support *D* that is also arranged to hold a pair of cones *A* projecting one at each side. Obviously, three supporting members arranged in this way have cones *A* in each end of a pair of cylinders. The work is located and leveled up for finishing the joint, frame fits, and other surfaces that have to be planed, according to standard practice. The advantages of such an arrangement are the speed with which the job can be set up and the reduction of planing time that can be effected by the simultaneous handling of a number of castings.

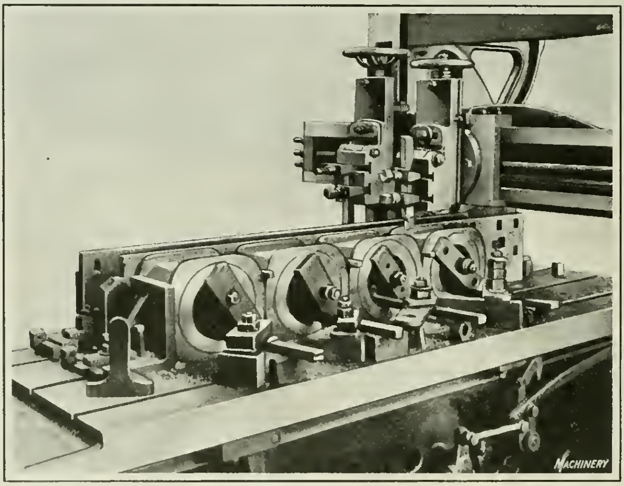


Fig. 3. Gang Planing applied to Rod Brasses

Fixture for Planing Main- and Side-rod Brasses

A better example of economical fixture design is illustrated in Fig. 2, which shows an equipment for use in machining the sides and flanges of bearing brasses for locomotive main-rods and side-rods. In this illustration, one of the pieces of work is shown in position in the fixture at *A*, where it will be seen that stepped cones *B* are furnished for the purpose of handling different sized pieces of work which are previously bored so that the finished hole may be utilized as the locating point.

This fixture is arranged to carry the castings in two rows, and ten pieces of work may be set up at a time. The method of operating the fixture is as follows: After casting *A* has been placed over cone *B*, the line of the joint on which the two halves of the bearing brass are sweated together is brought into coincidence with a graduation line *C*, so that the faces of the bearing brass may be properly finished relative to this joint. Then strap *D* is tightened by means of a cap-screw *E*. When ten cast-

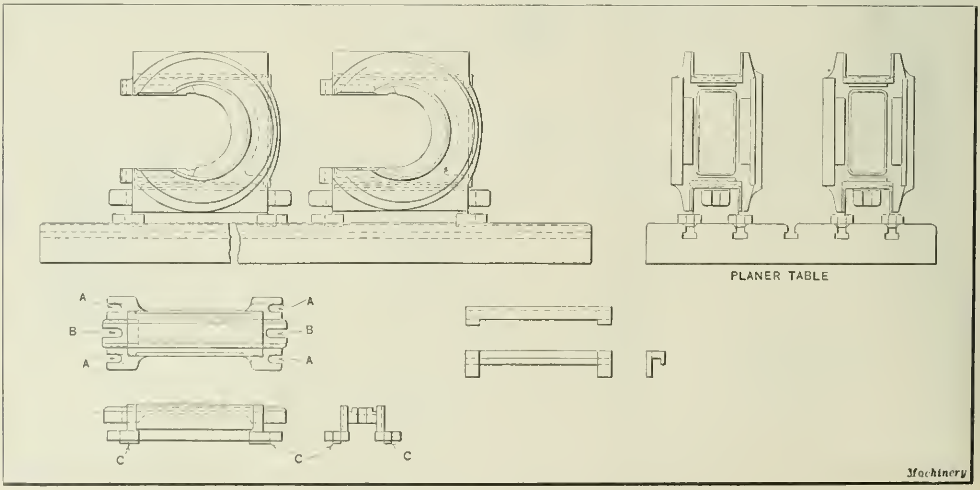


Fig. 4. Multiple Fixture for planing Locomotive Driving-boxes

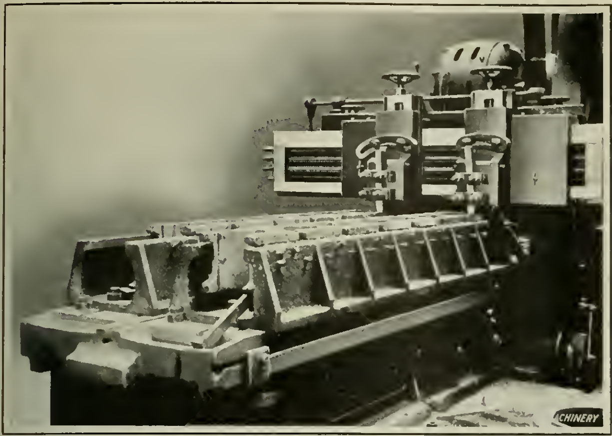


Fig. 5. Planing Two Parallel Rows of Engine Truck Boxes

ings have been set up in this way, the planing operation can be performed on the top face of each piece, two planer heads on the cross-rail being utilized so that the rate of output may be speeded up as much as possible.

After one side of each brass has been finished in this manner, a cap-screw *F* is loosened at the back of each fixture, so that cone *B* and the work carried by it are slightly released from the finished face of bracket *G*, against which each work-holding fixture is tightened. At the back, cone *B* is provided with a boss *H* that enters a socket in bracket *G*. After cap-screw *F* has been loosened, index-pin *I* is withdrawn from the hole in the back of cone *B* and the work is turned through a quarter revolution, after which the index-pin is allowed to snap back into position in the next hole. Then cap-screw *F* is again tightened. After each of the ten pieces of work has been reset, the planer-hand is ready to machine the next face on the castings. Four such sequences of operations are required to complete the job. This fixture is located on the table by a tongue *J* which enters one of the T-slots. Fig. 3 shows a row of rod brasses on the planer.

Fixture for Planing Driving-boxes

For planing the shoe and wedge faces of driving-boxes, the arrangement of the work on the planer table is similar to that employed in the case of the bearing brasses handled on the fixture shown in Fig. 2. However, the design of the fixture used for handling this work is quite different. In the present case, each piece of work is held in a separate fixture, the form of which is best shown at the lower left-hand corner of Fig. 4. Here it will be seen that the fixture consists of a member similar in form to a piece of channel iron, with three slots at each end.

The fixture is clamped to the planer table by bolts passing through the four slots *A*, and the driving-box casting is clamped down on the fixture by means of bolts passing through the two slots *B*. The number of castings set up at a time varies according to the type of locomotive on which they are to be used. Three pairs of boxes are set up in two rows, when the boxes are of the type used on eight-wheel locomotives, while in the case of six-wheel locomotives the boxes are planed with two pairs set up parallel to each other. After the shoe face has been planed, this finished surface is used as a locating point in setting up the work to plane the wedge face. The fixtures are provided with tongues *C* that enter T-slots in the planer table. The chief advantage of fixtures of this kind is that they are quite inexpensive to make and still enable a substantial saving of time to be effected through the application of the multiple principle of setting up the work.

The method of planing engine truck boxes is shown in Fig. 5. Two rows are planed at the same time, and the type of fixture used is clearly shown in the illustration.

Device for Casting Bearing Brasses on Shoe and Wedge Faces of Driving-boxes

Driving-boxes for locomotives used on the Canadian Pacific Railway are equipped with brass bearings on the shoe and wedge faces. After the boxes have been planed, the brass bearings have to be put in place, and reference to Fig. 6 will show that dovetailed anchorages *A* are planed in the driving-box to hold the brass securely. A better idea of the arrangement of the fixture *B* will be obtained by reference to Fig. 7, which shows the device in detail. It consists of three lateral members *C*, *D*, and *E*, which are assembled to form the composite plate, and two cross-strips *F* and *G* which carry bolts that hold the lateral members together.

Plates *C* and *E* are tapered in one direction and *D* is tapered to an equal degree in the opposite direction, so that when the three are assembled they form a single plate with parallel edges. Strips *F* and *G* are slotted in such a way that bolts passing through them have the necessary play to allow the center plate *D* to be adjusted by tapping a head *H* which is welded on it for that purpose. By slightly loosening the bolts and then tapping this head, plates *C* and *E* may be extended or drawn together so that they just fit the space in the driving-box. Conical-headed screws *I* rest against the planed shoe or wedge face of the driving-box, thus holding the plate at a sufficient distance from the box so that a brass bearing of the required thickness may be cast. The entire device is held in place by putting a heavy piece of iron against it while in position in the driving-box;

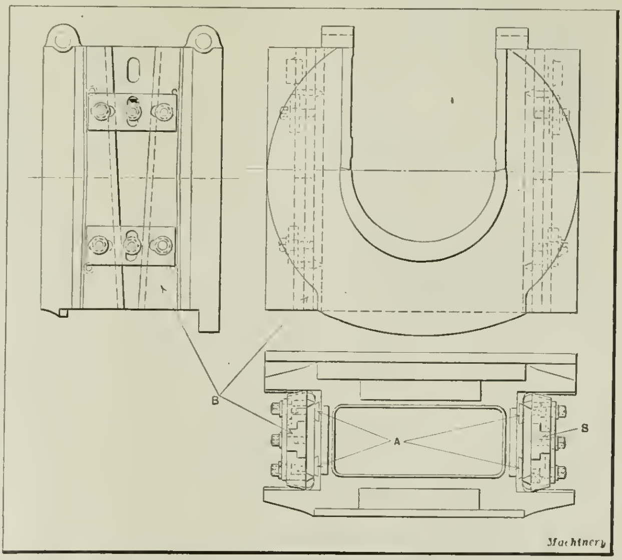


Fig. 6. Driving-box and Fixture used when casting Brass Bearings on the Shoe and Wedge Faces

and the space at the bottom, as well as the joints between the edges of the plate and the flanges on the driving-box, is luted with fire-clay to prevent the brass from running out.

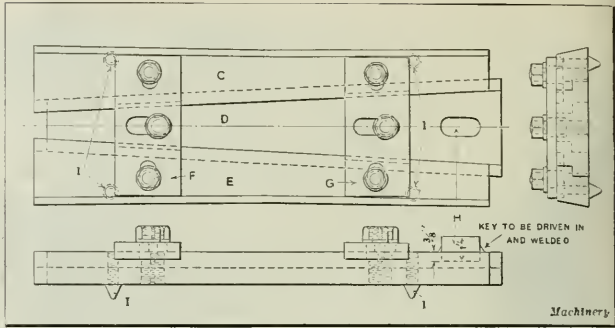


Fig. 7. Fixture used for casting Brass on Shoe and Wedge Faces of Driving-boxes.

Drill Jig for Replacing Dry-pipe Sleeves

Removing a sleeve from the end of a dry pipe in order to substitute a new one is not so simple an operation as fitting a new sleeve, because the new holes in the sleeve have to be drilled in alignment with the old ones previously made in the end of the pipe. To provide a convenient means for performing this operation, a jig shown in Fig. 8 has been developed, which is strapped into place on the table of any sensitive drilling machine. The jig consists of two arms, one of which carries a spring-pin *A* that enters successively the holes in the old dry pipe, while the other arm carries a drill bushing *B* that is located directly over the spring-pin. When the drill is fed down through this bushing, it produces a hole in the sleeve, the position of which coincides with that of the hole in the old dry pipe. After one hole has been located and drilled in this manner, the pipe is turned until pin *A* enters the next hole, after which the corresponding hole can be drilled in the new sleeve. By this method very little time is required to drill a series of holes, the location of which might otherwise cause considerable trouble.

Method of Handling the Labor Problem

Two measures have been adopted in the Angus shops which have been quite effectual in overcoming difficulties with labor. One of these is the application of a system of employe representation. The other is the use of what is known as a "contract" system to encourage industry on the part of the workers and to afford an opportunity for exceptionally industrious or capable men to earn more than the normal hourly rate of pay. This contract plan works out as follows: A so-called "contract price" is fixed for each job, and each class of workers in the plant is paid a specified scale of wages, which is guaranteed. All men working on contracts are credited daily with the cash value of the work done, and they are charged with the amount represented by their wages while on that job. All shop men are paid every two weeks, and once a month they receive as a bonus any difference between the amount earned on their contracts and the amount of the wages which have been charged against the job. According to this system, it is possible for good men to earn 20 or 25 per cent over their regular rate of pay.

Duties of the Contract Foremen

In carrying on this work, there is one contract foreman to approximately every seventy-five contract workers—in many cases less, never more. They are selected from the best mechanics in the shop and placed on the monthly payroll. Their duties are twofold: First, to recommend to the general supervisor of piecework, contract prices for the different jobs; and, second, to inspect the finished work and to credit the men with the number of pieces that pass inspection. It is important to note that these contract foremen are entirely independent of the shop supervision. In conducting their work, if they see ways in which they believe that the efficiency of an operation could be improved, it is their duty to go to the foreman of the department and make a recommendation for the change. If the change is not made within a reasonable time, the contract foreman takes the matter up with the head of his department. In this way, a constant check is kept on the plant's productive efficiency and weak points do not long remain undetected.

* * *

As an indication of the difficulty of selling American machine tools abroad, the following figures will prove of interest. A shaper of American make selling at $720, dealer's price, F.O.B. New York, is copied by an Italian manufacturer who delivers the machine in Paris, duty and transportation charges paid, for $465. The freight and delivery charges on the American machine would add about $75 to its cost in France, and in addition the import tariff would have to be paid. Even though it is understood that the copy of the American machine is not equal, in quality, to the original, it is clear that when the copy is sold for about one-half the price of the American machine in Paris, the advantage is with the copy.

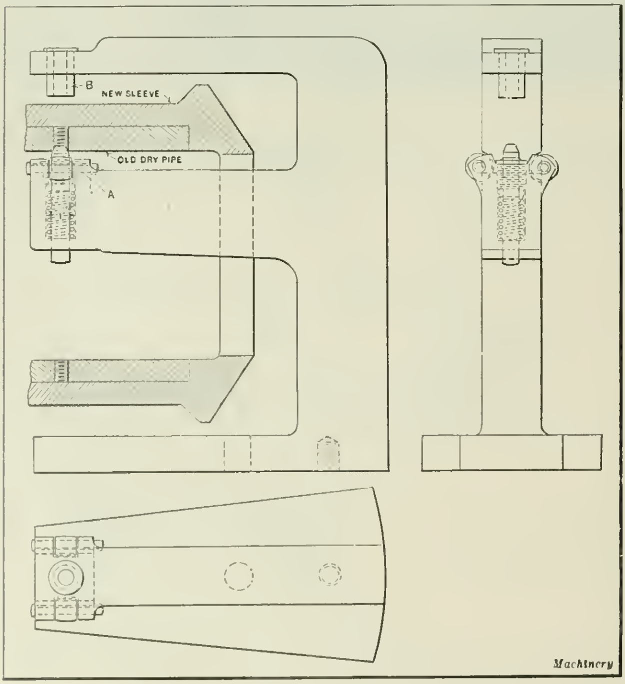


Fig. 8. Jig for drilling Holes in New Dry-pipe Sleeve in Alignment with Holes in Dry Pipe

Grinding Multiple Spline Gages

By C. F. SCHLEGEL

The following method of grinding multiple spline gages having six or more splines has been used successfully by the writer. The fact that fifteen or twenty multiple spline gages with limits of 0.0002 inch in both size and spacing of the splines were ground by this method without the loss of a single gage gives evidence of the accuracy of the method. A description of the procedure in grinding a gage with six splines, such as shown in Fig. 1, will make the method clear. First grind the outside of the gage on a cylindrical grinder, leaving the work a little over size for finish-grinding, and of a dimension which permits the circumference to be easily subdivided without using complicated fractions. Next mount the gage on centers and on a surface grinder, indicating both the top and the side of the gage to insure accurate alignment, and taking care not to subject the work to any strain when securing it to the center head.

Now grind the gage surfaces S between the splines by employing the center head to rotate the work while moving the table forward and backward. To finish these surfaces, it is necessary to go over the gage two or three times to insure concentricity of the surfaces with the axial center line. An angle-plate A is mounted firmly on the table of the grinding machine, care being taken to see that it rests close against the outside surface of a spline which is located in a horizontal plane passing through the axis of the gage. The face of the angle-plate must be set true or parallel with the axis of the work, and also at 90 degrees from the surface of the table.

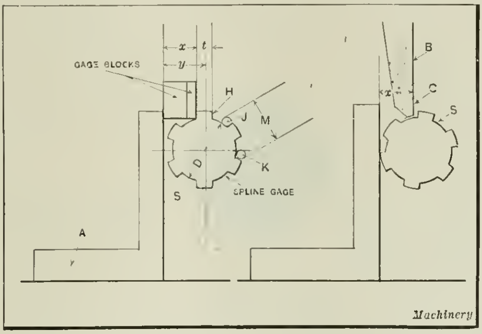


Fig. 1. Method of locating Work and setting Wheel for grinding Spline Gages

A saucer wheel B, dressed off on the periphery and side as shown in the illustration, is set 0.002 inch above the body surface S of the gage, the grinding face C of the wheel being set at a distance x from the face of the angle-plate. The grinding machine table is next moved back sufficiently to permit the gage to be revolved by means of the center head until a spline is brought approximately central at the top, making the distance x, shown in the view at the left, Fig. 1, 0.004 or 0.005 inch less than $y - \frac{1}{2}t$. Without raising or lowering the wheel, grind the side of the spline until dimension x equals $y - \frac{1}{2}t$. The cross-feed of the table is used in performing this grinding operation, and size blocks are employed for gaging dimension x.

The machine table is then moved forward and the gage revolved a sufficient amount to allow the grinding wheel to enter the next space. The side of the second spline is then ground, using the center head to feed the work to the wheel. The accurately ground wires J and K are placed in contact with the ground sides of the two splines as indicated. The side of the second spline should be ground until a micrometer measurement over wires J and K shows that this distance is only 0.0001 inch less than the calculated dimension M. Dimension M is calculated as follows: Add to diameter D the wire diameter; multiply by the sine of 180 degrees divided by the number of splines; add the product to the wire diameter. Expressed as a formula,

$$M = (D + d)\left(\sin \frac{180 \text{ deg.}}{N}\right) + d$$

in which d equals diameter of wire and N the number of splines. Care must be taken to keep the wheel in a free-cutting condition, and the distance from the faceplate to the face of the wheel, as indicated by dimension x, should always be maintained, the wear on the wheel being compensated for by means of the table cross-feed.

The spline gage is next revolved until the two ground splines are in the position indicated in the view at the left, Fig. 1, with the rods J and K in contact with the ground sides. Two adjustable dial indicators F and G, Fig. 2, are then mounted on a toolmaker's surface gage as shown, and adjusted until both indicators show a reading of approximately zero when the ball points pass over their respective rods J and K. The ball point of the upper indicator should pass over the rod J a little in advance so as to enable the workmen to easily read both indicators correctly. All clamping screws should next be tightened, and the indicators adjusted to read exactly zero when their contact points pass over the rods.

The spline gage should then be revolved so as to bring the next or third spline into the grinding position. This spline should be ground until both indicators F and G register zero. The work must, of course, be tested frequently during this operation by placing wire J in contact with the surface being ground, and revolving the work until it reaches the gaging position indicated in Fig. 2. This method of grinding and testing is employed in grinding one side of each of the six splines. The distance between the ground faces of the first and sixth spline will undoubtedly be a little greater than that between the faces of the other splines, say 0.0018 inch greater. Therefore, the distance between the ground faces of the other splines should be increased by 0.0003 inch. With the spline gage set so that the lower indicator shows a reading of zero when the gaging point passes over the ground face of the second spline, proceed to adjust the indicator so that it will show a dial reading of minus 0.0003, or in other words so that 0.0003 inch must be removed from the second spline in order to have both indicators again register zero. The sides of all six splines should then be reground in the manner previously described until all the spaces are exactly equal. It may be necessary to repeat these grinding operations three or four times before the required accuracy of spacing is obtained. Should the space between the ground sides of the sixth and first spline be a little less instead of greater than that required, it is only necessary to find the average discrepancy for each space, adjust the lower indicator so as to lengthen the distance between the two indicator points the amount required to rectify this error, and regrind the gage as previously described.

By taking a very light cut on the side of the first spline, any slight error can be rectified, thus minimizing the danger of spoiling a gage. In finishing the other sides of the splines, size blocks are used that have a total thickness equal to $y - \frac{1}{2} t$ to adjust the work. These blocks are placed between the face of the angle-plate and the ground side of the spline as indicated in the view at the left, Fig. 1. The grinding wheel is then brought into contact with the side H, and the spline ground to the required thickness. During this operation care must be taken to have the corner of the wheel from 0.001 to 0.002 inch above the surface of the body of the gage. The table cross-feed is, of course, employed for feeding the work to the wheel during this operation.

By moving the table in or out a little so that the spline, if pressed against the wheel, will be at an angle of about 1 degree, it is possible to finish-grind the gage so that it will have sharp corners where the sides of the spline and the body surfaces of the gage meet. In performing the latter operation, the gage can be revolved to bring the spline away from the wheel, and the wheel lowered until its edge just makes contact with the surface of the body of the gage. Then, while the work is being moved forward and backward, it can be carefully fed up to the wheel by revolving the index-head, this operation being completed when the edge of the wheel meets the base of the spline. The final

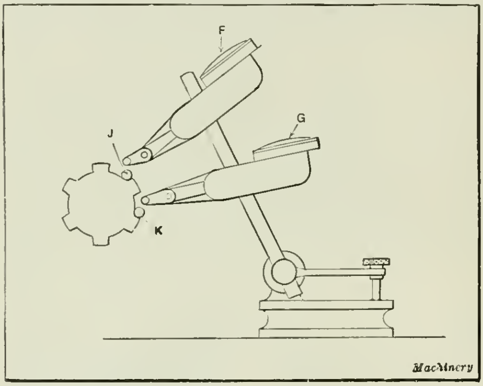


Fig. 2. Indicators used in testing Spacing of Splines

operation is that of finish-grinding the outside in a cylindrical grinder.

The method described can also be used for grinding index-plates having six or more index points or notches. For this work, the angle-plate is located as shown in Fig. 3. Instead of using size blocks, as in the case of the spline gage, it is possible to use micrometers for measuring dimension x in order to obtain the correct relationship between the sides of the notch and the center line of the work. The back face of the angle-plate must, of course, be parallel with the front face when used in this way. By using two indicators, as previously explained, it is possible to obtain very accurate spacing of the working faces L of the index slots. The other sides or faces M, whether straight or at an angle of 15 degrees—the latter design being preferable—may be correctly spaced by using the index-pin as a gage.

* * *

SWEDISH MACHINE INDUSTRIES

Statistics covering the Swedish machine industries for 1917, the last complete statistics published, show that in that year machine tools were manufactured in that country to a value of $12,000,000; oil engines, $10,000,000; agricultural machinery, not including dairy machinery, $8,000,000; woodworking machinery, $3,000,000; paper-making machinery, $3,000,000; steam turbines, $1,500,000; water turbines, $1,250,000; and bicycles, $5,000,000.

DEVELOPING MACHINISTS FOR JOBS HIGHER UP

By ARTHUR McCOMB

Notwithstanding the fact that the subject of developing men for better positions has been discussed frequently from various angles, there is still something further to be said. It is always good policy for a shop department to have at least one good man in the course of development and ready to take the place of the foreman in case of necessity. The average superintendent or works manager generally selects a man from the shop for the position of foreman, and is influenced in his selection by the fact that the man is most familiar with the work, regardless of his knowledge of handling men.

The writer is a firm believer in choosing men from the ranks when it is possible to do so; but he also believes that such men should be given a thorough training for at least a year before taking the job, so that in addition to the regular shop routine, they may become proficient in the handling of men and in maintaining a maximum amount of production with a minimum amount of attention to detail. The writer has worked for several men who have been taken from the ranks but have not received such training. Failing in this important detail and having no one to assist them

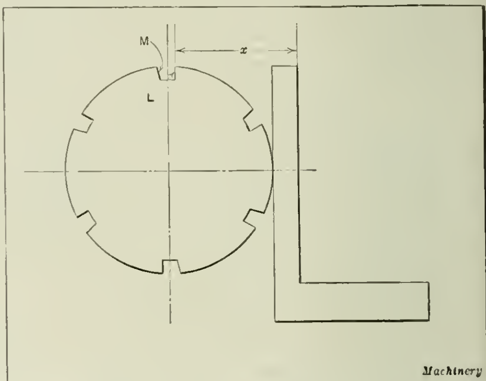


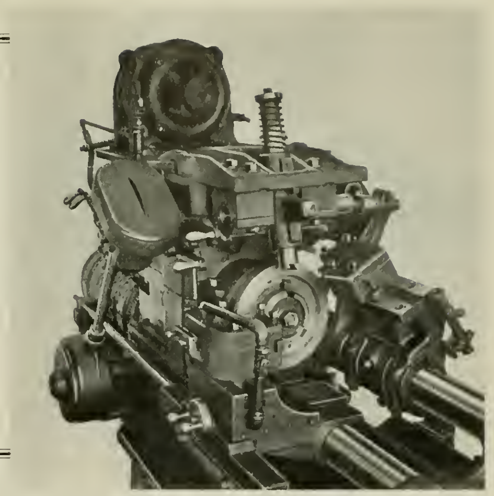
Fig. 3. Locating Index-plate for Notch Grinding

at the time they needed assistance most, these men became discouraged, and were not successful in filling the positions.

Some superintendents do not recognize the fact that there are men in the machine shop of high enough caliber to make high-class foremen. The writer believes that there are, and that there is hardly a shop of any considerable size that does not employ at least one such man who, if given a little encouragement and responsibility, would develop quickly. Responsibility in the development of a foreman is an important factor. Probably much labor trouble could be eliminated by employing a well-trained foreman who understands both the employer's and the workman's point of view, and who is capable of talking and explaining matters to the men in the right way.

The remark is often made that a certain shop cannot compete with some other concern because it does not have the same high-class workmen. The writer does not believe such a remark justified, because he has worked in a number of different machine shops and finds that as far as the men are concerned they are all very much alike. The one thing that makes a big difference is the foreman's organization within his department, and he can develop this organization until he really obtains high-class work with little effort from men who under other circumstances might not be classed as especially capable. This development work of the foreman also helps him to qualify for a higher position.

Cost-reducing Tooling Equipments



Machines and Tooling Equipments Used for Performing Turning, Boring, Facing and Recessing Operations on Automobile Gears

By RALPH E. FLANDERS
Manager, Jones & Lamson Machine Co., Springfield, Vt.

MACHINE or tool designers who endeavor to develop equipments that will enable one operator to run a large number of machines are extending their efforts in the wrong direction when the work must be inserted and removed by the operator. Their aim should be rather to bring out machines which will be so intensive in production that as few as possible will keep an operator busy, the ideal arrangement being one machine to one operator. In the examples of automobile gear manufacture presented in this article, there is one operator to each two machines.

The tooling equipments employed on Fay automatic lathes for turning and facing a stem bevel pinion used in the rear axle drive of an automobile are illustrated in Figs. 1, 2, and 3. This pinion has a projection on the head end which permits it to be driven, in the set-up shown in Figs. 1 and 2, by a hardened and balanced driving plate. The part should have the small end milled, and preferably straddle-milled, so that the end of the projection may be centered to a standard depth, as gaged from the shoulders of the forging. The shank is rough-turned by the tools mounted in the front holder of the equipment shown in Fig. 1, and is necked at the pinion end, and necked and beveled at the small end, by the tools in the rear holder. The formed tool *A*, which necks and bevels the small end, does not come into action until after the turning tool *B* has removed the scale from this end.

The equipment shown in Fig. 2 is employed for the next operation in which the taper surface near the small end is finish-turned by a tool in the rear holder, while tools in the front holder finish-turn the straight portions. The arrows in the various tooling diagrams, show the direction in which the front and rear tool-holders are fed.

On such cuts as those taken by the tools shown in Fig. 1, the work, if properly supported, will stand feeds, speeds, and a number of simultaneous cuts which will consume as much as fifteen horsepower or more, and to be successful in automotive practice the machines should be designed to transmit this horsepower continuously. Since so much depends on the support of the work in determining the output, the question may be raised as to the value of the commonly used driving projection shown, which is of small diameter and lengthens the blank. An alternative scheme that is particularly applicable to parts drilled in the head end is the gripping of this end in a chuck. The chuck drive is the better of the two if it will permit a sufficiently faster cut to compensate for the extra time required in chucking the work.

The gear end of the part is rough- and finish-turned and faced in the next operation, which is performed in a Fay automatic lathe provided with the equipment shown in Fig. 3. The work is gaged lengthwise against the back shoulder of the pinion by abutting this surface against a hardened collar carried on the faceplate fixture. The small end of the part is supported on a spring center, the fixture being slotted to allow the work and driving dog to drop into place. Tool *C* on the front carriage rough-turns the face of the gear, and tool *D* finish-turns it in the same continuous feeding movement. The rear tools do not come into action until the roughing cut has been completed, so that their finishing corners do not become injured by rough scale. In all finishing operations performed in the Fay

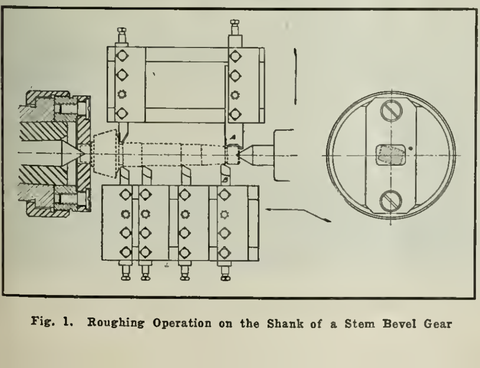


Fig. 1. Roughing Operation on the Shank of a Stem Bevel Gear

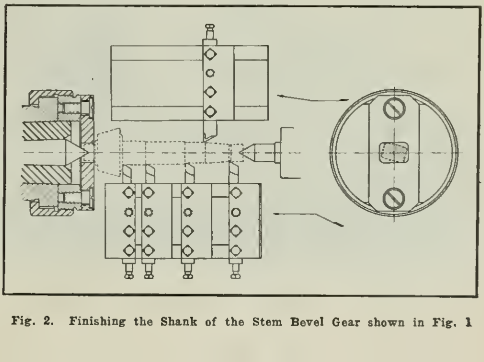


Fig. 2. Finishing the Shank of the Stem Bevel Gear shown in Fig. 1

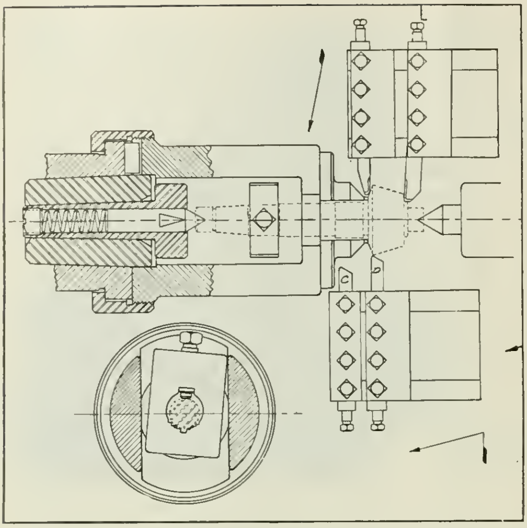


Fig. 3. Rough- and finish-turning and facing the Large End of the Stem Bevel Gear shown in Fig. 1

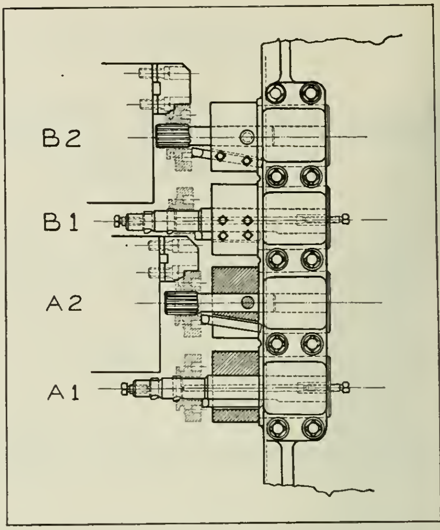


Fig. 4. Tooling Equipment for machining a Transmission Gear on a Double-spindle Production Lathe

automatic lathe, the turning tools on the front holder are relieved automatically on the return travel so that finished surfaces are not scored.

Finishing Two Gears Simultaneously

In the jobs described in the following, the work has a central hole which is finished first in a turret lathe or some similar machine, the finishing operations then being performed in a Fay automatic lathe with the work supported on an arbor. There are certain principles involved in the division of the cuts between two machines and the supporting of the work on an arbor; these are best illustrated by a simple case. In Fig. 7 is shown a job in which the holes in the blanks have been finished and the hubs faced in a preliminary operation. This operation is performed quickly, because the cutting is confined to a small diameter and done at high speed. The blank is held at the periphery so that a firm grip and a true running rim are obtained.

The standard arrangement illustrated in Fig. 7 consists of two machines, three arbors, and one operator. Then while one machine roughs the blanks on one arbor and the second machine finishes the blanks on the second arbor, the operator can change the work on the third arbor. It will be noted that the keyways have also been cut in the work prior to this operation, this provision permitting the heavy drive demanded by the intensive tooling. Simple rim-facing tools are supplied in the rear holder and rim-turning tools in the front holder.

This sequence of operations enables the work to be accurately machined, as it is supported on a true arbor mounted on true centers. The arbors are driven by a swiveling cross-pin, which balances cutting strains and eliminates any tendency of the arbor to spring. Furthermore, as the arbor has a heavy tapered male end supported in a hardened and ground bushing in the spindle nose, the stiffness of the spindle is brought directly into the arbor, and no long and yielding center intervenes. The following conditions give this method the maximum output: The simultaneous roughing and finishing of the work in two machines run by one operator; the simultaneous facing and turning of the work

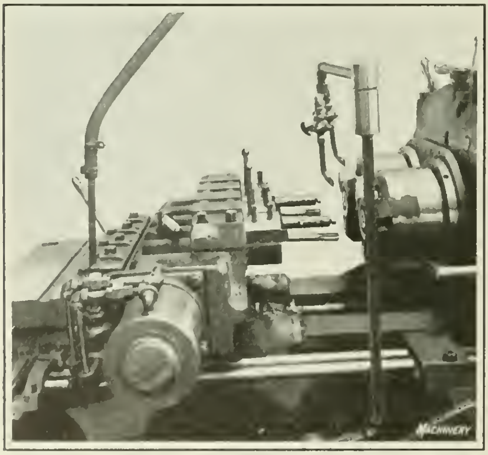


Fig. 5. Machine equipped with the Tool Set-up shown diagrammatically in Fig. 4

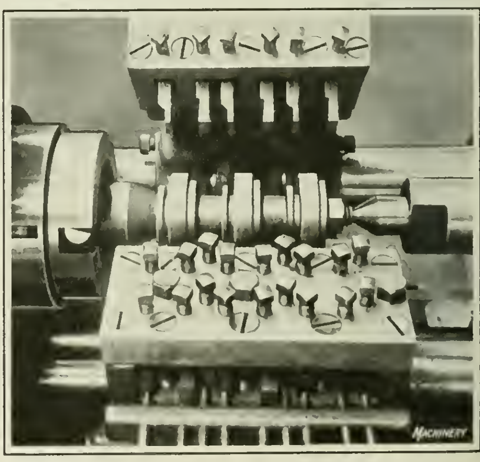


Fig. 6. Machining Three Transmission Gears at One Time by mounting them on an Arbor

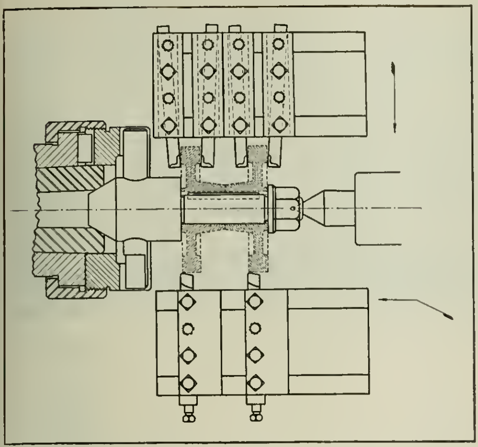


Fig. 7. Tooling Equipment for a Job in which Two Gears are finished at One Time

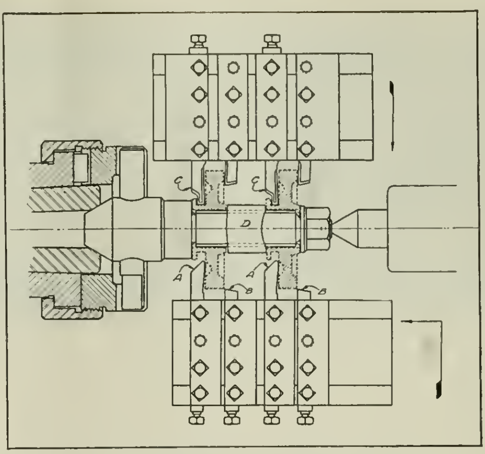


Fig. 8. Use of Spacing Collar to prevent Springing of Arbor when machining Two Gears at a Time

in each machine; the clamping of the work on the third arbor while the machines are in operation; the placing of the work between centers; and, finally, the mounting of two pieces at a time on each arbor, thus doubling the efficiency of the operation.

Tooling Equipments for Transmission Gears

The tooling employed in the production of sliding transmission gears is one of the most highly developed equipments used for machining automotive parts. Before the gears go to the double-spindle production lathe equipped with the tooling shown in Fig. 4, the rough forgings have the holes rough-drilled in a drilling machine. The work is held in the lathe by air chucks. The boring-bars in positions A1 and B1 carry roughing cutters which are immediately followed in the same feeding movement by finish-boring tools and rough butt-facing tools that machine the hub face. After the parts have been machined by these tools, the tools are withdrawn, the cross-slide automatically shifts, and the tools in positions A2 and B2 are brought up to the work. These tools finish-ream the holes and finish-face the hubs.

Fig. 5 shows a machine set up for this operation and gives a good idea of the construction of the automatically operated air slide. This machine is not classed as an automatic, but its results are comparable with those of a full automatic, because only a small effort is required of the workman. The operator runs two spindles, both of which are constantly under his observation, so that feeds and speeds may be used which would not be safe if he were tending a number of machines spread over a wide area.

The blanks now have the bore and one hub finished and are next sent to a broaching machine to be splined; in this operation the work is located against the finished hub. The facing of the opposite hub is next in order, and this is best done under a two-spindle drilling machine, which permits one spindle to be used for roughing and the other for finishing. The fixture used in this operation was shown in Fig. 3 of the article "Machining Automobile Transmission Gears" which appeared in March, 1920, MACHINERY.

The next operation on the sliding transmission gears is performed in a Fay automatic lathe equipped with the tooling set-up shown in Fig. 8. Tools *A* first feed in radially and face the sides of the gears, and then feed toward the left and turn the fork flanges, while tools *B* turn the outside circumference. The rear holder, in the meantime, is also fed radially, but the grooving tools *C* do not come into contact with the work until after the scale has been removed by tools *A*. The finishing operation is similar, except that additional tools are provided where necessary to break corners and to obtain a finished job.

A somewhat more elaborate set-up for machining transmission gears on a Fay automatic lathe is illustrated in Fig. 6. It will be noted that while the arbor in Fig. 8 carries two gear blanks, the one on the machine in Fig. 6 carries three. It is seldom that the machining of three blanks at a time is practicable; usually only two may be handled satisfactorily, and sometimes only one.

The conditions that determine how many pieces can be handled at one time are as follows: First, the size of the hole in the work (which determines the slenderness of the arbor) relative to the outside diameter and the amount of metal to be removed. Second, the required accuracy of the hub length; if the tolerance is too large and three blanks are placed on an arbor, the outside blank may be considerably shifted from its normal position so that its rim is displaced with reference to the hub. Third, the construction of the arbor and the spacing collar. As no particular pains have been taken to face the outside hub of the gear true with the inside one or with the bore, the arbor is likely to spring somewhat when two blanks are clamped on it, and a great deal when three blanks are clamped on it.

A remedy for this condition lies in the construction of the arbor and particularly in that of the spacing collar *D*, Fig. 8. This collar fits loosely over the arbor and its splines and has a narrow

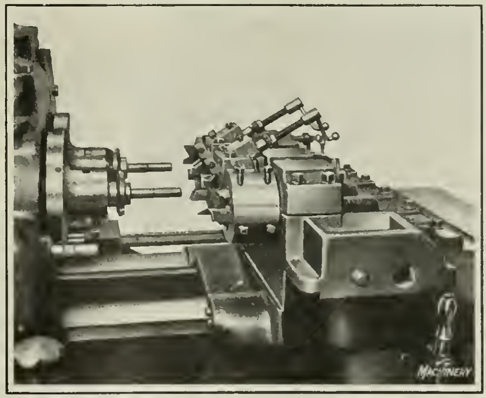


Fig. 9. Equipment for machining Differential Gears, Similar to that shown in Fig. 10 except that Hand-operated Recessing Tools are used

bearing against the opposing hubs of the gears, the bearing on one side of the collar being located 180 degrees from that on the opposite side. The collar thus has a solid seat against both hubs, whether they are true or not, and does not cramp itself, the arbor, or the work. By this means, the bending of an arbor is avoided. Of course, the same precautions must be taken in subsequent operations and especially in the cutting of the gear teeth. This is generally recognized, and tool designers usually arrange to clamp blanks by the rims so that the hubs have no influence on the truth of the arbor.

Production Lathe Set-ups for a Differential Gear

In the production of a differential gear, the work is first drilled and broached and then sent to a double-spindle productiou lathe provided with the tool set-up shown in Fig. 10. There are four double-ended arbors *B* supplied with each equipment, two of the arbors being used on the machine while the other two are having the work changed on them. These arbors drive the work by the splined hole and have bearings in hardened bushings, one of which is in the spindle fixture and the other in the cat-head tool-holder at the opposite end. An equalizing driving plate *C* keeps each arbor turning with the spindle, and spring *D* and the pressure of the cut hold the work back against the spindle fixture. When the tools are withdrawn, the arbor and work can be pulled out by hand.

The work is placed in the rear spindle and has one side roughed and finished by the two tool sets shown at the left-hand end of the plan view. The work is then withdrawn and inserted in the front spindle, where the other side is roughed and finished by the two tool sets shown at the right-hand end of the plan view. Both operations, of course, take place at the same time. A tool carried in the overhead fixture *E* cuts a recess on the work to facilitate the subsequent face- and cylindrical-grinding operations on the part. All other cuts are done by direct end cutting, and the tools for the different cuts can be readily identified by the legends on the illustration. The output of this machine for roughing and finishing both sides of the gears complete runs as high as thirty-six per hour for small gears. The set-up shown in Fig. 9 differs from the one in Fig. 10 only in that it is provided with simpler hand-operated recessing tools.

* * *

RAPID DRILLING OF NAMEPLATE HOLES

One of the jobs performed on a quantity basis in the plant of the General Electric Co. at Rochester, N. Y., is the drilling of nameplate holes in stators. In order to obtain a high rate of production on this job, a special-purpose two-spindle drilling machine is employed for this work, which was designed by the Leland-Gifford Co., Worcester, Mass. The machine is equipped with two spindles set at an angle in a horizontal plane, each of which is driven by an individual motor mounted on the spindle. The two spindles are operated simultaneously by a handwheel, which is placed between them and is connected with each by a universal joint, so that as the wheel is turned, the spindles feed at an angle corresponding to that of the nameplate pins. The stator is slipped over a horn in a jig, and by a single movement of the handwheel the two holes are rapidly drilled. The production time on this job, with an unskilled operator in attendance, is 10,000 nameplate holes a day, two holes each in 5000 nameplates.

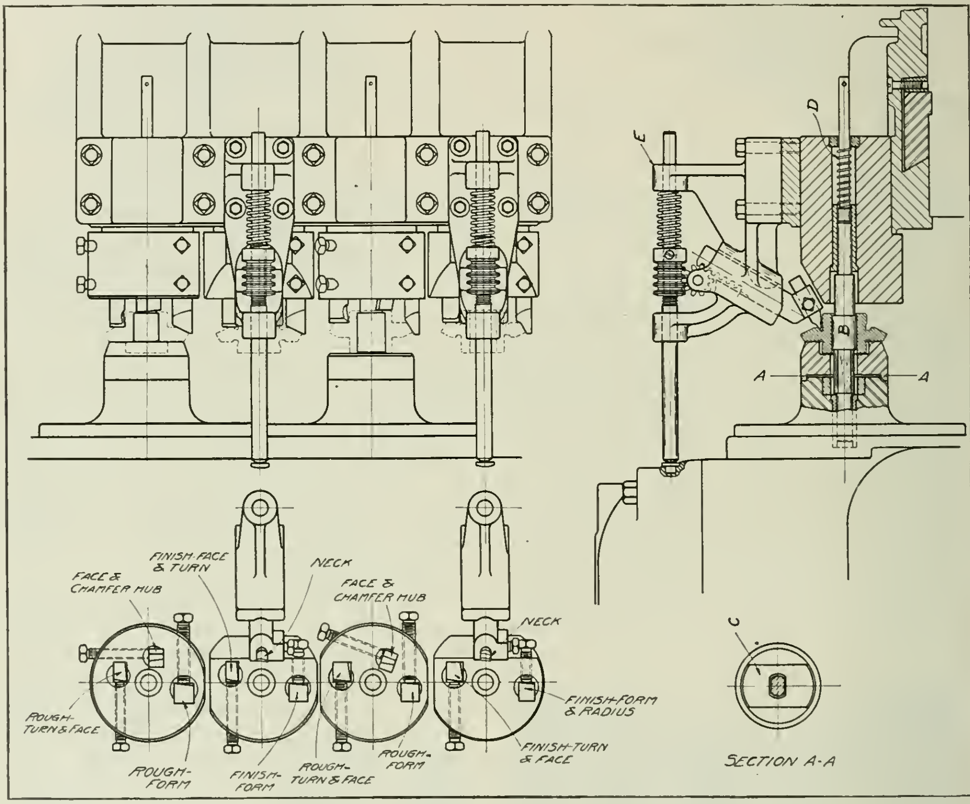
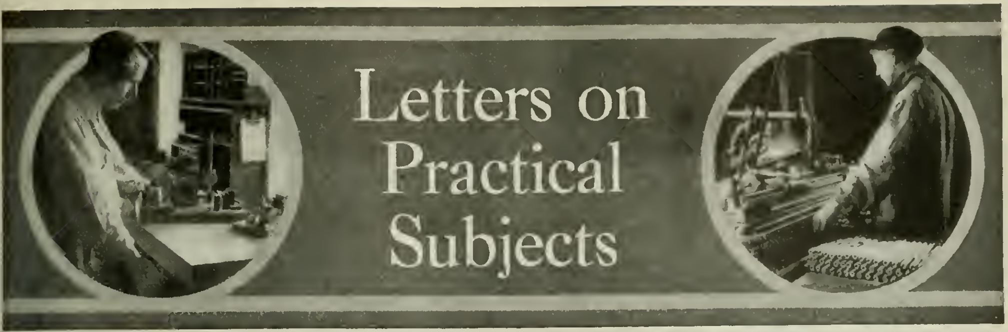


Fig. 10. Equipment supplied on a Double-spindle Production Lathe for machining Differential Gears



SPLINING FIXTURE FOR VALVE ROCKER ARMS

The fixture shown in the accompanying illustration was designed and built for the purpose of locating and holding valve rocker arms in a double-spindle automatic spline milling machine during the machining operation. The chief advantage of this fixture is that loading is performed while the machine is in operation and no time is lost, therefore, in putting in and taking out work. The table of the machine travels back and forth continuously while the cutters are fed into the work, backed out, and fed into the next piece of work automatically and without interruption.

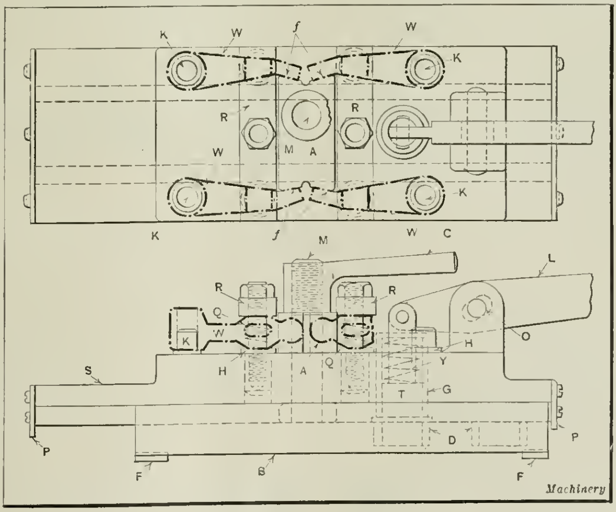
Referring to the illustration, base *B* is grooved on its under side to receive two fixture keys *F*, which, in turn, fit into the T-slot in the bed or table of the spline miller, thus squaring up the sides of a female dovetail in the top of the base with the spindles of the machine. It should be understood that the machine spindles are located on each side of the table and would meet each other if sufficiently extended. Two screws (not shown in the illustration) are used to hold the base to the table of the machine. There are two holes in the base fitted with bushings *D*, which are counterbored so that the bushings do not come through the bottom of the base. A slide *S*, with a male dovetail, is fitted to the base and is prevented from sliding too far in either direction by two retaining plates *P*, each of which is fastened in place with three screws.

Before the slide is assembled to the base, however, it is necessary to insert the guide bushing *G* in the hole in the slide provided for that purpose and place the locating plunger *T* with spring *Y* in the guide bushing, connecting plunger *T* with lever *L* by means of a pin. Lever *L* is also pinned to the lug *O* on the slide. Four parts or pieces of the work *W* are shown by heavy dot-and-dash lines in the upper view, but for clearness only one complete part is shown in the lower view. It will be noted that the work is located at three points. The reamed hole in the piece fits over plugs *K*, which results in machining the spline square with the hole. A block *A*, centrally located, which is attached to the slide, has four hardened and ground angular surfaces *f*, which serve as stops for the free ends of the work. It will be seen that these surfaces locate the rocker arm in the correct angular position for cutting the spline.

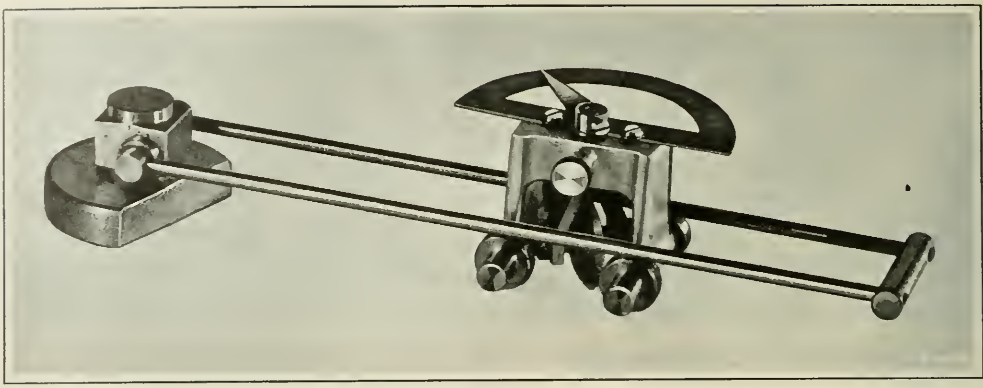
The third locating point is governed by the distance from the top of the table to the center line of the spindles. The base and the slide are made sufficiently thick to bring the center of the work to the proper height when it rests on the hardened pins *H*. This distance must be accurate, but the dimensions of the slide and base may be made to the nearest even figure, and the exact distance can be obtained by increasing or decreasing the thickness of the head of the pins on which the work rests. The steel bars *R* are used to clamp and hold the work. A bolt and nut accomplishes this, the former being threaded into the slide. These bars are forced up by springs *Q*, as soon as the nut is loosened, and are prevented from turning by the block *A* which is fastened to the slide.

A heavy bolt with a large head, one side of which is beveled to correspond to the dovetail, is shown at *M*, and is placed in the slide so that it wedges against the side of the dovetail in the base when the clamp *C* is tightened. The main function of this clamping arrangement is to prevent chattering of the cutters, since the plunger *T* insures the correct location of the work with respect to the cutters. The spring on the plunger *T* counterbalances the weight of the handle or lever *L*. The lever *L* is provided with an elongated hole at *O* in order to avoid the use of a link.

When two pieces of work are clamped in the fixture in the two right-hand positions, the machine may be started. While these two parts are being splined the operator will have ample time to load several fixtures in succession and start each one going. Another pair of parts can then be loaded in each fixture by placing each over plugs *K*, at the left-hand end and swinging them against block *A*, holding them in with the fingers while tightening clamps *R*. When the first pair is finished, the cutters back out and the operator loosens clamp lever *C*, pushes down on lever *L*, and pushes the fixture slide to



Splining Fixture for Valve Rocker Arms



Instrument designed to facilitate the Drawing of Logarithmic Spirals

the right allowing the plunger to drop into the other hole in the base. Clamp *C* is then tightened, and the next pair is brought in line with the cutters, ready for machining. The parts which have been machined can then be removed and two more blanks inserted. One man can operate a battery of several machines in this manner. B. S.

INSTRUMENT FOR USE IN DRAWING LOGARITHMIC SPIRALS

In the accompanying illustration is shown a device for tracing logarithmic spirals, which the writer made some time ago and which he believes possesses some advantages over the one described in August MACHINERY, page 1146. The design of this instrument is based on the fact that in a logarithmic spiral, radii to all points on the curve make the same angle with tangents to the curve at their extremities. The construction of the device is apparent from the illustration. It consists simply of a sharp-edged tracing wheel mounted in a slide which can move radially on an arm that is pivoted to swing about one end. When the tracing wheel is set at an angle other than 90 degrees to the arm, the slide will be drawn in or out as the arm is revolved about its pivoted end.

One advantage of this instrument is that spirals of any angle may be drawn in either direction, by simply adjusting the plane of the tracing wheel to whatever position is required, by means of the scale and pointer shown at the top of the slide. In case it is necessary to construct a curve outside the range of the instrument, it is only necessary to draw a spiral of the required angle, and then extend it by drawing several radii and dividing them internally or externally into some proportion that will carry the curve in or out as desired. A more complete description of the construction and operation of this device was published in the *Sibley Journal of Engineering* (Cornell University, Ithaca, N. Y.), April, 1920.

Niagara Falls, N. Y. HOWARD G. ALLEN

SIMPLIFYING DESIGN OF A WATER-COOLED JOURNAL BOX

In Fig. 1 is shown a water-cooled journal box made with a cored water circulating chamber at *A*. The metal between the chamber *A* and the bronze liner *B* is 3/4 inch in thickness. When the box is cast, four small cores are employed to support the chamber core in the mold. The vents for carrying off the gases pass through the four cores which are located at the outer ends of the casting at *C*. After the casting has been cleaned, these cored holes are drilled and tapped. The two holes at the left-hand end are drilled and tapped to receive the water inlet and outlet pipes, respectively. The holes at the opposite or right-hand end of the casting are drilled and tapped to receive threaded plugs.

The bronze liner *B* is held in place on the water-cooled box by means of brass pins *D*. While a casting made in this manner may appear satisfactory and pass a critical examination of the outside surface, there is no assurance that the water cooling chamber is perfect or that the water can circulate through the chamber as intended. To overcome this objection a new box was designed which is shown in Fig. 2. The pattern for this cast-iron water-cooled journal box is easily made, and no cores, core-prints, or core-boxes are required. It will be noted that the water-cooling chamber is open or exposed. This enables the molder to inspect the mold thoroughly, and also enables a thorough inspection of the casting produced by the mold.

The open top cooling chamber is divided into narrow pockets or spaces *E* by dividing ribs *F*. There are four

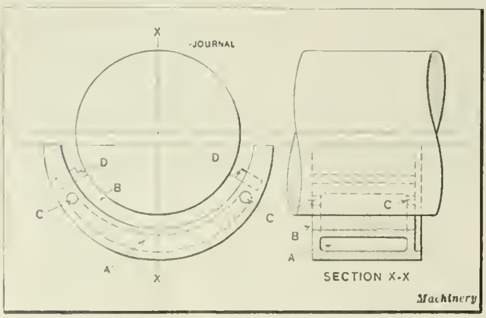


Fig. 1. Water-cooled Journal Box presenting Difficult Molding Problem

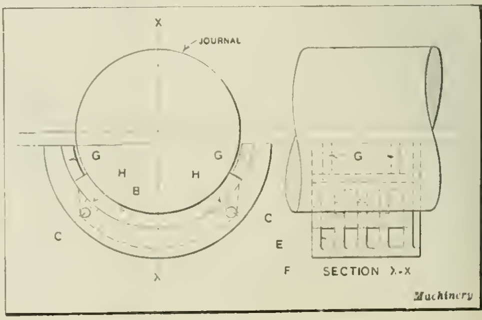


Fig. 2. Redesigned Journal Box which simplifies Molding Problem

stops *G* cast integral with the main casting. Two of these stops are located at each end of the casting. As these stops are in line with the pockets, it is possible to bore out the inside diameter or the supporting ribs *F*. The casting is, of course, finished all over. The bronze liner *B* covers the water chamber, and the water pipe connections are located to suit conditions. The ribs are cut out at *H* to permit proper circulation of the cooling water.

Kenosha, Wis. M. E. DUGGAN

DIAGRAM FOR DETERMINING RADII OF ELLIPSES

On complicated drawings it is frequently inconvenient to construct approximate ellipses by the methods given in engineering handbooks, because of the preliminary laying out involved in determining the radii required. By means of the accompanying diagram these radii can be determined readily and an approximate ellipse developed with little work. In using the chart, it is only necessary to know diameters *A* and *B*. Dividing these in two gives *a* and *b*, respectively. Corresponding radii of *R* and *r* are found by laying a straightedge across the known values of *a* and *b*. Assume that it is desired to find the radius required in constructing an ellipse of which *A* is 1 inch and *B* is ¾ inch. In this case *a* equals ½ inch and *b* equals ⅜ inch. By drawing a line connecting these values on the *a* and *b* scales as indicated by the dot-and-dash line, the value of *R* will be found on the *R* scale to be ⅝ inch, and *r* on the *r* scale to be 5/16 inch.

GEORGE L. HEDGES
Frankfort, Ind.

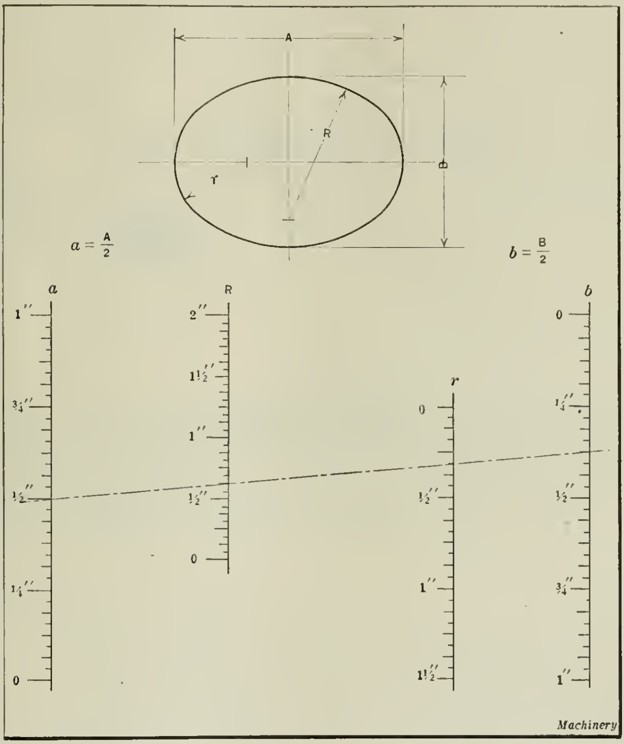


Diagram for rapidly obtaining Values required in constructing an Approximate Ellipse

A SIMPLE PATTERN NUMBERING SYSTEM

The plan for numbering patterns, explained in the following, has been found to have many advantages. The pattern number is composed of three distinct elements, or groups, each representing one of the three essential points to be considered in the identification of a pattern, namely, the kind of machine of which it is a part, the type or size of the machine, and the detail number which identifies the casting on the machine.

The number is so constructed as to contain as few digits as possible, and, at the same time, conform to all the requirements of the system. To this end both letters and figures are made to follow one another in a compact sequence, without the use of dashes or spaces, the letters of the alphabet being used in the first and last groups, and the figures placed between, forming the intermediate group. In this way a distinction of the three parts of the number is effected.

The first group indicates the kind, or general classification, of machine. The middle group gives the detail number of the part, and the last group represents the size or type, or both size and type of machine, which in such a case can be indicated by one symbol that is composed of one or two letters.

As an example, suppose a concern is manufacturing a line of engines and pumps. The engines would be in one classification, represented by a letter, such as A, and the pumps in another, represented by B, these letters being first in the sequence of the number. Suppose the cylinder head of the engine has the detail number 10, and the base of the pump 13. The size of the engine in the example may be represented by the letter A, and that of the pump by H. Then the number A10A would designate the cylinder head of a size A engine, and B13H the base of a size H pump.

The plan for assigning the detail numbers should be independent of that for all other numbers. The detail numbers should be taken from a list, in rotation, as the parts are placed on the drawings; thus 10 need not stand for the cylinder head for any other size or type than the one cited, since that one size or type may be very simple, with few parts, while another type may be elaborate in design and require a large variety of details. The letter indicating the kind of machine or product should be assigned at the time it is determined to make or design such a product, and should be taken in its turn from a list. The letters for the size or type should be assigned in a similar way, and a separate list of letters for sizes belonging to each general class or kind should be kept distinct from all other classifications; thus "A" representing a size of engines should have no relation to "A" in sizes of pumps.

If the products of the concern should increase so as to cover many classes and types of machines, it might be necessary to use two letters, either for classification or for size, and if the details of one machine run higher than ninety-nine, in number, it would be necessary to use three figures. The longest pattern number that is likely to occur under this system, however, would contain seven characters, such as AA107AB, but even such a case would be extremely rare. It is not likely that there would be over one letter in the end groups, or two figures in the middle, in most cases, making four altogether, which is as compact as it can usually be made.

There are some letters that are objectionable for use on patterns, when used in connection with figures, for the following reasons: The letter O is identical with the zero of the numerals, and the letter I can hardly be distinguished from the figure one. The letter C could be made from O if a portion of the side should be washed out in the mold, and a portion of the letter Q could be washed out in a similar manner and made to look like O or C. If the lower portion of E were washed out it would look like F, and if A were shown indistinctly, and were read upside down, as is often the case on a casting, it might be taken for V. By eliminating all such objectionable letters, and having it known that the system does not contain them, there would be no chance of mistaking one for another. The letters to be eliminated would then be C, F, I, O, Q, and V, there being six in all, and that would leave twenty to be used, which are, A, B. D, E, G, H, J, K, L, M, N, P, R. S, T. U, W, X. Y, and Z.

These twenty letters, if used in combination like numbers, would form a double decimal system giving a combination of 399 numbers where two letters are employed, which would more than take care of the needs of any concern. The twenty letters would usually be sufficient for all needs.

North Judson, Ind. William H. Kellogg

WINDING COIL SPRINGS

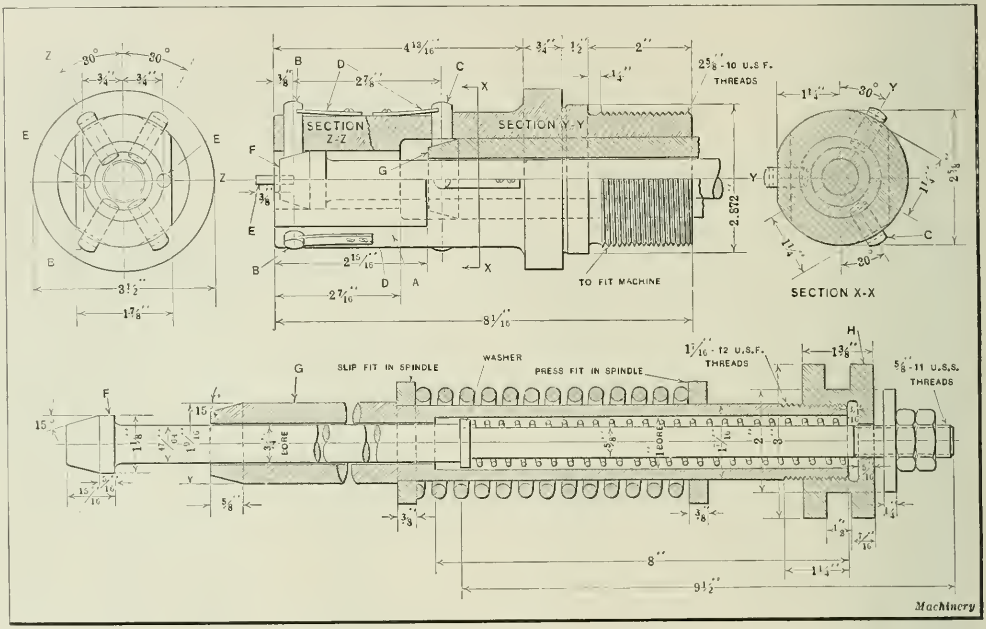
The following is a simple method of winding a coil spring. A piece of steel tube or pipe about 6 inches long with a ½-inch or ⅜-inch hole is fastened in the toolpost of the lathe, using a boring-bar vee to secure rigidity. The wire is passed through this tube, and the end gripped in the chuck or dog of the arbor on which the spring is to be wound. The lathe is geared to the pitch of the coil wanted, or in the case of the closed coil spring, it may be geared for a pitch slightly less than the number of coils per inch. In using this device, the end of the tool through which the wire is fed should be as close as possible to the winding arbor.

New Britain, Conn. W. C. Betz

PISTON CHUCK

The writer has noted with considerable interest the various designs of devices for chucking pistons from the inside while rough-turning the outside surfaces. The best results are obtained by chucking pistons in this manner; however, nearly all manually operated chucks designed for this purpose require the use of wrenches, and consequently result in increasing production costs. In the accompanying illustration is shown a type of piston chuck that does not require the use of wrenches and that can be operated by one lever.

The body of the chuck with the various operating parts assembled is shown in the upper half of the illustration, while in the lower half a sectional view of the actuating arrangement for the two plungers is shown. The machine-steel body *A* has flats milled on each side to a width which will permit it to fit between the wrist-pin bosses on the inside of the piston and thereby act as a driver. There are



End and Sectional Views of Piston Chuck and its Actuating Mechanism

four hardened tool-steel pins *B* carried in the outer end of the body to accommodate the nose of one plunger, and three similar pins *C* operated by the nose of the other plunger. These two sets of pins are held in place and moved radially inward by flat springs *D*. Two pins *E* projecting from the end of the body act as stops against the closed end of the piston and take up the end thrust of the cutting tool.

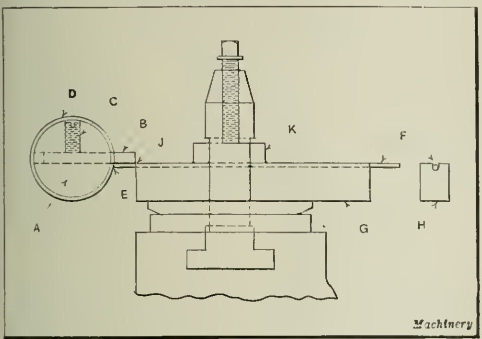
The plungers *F* and *G* are actuated by coil springs. The chuck is operated by a lever with a forked end, located at the rear of the machine above the spindle, which engages collar *H*. Movement of this lever is all that is required to operate the two plungers by means of which the piston is chucked. When the lever is moved to the right, the pins *B* and *C* are drawn in to permit the piston to be slipped over them preparatory to chucking. When the lever is released, the springs force the plungers to the left, thereby expanding the pins and securely chucking the pistons in place. An air chuck could be substituted for the larger spring, but if the proper springs are used, a hand-lever will be found satisfactory. This type of chuck has been used to chuck pistons when taking cuts that were as much as ½ inch eccentric.

Chicago, Ill. Harold A. Peters

CUTTING RIVETS IN THE LATHE

As about 6000 rivets, 1/16 inch in diameter, were required and nothing better than a hand shear was available for cutting the rivets from wire stock, it was decided to equip a lathe for the wire-cutting operation. The accompanying illustration shows how this was accomplished. An ordinary milling machine boring-bar *A* was set up in the lathe and a 5/16-inch tool bit *B*, ground on the face and end, was fastened in the boring-bar by a set-screw *C*, as indicated. Next, a piece of 1/16- by ½-inch cold-rolled steel was bent around a piece of shafting slightly smaller than the boring-bar in order to form a sleeve *D* which could be sprung on bar *A* to cover the back end of the tool recess and the set-screw hole. This sleeve formed a smooth surfaced stop for the end of the wire stock *F* which makes contact with it at *E*.

The high-speed steel lathe tool *G* was then ground smooth on its top surface and on one end. A groove was cut the full length of tool *G* on its top surface as indicated in the end view at *H*. This groove was made slightly larger than the wire except at the cutting edge *J* where it conforms to the size of the wire used for the rivets. The tool was fastened in the toolpost with a steel block *K* on its top surface to keep the wire in the groove while it is being fed forward. In operation, the cutting edge of the tool bit in the boring-bar is set a certain distance from the face of sleeve *D*, according to the length of the rivets or pins required.



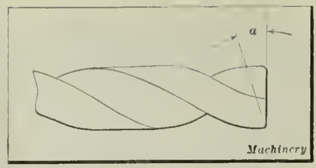
Lathe Equipment for cutting Rivets

The cutting edge of the lathe tool at *J* is fed up until it will just cut thin paper when the arbor is rotated. The carriage and the tailstock are then clamped tightly in place. The lathe can be run at a fairly high speed, depending upon the size of stock to be cut. The highest speed obtainable with an open belt was used in cutting the 1/16-inch wire. The wire is fed through under constant tension, and should jump forward and strike the stop sleeve *D* as each piece is cut off. With this arrangement 3000 rivets were cut within five minutes.

East Walpole, Mass. JAMES A. KIRK

USING A TWIST DRILL FOR AN END-MILL

The following describes a method that was employed for finishing a thin-walled core-box which was comparatively deep. The corners forming the sides of the box were joined with a 3/16-inch radius, and the bottom was filleted to the sides with a 1/16-inch radius. Ordinarily a ¾-inch end-mill would have been used, but on account of the depth of the box such a tool could not be conveniently employed. Consequently, a ¾-inch twist drill was especially ground in the manner shown in the accompanying illustration. The lips of the drill were ground with suitable clearance, but the cutting edges were produced nearly flat, as is sometimes done for bottoming a hole. A 1/6-inch radius was ground at the outer corners of the lips, to suit the fillets at the bottom of the box. The box had previously been planed so that it would seat evenly on the table of a drilling machine, where the finishing of the interior was accomplished. The drill was set to depth by the regular stop on the machine spindle, and was fed down to this stop in the course of routing out the metal. By moving the box around under the drill on the table, the operation was completed without difficulty.



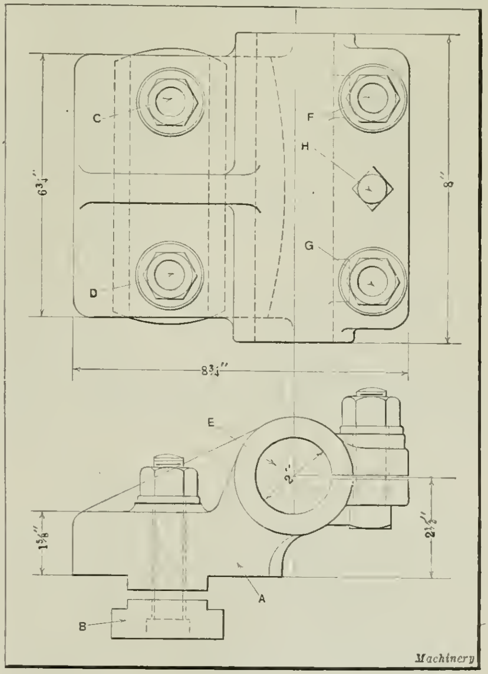
Twist Drill ground to serve as an End-mill

Since using the drill on this job, it has also been employed on a number of occasions for removing lumps and excess metal in core-boxes. It has been found that if proper care is taken in grinding, the drill will work easily and cut smoothly, and will not chatter nor gouge into the work. The angle *a* should not be greater than is necessary to provide clearance, and the center should be just a little above the two cutting edges of the drill. If the center is ground much above the edges of the drill, it will be found that the drill will cut freer, but it will not produce a smooth surface. It is not to be expected that a drill ground in this manner can be used in place of an end-mill in all cases, but in an emergency a tool of this kind will bridge over the difficulty very well.

Detroit, Mich. NELSON HALL

BORING-BAR HOLDER

The accompanying illustration shows one of a number of similarly designed boring-bar holders, intended for fast, heavy cutting on comparatively large work, such as big gears, sheaves, and large piston-ring castings of the pot type. The holder shown is used on a 24-inch gap-bed lathe, which



Boring-bar Holder for Heavy Cutting on Large Work has a swing of 48 inches when the gap is open. The cast-iron holder *A* and the steel slide *B* are made with tongues that are a snug fit in the tool-rest. When in use, the holder is clamped tightly down to the tool-rest by means of the two ¾-inch bolts *C* and *D*. The 2-inch boring-bar is a sliding fit in the reamed hole *E* of the holder, and is securely clamped by the two bolts *F* and *G*, located in the projecting ears.

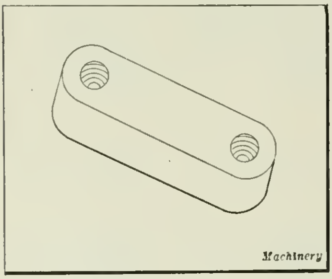
The upper ear is tapped for a ¾-inch set-screw *H*, which is used as a jack to loosen the grip of the holder when it is necessary to remove the boring-bar. When a bar smaller than 2 inches in diameter must be used, a split cast-iron sleeve is slipped over the bar, and both bar and sleeve are clamped in the holder. This design of holder has proved satisfactory for general maintenance work requiring accurate boring at high speeds and feeds. The holder and the boring-bar used with it are more rigid and have greater bearing surfaces than are ordinarily found in commercial holders.

Baltimore, Md. WILLIAM L. HAMPSHIRE

REMOVING KEYS FROM KEYSEATS

The width of a keyseat in small diameter shafts is usually given a tolerance of 0.001 inch, limiting the maximum width to the standard dimension, and the minimum width to 0.001 inch smaller than the standard dimension. The width of the key usually varies from the standard size to 0.001 inch large. It is possible, therefore, for a man, working within these limits, to take an allowance of the extremes in both cases and give to the key a force fit of 0.002 inch. To remove from a shaft any key having a forced fit is a difficult job, and very often an attempt to do so results in spoiling the key.

The ordinary practice is to tilt one end of the key up above the keyway by means of quick, sharp blows, using a chisel and hammer for the purpose, and then pry the key from its seat with a screwdriver. Even when extreme care is used, a badly marred key usually results. Another common method is to hold the key in a vise and tap the shaft with a lead hammer. These methods may appear crude, but nevertheless they represent common practice.



Key provided with Tapped Holes to facilitate Removal from Seat

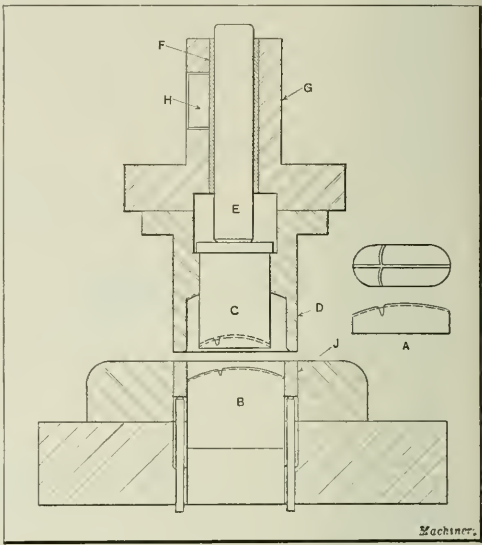
The illustration shows a key provided with two tapped holes. The removal of such a key is a simple matter, because all that is required to extract it is the insertion of two standard screws and the use of a screwdriver. The screws used in this manner are in reality miniature jack-screws. If the tapped hole projects into the shaft the threads on the ends of the screws that go into the shaft should, of course, be removed.

R. J. S.

FRICTION PAD FOR DRAWING DIE

The combination blanking and drawing die shown in the accompanying illustration is used on a single-action press to produce small shells of the shape shown at *A*. Considerable trouble was experienced in drawing these shells until the friction pressure-pad *C* was incorporated in the die. Before the pressure-pad was used, many pieces were spoiled from the slipping of the blank on the forming punch *B* during the drawing operation. The friction pad *C*, which entirely eliminated this trouble, is fitted in the combination blanking and forming punch *D* as shown. The hardened tool-steel pin *E*, in contact with pad *C*, is fitted in a hard fiber collar *F* which is held tightly in holder *G*. A tool-steel block *H* is set in a slot in punch-holder *G* so that it is located under a heavy set-screw in the ram of the press.

When the die is in operation, the set-screw in the press ram is screwed up fairly tight against block *H*. It should be adjusted until the proper amount of friction is obtained as determined by trial. As the ram descends, pad *C* comes against the blank as soon as it has been cut, and the friction between *E* and *F*, caused by the tightening of the screw on block *H*, is sufficient to emboss the grooves in the metal, thereby locating the piece and holding it firmly during the forming process. At the end of the downward stroke, the



Combination Blanking and Drawing Die

pad *C* is, of course, flush with the inside of the forming punch *D* and remains there until the top of the stroke, when the pin *E* is pushed down again by the knock-out of the press, which causes the shell to be ejected from the punch. This friction device, of course, takes the place of the spring which is commonly used for such work; a spring cannot be used in this case as the pressure would be maintained during the up stroke and the thin shell would therefore be crushed between pad *C* and pressure ring *J*. This die has been in use for some time, and has given satisfactory results.

East Orange, N. J. W. B. GREENLEAF

* * *

STEAM TURBINE LOCOMOTIVE

A locomotive has been put in service on the Swiss Federal Railways which is provided with a steam turbine and condensing plant. The engine is designed and constructed by the Swiss Locomotive & Machine Works, Winterthur. The locomotive frames carry the boiler in the usual way, and the steam turbine is placed in front on the smokebox. The turbine drives, through double spur gearing, a jack-shaft placed across the frame, which, in turn, transmits the power to the driving wheels. The surface condenser is placed between the frames under the boiler, the simplification of the mechanism, due to the use of the turbine, making this space available. The condensing water is cooled by the current of air produced by the movement of the locomotive. In the trial runs that have been made in ordinary railway service, the arrangement has proved successful, and considerable economy is expected from the design.

Reducing Costs by Electric Welding

Specific Examples of Savings Effected in a Number of Industries by the Use of the Electric Welding Process

THE electric welding process has been developed during the last ten years to a point where instead of being an unusual method, it is now commonly employed in the manufacture of a great number of devices and appliances. The following article gives details relating to the application of electric welding in metal-working plants using machines built by the Winfield Electric Welding Machine Co., and the Taylor Welder Co., both of Warren, Ohio. The data are presented in order to bring to the attention of manufacturers generally what has already been accomplished in securing economy and reducing costs by electric welding—a method which should be investigated whenever production work is contemplated for which the process would prove suitable. In the following, the data relating to each class of manufacture are given briefly and concisely, as a record of performance.

Electric Welding in Automobile Work

A manufacturer of sheet-metal parts for automobiles, trucks, and tractors in the Middle West uses the electric welding process for materials of a thickness from 1/4 inch down to No. 24 gage. On account of the variety of parts welded, it is difficult to state specifically the number of welding operations performed per hour, but on ordinary flat pieces requiring five or six welds, this company averages about 200 pieces per hour. The estimated increase in production as compared with the riveting process on this class of work is from 100 to 150 per cent.

In another plant, 1/4-inch soft cold-rolled steel is welded, four welds being made in each piece. As compared with the old method of performing this work, the saving is approximately $40 per 1000 pieces, and the production has been increased from 12 to 70 pieces per hour.

Welding Metal Furniture and Metal Doors

One plant making fireproof metal cabinets employs five welding machines for welding sheet steel of from 10 to 28 gage. In this plant electric welding has been applied for ten years, and riveting operations have been practically eliminated except in cases where it is considered impracticable to use a weld. Compared with riveting, however, it is estimated that the increase in production by electric welding is something like 500 per cent, and the company states that even this figure may be considered conservative. On the average work in this plant, sixty welding operations per minute are easily performed.

In another metal furniture plant parts of from 10 to 24 gage are welded at the rate of from 100 to 200 parts per hour. In this case practically all the assembling work is done by welding. The estimated saving in the cost of production is 50 per cent and, at the same time, the rate of production is increased about 50 per cent.

A well-known manufacturer of hollow metal doors and trimmed metal moldings and shapes, stampings, and various other metal specialties, employs both the butt-welding and spot-welding processes. The welding material ranges from 14 to 22 gage and varies in width from 2 to 10 inches. A material saving in cost is shown, and the estimated increase in production ranges from 25 to 500 per cent over methods formerly used, according to the particular operation performed.

Welding Foundry Supply Material

An Ohio manufacturer employs the electric welding process for double chaplets and plate-fitted chaplets, such as are used in foundry work. In making up the double-head chaplet, a plate is welded on each end of a round stem in one operation. On the plate-fitted chaplet, a single plate is welded to a stem in one operation. Stems 3/16 inch in diameter and plates of 18 and 20 gage are successfully welded by these processes, these dimensions being the minimum for which the machine is used. It is employed for either type of chaplet having stems up to 5/8 inch in diameter, with either 1/8-inch or 3/16-inch plate. The smaller sizes mentioned are welded at the rate of from 300 to 350 per hour, while the heavier sizes vary with the diameter and length of the stem.

Welding Curb and Gutter Rails

Another Ohio manufacturer making curb and gutter rails uses a spot-welding machine for welding the sleeves and reinforcing cleats to these rails. The material used is Nos. 10 and 11 gage. It has been found that 100 6-inch rails may be welded per hour, there being fourteen spots on each rail. At this rate of welding, the time required for placing the sleeves and cleats previous to welding is included. There is a saving effected in the cost of material, as compared with riveting, of 10 cents per rail, and the increase in production, which is the biggest factor, amounts to about 75 per cent.

Use of Electric Welding in the Manufacture of Household Utilities and Toys

A manufacturer in New York employs the electric welding process for welding operations on household utilities, such as wire soap-dishes and bathroom fixtures. The sizes of wire mostly welded range from 1/16 to 3/16 inch, and in this case each machine used welds approximately from 63,000 to 65,000 welds per day. As an indication of the reliability of the electric welding machine in its present state of development, this manufacturer mentions that for the last six years the cost of repairs on his machines has been negligible.

A New England manufacturer of children's play wagons uses electric welding machines for the welds on wheels and other metal parts, using principally black sheet and band iron and some light channel iron. The number of welds per hour for the different sizes of wheels vary from 150 to 300. This manufacturer states that while the saving in the cost of material is merely that of rivets, this item in the course of a year would amount to the cost of two welding machines. The saving in labor cost over the riveting method is estimated to be about double that of the saving on rivets.

The Metal-working Industries

DURING the last three months there has been improvement, although slight, in the machine tool industry. December is usually a quiet month in the machinery business, and as this year is no exception, the improvement noted goes back to the months of October and November. The improvement has not been uniform; generally there has been less demand for heavy machine tools than for the medium and small sizes. The demand has been more for the standard lines—especially the medium and low-priced types—than for automatic or high-production machinery. A few exceptions are noted, one of the leading builders of heavy machine tools reporting some very good sales. There has been only a limited amount of railroad buying, and the best trade has been in small machines for trade school use and for repair work. One builder, devoting himself exclusively to trade school machines, has been running at 50 per cent capacity during the entire year without adding to his stock.

Activity in the Small Tool Business

By comparison, the small tool business is very much better than the machine tool business at the present time. Whenever the metal-working shops begin to be active, even to a limited extent, they must have small tools—taps, dies, reamers, milling cutters, drills, etc., whereas they need not add to their machine tool equipment until they have reached capacity production. There has been a surplus stock of drills on the market during the past year, but the stock of other small tools in the hands of users and dealers appears to be exhausted, and one manufacturer of small tools is now operating at 45 per cent capacity, with present indications in the trade pointing toward 55 or 60 per cent within another month. Another of the leading makers of small tools is running at 40 per cent capacity, without adding to his stock. The hardware plants are among the best customers at the present time for tools of this kind, as many of the leading hardware factories are fully occupied. This, in turn, would indicate that there is expectation of increased building activity next year, which, if it materializes, would react favorably on all lines of business.

Machine Tool Prices

The substantial reductions in machine tool prices during the past year were made possible by reductions in pig iron, castings, and steel, brass and bronze, and also by reductions in wages, but there are many costs entering into machine tool building that have not come down, notably freight rates and taxes. The higher cost of transportation has increased the selling expense to a point where it is greater than ever before. While the increased cost of selling is due to many factors, high passenger fares and the higher cost of hotel accommodations are important items. In neither of these costs is there much prospect of any immediate or material reduction. These expenses become a permanent addition to the selling price, because they are definite factors that increase costs.

In the special machinery field and in the manufacture of parts as well as in jobbing work, competition is very keen—in some cases almost ruinous. In the parts manufacturing field, purchasing agents have been taking advantage of present conditions in the industry to force quotations so low that the seller loses instead of making a margin of profit; and sometimes the methods employed to get the lower prices would not stand the test of good business ethics. Some of the parts manufacturers, naturally anxious to get work for their idle plants, have too eagerly played into the hands of the purchasing agent.

A number of machine tool builders are partially occupied on contract work for machinery and devices outside of the machine tool field. In some cases it is likely that the plants will be permanently occupied on such work in addition to the regular machine tool business. In this way the excess capacity of some of the machine tool building plants will eventually be absorbed. There have been consolidations in the machine tool field also, and shops have been dismantled and added to the plants of other companies controlled by the same financial interests.

Perhaps the most serious factor in the machine tool field at the present time is the large stocks on hand. Even if buying should be fairly brisk within the next few months, it would be quite some time before the shops could run at anywhere near capacity. Foreign trade presents a new problem in the machine tool field, where 25 per cent of the production usually has been disposed of abroad. In some lines over 50 per cent of the business in pre-war years was foreign. Now the European trade has been reduced to almost nothing, and only the trade with Australia, Japan, China, and India—a comparatively small trade at best—is normal. There has been a fair trade with South America during the past year, but competition in the South American field with British and German machinery is very keen. The total foreign trade in machine tools during the month of October, the last month for which the Department of Commerce has issued complete detailed statistics, was only about 15 per cent of the trade early in 1920.

The Iron and Steel Industry

The iron and steel industry—the barometer for the entire metal-working field—is steadily though slowly improving. The average operation of the steel mills is from 40 to 43 per cent, but the November output was the largest of the year. There have been further price concessions, and a considerable agitation for lower freight rates; even though prices at base points may not be reduced further, lower freight rates would enable the consumer of iron and steel to obtain his raw materials at a considerable reduction, because freight rates are a very important item in the price of pig iron and steel at points removed from the iron-producing districts.

The Railroad Situation

It is estimated that the railroads will save $50,000,000 a year by the application of the revised working rules governing railroad shop employes, accepted by the United States Railroad Labor Board, which went into effect December 1. According to these new rules, the open shop principle is recognized on all railroads, and members of certain crafts are permitted to do minor jobs previously required to be done by members of other crafts. The new rules supplant the National Agreement made during Federal control of the railroads, and constitute one of the most important advances in restoring efficiency in railroad operation.

On account of the hampering influence of the unions, a number of railroads are understood to be considering leasing their repair work to outside shops. The Erie and the New York Central railroads have already had some of their repair work done in this manner, and it is stated that a considerable saving has been the result.

The net earnings for the month of October, the last month for which complete figures are available, show the highest increase for the year, and it is confidently expected that the railroads will soon be in the market for new equipment—both rolling stock and machine tools.

NEW MACHINERY AND TOOLS

THE COMPLETE MONTHLY RECORD OF NEW AMERICAN METAL-WORKING MACHINERY

The New Tool descriptions in MACHINERY are restricted to the special field the journal covers machine tools and accessories and other machine shop equipment. The editorial policy is to describe the machine or accessory so as to give the technical reader a definite idea of the design, construction, and function of the machine, of the mechanical principles involved, and of its application.

How To Reduce Production Costs ?

Fellows High-speed Gear Shaper

A NEW high-speed gear shaper designed to meet the requirements of manufacturers having a large number of gears of one particular size to cut, but which is so arranged that by the provision of suitable work-holding fixtures it can be adapted for many classes of work, is being introduced to the trade by the Fellows Gear Shaper Co., Springfield, Vt. This new machine is in many respects similar to the standard gear shaper built by this concern. External, internal, and helical gears can be handled. A special feature of the machine is that it can automatically take roughing and finishing cuts in one setting and with the same cutter. This is obviously an important factor in a production machine, as it eliminates the performance of second operations.

Principle of Operation

The principle of operation is fundamentally the same as that of the standard gear shaper in that the cutters used resemble gears and are employed on the generating principle. These cutters are standard and have the teeth generated with precision after hardening. Because of the high speed at which the cutter is operated and the short stroke of the machine it is not the practice to machine several gears at one time, except when they are very thin; but even though only one gear is machined at a time, high rates of production are secured. An advantage obtained by this method is that inaccuracies produced when a number of gears are held on one arbor are eliminated.

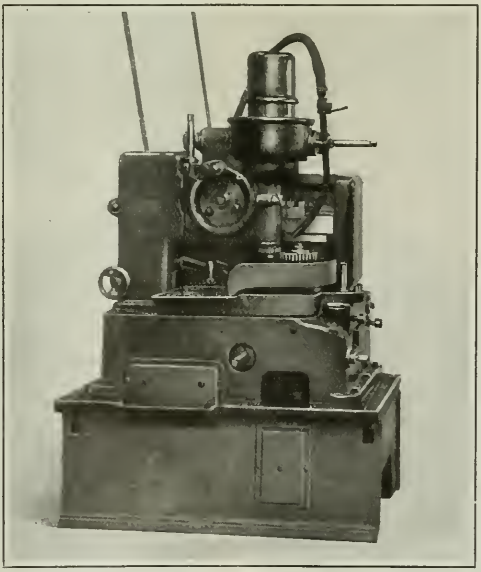


Fig. 1. High-speed Gear Shaper made by Fellows Gear Shaper Co.

As the cutter has a comparatively short stroke, and can therefore be operated at a high rate of speed, it remains in contact with the work for only a short period of time. This contact is so short that the cutter does not become heated and so its keen cutting edge is not impaired. As the work also does not become heated, variations in the teeth due to changes in temperature are not met with. Cutting compound is pumped to the cutter and the work to keep them cool, and this enables the machining of alloy steel gears to be done rapidly and accurately.

As on the standard gear shaper, change-gears are provided for taking care of the difference between the number of teeth on the cutter and the number of teeth on the gear being cut, but owing to a modification in the design of this machine the ratio is different, as will be explained later. The method of obtaining the rotary feed for the cutter also differs, and this too will be dealt with subsequently.

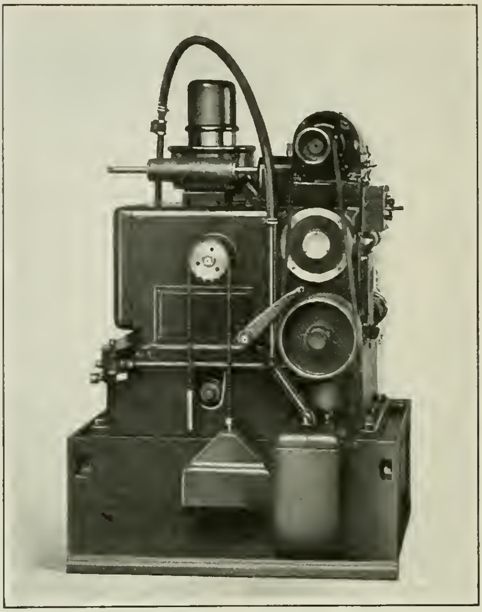


Fig. 2. Rear View of the Fellows High-speed Gear Shaper equipped with Individual Motor Drive

The Cutter-spindle and Saddle

The cutter-spindle is guided in a straight path by accurately finished guides, being reciprocated by means of a connecting-rod and crank-arm which may be clearly seen in Fig. 3. The operating end of the crank-arm has a hardened steel gear segment on it which meshes with rack teeth on the cutter-slide. The crank-arm has a bronze bushing at the fulcrum, and is equipped with ball bearings where it is attached to the connecting-rod. The connecting-rod is operated through a crankshaft having an adjustable crankpin, the position of which governs the length of the cutter stroke. The lower end of the connecting-rod is mounted on a self-aligning ball bearing on the crankpin, this construction permitting the use of high reciprocatory speeds.

The crankshaft is made from an alloy steel forging, and is driven from the rear through a single-pulley drive. This construction enables a group of gear shapers to be driven from a jack-shaft, without the employment of a countershaft. As shown in the rear view of the machine, Fig. 2, provision has also been made for the installation of an individual motor drive, a bracket being fastened to the top of the machine for attaching the motor. A 1-horsepower motor provides sufficient power for operating a single machine. When a group of machines is installed, it is economical to bolt the machine bases together and operate the machine as one unit. When this is done a 6-horsepower motor furnishes ample power for ten machines.

The position of the saddle carrying the cutter-slide is adjusted to suit different gear diameters by means of a worm, worm-wheel, pinion, and rack, and can be withdrawn to permit the location and removal of work. The saddle is mounted on accurately machined guides on the face of the housing. For the depth feed it is advanced toward the work by means of a cam which may be seen in Fig. 3, provision being made on this cam for automatically taking both roughing and finishing cuts. The cutter is gradually fed to the proper depth as the blank and cutter are rotated together. The cutter overlaps on the finishing cut so as to prevent variations in the thickness of the teeth.

Work-spindle and Relieving Mechanism

The work-spindle is almost identical in design with that on the standard gear shaper in that it carries a reverse taper work-arbor. It is rotated by means of worm-gearing which is directly connected through gears and shafts to the upper worm and index-wheel which operate the cutter. The spindle is held in an apron located in an accurately machined seat in the bed. The work is withdrawn from the cutter on the return stroke by means of a relieving mechanism consisting of a cam at the rear of the machine which operates the apron lever through a connecting-rod. This mechanism may be seen in Fig. 5.

Speed and Feed Mechanisms

As previously stated, the proper relation between the number of teeth on the cutter and on the work is secured through change-gears which the operator is in the act of changing in Fig. 5. Owing to the fact that the upper and lower worm-wheels have the same number of teeth, the ratio between the cutter- and the work-spindles is 1 to 1, and so the computation necessary in selecting the proper change-gears for a job is easy. Any needed pair may be determined by the use of a simple formula, which is cast on a plate fastened to the machine just above the change-gears. After a set of gears has been placed on the shafts, the gears are protected by a cover. The time for a gear-cutting operation is controlled by the speed at which the cutter-spindle is operated, in conjunction with the rotary feed. Change-gears are also provided for this feed, which are accessible by removing a plate; this was done prior to taking the photograph

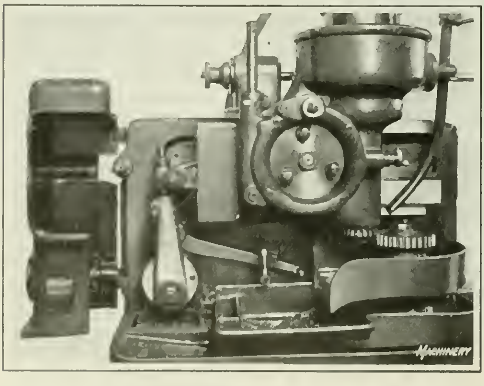


Fig. 3. Close-up View of Mechanism which imparts Reciprocating Movements to the Cutter-spindle

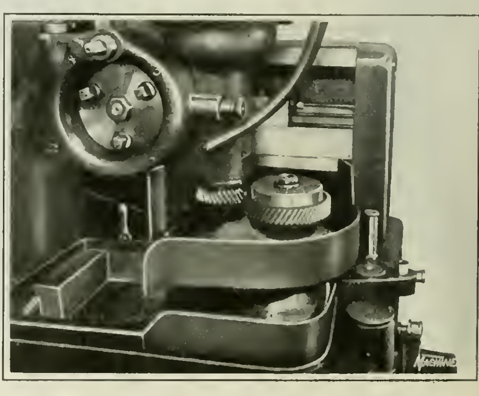


Fig. 4. Cutting an Automobile Engine Helical Timer Gear on the Gear Shaper

reproduced in Fig. 6. The plate is held in place by means of four safety set-screws. The rotary feed is expressed in strokes of the cutter per revolution, and gears are provided for securing seven different feeds ranging from coarse to fine. A feed chart is attached to the plate covering the feed gears. The coarsest feed is 435 strokes per complete revolution of the cutter, while the finest feed is 1735 strokes per complete cutter revolution. The selection of a feed is governed by the material being cut, a coarser feed, of course, being used for cast iron than would be possible for alloy steel. Roughing and finishing cuts are taken at the same rates of feed and speed.

Oiling Provisions

The machine has been designed to run with little attention so far as oiling is concerned. All high-speed shafts are mounted in ball bearings and are automatically lubricated. A reservoir in the bed holds two and one-half quarts of light machine oil, which is pumped to additional reservoirs from which wicks carry it to the different bearings. The cutter-spindle shoe and guide are lubricated from a reservoir in the saddle housing which may be exposed by removing a cover. A reservoir provided on the apron may be filled after unscrewing a cap. Only three grease cups are furnished on the machine, these being supplied because it was found that for a slight oscillatory movement, grease is more satisfactory than oil. Only one turn of the cups per day is sufficient to keep the working members well lubricated.

As previously mentioned, a 1-horsepower motor furnishes ample power to cut any type of gear within the capacity of the machine; this is due to the fact that all reciprocating members are light in weight and all high-speed shafts are mounted on ball bearings.

Provisions for Cutting Internal, Helical and Herringbone Gears

This gear shaper will handle any form of gearing used in standard automobile construction, as well as some gears of special design. It may be used for cutting both steps on a countershaft gear and the external and internal teeth on an internal clutch gear. In adapting the shaper for cutting internal gears, a slight modification is necessary in the design of the machine, owing to the fact that in cutting an internal gear the cutter must work on the right-hand side relative to the center of the work-spindle, instead of on the left-hand side. A special crank-arm is necessary with this arrangement, but all other members of the machine are identical in design with those on a machine for cutting external gears only.

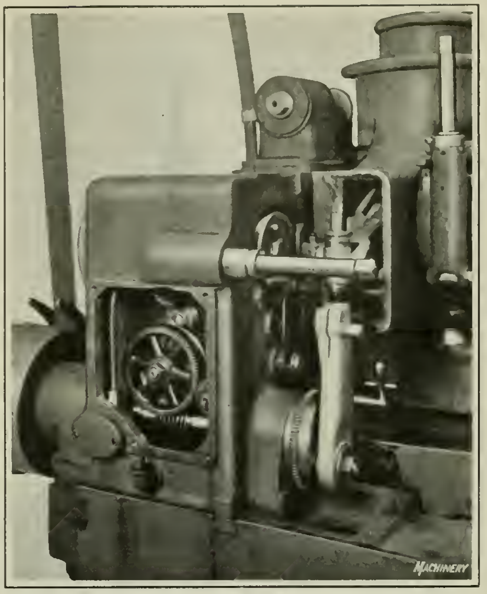


Fig. 6. View taken from the Left-hand End of Machine, showing Feed-change Gears, Crankshaft, Connecting-rod, etc.

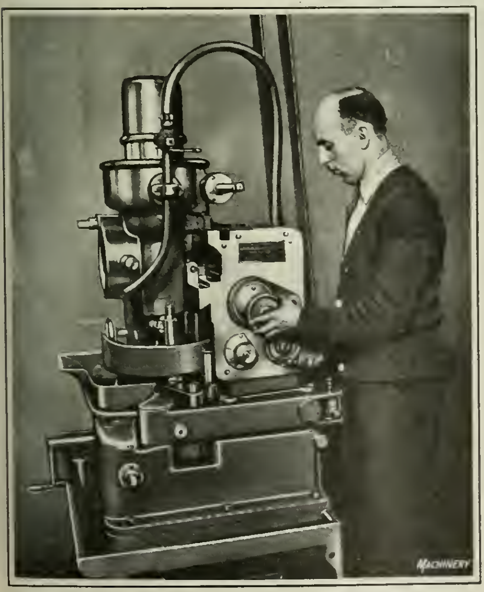


Fig. 5. View of Right-hand End of Machine showing Speed-change Gears and Relieving Arm connected to Work Apron Lever

By another slight modification somewhat similar to that used on the standard gear shaper for the same purpose, this high-speed shaper can be adapted for cutting helical and herringbone gears. Fig. 4 illustrates an operation on a timer gear for an automobile engine.

BARBER-COLMAN AUTOMATIC HOB-SHARPENING MACHINE

The proper sharpening of any cutting tool is essential if maximum efficiency is to be obtained in the operation of the tool, but in the case of formed cutters and hobs, it is a matter of exceptional importance, because tools of these types have their teeth relieved to allow for sharpening and still retain the form of each tooth throughout its entire length. To enable a cutter or hob to produce its true form continuously, it must be so sharpened that the cutting face of each tooth is on a radial line with the center of the cutter. In order to eliminate the personal element in the performance of such cutter grinding operations, the Barber-Colman Co., Rockford, Ill., has developed the automatic hob-sharpening machine here illustrated. Although primarily designed for sharpening hobs up to 4 inches in diameter and 4 inches in length, it is equally applicable to sharpening formed cutters of sizes within the capacity of the machine.

The hob to be sharpened is mounted on a mandrel carried in the headstock spindle and having the outer end supported by a sliding tail-center. A reciprocating motion is imparted to the work-slide, so that the hob moves back and forth under the grinding wheel. After each forward and return stroke of the table, the hob is indexed by a mechanism which provides for indexing hobs with different numbers of gashes. It is an easy matter to change the machine to grind a different hob. The machine is readily set for grind-

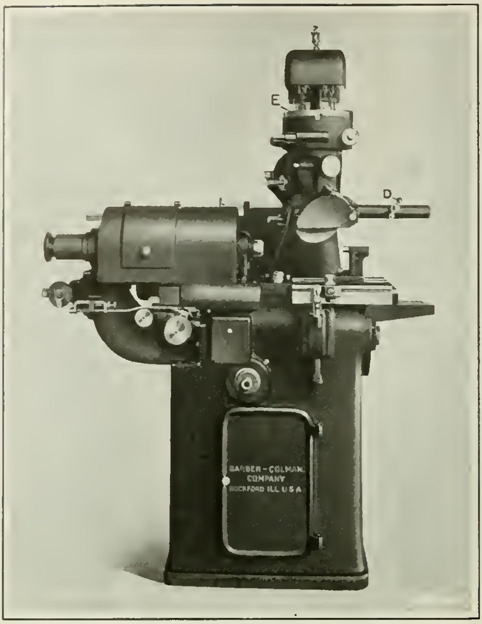


Fig. 1. Automatic Hob-sharpening Machine brought out by the Barber-Colman Co.

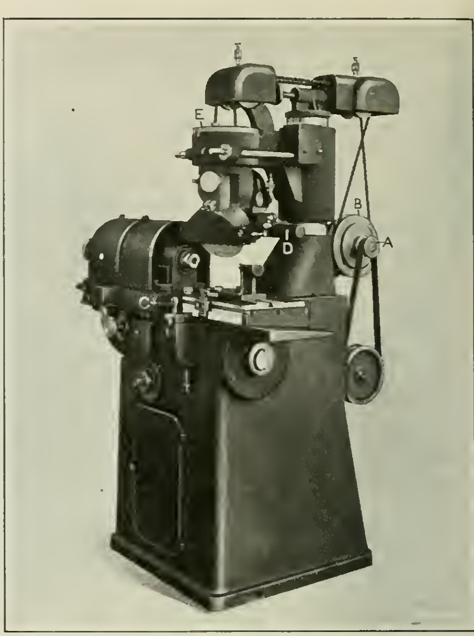


Fig. 2. Driving End of Barber-Colman Belt-driven Hob-sharpening Machine

ing hobs with either straight or spiral gashes, of various degrees of angularity, and either right- or left-hand. Provision is also made for feeding the hob to the grinding wheel after each complete revolution of the work, regardless of the number of gashes. The faces of the hob teeth are always ground or sharpened to conform with true radial lines from the hob center, irrespective of whether the gashes are of straight or spiral form.

The machine is driven from a countershaft *A*, Fig. 2, which carries tight and loose pulleys, but when motor drive is desired, the countershaft is dispensed with and pulley *B* is mounted directly on the motor shaft, the motor being set on a base substituted for the countershaft bracket. Power for driving the grinding wheel spindle is furnished by means of an endless belt running over grooved idler pulleys mounted on ball bearings, and is transmitted to the grinding wheel spindle by spiral bevel gears at the back of the wheel-head. The wheel-spindle is also equipped with Norma ball bearings which are mounted in a sleeve so that the entire construction is self-contained.

At the rear end, the wheel-spindle is extended through and loosely splined within the hub of the driven gear, affording the equivalent of a floating drive for the wheel-spindle which does away with any tendency toward vibration or loss of accurate alignment. Reciprocation of the work-table is accomplished through a drum cam driven from the rear of the machine. The friction clutch may be disengaged at any time by lever *C*, to stop the work in any desired position relative to the wheel. A diamond wheel-truing device *D* provides for keeping the grinding wheel accurately dressed.

In grinding hobs with spiral gashes, it is necessary to impart a reciprocating rotary movement to the work as the hob moves back and forth under the grinding wheel; no such movement is, of course, necessary in the case of straight-gashed hobs. The grinding wheel must also be set to suitable angles for grinding hobs with various forms of gashes. The wheel-head has a graduated dial *E* by means of which the wheel may be set to any desired angle with the line of travel of the work-table.

The reciprocating rotary movement of the work is accomplished by means of a slide *F*, Fig. 3, the top of which

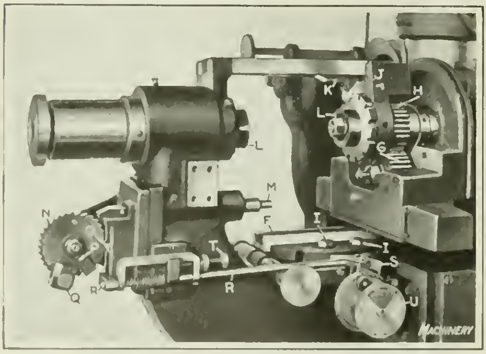


Fig. 3. Mechanism for Imparting Reciprocatory Rotary Movement to Spiral-gashed Hobs, for indexing and for feeding

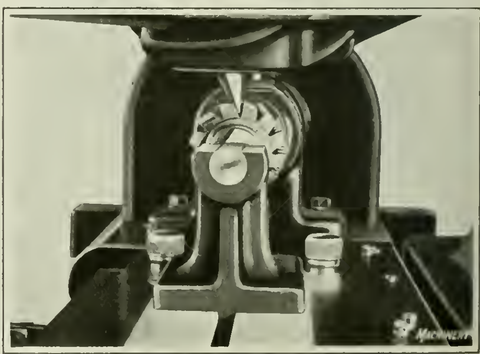


Fig. 4. Close-up View of Tailstock showing Setting of Grinding Wheel for sharpening Spiral-gashed Hobs

is grooved to receive a sliding block secured to the under side of a transverse rack. This rack meshes with idler pinion *G* which, in turn, transmits movement to pinion *H* secured to the work-spindle. Slide *F* may be set to various angles, either right- or left-hand, or located parallel to the line of travel of the table, according to the form of the gashes in the hob. The support on which slide *F* is mounted is furnished with a graduated dial, similar to dial *E*, so that angular settings may be accurately made without loss of time. After the setting has been accomplished, the slide is locked by means of two nuts *I*.

The mechanism employed for indexing the hob to suit the number of gashes is also clearly shown in Fig. 3. While a forward and return stroke of the work under the grinding wheel is in progress, the work is held in a definite position relative to the wheel by means of a dog *J* that enters a notch in the index-plate. As the slide approaches the end of its return stroke, cam *K* draws this dog out of the notch in the index-plate, and at the same time the two ratchet members *L* come into engagement. The left one of these members has a coarse-pitch screw running in a nut in the supporting bracket. Continuation of the table movement pushes the left-hand ratchet member *L* toward the left, the screw causing it to rotate and thus turn the index-plate. Immediately after the rotation commences, the catch carried by cam *K* releases dog *J*, so that it slides over the face of the index-plate and is free to snap into the next notch, thus locating the work for grinding the next consecutive gash.

While movement of the table toward the left indexes the work, it also provides for feeding the work toward the grinding wheel. This is accomplished by the engagement of the left-hand end of the table with plunger *M* that actuates a pawl and ratchet *N*. At each forward and return stroke of the table, this ratchet is turned and locked in place by means of a catch *O*. When the work has made one complete revolution, dog *P* disengages catch *O* to allow ratchet *N* to return to its starting position, and at the same time dog *Q* strikes the end of the feed mechanism plunger *R* and, through the action of a ratchet and pawl *S*, turns a feed-screw that imparts a transverse movement to the cross-slide on which slide *F* is mounted. This movement of the slide, through the medium of the rack and gears *G* and *H*, rotates the hob in such a way that it moves toward the grinding wheel and provides for taking a deeper cut. This indexing takes place after each complete rotation of the work. A graduated slide can be set by thumb-screw *T* for taking a cut from 0.0005 to 0.002 inch deep, according to requirements. Hand feeding may be accomplished by turning wheel *U*.

When furnished with an individual motor drive a two-horsepower motor running at 1800 revolutions per minute is furnished. The machine will handle spiral hobs with gashes of any angle from 30 degrees left-hand to 30 degrees right-hand. The grinding wheel is 7 inches in diameter. Seven index-plates are furnished for hobs having from ten to sixteen gashes. The machine weighs about 2250 pounds.

GLEASON 4-INCH SPIRAL BEVEL GEAR GENERATOR

The increasing demand for spiral bevel gears in preference to the straight-tooth type for certain purposes has led to the development of interesting and ingenious designs of machines at the Gleason Works, Rochester, N. Y. A 4-inch spiral bevel gear generator especially adapted for cutting small gears for sewing machines, motion picture machines, etc., is illustrated in Figs. 1 and 2. This machine finishes the tooth space from solid stock in one operation instead of cutting one side of a tooth at a time, as is frequently done when using machines designed for larger work. One of the distinguishing features of this 4-inch generator is that all the generating motion is applied to the gear, instead of rolling the gear and cutting tools together, as is done on the larger spiral bevel gear generators, and also on the machines used for generating straight-toothed bevel gears.

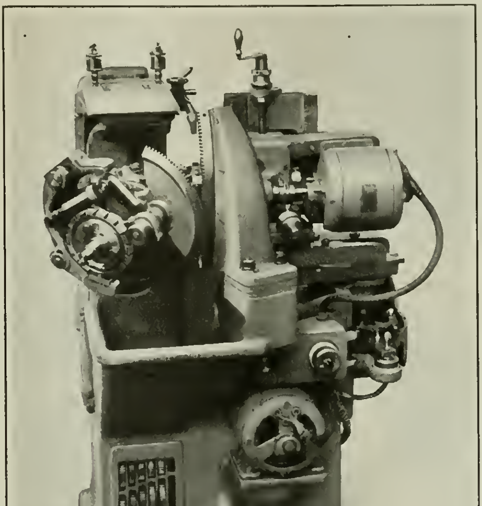


Fig. 1. Gleason 4-inch Spiral Bevel Gear Generator

The work-spindle is carried by a segment-shaped base and has the indexing mechanism at its outer end. The work-spindle is adjusted, according to the angle of the gear or pinion to be cut, upon this segment-shaped base which is attached to a drum or cradle that is given a rolling motion. This rolling cradle is oscillated by a crank mechanism through a connecting link. The crank mechanism consists of an ordinary slotted crank, for varying the amount of rolling motion, and is driven by worm-gearing and a Whitworth motion which accelerates the movement of the cradle after a tooth space is finished and the motion has been reversed.

The rolling movement of the cradle causes the work-spindle axis to swing about axis *A*, Fig. 2, which is the axis of both the cradle and the crown gear segment *B*. Segment *B* is fixed and is engaged by a master gear segment *C* having an arm or extension connecting with the work-spindle sleeve. The latter is locked to the work-spindle, except when the indexing pawl is released; consequently, as the work-spindle swings bodily about the axis *A*, gear segment *C* rolls upon the stationary crown gear segment *B*. The result is that the movement of the work-spindle axis corresponds to the path described by the axis of an imaginary gear rolling upon a crown gear; moreover, the rotation of the work-spindle about its own axis, as derived from segment gears *B* and *C*, corresponds to the rotation of the imaginary gear about its axis. The motion of the gear blank relative to the cutter is the same as on machines which are designed to apply the generating motions to both gear blank and cutting tools. The latter machines, however, are so arranged that the work-spindle and gear blank rotate about a *fixed* axis, while tools representing the sides of crown gear teeth are also given a rolling motion corresponding to the rotation of a crown gear about its axis.

The action of the machine when cutting a gear is as follows: The cutter, which is given an in-and-out movement, begins to cut as the work-spindle approaches the bottom of the rolling movement. As the gear rolls upward, one tooth space is finished on both sides, and when near the upper end of the rolling movement the cutter begins to withdraw. Then as the downward or backward motion begins, the work indexes, the cutter gradually advancing into the work during the remainder of the downward movement. The indexing movement is derived entirely from the generating motion through an ingenious mechanism located at the outer end of the work-spindle.

This machine is driven by two ½-horsepower motors. One motor drives the cutter-spindle through a flexible coupling and a pinion meshing with a large gear located just back of the cutter-head. The other motor supplies power for the feeding movement of the cutter-spindle head, and also for the generating action. The feeding movement of the cutter-head is obtained from a cam designed to give a relatively slow movement while the cutter is at work and a rapid return. The in-and-out movement can be varied according to the depth of the tooth by means of an adjustable cam-lever, which is similar in principle to the design used on other types of Gleason machines.

The cutter-spindle slide with its driving motor may be adjusted vertically, and a horizontal adjustment is also provided for the cutter-head. These adjustments permit setting the cutter in the correct position relative to the gear blank, according to both the spiral angle and the "hand" of the spiral. A reversible motor is used for the cutter-spindle, so that the rotation can be changed for using either a right- or a left-hand cutter. Graduated dials on the horizontal and vertical adjusting screws for the cutter-slide enable the latter to be set accurately to any given position by referring to a chart worked out for different gears.

The cutters are made either right- or left-hand and range in diameters from 1.10 to 3.5 inches. The small cutters are made solid and have four blades, two cutting on the inside and two on the outside. The larger cutters have eight adjustable blades, four cutting inside and four outside. The same cutter may be used for both gears and pinions, but the vertical position relative to the center of the work must be changed. Thus if the center of the cutter is below the center of the gear, it must be set above the center when cutting the mating pinion, since the latter must have left-hand teeth if the gear has right-hand teeth, or vice versa. The time required for cutting gears on this machine varies widely for different classes of work, the range being from five to twenty-six seconds per tooth.

The capacity of this machine is shown by the following specifications covering the 3½-inch cutter. Longest cone distance, 30-degree spiral angle, 2⅛ inches; longest face, ½ inch; greatest pitch angle, shafts at 90 degrees, 75 degrees 58 minutes; smallest pitch angle, shafts at 90 degrees, 14 degrees 2 minutes; extreme ratio, shafts at 90 degrees, 4 to 1; largest pitch diameter, 4 to 1 ratio gear, 4 inches; largest pitch diameter, 4 to 1 ratio pinion, 1 inch; largest pitch diameter, 4 to 1 ratio, 3 inches; largest diametral pitch, 10.

The equipment regularly furnished includes a set of eight cutter speed-change gears; a set of twelve feed-change gears; a set of eleven segments; an index-plate; a cutter gage; an automatic stop; and a gear-driven cutting-oil pump. The machine weighs approximately 2000 pounds, and occupies a floor space of 33 by 44 inches. A description of the Gleason 8-inch generator for spiral bevel gears was published in April, 1921, MACHINERY, and an article on the first machine of this type built by the Gleason Works appeared in April, 1914, MACHINERY.

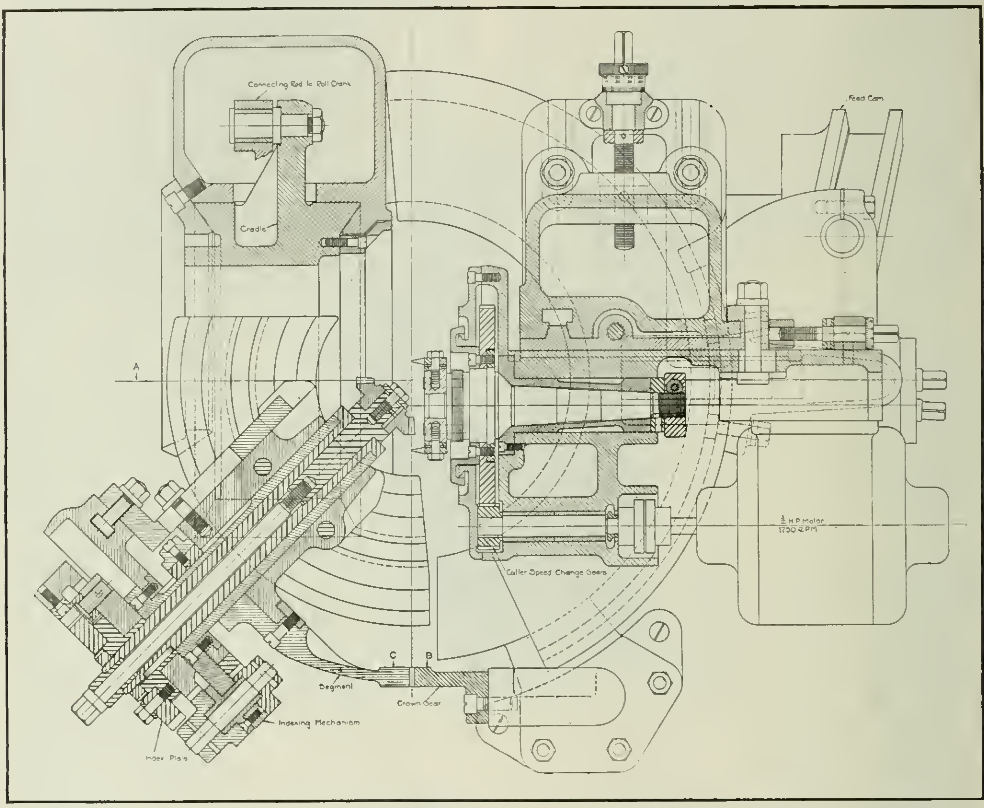


Fig. 2. Sectional Plan View of Generator for cutting Small Spiral Bevel Gears

UNIVERSAL "TRI-WAY" HORIZONTAL BORING MACHINE

A newly designed horizontal boring machine intended for handling heavy work in railroad and other shops, which is known as the "Original Tri-way" from the fact that the bed has three flat ways, has been placed on the market by the Universal Boring Machine Co., Hudson, Mass. The front one of the three ways and the center way serve as guiding surfaces for the sliding members on the bed, while the rear way helps to support the long carriage. The construction will be apparent by reference to Fig. 1. The bed is also designed for a coolant system, the top sloping toward the head end so that the coolant runs into a settling chamber at the end of the bed. From this settling chamber it overflows into another chamber from which it is pumped through piping to the work.

The design of the carriage and table is similar to that of the No. 3-A and 3½ machines built by this concern, except that the members are heavier and are designed to take care of coolant without piping. The head post has been provided with wide bearing surfaces for the head. The head has a reversing lever for the boring-bar, slow hand-feed for the boring-bar, and a lever for throwing in the higher boring-bar speeds. The handwheel on the head is used to obtain the fine hand-feeds, and the sprocket wheel for rapid hand-feeds. The vertical lever between the two is for reversing.

The starting and stopping lever of the machine is at the front of the bed and operates a friction clutch that controls the rotation of the main driving shaft. The gears for obtaining the various speeds and feeds are arranged in geometrical progression, and are operated by levers at the right-hand end of the bed. Attention is called to the convenient location of all control levers at this end of the machine. The left-hand upright lever is employed for throwing in either the table cross-feed, the longitudinal carriage feed, or the vertical head feed. The central upright lever is used to throw in all feeds and to effect rapid traverses, while the right-hand upright lever is used to reverse the feeding of the various members.

Wear of the rear post elevating screw may be compensated for by means of the nuts at the upper end of the screw. From the end view of the machine shown in Fig. 2, the method of mounting the driving motor may be readily observed. A few of the principal dimensions of the machine are as follows: Automatic travel of main boring-bar, 30 inches; travel of main boring-bar by resetting, 60 inches; size of table, 30 by 63 inches; power cross-feed of table, 48 inches; power longitudinal feed of carriage, 40 inches; power vertical feed of head, 30 inches; maximum distance from table to center of boring-bar, 30 inches; and greatest distance from faceplate to outer support, 72 inches.

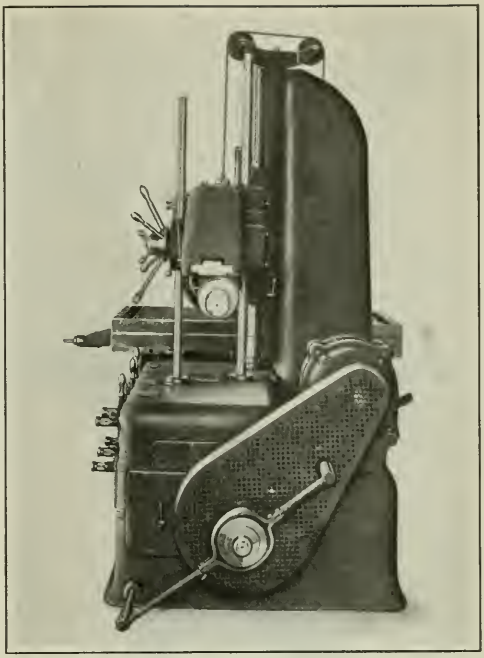


Fig. 2. End View of Boring Machine, illustrating the Motor Driving Arrangement

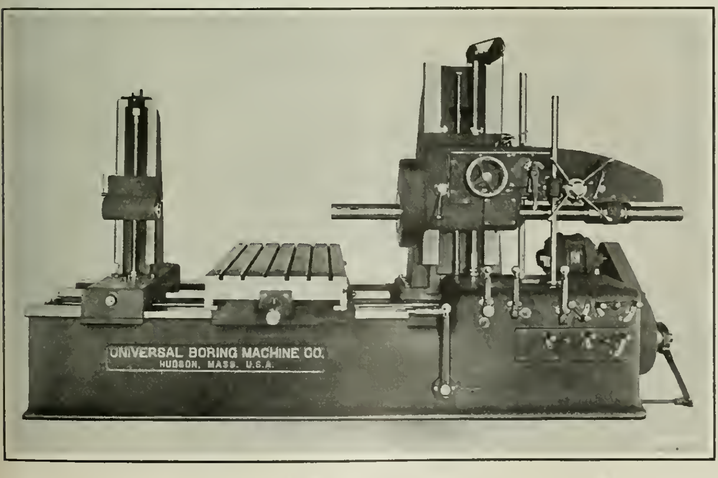


Fig. 1. "Tri-way" Horizontal Boring Machine developed by the Universal Boring Machine Co.

BRYANT WRIST-PIN HOLE GRINDING MACHINE

A double-head internal grinding machine primarily designed for finishing the wrist-pin holes of automotive engine pistons, but which can also be adapted for grinding holes in opposite ends of long pieces that cannot be handled conveniently on a single-wheel machine, has been placed on the market by the Bryant Chucking Grinder Co., Springfield, Vt. The main features of design of this machine are the same as on other machines built by this company. From the front view, shown in Fig. 1, it will be noted that the two grinding wheel heads are carried on the same slide. In the positions shown, the wheels are withdrawn from the hole preparatory to swinging the wheel-heads to the rear to permit gaging or changing of the work.

The work-holding fixture is mounted on the bed at about the middle, and from the sectional view of this fixture shown in Fig. 2, it will be seen that the piston is located in a vee and held securely in place by a clamp that operates against the inner surface of the piston directly over its contact points with the vee surfaces. The clamp is operated by a half turn of the wing-screw *A*. Body *B* of the fixture is provided with a stationary race C for the balls placed between this member and the rotating ring. The latter is held in place by the ball thrust bearing D which is secured to the chuck by ring E. The rotating members of the chuck are driven from the countershaft by belt F.

Fig. 3 shows the open side of the chuck after a piston has been removed. The clamp is in position for gripping the work at points G. In locating a piston, its skirt is slipped under the clamp, and the hand centering plug H, which fits a hole in the closed face of the fixture, is put in place and passed through the wrist-pin holes. This plug, of course, is of a size to fit the wrist-pin holes before they are ground. With the piston in place ready for grinding, the wheel-heads are swung down into the positions shown in Fig. 1, by turning handwheel I. Slide J is attached rigidly to the slide bar K, while slide L can be moved longitudinally on the bar. The movable slide is prevented from rotating on the slide bar by means of a bar located at the rear of the machine, which allows longitudinal movement between the two wheel-heads but keeps the wheels in correct alignment.

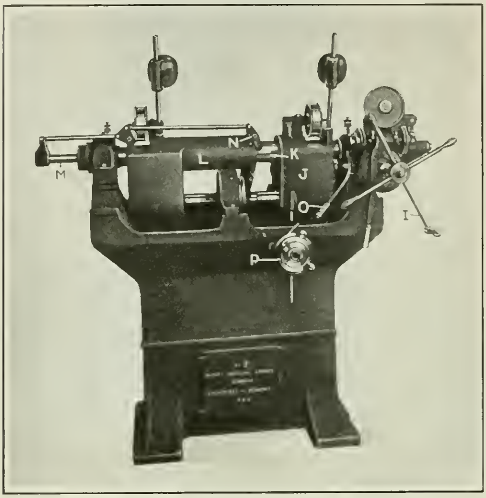


Fig. 1. Double-head Internal Grinding Machine developed by the Bryant Chucking Grinder Co.

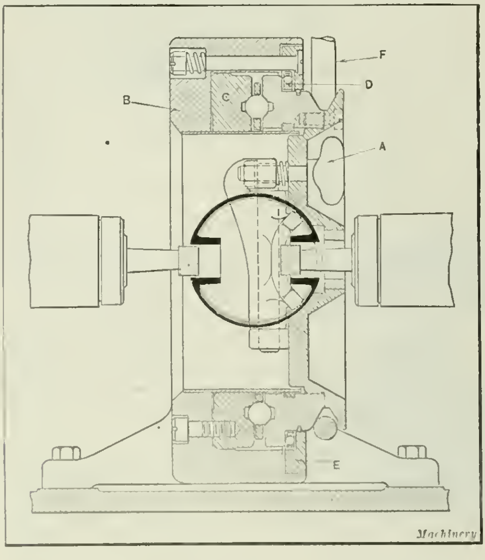


Fig. 2. Sectional View of Fixture for holding Automotive Pistons in Position for Operation

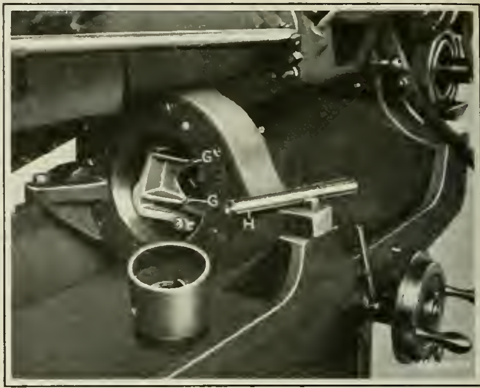


Fig. 3. Close-up View of Work-holding Fixture

The relative movement of the slides is obtained by means of racks which operate through bar M. As the wheels are advanced toward each other, crank-arm N strikes a stop and causes the movable slide to be clamped to the bar in the proper position. As previously stated, these actions of the machine are all obtained by one movement of handwheel I. Dropping lever O disengages one rack, and the two wheel-heads may then be operated as a single unit. The wheel traverse when grinding is provided for by a "load and fire mechanism" having reversing stops that are adjustable to give the desired length of stroke. This reversing mechanism is driven by a belt from the countershaft.

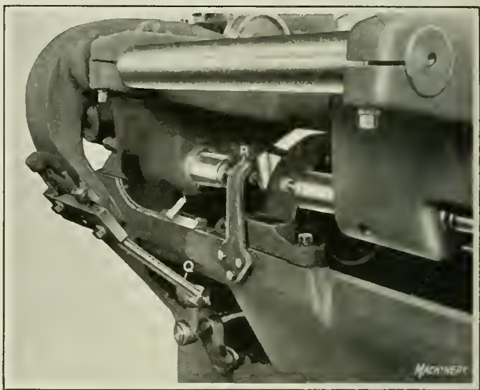


Fig. 4. Method of dressing the Grinding Wheels

The cross-feed is obtained by means of handwheel P at the front of the machine, which operates against a control plate clamped to an arm on the wheel-slide at the back of the machine, as shown in Fig. 4. The cross-feed extension Q is swung into position between the end of the feed-screw and the control plate, and adjusted so as to bring the wheels in contact with diamond R. The wheels must necessarily be separated in order to clear the fixture when they are being swung into the truing position. However, they are brought together again before dressing, to the same relative positions they occupy when grinding work. This insures that the two wheels will be dressed with the grinding points in line. The machine has a capacity for pistons up to 4½ inches in diameter and 4½ inches in length. The work-spindle operates at a speed of 250 revolutions per minute. The entire equipment weighs about 2300 pounds.

GORDON CRANKSHAFT-CHEEK TURNING LATHE

All the cheeks of automobile engine crankshafts are turned simultaneously on the machine shown in the accompanying illustrations which was developed by the Gordon Form Lathe Co. and is being built by the Willard Machine Tool Co., A St., Box 784, Cincinnati, Ohio. The particular machine illustrated is equipped with eight rocker arms, each of which controls a tool held in a block that swivels in the rocker arm, the number of rocker arms corresponding to the number of cheeks on the crankshaft. The rocker arms are located back of the work and swing from an over-arm shaft to and from the crankshaft to suit the contour of the cranks. The rocker arms are spaced to coincide with the spacing of the various crankshaft cheeks, by means of collars on the over-arm and guide plates fixed to the main frame of the machine. The guide plates are inserted in the rocker arms below the tool-blocks.

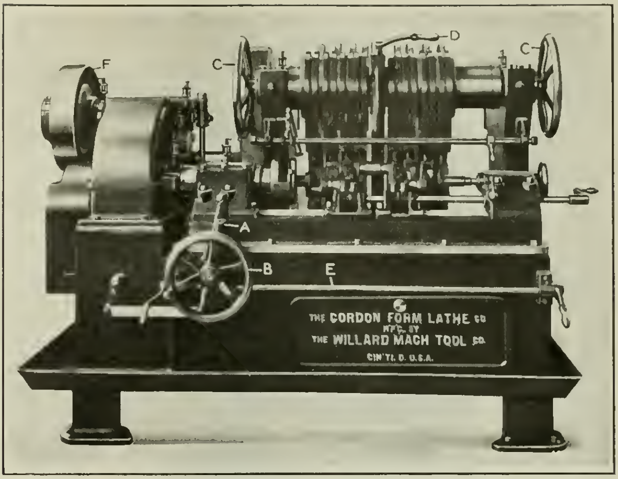


Fig. 1. Crankshaft-cheek Turning Lathe developed by the Gordon Form Lathe Co. and built by the Willard Machine Tool Co.

Feeding of the work is accomplished by movement of the platen, which is fed by a screw. A gear quadrant connected to the feed-screw at the front end of the machine provides a large range of fine and coarse feeds. An automatic trip serves to throw out the feeding movement through lever *A* at the conclusion of the cuts across the crankshaft cheeks. At the completion of an operation, the platen is returned to its starting position by turning handwheel *B*. The headstock, tailstock, and steadyrests are bolted to the platen to make one unit and travel as a unit with the work.

The machine has been arranged for taking both roughing and finishing cuts, this being controlled by two eccentric bushings which are located in the outer bearings of the over-arm and may be adjusted to a fixed stop by the large handwheels *C*. After the over-arm has been adjusted to either the roughing or finishing position, it is locked in place by lever *D*. The locking of the over-arm is at its central support which is a housing bolted to the main frame of the machine. The starting and stopping of the machine is accomplished quickly by means of shaft *E*, which has an operating lever at each end. Ample chip clearance has been provided between the bottoms of the rocker arms and the platen. The chips fall directly into a chip pan within the machine, and can be removed through the large door on the front of the bed. Cutting lubricant is supplied to the tools through a pipe extending past the rocker arms and having a tube leading to each tool. The lubricant pump is driven by belt as will be seen by reference to Fig. 2.

The main drive of the machine is through the friction-clutch pulley *F* which is geared directly to the main intermediate shaft *G*. It will, of course, be evident that there is a varying distance between the center line about which the crankshaft revolves and the point of contact of each tool with the crankshaft. The angularity of the surface presented to the cutting tool also constantly changes. To compensate for such conditions, it is necessary to have the positions of the cutting tools gradually change to enable them to conform to the contour of the work and at the same time to maintain theoretically correct cutting positions relative to the angular surfaces of the work. This is accomplished by swinging the rocker arm and rotating the tool, these movements being controlled by cams, mounted on the upper and lower shafts which are directly connected to shaft *G* through gearing. Fig. 3 shows a complete rocker-arm unit consisting of rocker arm *H*, tool-block *I*, tool *J*, upper master cam *K*, lower master cam *L*, and two levers connecting the roller of the upper cam with a gear segment having teeth that mesh with teeth cut on the circular flange of tool-holder *I*. These members are in the relative positions they occupy when assembled. The illustration also shows the position of the tool relative to the surface being machined.

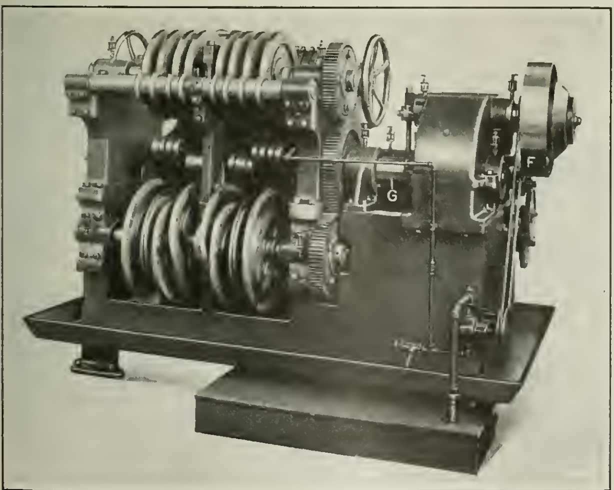


Fig. 2. Rear View of Crankshaft-cheek Turning Lathe showing Location of Master Cams

The large hole near the top of the rocker arm is provided for the over-arm. The cutting point of tool *J* is at the center of the tool-block and, this being the case, as the tool-block swivels to give the tool the proper cutting angle, the tool point itself remains in one position relative to the tool-block. Swiveling of the tool-block is accomplished by means of the upper cam and its roller, the motion of the latter being transmitted to the gear segment through the levers previously referred to. The form of the crank is obtained by swinging the rocker arm, the movement of which is controlled by the roller traveling in the track of cam *L*.

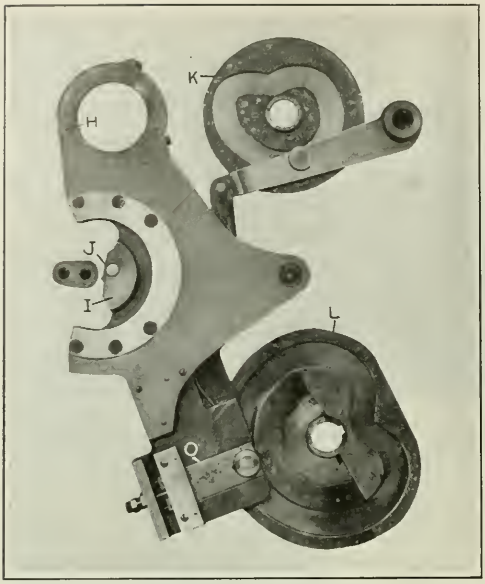
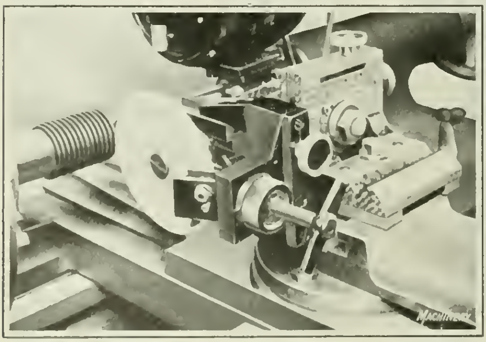


Fig. 3. Parts of the Rocker-arm Unit

Adjustments of the tool to suit different diameters are obtained through slide *O* at the bottom of the rocker arm, to which the roller of cam *L* is attached. The adjustments are made through a screw which may be locked in position. A gage provides for accurate resetting of the tool after it has been removed for regrinding. An adjustment at the tool point is effected through a worm in the tool-block which engages teeth cut on the tool.

PRECISION WHEEL-TRUING HEAD

The Precision & Thread Grinder Mfg. Co., 1 S. 21st St., Philadelphia, Pa., is now manufacturing the grinding wheel truing head here illustrated. In the illustration, the device is shown applied to the precision thread grinder made by this concern, but it may also be used as an auxiliary truing head on any grinding machine. The device is said to keep the wheel always in correct alignment with the thread being ground. It is feasible to dress the V-form on the wheel to a sharp point so as to facilitate the grinding of fine threads. There is no limit to the length of thread which may be accurately ground, because the wheel may be trued while grinding.



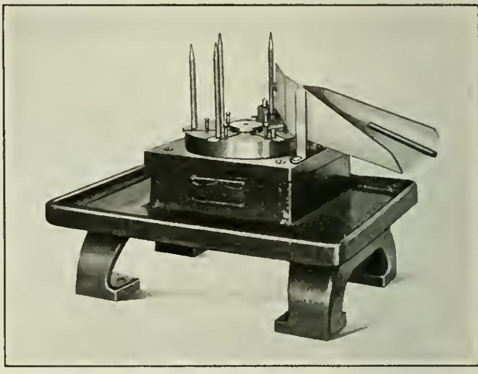
Two-diamond Grinding Wheel Truing Head made by the Precision & Thread Grinder Mfg. Co.

The mechanism for feeding the head has a dial graduated to 0.001 inch to enable the attachment to be fed forward sufficiently to make up for the reduction in wheel diameter by wear and dressing. The grinding wheel is trued by means of two diamonds, the form to which it is dressed being always in line with the axis of the work-centers. The diamonds are traversed by operating the double-ended handle on the extended screw, and they do not cut the wheel simultaneously but in progressive order; thus if one diamond becomes dull and the wheel springs away from it, the other and sharper one will not gouge the wheel.

When the diamonds become slightly worn, they can be rotated a fraction of a turn in order to present a new point to the wheel. The new point will always be sharp, and so the diamond can be worn down to its setting. A stop provided for regulating the return traverse of the diamonds can be utilized for predetermining the amount of flat produced at the bottom of the thread, thus insuring the same amount of flat, regardless of redressings and without subsequent regaging.

NOBLE & WESTBROOK TUBE-MARKING MACHINE

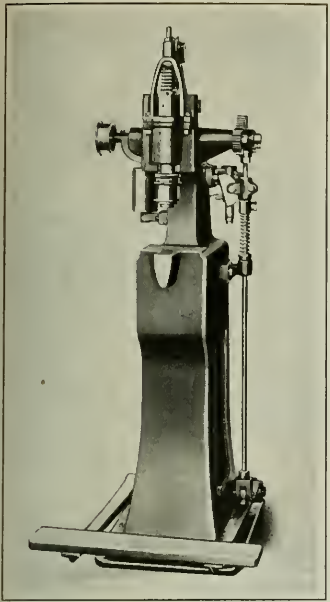
A marking machine produced by the Noble & Westbrook Mfg. Co., 19 Asylum St., Hartford, Conn., for marking names and patent marks on small tubes is here illustrated. The particular machine shown is employed for marking metal pencil tubes. The machine is driven by a three-step cone pulley from which power is transmitted to worm-gearing for revolving the table. The latter has six equally spaced mandrels upon which the work is placed by hand, and as the table revolves, the work is passed over a die which produces the desired marks on it. Then a cam raises a small lever that automatically removes the work from the mandrels and the machine. The possible production of this machine is over 10,000 marked tubes per day. The machine can be furnished for marking the ends of any size tubing in short lengths, and weighs about 90 pounds.



Small Tube-marking Machine which is a Product of the Noble & Westbrook Mfg. Co.

BLOMQUIST-ECK PNEUMATIC RIVETING MACHINE

The accompanying illustration shows a riveting machine built by the Blomquist-Eck Machine Co., 1146 E. 152nd St., Cleveland, Ohio. It consists primarily of a standard pneumatic hammer so mounted on the upright of the machine that it can be controlled entirely by a foot-treadle, leaving both of the operator's hands free to handle the work or the work-holding fixture in which the work is held. When the foot-treadle is moved downward, the hammer is brought



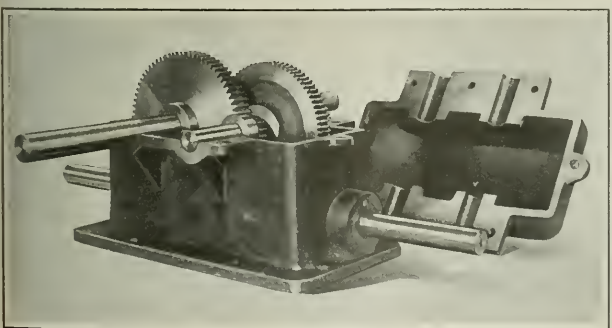
Riveting Machine which is a Recent Product of the Blomquist-Eck Machine Co.

down with it. This movement automatically turns on the air, the hammer then continuing to operate until the pressure on the foot-treadle is released. When that is done, the hammer is immediately returned to its upward position by a weight so attached that it counteracts the pressure of the foot-treadle.

As the hammer returns to the upward position, the air is automatically turned off. The air supply can be regulated by tilting the cam at the right-hand side of the machine, which controls the air throttle. The hammer slides within the carriage and is backed up by a spring at the top which absorbs the shock. While operating, the hammer is rotated by means of a belt passing over a pulley at its lower end. The machine illustrated has a pedestal designed with a special anvil or horn, but the anvils may be made to suit any condition and may be provided with vertical adjustment.

NATISCH GEARED SPEED TRANSFORMER

The speed of a driven shaft can be greatly reduced in relation to that of the driving shaft by the interpolation of a combined spur- and worm-gear transformer, which is made in various ratios between 1 to 75 and 1 to 1000, and for transmitting up to 5 horsepower, by the Natisch Gear Works, 451 Hudson Ave., Brooklyn, N. Y. The transformer illustrated is arranged to transmit ½ horsepower at a ratio of 1 to 600. The case is an iron casting of strong construction, and when the cover is assembled, is oil-tight and dust-proof. The design of all sizes of the transformer is similar, and for some ratios the same case is used, the change in ratio being accomplished by varying the number of teeth in the gears and the pitch of the worm and worm-wheel.



Combined Spur- and Worm-gear Speed Transformer built by the Natisch Gear Works

GENERAL ELECTRIC DIRECT-CONNECTED PLANER DRIVE

The General Electric Co., Schenectady, N. Y., has developed a new form of control which employs dynamic braking to prevent over-travel of direct-connected motor-driven planers either on reversal, through failure of voltage, or from other causes. The apparatus consists of a control panel on which are mounted the necessary rheostats and contactors, a resistance, a master switch or push-button, and a standard direct-current reversing adjustable-speed motor. The control is of two styles, one with a resistance selecting contactor and the other without. The remainder of the equipment, consisting of forward, reverse, and accelerating contactors, is the same in both cases.

The selective resistance contactor is connected to control the dynamic brake resistance in each direction of rotation, so that the resistor can be adjusted for one direction without affecting the adjustment in the other. A machine supplied with this control and geared for a table feed of from 25 to 50 feet per minute on the cutting stroke and from 50 to 100 feet per minute on the return stroke, with motor speeds of from 250 to 500 revolutions per minute on the cutting stroke and from 500 to 1000 revolutions per minute on the return stroke, can have the dynamic brake adjusted to give a maximum stopping effort at 500 revolutions per minute on the cutting stroke without regard to the return.

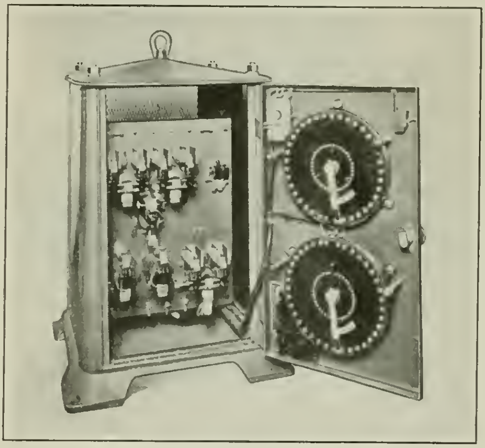


Fig. 1. Controller employed in Planer Drive developed by the General Electric Co.

Otherwise, if the resistance is adjusted for the maximum speed of 1000 revolutions per minute, the braking effort at 500 revolutions per minute will not be sufficient to stop the planer quickly on the return stroke.

One of the chief difficulties met with in planer drives is over-travel on reversal due to the contactor tips welding together under severe service conditions. In this new control the difficulty has been avoided by an arrangement whereby the welding of the contacts causes the planer to stop and will not allow it to over-run its set limits. Over-travel due to voltage failure and on reversal is taken care of by having the motor always connected to the dynamic brake. The utilization of dynamic braking, with a further refinement of the selective resistance contactor, makes it possible to jog the planer effectively by means of either the master switch or a push-button station. The switch or button, in jogging, can be operated in one direction, and when brought to the off posi-

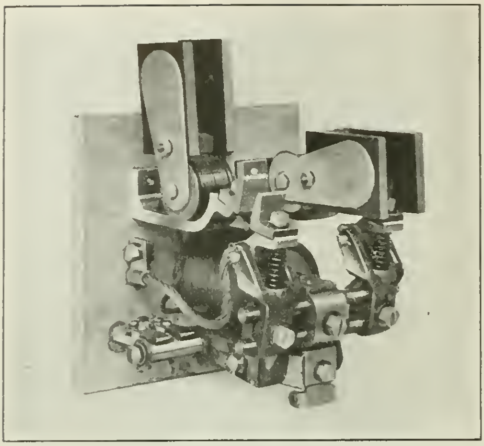


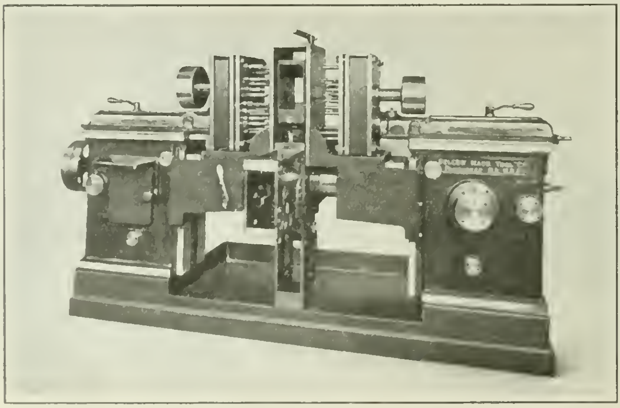
Fig. 2. View of Contactors showing Method of attaching Shunts

tion, the machine will stop. A machine equipped with the selective resistance contactor can be used on jobs having a small tool clearance, where the load varies from no load to full load and where cuts are made to the end of the planer travel.

SELLEW AUTOMATIC DRILLING MACHINE

An automatic drilling machine of the station type, having two horizontal heads, each of which contains a multiple number of drilling spindles, is a recent development of the Sellew Machine Tool Co., Pawtucket, R. I. In the accompanying illustration the machine is set up for drilling sixty holes in machine castings, 24 by 18 by 6 inches in size; however, it is also adapted for many classes of light drilling. Both heads are fed toward the jig and away from it simultaneously, the operation of the machine being continuous and automatic. The operator merely changes the work at the front station of the work-holding fixture and indexes this fixture through the stationary jig. An indexing takes place each time the drill heads are withdrawn from the jig.

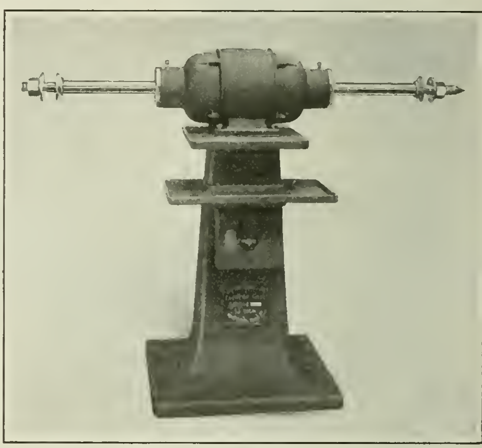
The drill spindles are mounted in radial and thrust ball bearings, and the individual spindles are run at speeds proportionate to the diameters of the drills attached to them. The feed of the drills, instead of being at a continuous rate, is eased as the drill enters the work and as it breaks through when the drilling is at an end, similar to a hand feed. The heads have a quick return. The head slides are arranged at their front ends to take different heads, and these can be changed quickly. The saddles provided on the table for carrying the jig are adjustable to accommodate a wide range of work. The machine is about 10 feet in over-all length, and weighs approximately 5000 pounds.



Automatic Multiple-spindle Drilling Machine built by the Sellew Machine Tool Co.

BLOUNT MOTOR-DRIVEN BUFFING MACHINES

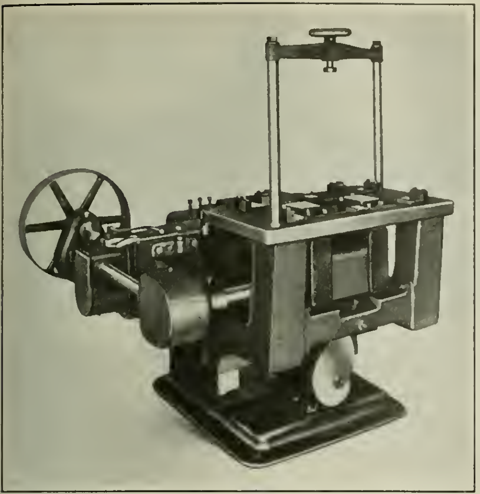
A line of alternating-current motor-driven buffing machines of the type shown in the accompanying illustration has been recently developed by the J. G. Blonnt Co., Everett, Mass. These machines are built in four sizes as follows: ½ horsepower, for 6- by ½-inch wheels; 1 horsepower, for 8- by 1-inch wheels; 2 horsepower, for 10- by 1½-inch wheels; and 3 horsepower for 12- by 2-inch wheels. Each machine is equipped with S K F ball bearings mounted in dustproof housings, and a snap switch having thermal cut-outs to afford protection for the motor. The spindle is made of high-carbon steel, and a taper point is fitted to the right-hand end so that the machine can accommodate small wheels. The head or motor unit is regularly mounted on a column with a pan, but it may also be supplied with a bench base when such a construction is preferable. The safety snap switch is placed on the column beneath the tool tray which serves to protect it from the buffing compounds used and from breakage or abuse. Westinghouse motors are supplied on this line of equipment.



Direct-connected Motor-driven Buffing Machine built by the J. G. Blount Co.

NEWTON STRADDLE-MILLING MACHINE

A recent development of the Newton Machine Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa., is the cycle-feed Model C-75 straddle-milling machine here illustrated. The particular machine shown was built for facing the crankshaft bearings of automobile cylinders. It may be driven by a belt connecting either to a motor or a countershaft, the drive being transmitted through gears enclosed to permit their running in oil. The machine has two spindles which are mounted in housings having individual end adjustment to permit regrinding of the milling cutters. The table motion includes a rapid advance downward, a slow feed while



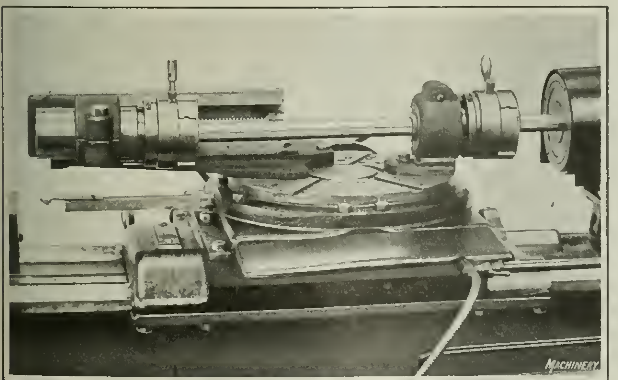
Model C-75 Straddle-milling Machine which has been recently designed by the Newton Machine Tool Works, Inc.

the cut is taking place, and an upward quick return. It automatically stops at the loading position which may be on a level with the conveyor rolls. Provision is made so that the rate of feed or the time required for the cycle of one operation may be increased or decreased to suit the material being machined. The table is provided with hardened steel jig plates. The work is clamped from above by a double-post beam clamp that is hinged at one end and supplied with a central clamping screw operated by a handwheel.

CINCINNATI-ACME TURRET LATHE STAYBOLT ATTACHMENT

Of particular interest to the railroad field is the staybolt attachment here illustrated which is manufactured by the Acme Machine Tool Co., Cincinnati, Ohio, for use on the Cincinnati-Acme flat turret lathes manufactured by this concern. The equipment has two die-heads which cut a thread simultaneously on opposite ends of the staybolt. The dies should be set from a master or staybolt tap to insure that the two threaded portions will have one continuous lead. The rear die-head can be adjusted to accommodate various lengths of staybolts.

When using bar stock, a roller back-rest multiple-turner is employed to turn the bolt to the proper diameter for the threads, a recessing slide being used in turning the relief. Both die-heads are used to cut the thread, the staybolt being finally severed from the bar by a cutting-off tool. When threads are to be cut on forged staybolts, the bolts are forged to the correct thread and recess diameters and length, when a continuous lead is desired, and both die-heads are used simultaneously, as when threading bar stock. The attachment is made in three sizes for staybolts from 1¼ to 1½ inches in diameter. The maximum length of staybolt which can be turned and threaded at one chucking varies with the sizes from 25 to 36 inches. When the staybolts can be threaded without a thread-lead relation, it varies from 48 to 71 inches.



Staybolt Attachment for Flat Turret Lathes built by the Acme Machine Tool Co.

PRATT & WHITNEY DIE-SINKING MACHINE

A new die-sinking machine incorporating unique features in its design that particularly adapt it for handling large dies, has been brought out by the Pratt & Whitney Co., Hartford, Conn. Through the medium of two "Bayrer's" compensating arms, dies up to 4 tons in weight can be suspended by elevating screws, and readily placed in position on the table. These arms also make it easy for the operator to swivel, tilt, or turn large work on edge. The hand feeds are thereby rendered sensitive to light cuts, and the die may be fed over to extreme limits for cutting gates, without cramping. In Fig. 1, the compensating arms are folded back against the sides of the column. The arms are carried on roller bearings supplemented by ball bearings, and are therefore sensitive to any movement of the die.

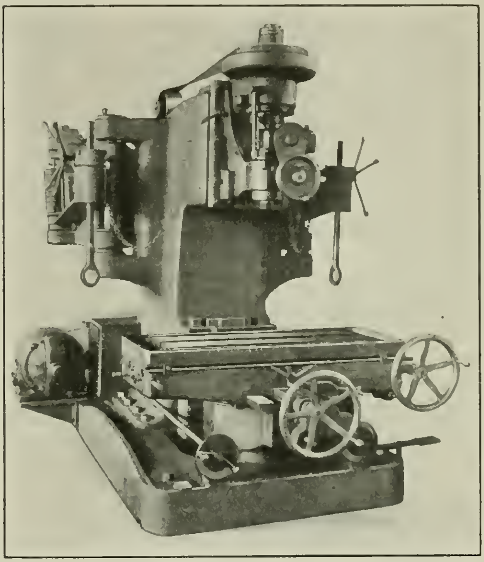


Fig. 1. New Large-size Die-sinking Machine brought out by the Pratt & Whitney Co.

Fig. 2 is another front view of the machine, showing the arms extended to support a die that has been swiveled on the table and moved into position for taking a cut near the end of the die. Both carrying arms are provided with balance beams and adjustable weights by means of which the weight of the die can be approximately balanced and relieved from the table. The holding members attached to the ends of the die act as trunnions on which it may be readily tipped on its side for edge cuts. When the die is being tipped on its side, the table is dropped clear of it, and consequently the arms sustain the entire load. Dies of various thicknesses may be adjusted to a convenient level for the operator

The cutter-spindle is mounted in a counterweighted vertical head having a hand feed with a graduated dial. A rapid traverse enables the head to be adjusted quickly. Power is transmitted to the cutter-spindle through a quarter-turn belt connected to the gear-box at the rear of the machine. All changes of speeds and feeds are effected by levers placed at the front of the machine for the convenience of the operator. Both hand and power feeds are supplied for the longitudinal and cross feeds of the table and, in addition, a rapid power movement is provided for all table traverses, including elevating and lowering. The mechanism that actuates the power movements operates from a friction clutch that prevents injury to parts in case the members are fed too far.

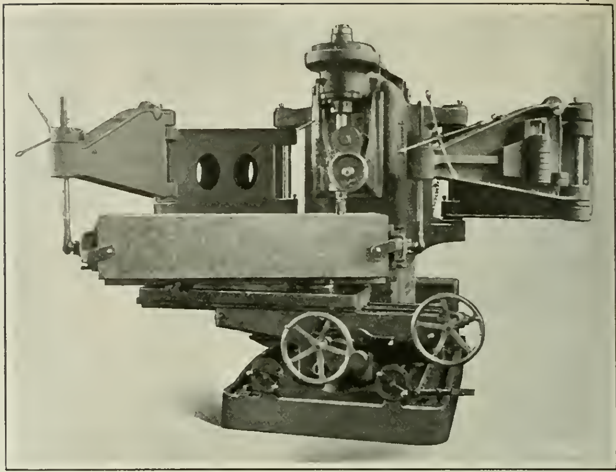


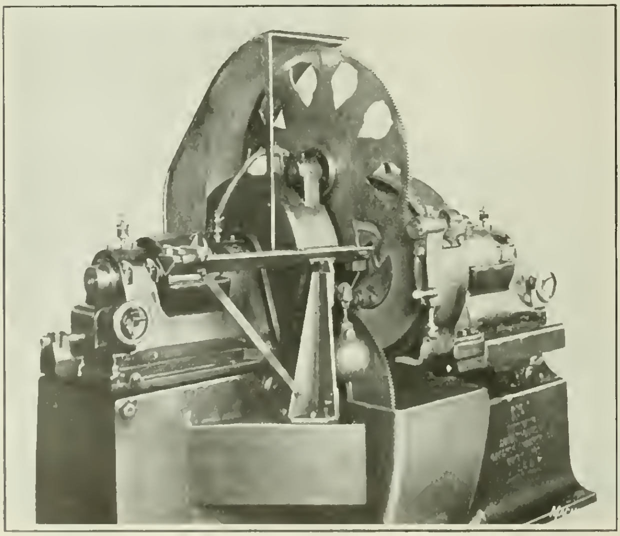
Fig. 2. The Pratt & Whitney Die-sinking Machine with the Arms extended

A cherrying attachment may be readily applied to the cutter-head and driven through gearing connected to the nose of the spindle. When not in use, the cherrying attachment may be swung out of the way so as not to interfere with the use of the machine on other work. This die-sinking machine may be equipped for either a constant-speed drive direct from a lineshaft or from a motor mounted on the machine. It is also built without the die-carrying arms when these are not required. The main dimensions are: Size of table top, 22 by 48 inches; longitudinal feed of table, 48 inches; cross-feed of table, 17 inches; vertical feed of table, 15 inches; and vertical feed of cutter-head, 12 inches. The weight of the machine is approximately 16,000 pounds.

GARDNER AUTOMATIC DOUBLE-SPINDLE GRINDING MACHINE

A machine designed for the rapid and simultaneous grinding of two opposite parallel sides of a piece, which differs from ordinary double-spindle disk grinding machines in a number of respects, is here illustrated. This machine is of the continuous-feed type, and has been developed and placed on the market by the Gardner Machine Co., 414 Gardner St., Beloit, Wis. The two spindles are offset in relation to each other, and for wet grinding the driving members consist of 24-inch diameter abrasive ring-wheels which are carried in chucks designed particularly for this type of machine. For dry grinding 24-inch steel disk wheels faced with abrasive disks, are used.

The parts to be ground are carried to the cutting position by a carrier that passes between the grinding wheels. For the purpose of accommodating a wide range of work, from pieces having a large surface requiring the removal of considerable stock to pieces with small areas over which only a slight cut is to be taken, the carrier is provided with a feed varying from six to forty pieces per minute. This carrier has a number of openings to receive the work. As the work approaches the grinding position one of the grinding wheels automatically advances until it reaches a positive stop. It approaches the work under an adjustable stroke pressure, and, consequently, advances only as rapidly as stock is removed. Thus constant pressure is maintained against the work. The wheel is returned to the open position by a cam, and the work is automatically unloaded as it passes from between the wheels. The cam referred to also governs the spring pressure feed. Provision is made for aligning the two spindles and an adjustment of the grinding members is obtained by a handwheel operating through worm-gearing and a screw, this handwheel being graduated to 0.0001 inch to permit close adjustments.



Gardner No. 1 Automatic Double-spindle Grinding Machine

When grinding work of a size that permits operation of the machine at the higher rates of feed, the automatic feeding device is of material assistance in keeping the work-carrier loaded at all times, as it practically eliminates all hand labor. However, in cases where larger work necessitates the operation of the machine at the lower feeds, it is usually more economical to feed the carrier by hand. Devices for truing the grinding members are an integral part of the machine. Although these are so located that they are ready for use at all times, they do not interfere with the operation. Among the parts for which this machine is particularly adapted, are piston rings, ball and roller bearing races, adding machine parts,

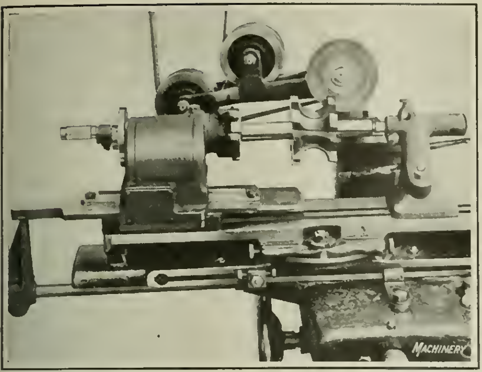


Fig. 1. "Curvex" Cutter and Hob Grinding Attachment made by the R. K. LeBlond Machine Tool Co.

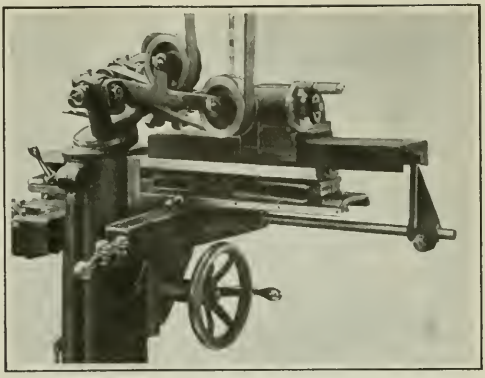


Fig. 2. Rear View of Cutter and Hob Grinding Attachment, showing Angular Raising Block

thrust washers, gear blanks and similar pieces. The openings in the work-carrier may be made to conform to the shape of practically any such piece. The holes in the particular carrier shown were made for ball bearing races, but by means of metal inserts they have also been used for conveying other pieces.

BLACK & DECKER PORTABLE DRILL

A half-inch portable electric drill having the familiar pistol grip and trigger switch used on other portable drills manufactured by this concern, which have previously been illustrated and described in MACHINERY, is being placed on the market by the Black & Decker Mfg. Co., Towson Heights, Baltimore, Md. The grip is placed beneath the housing, and the current connection is at the lower end of the grip. A three-jaw chuck for holding straight-shank drills up to ½ inch is provided with the equipment. The switch cover plate may be quickly removed to expose the terminal block to which the electric cable and motor leads are attached by means of screw terminals. The net weight of this tool is approximately 15 pounds.

LEBLOND CUTTER AND HOB GRINDER ATTACHMENT

An attachment lately developed by the R. K. LeBlond Machine Tool Co., Cincinnati, Ohio, for use on the universal tool-room grinding machine built by this firm, facilitates the grinding of "Curvex" milling cutters made by the Pratt & Whitney Company, and of spiral hobs. In grinding a "Curvex" cutter, the cutter is mounted on an arbor between the centers of the attachment, as shown in Fig. 1, the table is set to zero, and, from a chart of leads and angles, the taper guide bar of the attachment is set to the required angle. Although this guide bar is shown exposed in this illustration, it is ordinarily protected by a cover, as will be seen in Fig. 2. As the table of the grinding machine is fed horizontally, the cutter-spindle is automatically revolved in the proper relation to the lead and spiral angle. The cutter is indexed by the plunger and index-plate to bring each tooth to the grinding plane.

The wheel-head is mounted on an angular raising block, as shown in Fig. 2, to bring the wheel-spindle to an angle of 15 degrees from the horizontal. A special grinding wheel is used, the front face of which is dressed vertically to insure a single line of contact between the wheel and the work. This enables the work to be fed vertically to the wheel. The knee is swiveled to an angle corresponding to the helix angle of the cutter, and the table traversed past the wheel by the rack and pinion. The grinding plane is always on a true radial line from the center of the cutter, and the wheel always clears itself in the work.

The wheel is dressed on the face by clamping a diamond on the table and using the vertical feed. Fig. 2 also shows the belt sheaves provided for aligning the belt when using an angular raising block; this equipment is not required in grinding spiral hobs.

MURCHEY NIPPLE REAMING AND CHAMFERING MACHINE

The front view of a nipple reaming and chamfering machine, and a close-up view of the chuck and reaming and chamfering tools are shown in Figs. 1 and 2. This machine is a recent product of the Murchey Machine & Tool Co., 34 Porter St., Detroit, Mich. The piece of pipe being operated upon is held in the chuck jaws, which are opened by the manipulation of a foot-lever, and automatically closed when pressure is released from the lever. The jaws are hardened and ground. The chuck unit slides on wide bearings, and centers itself as the tools begin to cut. After a nipple has been machined, the operator pushes it from between the jaws as he inserts a

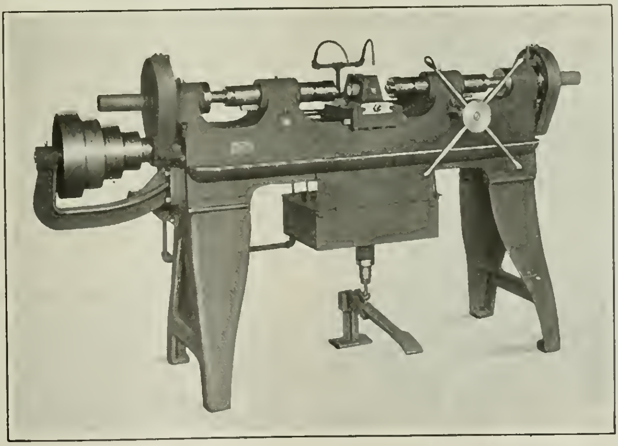


Fig. 1. Nipple Reaming and Chamfering Machine made by the Murchey Machine & Tool Co.

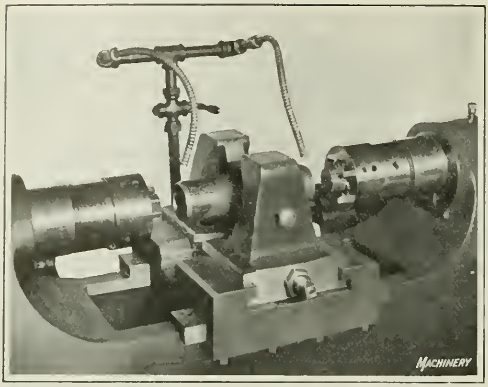


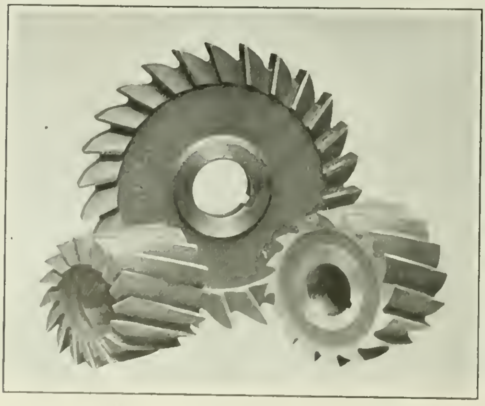
Fig. 2. Close-up View of Chuck and Reaming and Chamfering Tools

new piece, the finished nipple dropping into a receptacle. The countershaft of the machine is arranged with right- and left-hand pulleys, while four-step cone pulleys give a selection of four speeds. A pump provides for an adequate supply of lubricant to the work. The machine is suitable for pipe of all sizes from ½ inch to 2 inches, and will handle lengths up to 12 inches. It weighs about 1200 pounds.

While primarily designed for the reaming and chamfering of nipples, the machine can also be equipped with die-heads for threading nipples made from ⅛- to ¾-inch pipe. It may also be employed for threading tees, valves, studs, and other parts requiring a thread on both ends. The opening and closing of the die-heads is automatic.

"PARABOLIC" MILLING CUTTERS

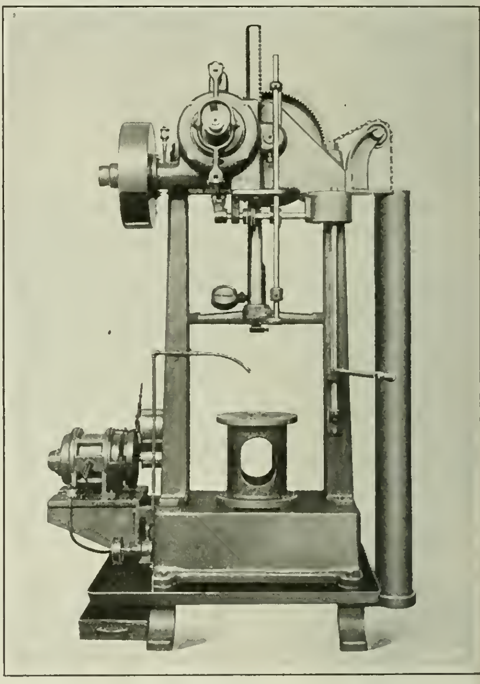
As the result of several years of research, the National Twist Drill & Tool Co., Detroit, Mich., has placed on the market a new type of milling cutter known as the "Parabolic," three examples of which are here illustrated. This name was selected to characterize the distinctive construction of the teeth. The tests indicated that in order for a milling cutter tooth to be of uniform strength throughout its length, its shape should be that of a parabola, slightly modified at the small end, and so this shape was adopted for these cutters. The number of teeth is nearer to that of the conventional fine-tooth cutter than to that of the coarse-tooth type. In order to obtain an efficient chip thickness per tooth without an excessive peripheral speed, a fairly large number of teeth was found desirable. This cutter is made in plain side and end-mill types, as well as for special purposes.



"Parabolic" Milling Cutters manufactured by the National Twist Drill & Tool Co.

LUCAS VERTICAL BROACHING PRESS

The machine shown in the accompanying illustration is a modification of the general-purpose power forcing press which has been manufactured by the Lucas Machine Tool Co., Cleveland, Ohio, for a period of more than twenty years. The utility of the machine for repetition work has been enhanced by an increase in the speed of the stroke and the addition of a quick-power return and lever control. The machine is especially adapted for vertical push-broaching operations. The working elements consist of a ram to which motion is transmitted by gearing controlled by a friction clutch which engages a worm-wheel driven by a worm on the pulley shaft. The operating lever for controlling the clutch is adjustable vertically on the rod in front of the right-hand column so that it is within convenient reach of the operator, whether he is standing or sitting. Movement of this lever to the left engages the clutch and causes the ram to start on the down or pressure stroke. The ram



Vertical Press of Modified Design placed on the Market by the Lucas Machine Tool Co.

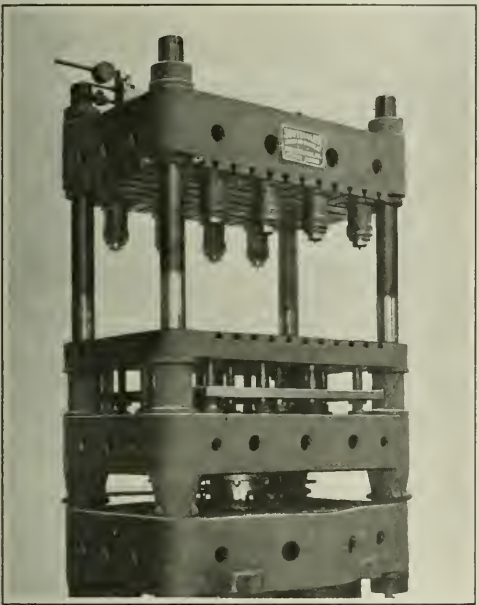
descends until the upper trip on the rod in front of the ram strikes a dog on the horizontal shaft. This shaft is connected by bevel gears with the vertical shaft to which the operating lever is attached, and thus stops the downward movement of the ram.

Movement of the operating lever to the right causes the ram to start on its return stroke at a quick rate of speed, which continues until the lower trip strikes the dog on the horizontal shaft. Both trips are adjustable vertically on the rod so as to stop the ram at predetermined points. The number of strokes the ram makes in any given time, therefore, depends upon the length of the stroke. A graduated gage registers the pressure in tons up to the rated capacity of the machine. The friction drive can be adjusted to any pressure up to the maximum capacity of the press. The machine is made in two sizes of 15 and 30 tons capacity. The net weight of the 15-ton machine is approximately 2900 pounds, and that of the 30-ton machine, 3800 pounds. The 15-ton press is driven by a 7½-horsepower constant-speed motor, and the 30-ton press by a 10-horsepower motor.

SOUTHWARK HYDRAULIC AUTOMOBILE-BODY PRESS

The Southwark Foundry & Machine Co., Philadelphia, Pa., has recently developed a press for the production of all-steel automobile bodies. The general construction of this machine will be apparent by reference to the illustration. The press has a capacity of 450 tons. The main ram is located in the lower base to which are secured four columns. The press is provided with clamping and stripper platens. The stripper platen carries four hydraulic cylinders acting upon a forged steel plate which, in turn, has sixty stripper pins, 1½ inches in diameter. These pins project through the clamping platen, which is a solid steel casting and is provided with T-slots.

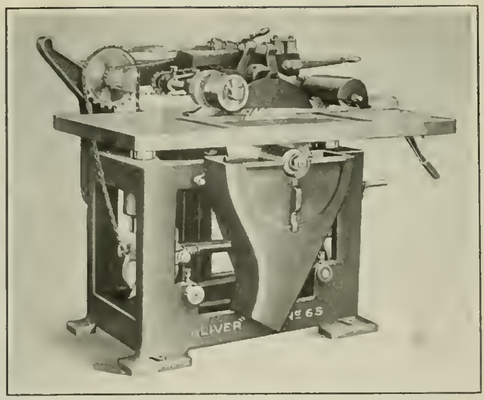
The top platen carries eight hydraulic jacks having 5-inch diameter rams and strokes of 5 inches, these jacks being employed to accomplish the clamping. This platen is adjustable to accommodate the various sizes of dies which it may be desired to employ with the press. The machine operation is controlled by a single lever; this lever operates a valve which subjects the four hydraulic cylinders and the main ram to a low pressure, and as soon as the dies have come together, high pressure is applied through the steam operating valve to complete the operation. The clamping cylinders are automatically controlled from a low-pressure filling tank, and are capable of standing a pressure of 5000 pounds per square inch. The press has a die space of 7 by 5 feet, a minimum vertical opening between the platens of 18 inches, and a maximum opening of 4 feet.



Hydraulic Automobile-body Press made by the Southwark Foundry & Machine Co.

OLIVER SELF-FEED RIP SAW

Safety provisions and a dust chute are the principal new features on the No. 65 self-feed rip saw brought out by the Oliver Machinery Co., Grand Rapids, Mich., which is an improved design of other machines sold by this company. The machine is intended for ripping all kinds of lumber and may be used for rough as well as for finished stock. The saw arbor is mounted on a frame having a vertically adjustable table with an in-feed roller which may be either corrugated or smooth, according to the requirements of the work. This roller carries the stock through the saw and across the table. A gang of six saws separated by 1-inch spacing collars may be used at one time. Three rates of feed are provided, 80, 110 and 140 feet per minute, respectively.



Self-feed Rip Saw now being placed on the Market by the Oliver Machinery Co.

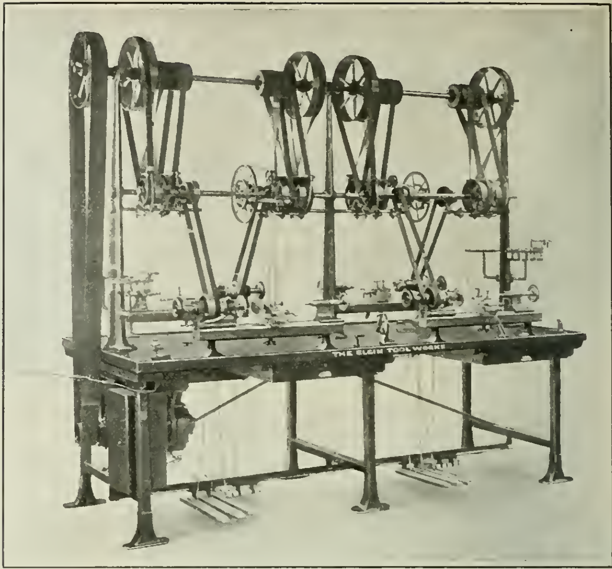
The features of the machine include a quick adjustment for the feed rollers, quick adjustment and locking of the ripping fence, and quick vertical table adjustment. The machine has a mechanism that absorbs shocks on the feed rollers and overcomes any jerks produced in starting the stock through the machine. The lower portion of the saw is adequately guarded by means of the dust chute and a cover, while the upper portion runs in another guard. The feed rollers are also covered by metal guards to eliminate accidents while feeding the machine. This saw may be arranged for either a motor or countershaft drive. It will accommodate saws up to 18 inches in diameter, will cut lumber up to 5 inches in thickness, and rip pieces up to 24 inches in width.

"PAKFULL" SECTIONAL FILING EQUIPMENT

Two five-drawer sections of a filing case made by the Economy Drawing Table & Mfg. Co., Adrian, Mich., for filing tracings and blueprints are shown in the accompanying il-

Sectional Filing Case made by the Economy Drawing Table & Mfg. Co.

lustration. Between each drawer is a frame, on the under side of which is a piece of heavy paper that is flush with the bottom of the frame so that the drawer enters a pocket. The sides of the drawer extend upward into the frame a sufficient distance to keep the contents from sliding over the top of the drawer on either side, while two dowels at the back, which protrude upward into the frame, keep the contents from sliding over the back and into the rear of the cabinet. When the drawer is closed the front comes up against a groove in the frame, so that it is dustproof. The cabinet can be furnished with drawers either 26 by 38 by 2 inches or 32 by 44 by 2 inches, inside measurements.



Four-machine Bench-lathe Unit built by the Elgin Tool Works, Inc.

ELGIN BENCH-LATHE UNIT

The accompanying illustration shows a unit consisting of four bench lathes, countershafts, jack-shaft, driving motor, and bench, which is being introduced to the trade by the Elgin Tool Works, Inc., Elgin, Ill. This unit may be supplied with either the regular No. 4 or No. 4 by 5 lathes manufactured by this concern and two- or three-speed countershafts. The motor can be furnished for operation on either alternating or direct current. The belt-shifters are operated through foot-treadles. The bench is made of kiln-dried hardwood and furnished with a tool drawer and collet rack for each lathe. Although the machine illustrated is equipped with four lathes, it can be provided with a larger or smaller number.

HARRINGTON MULTIPLE-SPINDLE DRILLING MACHINE

A No. 19 multiple-spindle drilling machine of the rail type, on which the spindle heads have not only a longitudinal movement on the cross-rail but also an in-and-out movement on arms mounted on the rail, has been added to the line of machines built by Edwin Harrington Son & Co., Inc., 17th and Callowhill Sts., Philadelphia, Pa. An advantage of this design is that it enables irregularly located holes to be drilled, permits close center distances, and has a relatively large in-and-out movement. The machine illustrated in Fig. 1 has three spindles, although four are usually provided. The machine is designed to transmit 25 horsepower which is considered ample for driving four 2-inch drills at ordinary speeds and feeds.

The in-and-out movement of each spindle head is independent of the others, and is effected through a ratchet-operated screw. Each spindle is provided with a counterweight, and a clutch on the driving gear allows any spindle to be stopped independently of the others. The heads are moved along the cross-rail by revolving a pinion that engages a rack on the rail, this pinion being rotated by turning the squared end of a shaft extending to the outer end of the arm. Another shaft located above this traversing shaft operates the arm-clamping device. Simultaneous feeding of the different spindles is controlled from the right-hand end of the machine, while separate feeding of any spindle is governed at the end of its corresponding arm. The feeding mechanism is driven by a belt from the top shaft, through change-gears and worm-gearing. By turning a handwheel, quick vertical movements of the spindles are obtainable. The several spindles are fed together through the medium of a clutch located at each arm. A handwheel provides for moving the spindles up and down independently or for setting them to the proper height when the universal feed is used. Automatic stops that disengage the spindles at any predetermined point are provided for use with the individual feed.

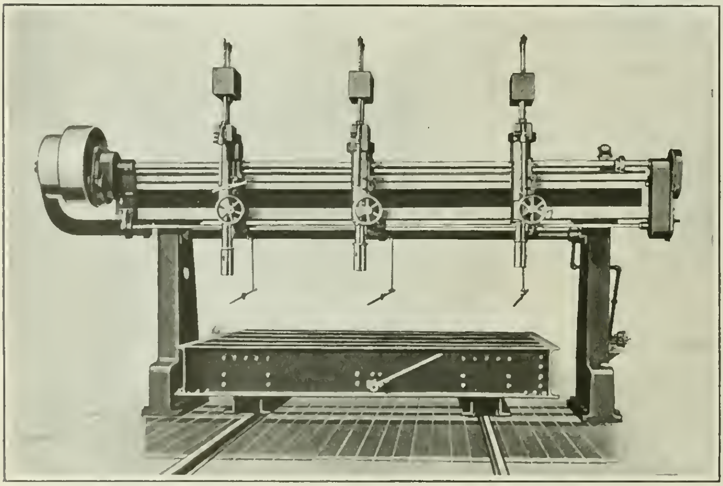


Fig. 1. No. 19 Multiple-spindle Rail Drilling Machine built by Edwin Harrington Son & Co., Inc.

When the machine is driven from a countershaft, two-step cone pulleys and back-gears provide four spindle speeds. When an adjustable-speed motor is employed for driving the machine, a single pulley is supplied, and when a constant-speed motor is used, the motor is placed on top of the machine and the countershaft mounted in a frame fastened to one upright. A speed-gear box can also be furnished in place of the countershaft. For large work a truck table made of structural steel, as illustrated, is generally considered best. This table is fitted with wheels to travel on tracks placed on the floor level, and can be readily moved by the use of a ratchet lever, although a power movement through an individual motor can also be provided. For other work a stationary table of structural steel may be preferable. Cast-iron tables with finished surfaces of various areas and arranged either to slide or roll are also applicable by providing the uprights with proper guides. A pump and distribution manifold furnish a continuous supply of cutting lubricant to the drills through universal-joint outlet pipes.

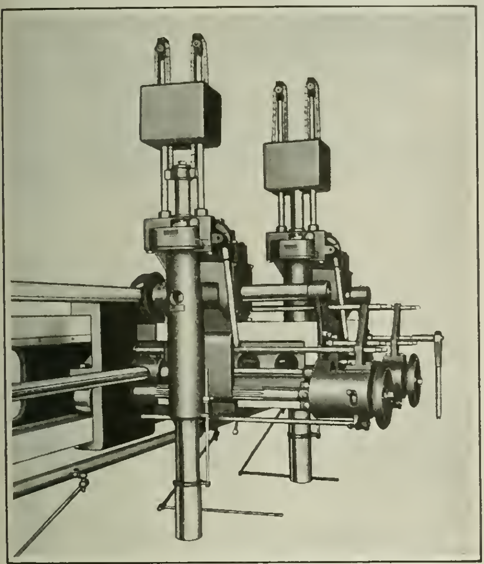


Fig. 2. Close-up View of Spindle Heads showing Construction of Mechanism governing In-and-out Movement

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ECLIPSE INTERCHANGEABLE SPOT-FACER AND COUNTERBORE

The accompanying illustrations show assembled and disassembled views of an interchangeable spot-facer and counterbore known as the "Junior," which is manufactured by the Eclipse Interchangeable Counterbore Co., 7410 St. Aubin Ave., Detroit, Mich. The complete tool consists of a nickel-steel holder, an externally and internally threaded nut, a high-speed steel spot-facer having milled flutes, and a machine-steel pilot. The cutter is aligned accurately with the holder by means of a ground boss that snugly fits a hole in the holder. The nut is screwed into the holder by means of its external threads, and serves two purposes. First, it enables instant removal of the pilot in case of breakage, and second, by quickly changing it for one with a smaller internal thread, the same holder may be used with different pilots and cutters. The end of the pilot head is provided with a slot to receive the end of a screwdriver, and flats to facilitate its removal by means of a plier or wrench. The spot-facing tool may also be used with standard Eclipse holders and pilots through the use of an adapter. The spot-facer is made in various sizes, from ½ to 3 inches in diameter, and the shank of the holder is made with a No. 2, 3, or 4 Morse taper. Spot-facers can also be supplied without the pilot.

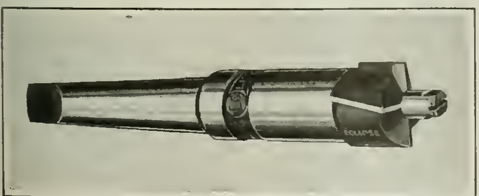


Fig. 1. Spot-facer and Counterbore made by the Eclipse Interchangeable Counterbore Co.

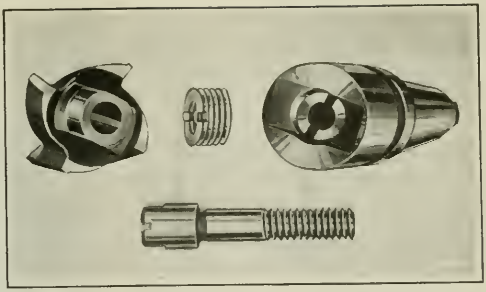
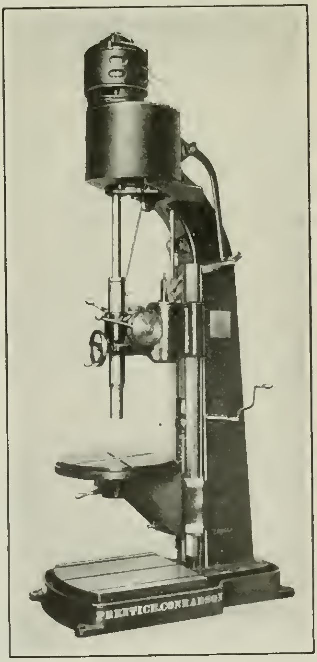


Fig. 2. Disassembled View of the Tool illustrated in Fig. 1

CONRADSON UPRIGHT DRILLING MACHINE

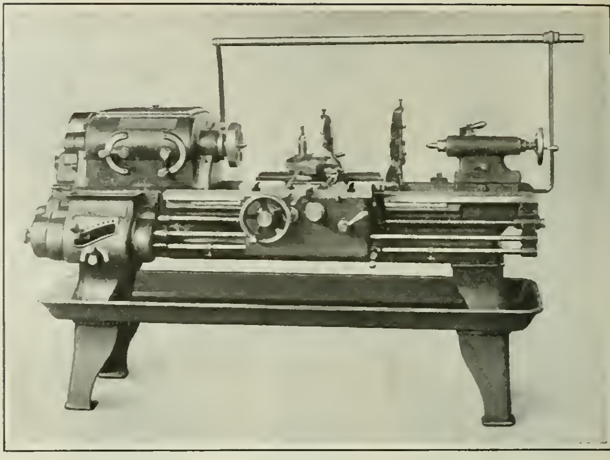
A 32-inch upright drilling machine driven from a motor mounted at the top of the column and connected to the spindle through gears is built by Prentice Conradson, Green Bay, Wis. The armature shaft of the motor consists of a hollow sleeve into which the upper end of the spindle extends, but the spindle is not fastened to this shaft. On the lower end of the armature shaft is mounted a gear from which the drive is transmitted to the spindle through the plain and sliding cluster gears contained in the column just beneath the motor. Nine speed changes are obtainable, while the feeding mechanism provides for six feeds ranging from 0.006 to 0.035 inch per spindle revolution.



Upright Drilling Machine built by Prentice Conradson

The table has the usual adjustments, and a rectangular or sliding table can be supplied instead of the circular table shown, if desired. A reversing motor is provided for tapping. Alternating- or direct-current motors can be supplied, a 3-horsepower motor being recommended for ordinary work, and a 5-horsepower motor running at 1800 revolutions per minute for rapid work. The controller furnished with the machine protects the motor against accidental over-loads. Some of the specifications are as follows: Maximum distance from base to spindle nose, 56 inches, and minimum distance, 15½ inches; vertical traverse of table, 16 inches; and maximum distance from table to spindle nose, 37 inches. The machine has a capacity for driving a 3-inch high-speed drill through steel, and weighs about 3700 pounds.

SUNDSTRAND TOOL-ROOM LATHE



New 14-inch Tool-room Lathe built by the Rockford Tool Co.

A 14-inch tool-room lathe driven either through a cone pulley or a geared headstock is a recent product of the Rockford Tool Co., 2400 Eleventh St., Rockford, Ill. The machine illustrated is equipped with the geared headstock. All gears in the headstock are submerged in oil, and sliding gears are used exclusively. The spindle speeds range in geometrical progression from 13 to 326 revolutions per minute, and all speed changes can be made while the machine is in motion. The headstock has a friction clutch designed to stop the spindle immediately when the clutch is disengaged. Oiling of the spindle bearings is accomplished from a reservoir.

The quick-change gear-box has a tumbler and a cone of eight gears, which can be set to run at different speeds by the lower lever on the feed-box. By this arrangement forty-eight different threads and feeds are obtainable. By shifting the position of an intermediate slip gear located beneath the spindle, the feed-box may be disengaged. A number of special threads can be obtained without the use of extra gears; however, the design of the feed-box is such that any special thread may be cut by furnishing the proper gears.

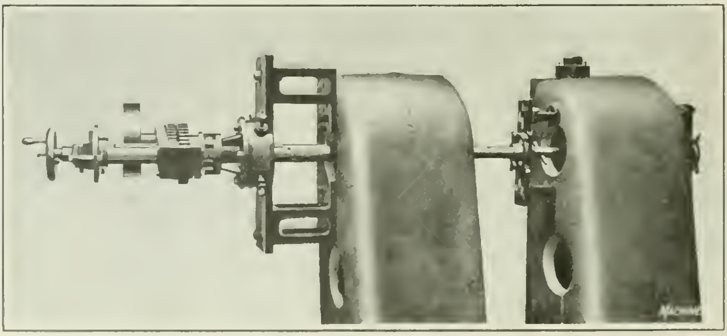
The apron is of box construction with all gears enclosed by a plate on the rear side. The rack pinion may be disengaged from the rack when desired. The apron is provided with a sensitive clutch for throwing in both the longitudinal and the cross feeds. A separate feed-rod and a reversing rod are provided. Reversing of the feeds is effected by a lever conveniently located on the right-hand end of the apron. With this construction it is convenient for the operator to set the feed instantly to neutral or reverse. Collars can be placed at certain positions on the reversing rod for stopping the carriage automatically at desired points. This possibility is especially convenient in cutting threads.

The lead-screw is connected directly to the cone of gears in the feed-box and has end thrusts taken up by ball bearings at the tailstock end of the lathe. Micrometer stops are regularly furnished for the cross-slide. The tailstock is clamped by a device at the back having a handle which is conveniently operated from the front. Boring and counter-boring operations are facilitated by the provision of a collar on the tailstock which is graduated to 0.001 inch. The relieving attachment is operated through a knuckle-joint connection. The taper attachment is located close to the cross-feed screw extension block which receives all strains on the attachment. This attachment is graduated both in taper per foot and degrees, and is provided with a micrometer adjustment. On a motor-driven lathe the motor is supported on a bracket attached to the back of the left-hand leg, thus eliminating the necessity of an idler pulley.

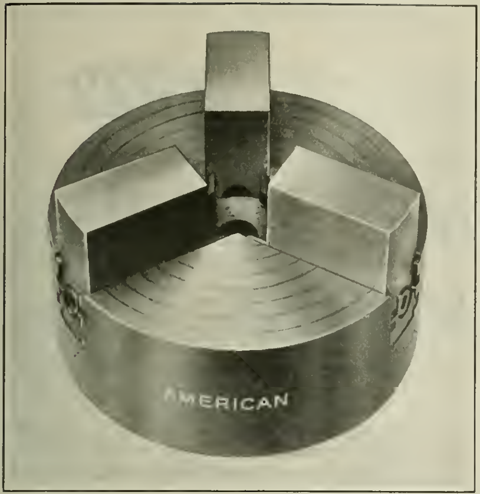
PEDRICK BORING UNIT

In December MACHINERY was published a description of a taper boring-bar placed on the market by the Pedrick Tool & Machine Co., 3639 N. Lawrence St., Philadelphia, Pa. Another boring unit somewhat similar in design and which may also be driven by belt, electric motor, air drill or by hand, is here shown applied to large housings for boring the bearings in line with each other. The unit consists of a boring-bar, feeding and driving mechanisms, and the cross-head. The bar is a steel forging having a square-thread feed-screw located in a groove that extends almost the full length of the bar. The bar is 3 inches in diameter by 3 feet long and affords a travel of 18 inches. In the illustration the device is shown provided with an extension for the particular job in hand.

The feed-case is attached to one end of the bar, and by blocking the handwheel, this mechanism will be automatic in operation. Two changes of feeds may be thrown in or out of operation by the movement of a slip-pin. When a larger range of feeds is required, a three-change feed-case may be furnished. It will be seen that the unit is attached to the work by means of the cross-head, which also serves as a guide for the boring-bar. This cross-head is provided with a convenient means of accurately setting the boring-bar for an operation. The latter may also be used in vertical positions.



Boring Large Housings with a Boring Unit made by the Pedrick Tool & Machine Co.



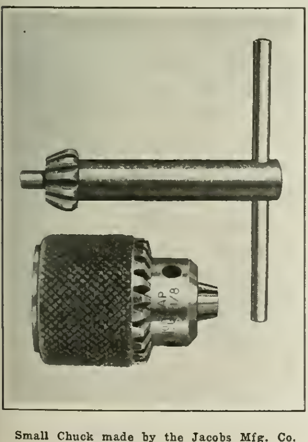
Three-jaw Air-operated Combination Chuck made by the S-P Mfg. Co.

AMERICAN IMPROVED AIR-OPERATED CHUCKS

The line of air-operated chucks formerly manufactured by the American Air Chuck Co. has been redesigned and is now being made by the S-P Mfg. Co., 872 E. 72nd St., Cleveland, Ohio. The capacity of the standard chucks in this improved line ranges from 6½ to 18 inches. The accompanying illustration shows a three-jaw combination chuck designed to hold the work by either internal or external surfaces and intended for general manufacturing purposes. Special jaws or master slides having false jaws can also be furnished for quantity production work. Sector levers operate the chuck slides for the universal movement, these levers being fastened to steel blocks fitted to the rim and center part of the chuck. A patented feature permits shutting off the air from the cylinder without releasing the grip on the work. The chuck can be quickly arranged for use as an ordinary lathe chuck in the event that the supply of air fails.

JACOBS DRILL CHUCK

A small chuck designed for use on watchmakers' lathes and jewelers' drilling machines, and in the multiple drilling, and tapping of work on which the holes have close center distances, has been brought out by the Jacobs Mfg. Co., Hartford, Conn. This chuck is of the same design as the "Super" drill chuck described in May MACHINERY, but is intended for holding drills as small as No. 80, which is 0.013 inch in diameter, and for operation at a speed of approximately 20,000 revolutions per minute. The body of the chuck is machined within a tolerance of 0.0005 inch, this degree of accuracy being essential to obtain a correct balance in operation on account of the high speed at which the chuck is employed. The chuck is ⅞ inch outside diameter, 1 5/16 inches maximum over-all length, and weighs about 2 ounces.



Small Chuck made by the Jacobs Mfg. Co.

NEW MACHINERY AND TOOLS NOTES

Nipple-holder: Armstrong Mfg. Co., 297 Knowlton St., Bridgeport, Conn. Two sizes of holders intended for use in making both right- and left-hand nipples. The No. 20 holder is suitable for nipples from ¼ to 1 inch in size, while the No. 30 holder is for nipples ranging in size from 1 to 2 inches.

Bending, Forming, and Shearing Machine: Bussel Machine Co., El Paso, Texas. A hand-operated machine which requires no extra dies to bend any size of stock within its capacity to any angle. The machine will bend right- or left-hand work without adjustment. The bending posts have four bending edges and make less than one-quarter turn in producing a 90-degree angle which is obtained without the use of a square.

Drilling and Tapping Machine: W. Gaterman Mfg. Co., Manitowoc, Wis. A drilling and tapping machine known as the "Electro-magnetic." The tap is held in a floating spindle driven through two coil springs in such a manner that shocks and jars on the tap are eliminated. On the top of the machine is a device which automatically reverses when the torque transmitted to the tap is too great. Electromagnets are employed in the reversing mechanism.

Portable Electric Rivet Heater: U. S. Electric Co., New London, Conn. A portable electric rivet heater built with two, four, or six electrodes for manual operation. The larger sizes can also be furnished with an automatic movement for carrying the rivets between the electrodes and discharging them when heated. In a machine of the latter design, two intermittently rotating members carry the rivets forward in pairs. Cams open and close the electrodes with the movement of the carriers.

Drilling Fixture: Hartman Mfg. Co., 308 Pearl St., Hartford, Conn. A device intended for use on drilling machines to take the place of the many parallel strips and pieces of blocking required when much drilling of irregular shaped pieces is done but where a quantity of any one kind does not warrant making a special jig. The fixture consists primarily of a base block and two adjustable angle-plates that may be placed in any position relative to each other and securely fastened.

Hot-pressed Nut Machine: Acme Machinery Co., Cleveland, Ohio. A machine for making hot-pressed nuts from a bar of special section. In the first operation the bar is indented on both sides to form the sides at angles equal to those of the sides of two abutting nuts. As the indenters withdraw, the blanks are sheared off and carried to the die box, where two punches advance from opposite sides and pass part way through each blank, compressing it in the center so that the surrounding metal flows and fills all parts of the die. The core is finally punched out.

Bolt-cutting and Nut-tapping Machine Operating Device: Key Boiler Equipment Co., 27th St. and McCasland Ave., East St Louis, Ill. An air-operated automatic device which controls the operation of bolt-cutting and nut-tapping machines. When applied to a bolt-cutting machine, the device clamps the work, feeds it into the dies, opens the dies after the thread has been cut, returns the carriage to its starting position, and sets the dies for the next cut. When applied to a nut-tapping machine, the spindles are held up by an air-operated piston when the taps are full, the rising and falling of the spindles is controlled, and the blanks are automatically fed.

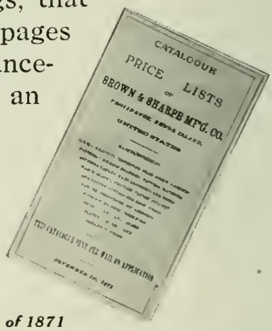
1833 1922

Eighty-Nine Years Of Progress

Since the foundation of the business in 1833

Brown & Sharpe Products

have met with increasing favor throughout the entire mechanical world. One of the earlier catalogs, that of 1871 for example, contained only sixteen pages but this small pamphlet carried its announcements of high grade Machines and Tools to an ever-widening mechanical field.



Sixteen page Catalog of 1871

General Catalog No. 137
The 1922 Buyer's Guide
for Mechanical Equipment

The demand for products of uniformly high quality has so increased that today, in 1922, the General Catalog describing Brown & Sharpe Products contains over six hundred pages and lists a quantity and variety of equipment unthought of in the earlier years. 1922 marks the eighty-ninth year since the origin of the business and the fiftieth year since the moving of our plant to its present location. Our customers have the benefit of a rare fund of accumulated knowledge and experience which is reflected in the design and manufacture of our products and is at the disposal of customers seeking practical solutions of their mechanical and manufacturing difficulties.

The Industrial Machinery Division of the Department of Commerce

THE reorganization of the Department of Commerce, which was taken in hand by Mr. Hoover when he became Secretary of the Department, has now proceeded to a point where the various bureaus and divisions are actually engaged in the work for which each one was created. The division to which the machine tool industry belongs is known as the Industrial Machinery Division. According to the 1919 census, there are more than 4000 factories in the United States producing industrial machinery, the value of these factories exceeding $2,200,000,000 a year. These 4000 factories have more than 400,000 employes in normal times, providing a support for probably 1,500,000 people. Seventeen per cent of the products of these factories, or nearly $400,000,000 a year is exported, and it is evident that an export business of such a volume is of great importance both to the owners and the employes of the factories employed in making industrial machinery.

The Industrial Machinery Division of the Bureau of Foreign and Domestic Commerce was developed in order to promote the export trade of the machine-building industries, and it is believed that the foreign trade in this field can be materially increased by the work that will be done by the Bureau under Mr. Hoover's leadership. W. H. Rastall, chief of the Industrial Machinery Division, believes that while present export figures equal approximately an export of $1000 a year per employe, this figure can be doubled by the application of American salesmanship and good business methods, aided by the Government through a properly organized and conducted Department of Commerce. The work of the Machinery Division will be directed toward this end.

Purpose and Aim of the Industrial Machinery Division

The Industrial Machinery Division covers, in addition to machine tools and metal-working machinery, mining machinery; paper and pulp mill machinery; pumps; printing presses; refrigerating machinery; shoe machinery; sugar mill and saw mill machinery; woodworking machinery; textile machinery; typesetting machinery; road-making machinery; air compressors; concrete mixers; engines and railway cars; excavating machinery; laundry machinery; flour mill machinery; gas and water meters; and elevators. Briefly described, it may be said to include every kind of machinery used in factories, power plants, mines, railways, and engineering construction work, but it does not take in agricultural and farm machinery, or electrical machinery or equipment. The Division of Industrial Machinery has been placed in the hands of qualified engineers, who have actually sold a great variety of machinery in different parts of the world, and who are therefore familiar with conditions existing abroad. They are experienced exporters of American machinery, and have faced world-wide competition in foreign markets.

The Division is anxious to have American manufacturers in the machinery field realize that it aims to be of the greatest possible service to them, and feels that the best way to accomplish this is by establishing close contact with the industries. There are 600 representatives of the Government in foreign countries who can be called upon to obtain specific trade information when required, and should circumstances justify, arrangements can be made to send special investigators into the foreign trade fields. No problem is too large or too small for this service. As an indication of what the Department of Commerce actually accomplishes, it may be mentioned that the Department as a whole answers more than 1000 inquiries daily, or approximately 350,000 a year.

Services Offered by the Industrial Machinery Division

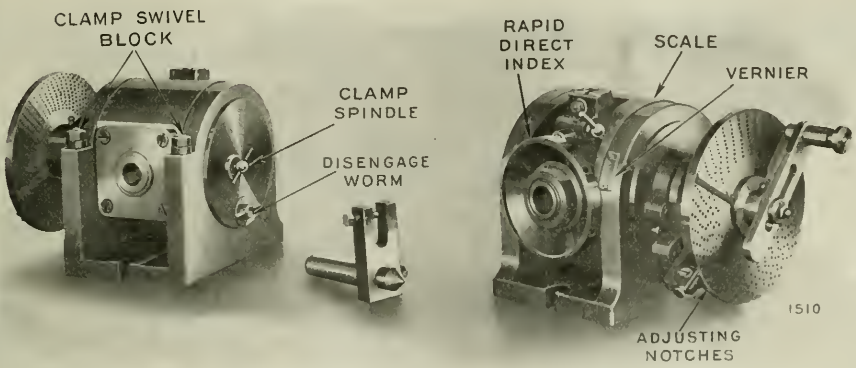
The men in charge of the Industrial Machinery Division are familiar with the different sales methods used in the various markets of the world in marketing machinery. Where it is wisest to sell through agents or dealers, the Division has reasonably complete lists of available dealers which will be furnished to manufacturers who are interested. When the manufacturer is able to visit Washington, he can also obtain much additional information relating to these dealers, which has been collected by the Bureau from time to time, to make it possible to select suitable agents for any specific product.

Through its overseas' representatives the Government is now receiving information relating to new engineering enterprises. Manufacturers who wish to obtain such information quickly should communicate with the Industrial Machinery Division so as to be placed on its list for this kind of information. The Division is also making studies of the various foreign markets and export problems, and these studies are published in Commerce Reports, the newspapers, and the trade press, according to circumstances. A report on the machinery markets of Asia is now being prepared, which is the result of a special investigation made by Mr. Rastall personally, who visited every important city between Yokohama and Bombay, thirty months having been spent in this investigation. The Division is also in a position to answer questions relating to foreign tariffs, patents, trademarks, agency agreements, and legal matters, through the cooperation of the Commercial Law Division and the Foreign Tariffs Division. The Bureau of Foreign and Domestic Commerce has frequently been able to assist in adjusting disputes, and, if necessary, the cooperation of the Department of State may be obtained through the Bureau.

Present Work of the Division of Industrial Machinery

One of the present activities of the Industrial Machinery Division is to collect the laws and regulations of all foreign countries covering the inspection, construction, and operation of steam boilers and air- and gas-containers. These will be available to American manufacturers and exporters of machinery. A general survey of the railway mileage and rolling stock all over the world is in preparation. A collection of the electrical regulations covering the whole world will be made.

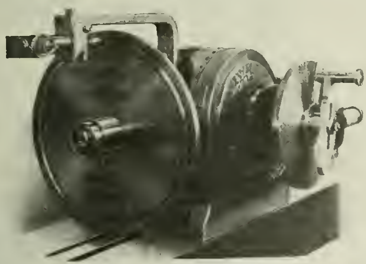
Briefly, it is the object of the Department of Commerce, through the Industrial Machinery Division, to collect any information that American manufacturers deem necessary for extending their foreign trade. The cooperation of the industries is requested as regards suggestions for the extension of the work of the Department. In making plans for the future work of the Industrial Machinery Division, advice from manufacturers is needed. The Division wishes to aid manufacturers in securing actual sales in the widely distributed markets of the world, and welcomes advice and suggestions from manufacturers in preparing its plans. Furthermore, the Department of Commerce invites manufacturers to use the information stored up in the Department to the fullest extent, and to present any problem relating to foreign commerce to the Department.



Cincinnati Tool-room Millers

When you talk about the Tool-room Miller, you think first of the Dividing Head. This is a feature that you depend most upon. You want it to be accurate and reliable. We believe we can show you that CINCINNATI UNIVERSALS, both MILLERS and DIVIDING HEADS, come closest to meeting your requirements.

There is not space to give details here. Ask for them.

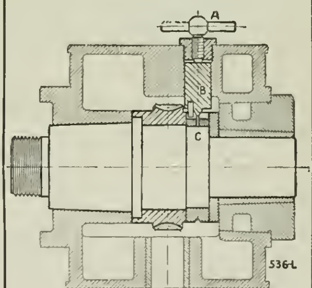


The Indexing Test

The 12 in. disk contains an accurately graduated silver ring. By means of a microscope with a micrometer adjustment, we can read the errors in the wormwheel and also those in the worm to one-fortieth of a thousandth (.000025) of an inch; not only the errors in pitch, but also the inaccuracies of the tooth face.

The maximum indexing error allowed is .001 in. in 12 in.

Let Us Send You the Catalog



HORIZONTAL SECTION OF CINCINNATI DIVIDING HEAD

The spindle clamp consists of a split ring, C, which is spread by the wedge B by tightening the screw A, thus clamping the spindle endwise, securely, without crowding it out of alignment.

The Cincinnati Milling Machine Co.

CINCINNATI, OHIO, U. S. A.

BRITISH MACHINE TOOL EXPORTS AND IMPORTS

In a review prepared by W. H. Rastall, chief of the Industrial Machinery Division of the Bureau of Foreign and Domestic Commerce, at Washington, some very interesting figures and charts are presented that will prove of value to all engaged in the export of machine tools. A chart is shown in Fig. 1, illustrating comparative British and American exports of metal-working machinery, as well as German exports

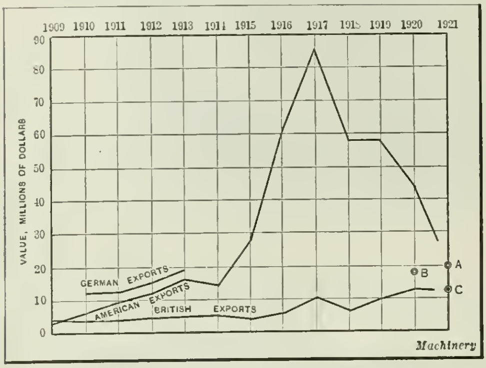


Fig. 1. Exports of Metal-working Machinery since 1909 by the United States, Germany, and Great Britain

for the years 1910, 1911, and 1912. It will be noted that, while in the four years preceding the war American exports increased rapidly, the exports of Great Britain made but little progress. During the war period American exports increased in an unprecedented manner, but show a rapid falling off in 1920 and 1921, while the British exports at the end of 1920 reached a higher level than they had ever attained before. The line representing German exports in pre-war years is somewhat deceptive, because the classification employed by the German customs authorities includes a great deal of metal-working machinery and tools not included in the British and American returns. The estimated exports of America for 1921 are denoted by circle *A*; those

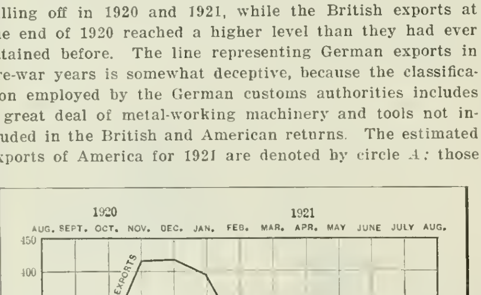


Fig. 2. British Exports and Imports of Machine Tools from August, 1920 to August, 1921

of Germany for 1920, by circle *B*; and those of Great Britain for 1921, by circle *C*.

The diagram Fig. 2 shows details of recent British exports and imports prepared from data published by MACHINERY, London. This chart shows that at the present time the British exports are falling off, though not in as marked degree as the imports. The chart also contains a line for exports of lathes from Great Britain, showing that the general tendency in regard to decreased exports is practically followed by the decreased exports in this type of machine tool. Complete details showing the exports of machine tools from Great Britain for each month beginning August, 1920, and including August, 1921, have also been compiled by Mr. Rastall, giving in detail both the number of machines and the value for the following groups: Lathes, drilling machines, grinding machines, milling machines, planing and shaping machines, punching and shearing machines, and all other machine tools. The imports of machines into Great Britain for the same classes of machines are also covered. This information may be obtained by individual manufacturers through application to the Industrial Machinery Division, Department of Commerce, Bureau of Foreign and Domestic Commerce, Washington, D. C.

* * *

PERSONALS

CHARLES ADDAMS, formerly a sales engineer with the Standard Roller Bearing Co., Philadelphia, Pa., is now connected with the Bearings Co. of America as sales engineer in the eastern territory.

J. M. MCNEAL, sales engineer of the Landis Machine Co., Inc., Waynesboro, Pa., manufacturer of bolt and pipe threading machines, has returned to this country after spending a year and three months traveling in England and on the Continent.

C. F. MEYER, assistant secretary of the Landis Machine Co., Waynesboro, Pa., manufacturer of bolt and pipe threading machines, has recently returned from a year's trip around the world, having visited India, Java, China, Japan, and the Hawaii Islands.

JAMES HARTNESS, president of the Jones & Lamson Machine Co., Springfield, Vt., and governor of the state of Vermont, has been awarded the Edward Longstreth medal by the Franklin Institute, acting through its Committee on Science and the Arts, for the development of the Hartness screw thread comparator.

WILLIAM S. DICKSON has been appointed assistant manager of the Crane Machinery Co., Buffalo, N. Y. Mr. Dickson was identified for many years with the Cincinnati Planer Co. Later he became sales engineer of the Acme Machine Tool Co. and general manager of the Greaves-Klusman Tool Co. During the last two years he has been connected with the Cleveland office of W. K. Stamets.

EARL B. STONE has been appointed advertising manager of the Cleveland Tractor Co., Cleveland, Ohio, to take the place of G. B. Sharpe, who has resigned. Mr. Stone has been connected with the company for two and a half years, serving as sales representative, assistant advertising manager, and district sales manager. His former advertising experience included work with the General Fireproofing Co., Youngstown, Ohio, and the National Acme Co., Cleveland.

MARTIN G. SPERZEL has been made sales manager of the Royersford Foundry & Machine Co., Royersford, Pa., succeeding John D. Sells, who is retiring from active business. Mr. Sperzel has been connected with the company for the last six years as sales engineer, and was connected with the Standard Roller Bearing Co. for almost the same length of time. The Royersford Foundry & Machine Co. will continue to make and market the Sells roller bearings, which it has done since the latter part of 1904, when Mr. Sells became identified with the company.

HJALMAR G. CARLSON, of Worcester, Mass., was awarded a gold medal—the annual prize of the American Society of Mechanical Engineers—December 7, at the meeting of the society in New York. The medal is awarded to the engineer who is responsible for the most noteworthy development in mechanical engineering practice that has been called to the attention of the society during the past year. Mr. Carlson won the prize for the work that he did in connection with a process for the production of 30,000,000 drawn steel booster casings used as component parts in high-explosive shells. The method developed is not one confined to the production of war material, but may also be applied to drawn steel parts for industrial purposes in general. In awarding the prize, it was stated that Mr. Carlson's invention, according to the Army Ordnance Department, was of the greatest importance during the war, in enabling the military authorities to secure adequate artillery ammunition for the American Expeditionary Forces.

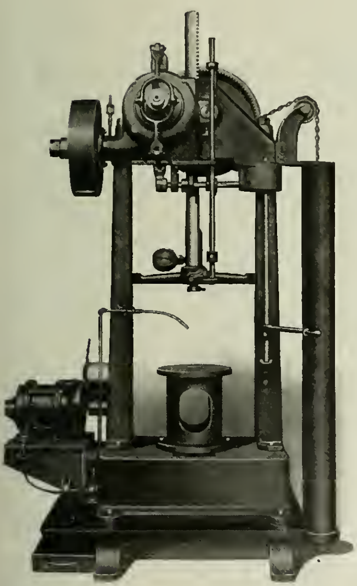
ANNOUNCEMENT

SOMETHING NEW

Yet tested and tried

The Lucas Vertical Push-Broaching Machine

(A modification of the Lucas Power Forcing Press)



Has been in successful operation for over two years on *vertical push-broaching* and *production assembling.*

ADVANTAGES:

Shorter, and therefore less expensive broaches.
Better lubrication of cutting edges.
Easier setting of work, easier manipulation of broaches.
More production.
A choice of fixed positions for the operator.
Lever Control (adjustable for height).
Less Floor Space Required.

WE ALSO MAKE THE
"PRECISION"

BORING, DRILLING AND MILLING MACHINE

Send for Special Circular C-26-M.

LUCAS MACHINE TOOL CO. NOW AND ALWAYS OF **CLEVELAND, OHIO, U.S.A.**

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry. Societe Anonyme Belge, Alfred Herbert, Brussels. Aux Forges de Vulcain, Paris. Allied Machinery Co., Turin, Barcelona, Zurich. Benson Bros., Sydney, Melbourne. V. Lowener, Copenhagen, Christiania, Stockholm. R. S. Stokvis & Zonen, Rotterdam. Andrews & George Co., Tokyo.

NEW BOOK ON SHOP MATHEMATICS

SHOP ARITHMETIC FOR THE MACHINIST. By Erik Oberg. 116 pages, 6 by 9 inches; 92 illustrations. Published by THE INDUSTRIAL PRESS, 140-148 Lafayette St., New York City. Price, $1.

This treatise is intended for men in machine shops and tool-rooms whose training has been chiefly along practical lines, and also for students of mechanical subjects who desire a book featuring the problems commonly encountered in shop work. All subjects have been treated as simply as possible, and many examples are used to show exactly how different arithmetical processes are applied to practical shop problems. The advantages and use of formulas are explained, and most of the formulas are written out or expressed in words to show the student just what each formula actually means. In fact, a special effort has been made to explain all methods in plain, simple language.

Many text-books deal with principles rather than with specific examples, but the shop man not used to solving problems often finds it difficult to apply these principles. The purpose of this treatise, therefore, is to present the most common machine shop and tool-room problems and show clearly, by carefully selected examples, how the principles are applied in each case. It is assumed that the student understands such elementary subjects as addition, subtraction, multiplication, and division of whole numbers and fractions, and that he is familiar with the use of common mathematical signs for indicating the different operations referred to. If the student is not entirely familiar with the elementary arithmethical processes mentioned, it is advisable for him to study a text-book on arithmetic before attempting the solution of the problems given.

COMING EVENTS

January 11-14—Annual meeting of the Society of Automotive Engineers in New York City. Secretary, Coker F. Clarkson, 29 W. 39th St., New York City.

April 19-20—Annual meeting of the National Metal Trades Association in New York City; headquarters, Hotel Astor. Secretary, Homer D. Sayre, Peoples' Gas Bldg., Chicago, Ill.

April 24-29—Annual convention and exhibit of the American Foundrymen's Association in Cleveland, Ohio; headquarters, Cleveland Public Hall, Lakeside Ave. and E. 9th St. Secretary, C. E. Hoyt, 140 S. Dearborn St., Chicago, Ill.

May 8-11—Spring meeting of the American Society of Mechanical Engineers in Atlanta, Ga. Assistant Secretary (Meetings), C. E. Davies, 29 W. 39th St., New York City.

NEW BOOKS AND PAMPHLETS

Ninth Annual Report of the Secretary of Commerce Covering the Fiscal Year Ended June 30, 1921. 149 pages, 6 by 9 inches. Published by the Department of Commerce, Washington, D. C.

Results of Some Tests of Manila Rope. By Ambrose H. Stang and Lory R. Strickenberg. 11 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Technologic Paper No. 198 of the Bureau of Standards. Price, 5 cents.

A Course in Mechanical Drawing. By Louis Rouillion. 92 pages, 8 by 9½ inches. Published by the Norman W. Henley Publishing Co., 2 W. 45th St., New York City. Price, $1.50.

The fifteenth edition of this book has now been issued in revised and enlarged form. It explains the art of making working drawings, lettering, and dimensioning, and is intended either for school use or for self-instruction. This course was originally issued in blueprint form with accompanying typewritten notes, and has been in use at the Pratt Institute and Y. M. C. A. classes for a number of years. The course covers a period of two school years of about twenty-four weeks each. Because of the interest in isometric drawing evinced by students, this subject has been added to the present edition. A parallel course, in the form of supplementary exercises, is presented at the end, so that the book may be used as a text-book in class work.

Railroad Shop Practice. By Frank A. Stanley. 331 pages, 6 by 9 inches. Published by the McGraw-Hill Book Co., Inc., New York City. Price, $4.

This book deals with shop practice in railroad repair shops, including large, medium and small shops, and describes typical methods and appliances adapted to the class of work handled in these shops. The material in the book is presented in twenty-three chapters. An idea of the operations dealt with will be obtained from the following list of chapter heads: The Work of the Railroad Repair Shop; Operations on Locomotive Cylinders; Machining Pistons and Piston-rings; Piston Valves, Cages and Rings; Tools for Crossheads and Guides; Connecting-rod Operations; Making Driving-boxes; Machining Shoes and Wedges; Eccentrics, Links, and Tumbling Shafts; Locomotive Frame Work; Driving Wheels and Axles; Wheel Shop Equipment and Methods; Machining Pipe Joints and Other Parts; Brass Tools for Locomotive Valves and Fittings; Some Portable Tools and Appliances; Special Tools, Cutters and Tool-room Methods; Air Pump, Hose Coupling, and Miscellaneous Devices; Blacksmith Shop Equipment and Work; Boiler Shop and Flue Work; Tools and Methods Used on Steel Car Work; Welding Operations on Locomotives and Cars; Reclamation Work; and Handling Materials in the Railroad Plant.

Hendrick's Commercial Register of the United States. 2324 pages, 8½ by 11½ inches. Published by the S. E. Hendricks Co., Inc., 70 Fifth Ave., New York City. Price, $12.50.

This is the thirtieth annual edition of this well-known commercial register of producers, manufacturers, dealers, and consumers. The new edition appears in a slightly larger size, with a type face of 7 by 10 inches. The text matter has been opened up, leaving a space between columns, thus making it more readable and giving ample space for checking and memoranda. The larger page, taking more matter, naturally makes a smaller book, which is easier to handle. Although the increased size of the page takes 25 per cent more matter and would normally reduce the number of pages from 2800 to 2100, new matter has been added to make more than 2300 pages. The book covers the engineering, machinery, electrical, building, chemical, hardware, iron and steel, mining, quarrying, railroad, architectural, constructional, contracting, mill, and kindred industries throughout the United States. It contains over 100,000 names of individuals and firms, comprehensively classified by trades or products and thoroughly indexed and cross-indexed. The first and main section of the book is the classified trades section, covering 1552 pages, in which are classified alphabetically all the trades in the various fields mentioned. There are over 3000 classifications in the mechanical industries which include the names and addresses of the manufacturers of practically every kind of machine and operating supply used in the production of raw materials and in the manufacture of finished and semi-finished products. A special list of over 15,000 machine shops and foundries, classified according to the exact type of work done, is included. The second section contains a list of trade names or special brands of the products included in the classified directory, and covers 190 pages. This is followed by the alphabetical section, including 403 pages, in which are given the names and addresses of all manufacturers in the fields covered, as well as the main industry of each firm. The address of the head office or works only is given, the branch office and work addresses being included in the various classified lists. A complete index to the trade classifications is included, which covers 132 pages.

NEW CATALOGUES AND CIRCULARS

Lovejoy Tool Works, Chicago, Ill. Circular illustrating the Lovejoy No. 3 portable electric drill with a capacity for drilling ¼ inch in steel.

Atlas Vise Co., Inc., Lowville, N. Y. Circular containing illustrations and specifications covering the line of "Nutyp" vises for machinists and pipe fitters.

Gas Producer & Engineering Corporation of New Jersey, 115 Broad St., New York City. Leaflet containing a list of representative users of "Galusha" gas generators.

Turner Machine Co., Danbury, Conn. Circular showing typical examples of Turner spur and bevel cut steel gears. This company makes a specialty of replacement gears for Ford cars.

New Departure Mfg. Co., Bristol, Conn. Loose-leaf sheets Nos. 141 and 142FE, illustrating and describing the application of New Departure ball bearings in portable electric drills and pneumatic corner drills.

Jones Machine Tool Works, Philadelphia, Pa. Circular containing illustrations and dimensions of the Jones motor-driven slotting machines, which are made in five sizes of 12, 16, 20, 25, and 32 inches, respectively.

Monitor Controller Co., Baltimore, Md. Circular illustrating an installation of the Monitor system of controllers operating diamond polishing machines, which require a positive drive, free from vibration and fluctuation.

Pratt & Whitney Co., Hartford, Conn. Circular 269, describing the distinctive features and details of construction of P & W vertical shapers, which are made in 6- and 10-inch sizes, for tool-room work on a production basis.

Brown & Sharpe Mfg. Co., Providence, R. I. Leaflet containing a chart showing the growth of the Brown & Sharpe plant from 1872, when it included 55,000 square feet of floor space, to its present size of 1,471,400 square feet.

Universal Boring Machine Co., Hudson, Mass. Circular illustrating and describing the Universal horizontal boring machine made by this concern, which is equipped with a boring-bar 4½ inches in diameter for performing heavy work, such as is done in railroad shops.

American Spiral Pipe Works, Chicago, Ill. Circular showing installations of American spiral-riveted pressure pipe, lap-welded steel pipe, and corrugated boiler furnaces. Examples of special fittings and forged steel pipe flanges are also illustrated.

Pawling & Harnischfeger Co., 38th and National Aves., Milwaukee, Wis. Bulletin 4F, describing the details of construction of the P & H No. 4F horizontal, boring, milling and drilling machine of the floor type, which is designed to drive high-speed tool steels to capacity limits.

Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., is distributing small vest-pocket blotters (No. 57), illustrating the Westinghouse Type LC crane safety switches. A larger size blotter, No. 56, telling how to insure against loss by stocking renewal parts, is also being distributed.

Hisey-Wolf Machine Co., Cincinnati, Ohio. Bulletin 105-A, descriptive of Hisey "Super" universal motor drills, designed for operation on direct current or single-phase alternating current, for any frequency from 25 to 60 cycles. These drills may be used for drilling in either wood or metal.

Triplex Machine Tool Corporation, 18 E. 41st St., New York City. Catalogue 1, illustrating the uses of the Triplex No. 1 combination bench machine tool for turning and boring; horizontal, angular, and vertical milling; thread cutting; and drilling. Specifications of the machine are included.

United States Blueprint Paper Co., 201 S. Wabash Ave., Chicago, Ill. Circulars descriptive of several drafting instruments, including the "Draftsquare" for use in drawing nuts, circumferences, radii, screw threads, and for lettering; the Ames lettering instrument; and sets of drawing instruments.

Harrisburg Corporation, Harrisburg, Pa. Bulletin A, containing an illustrated description of the Rainsford type of radial drilling machine made by this concern. These machines are made in seven sizes, with capacities for drilling to the center of circles 7, 8, 10, 10, 12, 14, and 16 feet in diameter, respectively.

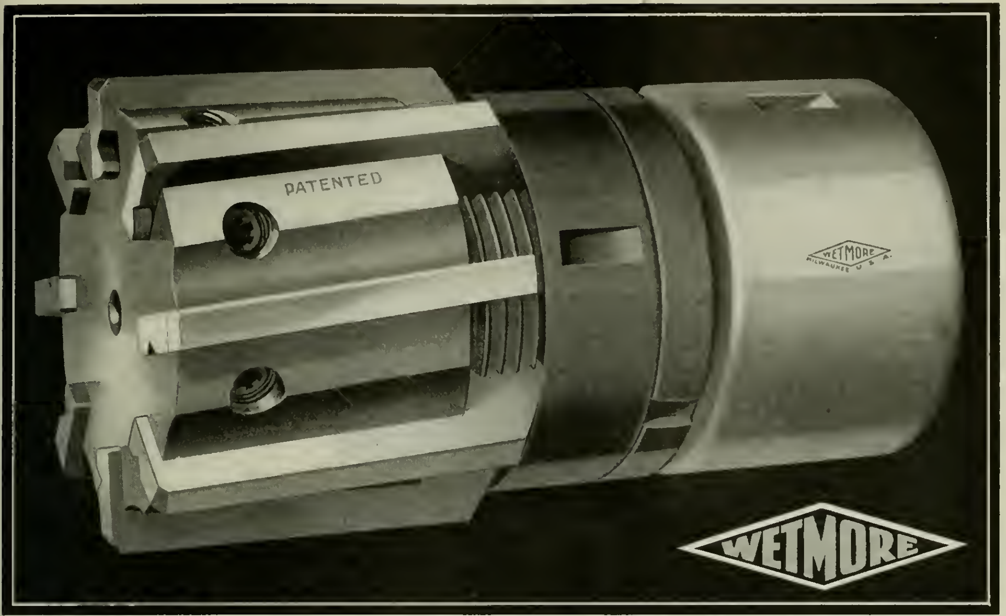
Pangborn Corporation, Hagerstown, Md. Pamphlet giving data on the Pangborn Type GF industrial barrel sand-blast intended for the manufacturing plant, small foundry, or shop doing small work in limited volume. The company is also distributing a blotter illustrating the Type DC sand dryer and the Type HC moisture and oil separator.

Ingersoll Milling Machine Co., Rockford, Ill. Circular showing examples of standard Ingersoll inserted-tooth milling cutters, which are adapted for face-milling steel, aluminum, or cast iron. This line of cutters also includes arbor mills, solid mills, and special inserted-tooth profile cutters. The field of application of the types illustrated is outlined.

Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. Folder 4474, treating of lead-base babbitt metal for use in motor and generator bearings. This metal, which has been used for years in the motors made by this company, has just been placed on the market. The pamphlet contains instructions for using this metal so as to obtain the best results.

Howe Chain Co., Muskegon, Mich. New 100-page catalogue No. 121, illustrating and describing the Howe complete line of chains for elevating, conveying, and power transmission. The catalogue contains full-size illustrations, complete information and data, and price lists for all standard chains. Copies of the book will be sent to those interested upon request.

Eck Dynamo & Motor Co., Bellville, N. J. Bulletins 1300, 1500, 1600, and 1900, descriptive of Eck direct-current motors, vertical motors, back-geared motors, and Types 1 and I-B induction motors, respectively. Each of the bulletins gives complete specifications for the different sizes of motors, in addition to a general description covering the features of construction.



Announcing

The New Wetmore "Bull-dog"

Combining all the advantages of both solid and adjustable reamers, this new Wetmore Expanding Heavy-duty Reamer (6, 8 or 10 blades) represents the highest development of quantity-production precision tools.

No huskier or more enduring reamer has ever been produced for heavy duty work than this Wetmore "Bull-dog". The body is *guaranteed* against breakage, even under severest reaming tests. Its new tongue drive relieves the strain on the coupling nut. Assures perfect alignment between arbor and body. Large adjustment provides for wear and regrinding, so that the "Bull-dog" with its original blades will outlast several solid, non-adjustable reamers.

In every detail—design, quality of materials, workmanship, finish—the "Bull-dog" is typical of Wetmore standards of manufacturing. And the more carefully you compare it with other good reamers, the more you will appreciate these advantages of Wetmore Expanding Reamers:

Left-Hand Angle Cutting Blades that prevent digging in, chattering, and scoring of the reamer while backing out.

Solid, heat-treated alloy steel body—guaranteed against breakage.

Adjustments to the thousandth of an inch can be made in less than a minute. In fact, the Wetmore is the quickest and easiest adjusting reamer made. Cone expansion nut keeps blades always parallel with axis.

No grinding arbor required for regrinding. Wetmore Reamers can be reground on their original centers.

The above are but a few of many features of Wetmore Expanding Reamers. Let us send you our 1922 Catalog—just off the press. No better "hand-book" on reamers was ever published, we believe. Write for *your* copy.

WETMORE REAMER COMPANY., Milwaukee, Wisconsin

(Manufacturers of Expanding Reamers and Cylinder Reaming Sets, Arbors and Thread Gauges)

WETMORE REAMERS

EXPANDING

G. A. Gray Co., Cincinnati, Ohio. Catalogue 37, containing a detailed description and illustrations of Gray planers, which are made in three types known as standard planers, maximum service planers and switch and frog planers, and in a variety of sizes. The various details of construction are made clear by a liberal use of illustrations in connection with the text.

Gould & Eberhardt, Newark, N. J. Bulletin 90, containing a description of a new system of automatically hobbing worms, utilizing a hob which has a broaching action and is so designed that worms having shoulders at both ends may be cut. These hobbing machines will cut either single or multiple threaded worms. Copies of the pamphlet will be sent to those interested upon request.

American Bronze Corporation, Berwyn, Pa. Engineering data sheets 107, 108, 109, 110, 111, 112, containing data on running clearances allowed for different classes of bearings; permissible angular deflection of journals in plain bearings, with chart; relation of rubbing speeds to revolutions per minute; allowances for press fits of hard bronze bushings; and design of water pump for automotive engines.

Eclipse Interchangeable Counterbore Co., 7410 St. Aubin Ave., Detroit, Mich. Circular D, containing data covering Eclipse "Junior" interchangeable spot-facers, which are so made that many different sizes may be used with each holder, the tool being made of high-speed steel and the holder of nickel steel. Adapters are provided for these tools so that they can be used with standard Eclipse holders and standard pilots.

Hadfield-Penfield Steel Co., Bucyrus, Ohio. Catalogues descriptive of this company's Diesel type horizontal and vertical standard fuel oil engines, which are built on the two-cycle principle. The horizontal engine is made in three sizes of 50, 75, and 100 brake horsepower, the latter two sizes being built as twin units giving 150 and 200 brake horsepower. The vertical engine is built in two- to six-cylinder units, developing 50 and 125 brake horsepower per cylinder.

Electric Furnace Co., Alliance, Ohio. Folder showing a large number of typical installations of Bailey electric furnaces in the eastern states, Pennsylvania region, Ohio, Ohio valley, Michigan, Middle West, and Canada. The furnaces selected as examples are those that handle a wide range of non-ferrous alloys and a diversity of brass products, and the illustrations show the various sizes that have been built to meet the needs of different melters of non-ferrous metals.

W. S. Rockwell Co., 50 Church St., New York City. Bulletin 240, entitled "Heat-treatment of Springs with Stationary and Continuous Furnaces," containing an outline of the fundamental principles of heating and handling, with illustrations of their practical application in the manufacture of a wide variety of springs. This pamphlet is not merely a furnace catalogue, but contains general information which should be of interest to those engaged in this class of work.

Ingersoll-Rand Co., 11 Broadway, New York City. Pamphlet containing a reprint of a paper entitled "Steam Condensing Plants," by Paul Bancel, read before the Baltimore Section of the American Society of Mechanical Engineers. This paper presents a study of power plant conditions and discusses new phases of the fixed and operating charges of power plant equipment. A new Ingersoll-Rand surface condenser is described in the article, as well as the barometric and low-level, multi-jet types made by this company.

Seifreat-Woodruff Co., 20 S. Canal St., Dayton, Ohio. Circular announcing an industrial exhibit of machine tools in operation which was shown at the company's Dayton show-rooms in December. Among the tools exhibited were an American Tool Works Co.'s lathe, shaper, and radial drilling machine; Barnes drilling machine; Colburn manufacturing drilling machine; Gooley & Edlund manufacturing milling machine; LeBlond universal milling machine and universal cutter grinder; Libby turret lathe; Lumsden tool grinder; Springfield Machine Tool Co.'s lathe and straightening press; and Wood turret screw machine.

Fafnir Bearing Co., New Britain, Conn. Catalogue 21, of Fafnir ball bearings. The first section of the book contains descriptive material on types of Fafnir ball bearings and how to mount them; cleanliness and lubrication; types of closures; cross-sections of mountings; and Fafnir double ball bearing hanger boxes and transmission ball bearings. The construction is made clear by a liberal use of both halftone and line illustrations. The second part contains tables of sizes, dimensions, load ratings and prices of Fafnir ball bearings, as well as tables of standard fits for ball bearing mountings, and decimal equivalent tables.

American Broach & Machine Co., Ann Arbor, Mich., has published a broach handbook which has been compiled for the purpose of placing information on broaching, broached fittings, and the use and care of standard broaches before engineers, superintendents, draftsmen, purchasing agents, and others who come in contact with broaching operations. The first few pages are devoted to S A E broached fittings. In the following pages are discussed the method of setting up, grinding, care and use of keyway broaches, round broaches, square broaches and spline broaches. A number of illustrations are included showing interesting broaching operations. The last part of the book contains illustrations and specifications of American rack-operated broaching machines.

National Tube Co., Pittsburg, Pa. National Bulletin No. 17B, containing detailed information on the mechanical uses of Shelby seamless steel tubing. The material is divided into seven subjects as follows: Properties and general characteristics of Shelby steel tubing; use of tubing in place of solid stock or forgings; advantages of tubing in mechanical services; special operations on mechanical tubing; forming and machining mechanical tubing; mechanical tubing for specific purposes; and a survey of the uses of mechanical tubing. The section dealing with special operations on mechanical tubing contains a large number of line illustrations showing examples of parts for which seamless tubing is especially suitable. An idea of the wide application of this product will be obtained by referring to the alphabetical list of applications of seamless steel tubing.

Hunter Saw & Machine Co., Pittsburg, Pa. Catalogue E, illustrating and describing the Hunter complete line of solid and inserted-tooth metal-cutting circular saw blades, inserted-tooth setting device, serrating device for friction disks, slate saws, pipe cutters, circular knives, rotary shear blades, saw sharpening machines, pneumatic hammer rivet sets, chisel blanks, and hardened steel specialties. Tabulated matter giving sizes and prices for each of the products is included. One of the sections of the book contains instructions for the care and operation of Hunter inserted-tooth saws, and the heavy work which can be handled with these saws will be understood by reference to the illustrations. The book concludes with a section of useful information, containing milling saw specifications for different types of machines, tables of number of teeth in milling saws for a given diameter and pitch, approximate weights of circular blades, etc.

R. K. LeBlond Machine Tool Co., Cincinnati, Ohio. Catalogue illustrating and describing the LeBlond line of heavy-duty milling machines. The catalogue contains 111 pages, 8½ by 11 inches, and gives a detailed description of the construction of the cone type and geared drive milling machines. Specifications are given for the different sizes in both types. This line of machines is made in both plain and universal styles, and attention is called to the fact that there has been a complete regrouping and rearrangement of sizes and ranges, the heavy-duty machines having been made considerably heavier and supplemented by a lighter line. The section on dividing heads and milling attachments for LeBlond milling machines includes tables for spacing on plain dividing heads and on LeBlond dividing heads, as well as tables for cutting spirals. The book concludes with instructions for oiling, adjusting, and setting up these machines.

TRADE NOTES

Eastman & Co., 63 E. Adams St., Chicago, Ill., has been organized by D. T. Eastman, formerly advertising manager of the Eagle Picher Lead Co. of Chicago, to engage in technical advertising.

Rich Tool Co., 513 A, Railway Exchange, Chicago, Ill., manufacturer of drills, reamers, etc., has appointed the Busch Corporation of St. Louis representative of the company in the St. Louis territory.

Ford Chain Block Co., Second and Diamond Sts., Philadelphia, Pa., has opened a branch office and warehouse at 85 Walker St., New York City, where a complete stock of chain blocks and trolleys will be carried.

Pennant Tool & Engineering Co., Springfield, Ohio, is now located in its new building at North and Isabella Sts. The company handles tool and die work and special machine work. H. H. Swope is president and general manager.

Rockford Milling Machine Co., Rockford, Ill., has appointed the Charles A. Strelinger Co. of Canada, Ltd., Windsor, Ontario, Canada, exclusive distributor for its products. The products of the Rockford Tool Co. will also be handled exclusively by this company.

Harrold Tool & Forge Co., Columbiana, Ohio, manufacturer of mechanics' hand tools, screw-drivers, and drop-forgings, has recently changed its corporate name to the Colonial Tool & Forge Co. Wiebusch & Hilger, Ltd., of New York City, will continue to be the selling representative of the company.

Manning, Maxwell & Moore, Inc., 119 W. 40th St., New York City, has moved its Philadelphia office from the Lincoln Building, to larger and better quarters in the Pennsylvania Building at 15th and Chestnut Sts., occupying rooms 905 and 906. This concern also moved its Boston office on December 1 from 10 High St. to the Textile Building at 99 Chauncey St., rooms 802 and 803.

J. B. Engineering Sales Co., Hartford, Conn., has recently moved from 60 Prospect Ave. into larger quarters at 54 Church St. The company specializes in power plant equipment, and is a distributor for Sells roller bearings and other products of the Royersford Foundry & Machine Co., as well as for the products of the Oriscom-Russell Co., and the Conveyor Corporation of America.

Rivett Lathe & Grinder Co., Brighton District, Boston, Mass., has recently opened a sales office in Detroit, Mich. The new office is located with the Reed-Prentice Co., at 408 Kerr Bldg. It is requested that prospective purchasers of Rivett machinery in the Detroit district communicate with the Detroit sales office, as facilities have been provided for furnishing information promptly and for filling orders with dispatch.

Greenfield Tap & Die Corporation, Greenfield, Mass., announces that it has consolidated the small tool and drill divisions of the company, and has placed P. T. Irvin, former manager of the drill division, in charge of the consolidation, which will be called the small tool division. Mr. Irvin has had considerable experience along these lines, having been sales manager of the Lincoln Twist Drill Co., Taunton, Mass., for the last three years, and prior to that sales manager of the Wells Bros. Co. of Greenfield.

Cincinnati Shaper Co., Elam St. and Garrard Ave., Cincinnati, Ohio, and its subsidiary the Cincinnati Gear Cutting Machine Co. have arranged to open a branch sales office at 940 Lemcke Annex, Indianapolis, Ind. T. C. McDonald has been appointed local manager. This office will supervise the sale of machine tools for these companies in the Indianapolis and Louisville district, as well as in certain states in the southwest. Mr. McDonald will also continue as local representative of the Reed-Prentice Co.

Leonard Machine Works, Philadelphia, Pa., moved on January 1 to their new plant, Baltimore Ave. and Hirst St., Lansdowne, Pa. The new plant was built according to plans made by Mr. Leonard. It is a one-story building, of steel framework and brick construction, with all-steel sash and a monitor roof. The manufacturing floor space is approximately 50 by 100 feet. The company will continue its contract manufacturing, and in addition will develop further and manufacture its line of pipe-bending machines, as well as a line of special machinery.

Whiting Corporation, Harvey, Ill., manufacturer of cranes and foundry equipment, has purchased a controlling interest in the Grindle Fuel Equipment Co., manufacturer of powdered coal plants for use in connection with steam boilers, malleable furnaces, annealing ovens, and other types of furnaces. The Grindle Fuel Equipment Co. has moved its offices to Harvey, and will continue its business under the same name. The Whiting Corporation will manufacture all Grindle equipment. The following officers have been elected: President, B. H. Whiting; vice-president and general manager, A. J. Grindle; and secretary and treasurer, T. S. Hammond.

Diamant Tool & Mfg. Co., Inc., 95 Runyon St., Newark, N. J., has appointed Russell, Holbrook & Henderson, Inc., 30 Church St., New York City, its exclusive sales representatives, handling Diamant standard punch and die sets in the territory covering New Jersey north of Trenton, all of New York City, New York state south of Kingston, and all of Connecticut west of the Connecticut River. The company has also appointed H. M. Bush, 16 S. Third St., Columbus, Ohio, sales representative for central Ohio, and Russell Propes, 1025 Cherry St., Norristown, Pa., sales representative for southeastern Pennsylvania, including the Philadelphia section.

Wetmore Reamer Co., 60-64 Twenty-seventh St., Milwaukee, Wis., manufacturers of a line of expanding reamers, including cylinder reaming sets, and the Wisconsin Tool & Supply Co., of Milwaukee, manufacturer of special tools, jigs, dies, fixtures, and thread gages, have been consolidated and will hereafter be operated under the name of the Wetmore Reamer Co. The company will specialize in the manufacture of expanding reamers for high-speed and quantity production work, as well as expanding machine reamers under one inch in size, which are a recent development. It will also continue to build tools and dies, fixtures and special thread gages. The officers of the consolidated corporation are as follows: President and general manager, Edward J. Waltzer; vice-president, Charles G. Forster; secretary, Carl A. Forster; and treasurer, Edward D. Johnson. The direct management of the company will be under the supervision of the Wisconsin Tool & Supply Co. organization.

Atlas Vise Co., Lowville, N. Y., has been incorporated, with a capitalization of $25,000, by Foster M. Strickland of Champlain, N. Y., and E. W. Fulton, G. L. Fulton, Henry Petrie, and H. W. Green of Lowville, for the purpose of manufacturing, buying, selling, importing, and exporting vises and tools of all kinds. Executive and sales offices have been opened in the Bowen Block, Lowville. Manufacturing and selling rights under patents owned by E. W. Fulton, former president and general manager of the Fulton Machine & Vise Co. of Lowville, have been secured, as well as similar rights to the trade name and patents of the Velox Vise Co. The vises are now being manufactured for Mr. Fulton by the Porter-Cable Machine Co. of Syracuse, N. Y., and it is expected that the new organization will continue the arrangement and that all shipments will be made from Syracuse. The line of vises acquired includes a new type of combination vise especially designed for garages, and a Velox steel bar quick-action vise more especially adapted to the needs of industrial plants. Standard bench vises will also be carried.

FEBRUARY MACHINERY 1922

Commercial Gear-cutting Practice

First Article of a Series Dealing with the Use of Different Types of Gear-cutting Machines for Cutting Various Classes of Gearing

This Installment Covers the Cutting of Spur Gears on Automatic Machines of the Formed-cutter Type

By FRANKLIN D. JONES

A COMPLETE history of all machine tools and mechanical processes used in machine shops would contain no part more fascinating than that dealing with the origin and development of gear-cutting machines. The necessity of utilizing positive means for transmitting rotary motions in machines accounts for the fact that the general subject of gearing has engaged the attention of engineers for generations, and since gearing of some type is in common use on almost every kind of mechanism, it is not surprising that gear-cutting is a subject of unparalleled interest among machine shop processes.

This article and others to follow will deal with the different methods and machines now used for cutting gears of various types and sizes, from small precision gears up to very large, heavy designs. In this general review of the subject, the object will be to show (1) how gears of different kinds are cut; (2) what types of machines are used under different conditions; (3) what factors affect production and quality; (4) commercial rates of production for cutting gears by different processes; and to give other important facts for the user or prospective user of gear-cutting machines. The development of the highly specialized gear-cutting machines now employed has required a vast amount of experimenting, and the designing and redesigning of many different types of machines and cutters to obtain equipment capable not only of cutting accurate gearing but also of working on a commercial basis. The modern gear-cutting processes to be described will include the cutting of spur, straight-tooth, bevel, spiral bevel, helical (or spiral), double-helical or herringbone, and worm gearing.

General Classification of Gear-cutting Processes

The gear-cutting processes commonly utilized for producing different types of gears may be divided into three general classes. One includes the use of tools or cutters which form gear teeth by reproducing the shape of the cutter itself; in another class are the generating processes whereby the proper tooth curves are formed through relative motions of the tool and work, as when a straight-sided cutting tool generates the required tooth curves due to the rotary motion imparted to the gear blank. The third general classification includes the use of templets or master formers, which control the path followed by the cutting tool, and consequently the curvature of the gear tooth. This method is applied chiefly to the cutting of very large gears, and like the other processes referred to will be illustrated later by examples from practice.

The tool which cuts or forms the gear teeth may either revolve or have a reciprocating motion. When the shape of the cutter is directly reproduced on the gear, a revolving or disk type of cutter is generally used, the gear teeth being formed by milling operations. In some cases, a formed tool having a reciprocating motion may be employed, as, for example, when a gear is cut on a shaper or slotter because a regular gear-cutting machine is not at hand. Many machines of the generating type have revolving cutters, whereas other classes of generating machines operate with a planing or reciprocating motion. Machines of the templet or form-copying type are in the planer class. The forms of cutters used on different machines and the methods of applying these machines to various classes of gearing are to be illustrated by examples representing a wide range of practice.

Different Methods of Cutting Spur Gears

The cutting of spur gears will be dealt with first, since this type is used much more than any other. Spur gearing, in common with other classes, may be cut by a number of different methods, each of which is satisfactory when applied under favorable conditions. These gear-cutting methods include (1) milling the teeth with cutters conforming to the shape of the spaces between the teeth; (2) milling the teeth with a cutter of the hob type, which represents a rack in the axial plane and is used in generating the tooth curves; (3) planing with a circular cutter which has teeth like a gear and serves to generate the tooth curves as the cutter and gear blank revolve

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This series of articles will form a complete treatise on the cutting of spur gears, straight-tooth bevel gears, spiral bevel gears, helical and herringbone gears, internal gears, worm-gears, and worms. There will be numerous examples from practice ranging from small instrument gears up to very large spur and bevel gears. Recent developments in gear-cutting machinery will be included, together with specific information covering operating principles, methods of setting up machines, time required for cutting gears of different types and sizes, and other essential points.

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in unison; (4) planing with a tool that takes a series of cuts across the side of the tooth and is guided by a templet or former as it is gradually fed inward; (5) planing with a tool that conforms to a single rack tooth and generates the tooth curves as it moves laterally after each stroke, while the gear blank receives an indexing movement that causes each tooth to mesh properly with the traversing tool; (6) planing with a tool which is similar to a short section of a rack and is used in generating tooth curves as the gear blank rotates relative to the rack cutter; and (7) planing the teeth of the gear by the use of a formed tool which is of the same shape as the tooth spaces.

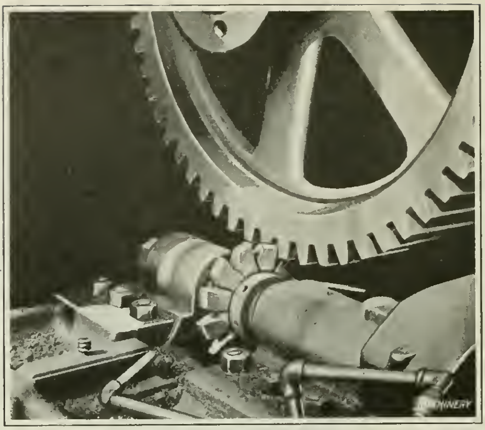


Fig. 1. Cutting a Spur Gear with a Formed Cutter

These various processes are utilized in manufacturing plants of different kinds, because the method of cutting gears, in common with other shop processes, depends upon such factors as the quantity of work to be done, its size, and the degree of accuracy necessary. For instance, the gear-cutting practice in a general repair shop would ordinarily differ from the methods used in the average plant manufacturing, say, machine tools; and still other variations are found in automobile plants, particularly where production is on a very large scale. The manufacturers of gear-cutting machines have developed types to meet these different conditions. For example, there are machines designed for general gear-cutting operations, and other highly specialized types intended solely for cutting large numbers of duplicate gears.

An example of specialization is found in the automotive field where machines of special design are used exclusively for roughing bevel gears preparatory to finishing in other machines. In this instance, it is essential to combine high production with accuracy, which is obtained by using the special machines for rapid roughing and other machines for accurately generating the tooth curves. While these very special types of gear-cutting machines are not found in many shops—considering the machine-building field as a whole—they illustrate what has been done by gear-cutting machine manufacturers to meet different commercial requirements. Just how various gear-cutting processes and types of machines are applied both in plants requiring high production as well as in shops where the variety of gear sizes is large in proportion to the number of gears cut, will be illustrated by many diversified examples of gear-cutting practice.

Cutting Spur Gears by the Disk or Formed-cutter Method

The disk or formed-cutter method is utilized in a great many shops, especially for cutting spur gears. This is a non-generating method, the shape of the gear tooth being a reproduction of the shape of the cutter. It has been applied successfully to a wide range of work, including very small precision gears as well as large heavy spur gears. A close-up view of a formed cutter at work is illustrated in Fig. 1. It will be seen from this illustration that this is merely a milling operation.

When gears of small or medium size are required in small quantities or odd sizes, formed cutters are often used in standard types of milling machines, particularly in repair and jobbing shops, but this and other articles to follow will deal only with machines designed expressly for gear-cutting.

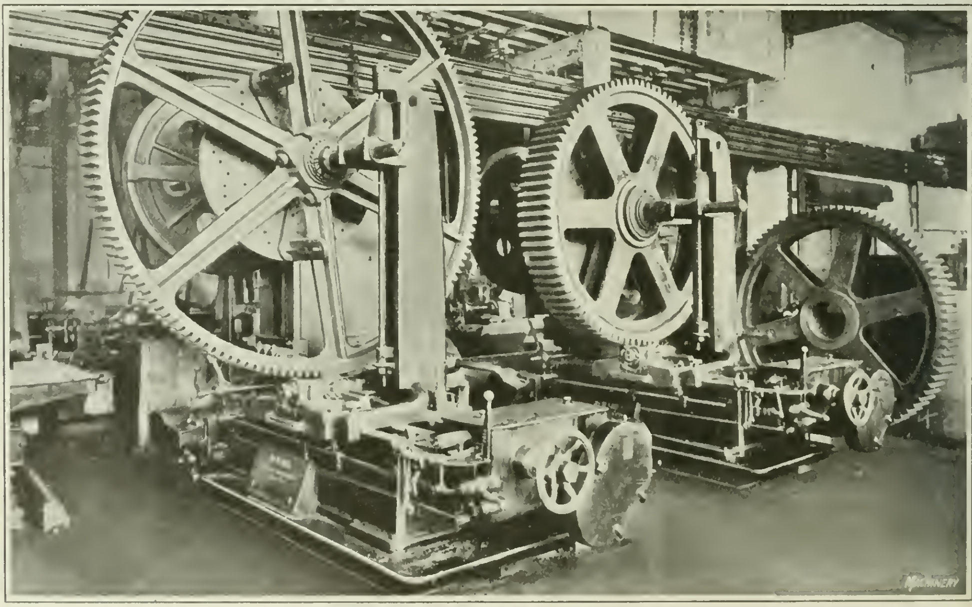


Fig. 2. Examples of Gear-cutting on Machines of the Formed-cutter Horizontal-feeding Type

The machines of the formed-cutter type are commonly known as automatic gear-cutting machines because, after the gear blank or blanks are in the cutting position and the machine is properly adjusted, all the gear teeth are cut automatically without further attention on the part of the operator. Certain other types of gear-cutting machines also operate automatically except for the insertion and removal of the work, although the term "automatic" is not used in designating them to the same extent as in the case of spur-gear machines.

The general characteristics of these automatic spur-gear machines include a main spindle for holding and driving the work-holding arbor; a cutter-slide arranged to move parallel with the axis of the work-spindle; a mechanism for feeding the cutter-slide at a suitable rate and returning it to the starting point; and a mechanism for indexing the gear blank after each tooth space is milled. The arrangement of different makes of these machines varies somewhat. For instance, the cutter-slide of some machines has a horizontal feeding movement along the main bed, as in the example shown in Fig. 2, and the work-spindle is carried by a slide having vertical adjustment along a column, to suit the gear diameter. The cutter-slides of other machines feed vertically along the face of the column, as in Fig. 4, and the work-spindle is held in a vertical position on a slide or table mounted on horizontal ways formed on the main bed. The details of indexing and feeding mechanisms as well as other parts also vary in design, as will be seen by a comparison of illustrations to follow; this series of articles, however, will deal chiefly with gear-cutting processes and the methods of *using* different types of machines rather than with their design, especially as the latter is related to constructional details.

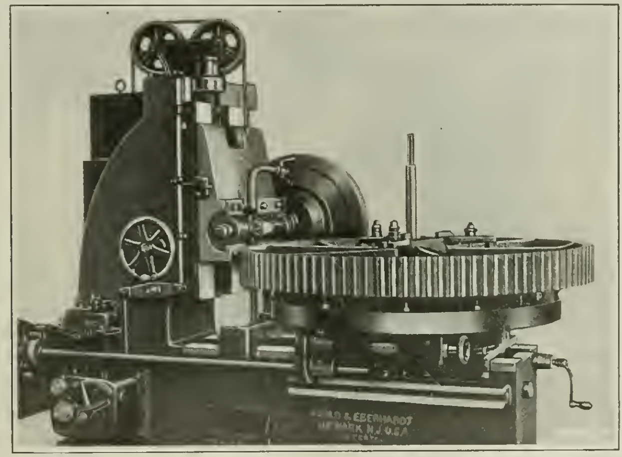


Fig. 4. Cutting a Cast-steel Spur Gear on a Machine of the Vertical-cutting Type

Centering Cutter Relative to Gear Blank

While the exact method of setting up or adjusting automatic gear-cutting machines varies somewhat for different makes, the general procedure will be reviewed briefly and later some of the more important features will be more fully described. After selecting a cutter of the right pitch and number, this cutter with its arbor is placed in the working position. The cutter-spindle bearing is then adjusted to locate the cutter central with the work-spindle so that the center line of each tooth space cut in the gear blank will be radial. This is usually done by means of a centering gage or indicator supplied with the machine. The type of gage used on Newark gear-cutting machines is illustrated in Fig. 3. It consists of a steel straightedge *A* having a vee formed in one end. This straightedge or gage, when in use, is placed on a horizontal surface in contact with the raised edge *B* which holds the gage in alignment. The gage-supporting surface is located on the cutter-slide. The cutter is set in the central position by simply adjusting the spindle laterally until one of the cutter teeth is in contact with both sides of the V-shaped notch when the gage is held firmly against the raised aligning edge *B* of the support.

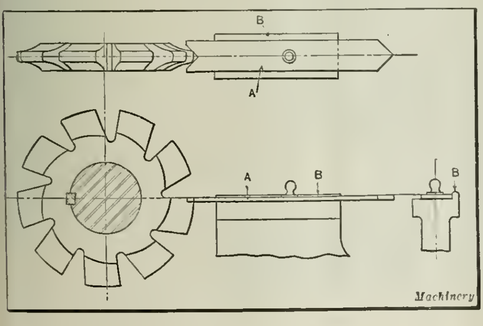


Fig. 3. One Type of Gage used to center Cutter Relative to Gear Blank

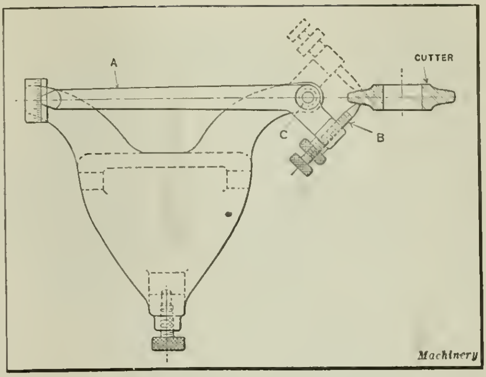


Fig. 5. Another Type of Cutter-centering Gage

The type of indicator used on Brown & Sharpe machines is illustrated in Fig. 5. This indicator is clamped to the ways of the bed in front of the cutter-slide. The cutter-spindle is adjusted until indicating lever *A* shows that it is in a central position. The point of screw *B* should come in contact with the cutter approximately at the pitch line. The position of the indicating lever is then reversed on pivot *C*, as indicated by the dotted lines. If the zero line on lever *A* is equidistant from the zero line on the gage, for the two positions of contact point *B*, this shows that the cutter is in a central position. If preferred, screw *B* may be so adjusted that the lever *A* stands at the zero position and both zero lines will coincide when the cutter is central.

While the indicator just described enables the cutter to be set accurately enough for ordinary purposes, the method of centering recommended when very accurate quiet-running gears are required is as follows: First turn a blank to the same size as the gears to be cut; then, after centering it as accurately as possible, take a single cut through this blank. Without changing the position of the cutter, remove the blank from the work-arbor and reverse its position. Next, with the blank free to turn on the arbor, feed the cutter into the slot previously milled and revolve it by pulling the

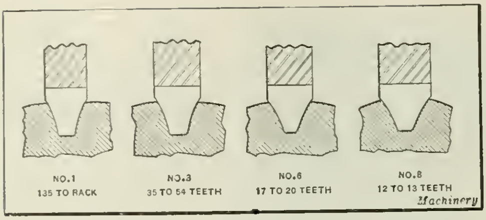


Fig. 6. Diagram showing Variations in Shapes of Gear-cutters of the Same Pitch but intended for Small, Medium, and Large Size Gears

belt so as to mark its position relative to the slot. If the second cut follows the outline of the first, the cutter is exactly central, but if the cutter removes some stock from the top of the space on one side and the bottom of the other, this indicates an inaccurate setting. When such an error is detected, the cutter should be adjusted away from that side of the tooth from which stock was removed at the deepest part of the cut. After this has been done, a second cut is taken in the blank, and the procedure described in the foregoing is repeated to check the adjustment again.

Other Adjustments when Setting up Machines

Another important point to consider when setting up a machine is the method of supporting the work. An arbor inserted in the main spindle is generally used, and frequently this arbor is additionally supported by an arm or outer bearing. It is good practice to test the accuracy of the arbor when setting up a machine. This may be done by placing a dial indicator in contact with it; the worm of the indexing mechanism is disengaged from the index-wheel to permit revolving the spindle and arbor by hand, and then the indicator shows whether the arbor is concentric with the machine spindle. The gear blank or in some cases two or more blanks are placed on the arbor, the number depending upon the width and general proportions of the blanks. The indexing mechanism is geared to agree with the number of teeth to be cut, the proper combination of gearing for a given number of teeth being shown by the chart accompanying the machine. The cutter speed and rate of feed are regulated by means of change-gears, according to the pitch of the gear to be cut, the kind of material, and the kind of steel used in making the cutter. Speed and feed plates attached to the machine show the speeds in revolutions per minute, and the feeds either in inches per minute or per revolution of the cutter. The slide supporting the gear blank is adjusted to mill teeth of the proper depth and thickness, usually by means of a graduated dial on the machine, reading to thousandths of an inch.

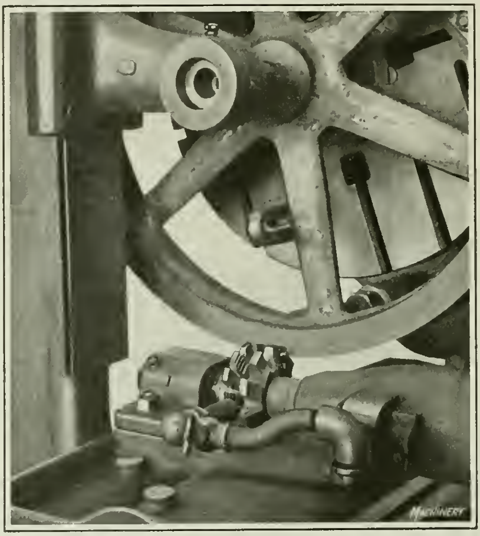


Fig. 7. Machine equipped with Two Cutters for taking Roughing and Finishing Cuts simultaneously

The usual practice is to finish each tooth space by one passage of the cutter, although two cuts are sometimes required. The rim rest, which is used whenever possible to take the thrust of the cut, is adjusted so as to support the gear blank without interfering with the indexing movement. Before bringing the indexing worm in mesh with the wheel, it is well to turn the spindle by hand to make sure that the rim rest does not bind tightly against the work.

As any error in the adjusting of the indexing mechanism would be very serious, the indexing movement is sometimes tested before cutting the gear. One method is to nick the blank in one place and then index by hand to correspond to the number of teeth to be cut in order to see if the nick in the blank is in alignment with the cutter after the work has been indexed one revolution. Another method is to start two grooves or tooth spaces, cutting far enough into the blank to give the tooth its full form for a short distance. The chordal thickness at the pitch line is then measured by using a vernier gear-tooth caliper.

Before the machine is ready for use, the dogs that control the stroke of the cutter-slide must be adjusted to give the slide a movement sufficient to allow the cutter to pass through the blank and then return far enough to permit indexing. One dog is set so that the feeding movement of the slide is reversed after the center of the cutter passes the end of the work. The other dog is then set to stop the return movement when the cutter clears the blank, at a distance of, say, about 1/4 inch, or enough to provide clearance for the indexing movement. This clearance should not be excessive, as this simply increases the idle time, thus decreasing the rate of production.

Selecting a Formed Cutter for Spur Gears

Formed cutters for cutting spur gears must not only be of the required diametral pitch, but they must also be selected with reference to the number of teeth in the gear to be cut. For example, a cutter for a gear having 28 teeth of 8 diametral pitch differs in shape from a cutter for a gear of the same pitch having, say, 60 teeth. The variations in the shapes of cutters Nos. 1, 3, 6, and 8 are illustrated by the diagrams in Fig. 6. The involute cutters commonly used are made in series of eight cutters for each diametral pitch. Cutter No. 1 is intended for gears ranging from 135 teeth to a rack; No. 2 from 55 to 134 teeth; No. 3 from 35 to 54 teeth; No. 4 from 26 to 34 teeth; No. 5 from 21 to 25 teeth; No. 6 from 17 to 20 teeth; No. 7 from 14 to 16 teeth; and No. 8

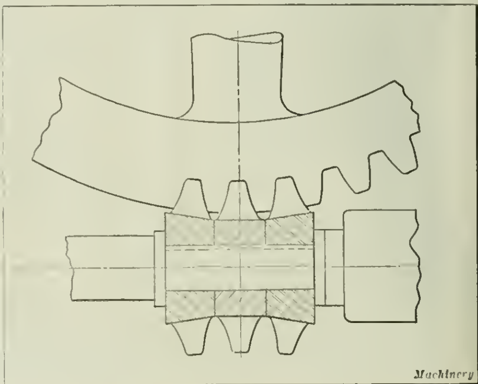


Fig. 8. Gang Cutter for finishing Two Teeth simultaneously

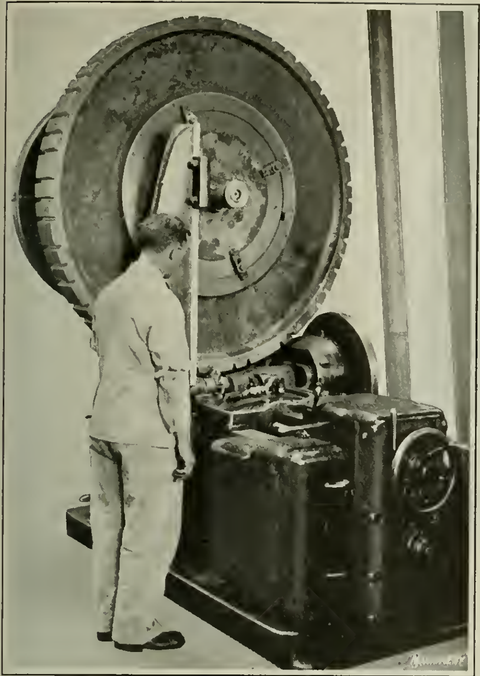


Fig. 9. Example illustrating Application of Intermittent Indexing

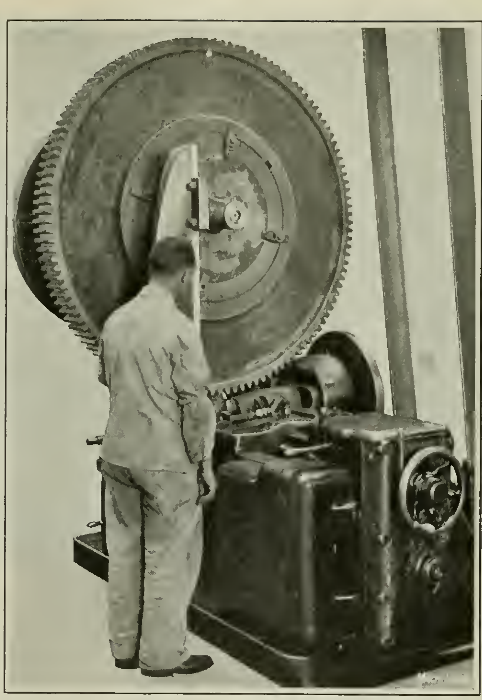


Fig. 10. Finishing the Gear roughed out as illustrated in Fig. 9

for 12 and 13 teeth. The shape of each cutter in this series is correct for a certain number of teeth only, but it can be used for other numbers within the limits given. For instance, a No. 6 cutter may be used for gears having from 17 to 20 teeth, but the tooth outline is correct only for 17 teeth or the lowest number in the range, which is also true of the other cutters listed. When this cutter is used for a gear having, say, 19 teeth, too much material is removed from the addenda of the teeth, although the gear meets ordinary requirements.

These cutters are so formed or relieved that the faces of the teeth may be ground for sharpening without changing the outline of the tooth curve. It is essential when grinding to keep the face of each tooth radial or in a plane intersecting the axis. All teeth must also be of the same height, so that the work of cutting will be distributed uniformly, instead of having one or two high teeth do all the work. Another important point is to keep the cutters sharp, because this increases production, decreases the power required for driving the machine, and produces a smoother and also a better wearing tooth surface on the gear.

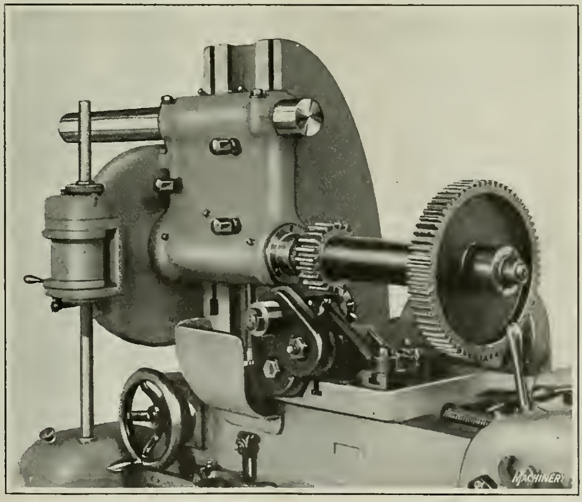


Fig. 11. Gear-cutting Machine equipped with Special Attachment for cutting Quill Gears

Intermediate Series of Cutters to Obtain Greater Refinement

When greater accuracy of tooth shape is desired to insure smoother or quieter operation, an intermediate series of cutters having half numbers is used. The half numbered cutters made by the Brown & Sharpe Mfg. Co., Providence, R. I., are for the following ranges of tooth numbers: Cutter No. 1½, 80 to 134 teeth; No. 2½, 42 to 54; No. 3½, 30 to 34; No. 4½, 23 to 25; 5½, 19 and 20; 6½, 15 and 16; and 7½, 13 teeth. There are seven cutters in this series, No. 8½ being omitted since this would be for a pinion with less than 12 teeth. What has been said about cutter selection applies particularly to spur gears. When bevel gears are cut by the milling process, as will be explained in one of the articles to follow, the method of determining what cutter number to use is different from the method employed in the case of spur gears.

Formed Cutters for Spur Gears with Stub Teeth

Involute gears having a 14½-degree pressure angle are generally considered standard, and are ordinarily cut by gear manufacturers unless otherwise specified, although the stub-tooth gear having a 20-degree pressure angle might be considered standard in the automobile field, as applied to transmis-

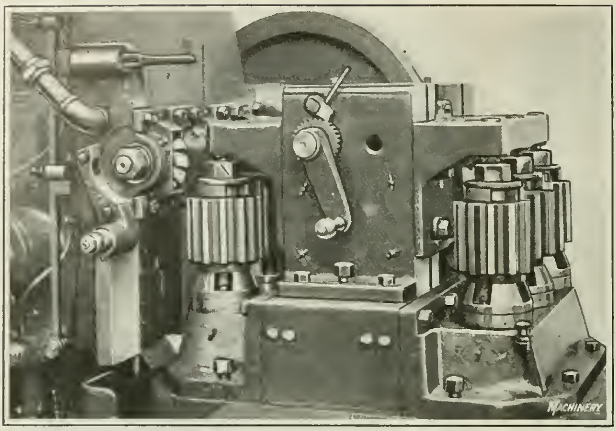


Fig. 12. Example of Gear-cutting on Machine of Multiple-cutter Revolving-turret Type

sions and for certain other applications requiring exceptionally strong gear teeth. Because of the increased pressure angle of a stub-tooth gear, the change in tooth outline is more pronounced for different numbers of teeth than with a 14½-degree pressure angle; hence, in order to secure the same degree of refinement, a larger number of cutters is required for each pitch. While the series of eight cutters referred to may be used for each pitch, a set of fifteen cutters is recommended by the Brown & Sharpe Mfg. Co. to obtain the accuracy ordinarily expected in gears of smaller pressure angle. This set of cutters includes the eight regular numbers plus the seven half numbers or intermediate shapes referred to. To obtain the best results, the cutter should be made special to suit the exact number of teeth required.

RATES OF FEED, IN INCHES PER MINUTE, FOR CUTTER-SLIDE

Diametral Pitch	2	2½	3	4	5	6	7	8	10	12	16
Cast iron ..	3½	3½	4	4½	4½	5	6	6	7	8	9
Steel	1½	1½	2	2½	2½	3	4	4	4½	5	6

Machinery

Number of Cuts Necessary for Gears of Different Pitches

As a general rule, each tooth space is finished by one passage of the cutter when the teeth are formed by milling, although two cuts are frequently taken, especially when cutting large pitches. The degree of accuracy and finish desired may also have a bearing upon the number of cuts necessary. Ordinarily, when the teeth of cast-iron gears are coarser than 2 diametral pitch, it is good practice to take roughing and finishing cuts. When the gears are made of steel or hard bronze, roughing and finishing cuts are preferable for 4 diametral pitch or coarser. While cast-iron gears up to 2½ diametral pitch can usually be finished satisfactorily with one passage of the cutter, it will be understood that the condition of both machine and cutter might change the conditions decidedly. When a second cut is taken for finishing, it is important to have the roughed-out tooth spaces central with the cutter to avoid removing unequal amounts of metal on the sides, since this tends to wear the cutting edges unevenly and produce inaccurate teeth. If roughing cuts are taken, the stocking cutter should be set to mill the teeth the full depth, the allowance for finishing being on the sides. Stocking cutters having ridges to break up the chips are commonly used.

Using Cutters in Gangs to Reduce Time for Cutting Gears

A gang of two or more cutters is sometimes mounted on an arbor, so that all the cutters operate simultaneously. One method is to place a stocking cutter in advance of the finishing cutter, as illustrated in Fig. 7, the finishing cutter being in the central position. This plan is also followed in cutting rack teeth, a common method being to place a stocking cutter and a finishing cutter side by side.

Another arrangement of gang cutters is illustrated in Fig. 8, which shows how two teeth may be finished at each indexing by using a gang of three cutters. It will be noted that the end cutters are of special shape, which is one disadvantage of this method. When accurate gears are required, the gang-cutter method is not advisable; when used, it is generally applied to cutting gears of small pitch, especially when required in large quantities. In general, the use of gang cutters is not recommended for the best classes of work. Ordinarily when the finishing cutter is preceded by a stocking cutter, the teeth are not milled as accurately as when these cutters are used separately; moreover, gang cutters for finishing two or more teeth simultaneously are inferior to the single-cutter method as regards accuracy.

Determining Cutter Speed and Rate of Feed for Cutter-slide

Actual tests are necessary to determine the most effective combinations of cutter speed and feed, because in addition to the pitch of the gear and the cutting qualities of the metal, speeds and feeds are decidedly affected by the kind of cutter used, its condition, especially in regard to sharpness, rigidity of both machine and work, the provision for cooling the cutter, and other variable factors. The following figures obtained from the Brown & Sharpe Mfg. Co. are given as a guide only, and other speeds and feeds should be substituted whenever actual tests show that they will give better results and higher production. When average conditions exist, high-speed steel cutter speeds may vary from 80 to 125 feet per minute for cast iron, and from 65 to 100 feet per minute for machine steel. When carbon steel cutters are used, the speeds for cast iron are ordinarily from 60 to 70 feet per minute, and for machine steel from 30 to 40 feet per minute.

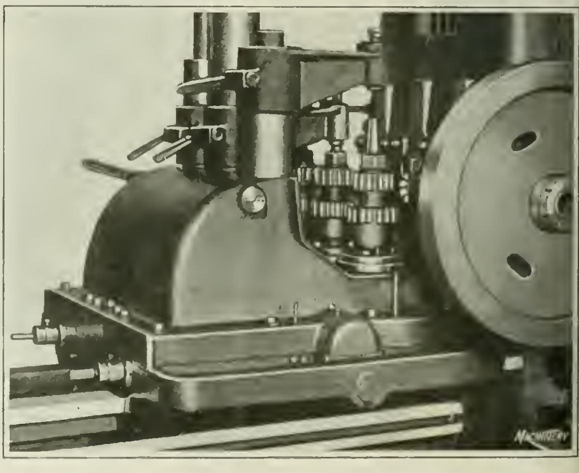


Fig. 13. Another Example of Multiple Gear-cutting

Rates of feed for the cutter-slides, in inches per minute, are given in the accompanying table, which applies to high-speed steel cutters and covers diametral pitches from 2 to 16. In determining the proper rate of feed by actual test, it is necessary, of course, to consider the amount of time the cutter may be used without regrinding, because the highest rate of feed that may be used for a short period is not necessarily the most economical rate.

Changing Rate of Feed when Using Double Cutters

The use of double cutters (one for roughing and the other for finishing) is considered advantageous in many shops when a large number of gears are to be cut, although this method is sometimes employed even when cutting a single gear. When taking the first cut, as illustrated in Fig. 7, both cutters must cut a tooth space through solid stock, whereas for the following cuts the finishing cutter simply removes what has been left by the roughing or stocking cutter. Because of this heavy cutting at the start, a slower feeding movement should be used, and to avoid feeding by hand or changing the gears, the Brown & Sharpe machine (Fig. 7) is equipped with a feed-changing mechanism, which automatically changes the slow feed used for the first cut to a feeding movement twice as fast for the remaining cuts. The feed is again reduced for taking the first cut on the next blank, by means of a hand-lever.

The cast-iron gear shown in Fig. 7 is to have 75 teeth of 2½ diametral pitch; the face width is 3½ inches. Cutters of 5¾ inches diameter operate at a speed of 66 revolutions per minute, or about 90 feet per minute at the pitch line, and the feeding movement after the first cut is 2¼ inches per minute. The time per gear is 3¾ hours.

Additional examples illustrating the use of roughing and finishing cutters at the same time are illustrated in Fig. 2, which shows two gear-cutting machines made by the Newark Gear Cutting Machine Co. of Newark, N. J. When taking the first cut through the solid rim, a relatively slow feed is used, and for all succeeding cuts, where only one cutter is cutting into the solid rim, a faster rate of feed is obtained simply by pulling the triple-geared feed knob out another notch. The large gear on the machine at the left has 150 teeth of 1¾ diametral pitch, and the gear at the right has 86 teeth of 1¼ diametral pitch. Both of these gears are made of cast steel.

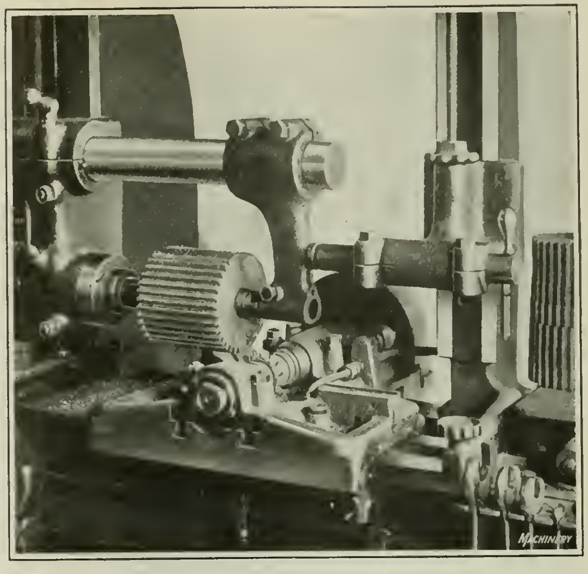


Fig. 14. Stack of Five Gears mounted on an Arbor

Adjustment for Tooth Depth, and Methods of Gaging

Adjustment for depth of cut is made by changing the position of the work-holding slide until the cutter (which should be revolving) just grazes the blank; the cutter is then withdrawn to clear the blank, and the slide carrying the work-spindle is adjusted an amount equal to the whole depth of the tooth, as shown by the graduated dial of the adjustment screw. The whole tooth depth equals 2.157 divided by the diametral pitch. In using this method, care should be taken to safeguard against errors which might result from lost motion between the adjusting screw and nut. The outside diameter of the gear blank should also be measured carefully, and an allowance made if it is not the correct size. The outside diameter of a spur gear is found by adding 2 to the number of teeth and dividing this sum by the diametral pitch.

A good method of checking the position of a cutter relative to the blank is by measuring the tooth thickness with a vernier gear-tooth caliper. This caliper measures the chordal thickness of the tooth at the pitch line. In order to use the caliper, it is necessary to know what the chordal thickness should be and also the perpendicular distance from the chord to the top of the tooth. These dimensions may be determined by formulas or by referring to tables to avoid calculations. (See formulas and tables in MACHINERY'S HANDBOOK, pages 589 to 591.)

Another method of gaging tooth depth is by first cutting two spaces in the blank diametrically opposite (assuming that the gear has an even number of teeth) and a little less than the correct depth. The root diameter is then measured, and

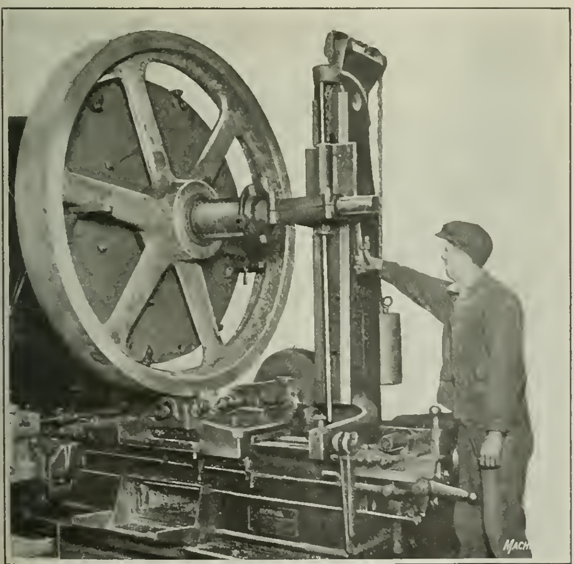


Fig. 15. Method of supporting a Fairly Large Gear

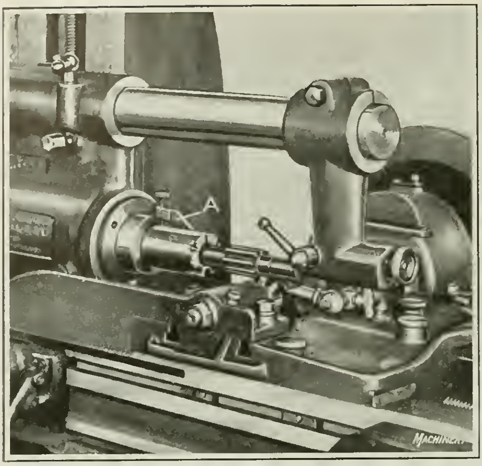


Fig. 16. Pinion held between Centers and aligned by Lever A engaging Keyway

the spaces are recut accordingly; the root diameter is again measured to check the accuracy of the adjustment. A special gage applied to the work-arbor is sometimes used for testing the depth of the cut, especially when cutting a number of duplicate gears.

Single and Block Systems of Indexing

Most gears are cut by indexing from one tooth to the next, but sometimes the index mechanism is arranged to rotate the blank an amount equal to two or more tooth spaces. This "block indexing" is done when using a gang of cutters, which finishes two or more teeth at one time. Block indexing may also be employed with a single cutter, as, for example, when every seventh tooth space is cut in a gear having 100 teeth. When this method is employed, the gear must make two or more complete revolutions in order to finish all the teeth. The object of this system of indexing is to distribute the heat generated by the gear-cutter, and secure greater accuracy and more rapid production. When the teeth are cut by indexing one tooth at a time, the tendency is toward local heating of the gear rim, especially if there is no provision for cooling the cutter and the work. Some compound is ordinarily used, however, for steel gears, and compressed air has been utilized when cutting cast-iron gears, although this is not the general practice. With block indexing, the total number of teeth in the gear must not be a multiple of the number of teeth indexed.

An example of intermittent or block indexing is shown in Fig. 9, which illustrates a roughing operation. A Brown & Sharpe machine is being used and also the improved stocking cutter made by this company. The stepped and plain teeth alternate, the stepped teeth projecting beyond the outline of the plain teeth just enough to break up the chips. This cutter enables comparatively heavy cuts and coarse feeds to be employed, and the intermittent indexing is adopted to prevent errors which might arise from local heating when taking the stocking cuts. This is a cast-iron gear having 124 teeth of 2 diametral pitch, and 6 inches face width. The cutting speed is 90 feet per minute, and the feed 3½ inches per minute. The roughing cuts are taken in six hours. Fig. 10 shows a machine finishing the same gear. The rate of feed for finishing is reduced to 1½ inches per minute.

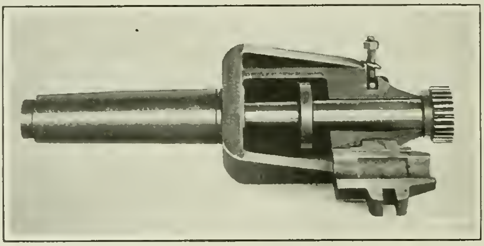


Fig. 17. Special Device for holding a Turret-driving Sleeve when cutting Gear Teeth

Attachment for Cutting Quill Gears

Automatic gear-cutting machines are sometimes equipped with special attachments to adapt them for gear-cutting operations which otherwise could not be performed. One type of attachment is shown in Fig. 11. This attachment, which is for a Brown & Sharpe automatic gear-cutting machine, is clamped on the cutter-slide in place of the regular cutter-spindle bearing. The cutter-spindle of the attachment is elevated enough to permit cutting the teeth of the smaller member of the quill gear. This cutter is driven from the main spindle through a train of steel spur gears. Fig. 11 illustrates the cutting of a gear having 22 teeth of 4 diametral pitch and 2¼ inches face width. The cutter speed for roughing is 100 revolutions per minute, or 78 feet per minute, and the feed 2½ inches per minute. The time required for roughing varies from thirty-eight to forty minutes per gear. On the finishing cut the speed is reduced to 80 revolutions per minute, or 62 feet per minute, and a feed of 2 1/16 inches is used. The time required for the finishing operation on this job is forty-five minutes per gear.

Cutting Spur Gears on Machines of the Multiple Type

Multiple types of gear-cutting machines are sometimes used when the production of duplicate gears is large enough to warrant installing a machine designed for multiple operation. Fig. 12 shows one of the vertical-cutting machines made by Gould & Eberhardt, Newark, N. J., which is arranged for cutting three steel pinions at the same time. In this particular instance, the pinions are roughed out on this machine and afterward finished on a gear-hobbing machine, but this type of machine is used also for finishing certain classes of gears.

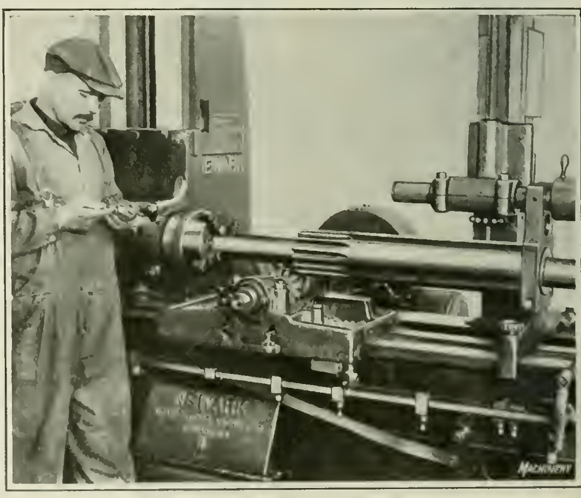


Fig. 18. Cutting a Pinion Integral with a Long Shaft

The pinions are held on a turret which is arranged to hold three on each side. As soon as the pinions on one side are cut, the turret is turned a half revolution, thus locating the uncut blanks opposite the cutters, which are at work while the operator is removing the finished pinions and replacing them with blanks. The support for the upper ends of the work-spindles is in one piece, and is raised for removing the pinions by turning the hand-lever seen in the illustration.

Another multiple gear-cutting operation on a Gould & Eberhardt machine is shown in Fig. 13. This machine is used for cutting three pinions simultaneously. These are double pinions, having twelve and sixteen teeth respectively of 3–4 pitch. Each work-spindle has independent adjustment toward or away from the cutters to compensate for any variations in the cutter diameters. Machines of this kind are intended especially for cutting the coarser variety of spur gears used in trucks and tractors.

Arbors and Fixtures for Holding Gear Blanks

The results obtained with gear-cutting machines may be decidedly affected by the method of holding and supporting gear blanks while cutting the teeth. Many inaccurate gears have been due entirely to poor chucking practice. The aim should be to hold the blanks rigidly but without distortion due to clamping stresses. If there is chattering, the cutter is dulled rapidly, the rate of production lowered, and the quality of the work affected. The size of the blank, its shape, and the shape of any section which may be cast integral with it, largely determine the method of chucking, which should be arranged to permit inserting and removing work readily.

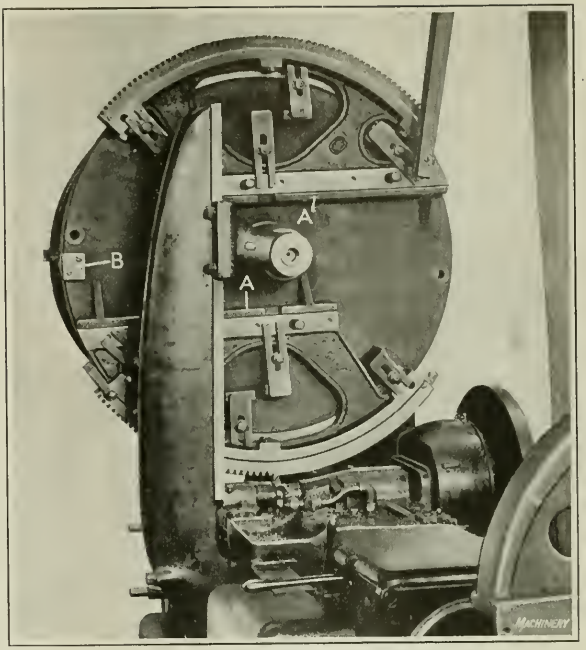


Fig. 19. Cutting Segment Gears which are held on a Special Fixture

The means regularly employed on automatic spur-gear cutting machines include the use of solid arbors, expanding arbors, arbors having stepped flanges or adapters for accommodating bores of different diameters, and special fixtures for large gears or odd shapes. The faceplate of the machine may be put on the spindle and used in conjunction with small jacks or supports placed at different points. The most important support, however, is the rim rest, which is so located as to prevent deflection due to the thrust of the cut, and should always be used if possible. A gear rim should run true to prevent binding against the rim rest, and it is well to apply a little oil to that side of the rim.

Gear Blanks Mounted on Arbors

When cutting small and medium-sized gears it is common practice to cut two or more at the same time by clamping the blanks together in the form of a gang or stack. Fig. 14 shows five gears mounted on an arbor. This arbor has a taper shank which enters the hole in the machine spindle, and the outer end of the arbor is held by the overhanging supporting arm, which is also braced (in this particular instance) by the vertical box column support. The work-holding part of this arbor is straight, and the gears are clamped against the shoulder by a nut at the outer end of the arbor. When gears are held in this way, the rims should be faced true, because inaccuracies will tend to distort the arbor when the clamping nut is tightened. This illustration shows a Newark machine cutting cast-iron gears having 36 teeth of 6 diametral pitch and 1⅛ inch face width. By cutting the gears in gangs of five, a production rate of four minutes per gear is obtained. One cut is taken, and a high-speed steel cutter used. This cutter makes 142 revolutions per minute, and the feed of the carriage is 15 inches per minute.

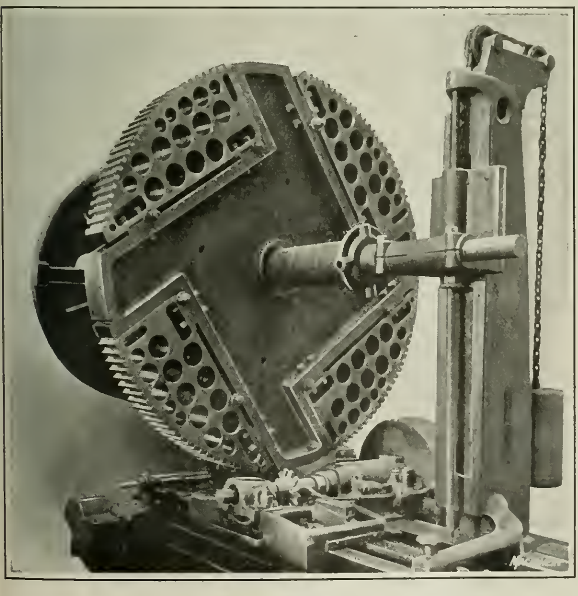


Fig. 20. Another Example of Segment Gear-cutting

Sometimes a gear is mounted on an ordinary lathe arbor, which is supported between centers. The arbor has a dog at one end so that it indexes around with the work-spindle. When cutting larger and heavier classes of gearing, the outer end of the arbor is frequently supported by a bearing instead of using a center. Fig. 15 shows a machine set up in this way. The outward bearing is adjustable along the vertical face of the supporting column, so that it can be set in alignment with the arbor or work-spindle, the height of which varies, of course, for different sizes of gears.

The tractor pinion shown in the Brown & Sharpe machine in Fig. 16, is held between centers, the work being centered at each end. It was necessary in this case to align the teeth relative to a keyway, which is done by engaging the keyway with lever *A* pivoted to a sleeve into which one end of the pinion-shaft extends. Incidentally this stub-tooth pinion has 9 teeth of 7–9 pitch, and a face width of 2¼ inches. It is made of low-carbon steel and one pinion is finished in five minutes, only one cut being taken for each tooth space. The high-speed cutter makes 166 revolutions per minute, or 120 feet per minute, and the feed is 9½ inches per minute.

Fig. 18 shows how a steel spur pinion was cut on a shaft 6 feet long in a Newark machine. On account of the length of this shaft, it would ordinarily have to be cut in a milling machine unless a gear-cutting machine were available with a large enough hole in the work-spindle to take the shaft. In this particular instance, a gear-cutting machine was used by holding one end of the shaft in a chuck screwed on the work-spindle, and the outer end by a bearing attached to the box column support. The feeding movement of the cutter-slide was reversed because the work was too long to feed the cutter forward.

A special holding device used when cutting the teeth on a turret-driving sleeve is shown in Fig. 17. The work is held in place by the hinge cover, which is shown in the open position. This fixture has a taper shank which fits into the spindle of the machine.

Fixtures for Holding Segment Gears

The special fixture shown in Fig. 19 applied to a Brown & Sharpe machine is used for holding two segment gears used in the elevating mechanism of anti-aircraft guns. Great accuracy was required for these parts, and the fixture is designed to hold each of the segments in the same relative position. As the illustration shows, each segment not only fits around the periphery of the fixture or faceplate, but is also located against a projecting ledge or shelf *A* extending along the side of the fixture. The block *B* is used for locating purposes to insure obtaining segment gears which are as near exact duplicates as possible. These segments each have 60 teeth of 4 diametral pitch, and 3 inches face width. Roughing and finishing cuts are taken. The speed for roughing is 57 revolutions per minute or 75 feet per minute, and the feed 1½ inches per minute. The roughing time is seven hours for the two segments. The cutting speed for finishing is the same as for roughing, but the feed is reduced to one inch per minute, and the time is ten hours for finishing the two segments.

Another example of segment gear work is shown in Fig. 20. These segment gears are for the elevating mechanism of 9.2-inch howitzers. As will be seen by referring to the illustration, four segments are mounted on the fixture and are accurately located by bolting them against finished seats. The teeth in this case were cut to a special pitch, and the work was performed at the plant of the Earle Gear & Machine Co. in Philadelphia, Pa.

* * *

THE DeLAMATER-ERICSSON MEMORIAL

The DeLamater-Ericsson Tablet Committee announces that it has had a communication from the Association of Swedish Engineers, Stockholm, Sweden, stating that the association will hold a celebration of the sixtieth anniversary of the battle of the *Monitor* and *Merrimac* simultaneously with the celebration which will be held in New York and Washington on March 9, when tablets in commemoration of the work of Ericsson and DeLamater will be unveiled at four different places in New York City, as mentioned in the December number of MACHINERY, page 312.

ANNUAL MEETING OF AMERICAN ENGINEERING COUNCIL

The American Engineering Council, the governing body of the Federated Engineering Societies, at its first annual meeting at Washington, January 5 and 6, made plans for the coming year. Dean Mortimer E. Cooley of the University of Michigan, president of the Federated Societies, presided. Dexter S. Kimball, dean of the College of Engineering, Cornell University, who is also president of the American Society of Mechanical Engineers, was elected one of the vice-presidents of the Federated Societies. Among the questions discussed was the principle of licensing or registering engineers. The secretary's report showed that the membership of the society is now composed of eight national and twenty state and local engineering societies.

The council voted to continue its support of the legislation for the relief of the United States Patent Office as reported in the Lampert bill. A report of the committee described conditions in the Patent Office as alarming. It was brought out by this report that one of the leaders of the House opposed the bill on the ground that it carried salaries higher than those paid for similar service in other departments of the Government. The chairman of the council's patent committee showed that there were many government positions involving legal or scientific knowledge that carried salaries above those requested for the Patent Office examiners, and demonstrated that the Patent Office examining force would be disintegrated if the matter were not soon adjusted.

* * *

SAFETY AND HEALTH WORK IN THE INDUSTRIES

A constructive article on the importance of safe and healthy working conditions in the industries appears in the December number of *The Nation's Health*, written by Otto P. Geier, M.D., of Cincinnati, Ohio, in charge of the health and safety work at the plant of the Cincinnati Milling Machine Co. The article points specifically to the value of hygienic and safe working conditions in producing better workers and better citizens. It is urged that safely guarded modern machinery, education in safety, clean working conditions, adequate ventilation and lighting, reasonable comforts and conveniences, and a fair wage system make for better efficiency, teamwork, and individual responsibility. On the other hand, Dr. Geier points out that unsafe and unclean working conditions, frequent accidents, careless treatment of employes, driving rather than leading, and slipshod wage systems produce constant dissatisfaction and irritability, affecting both the mental and physical state of health of the individual.

A health exposition was recently held in Cincinnati, which showed the work of the industrial physician. The article referred to places the information gathered relating to industrial relations, health and safety work at this health exposition at the disposal of executives in the industries in an interesting and instructive form. Reprints of the article, which should prove of great value to manufacturers in general, may be obtained from the Cincinnati Milling Machine Co., Cincinnati, Ohio, upon request. The article is distinctly constructive in its tendencies, and should prove helpful to many manufacturers who are realizing the importance of constructive work to counteract the pleas of agitators who are endeavoring to produce strife and discontent.

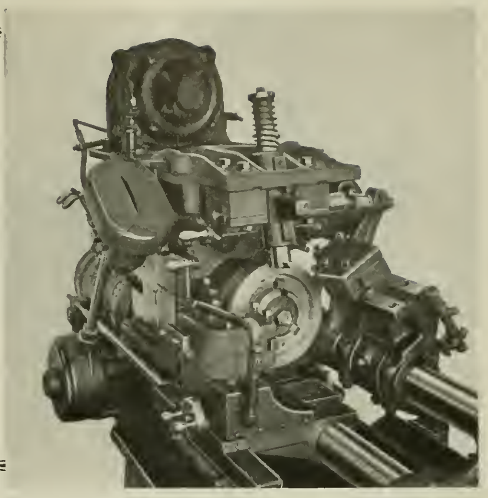
* * *

Building construction in Germany has increased steadily since 1919, according to an item in a Commerce Report. Figures for the first quarter of 1921 show that 5402 buildings were completed during that period, as against 1063 in the same period of 1919. The larger proportion of the buildings constructed were dwellings.

Tooling Equipment for Automobile Gears and Ball Races

Second of Two Articles Dealing with the Production of Automobile Gears

By RALPH E. FLANDERS
Manager, Jones & Lamson Machine Co., Springfield, Vt.



IN the preceding article on the machining of automobile gears, published in January MACHINERY, the operations dealt with were those in which Fay automatic lathes and double-spindle production lathes were employed. In the present article, the examples will include jobs performed on Fay automatic lathes and, in addition, operations on double-spindle flat turret lathes and Hartness automatic lathes.

Operations on a Camshaft Gear

The tooling equipments employed in machining a camshaft gear are shown in Figs. 2 and 3. Although the part is simple in construction, the example will serve to illustrate two or three points of importance. The first operation is performed on a double-spindle flat turret lathe provided with the tooling equipment shown in Fig. 2. The drilling and rough-boring are done in the first position. The rough- and finish-facing steps performed by tools in the second and third positions are effected by the use of the cross-sliding head. In the rough-facing step, the head feeds away from the operator, while in the finish-facing step it is returned. By this arrangement, there are no idle movements of the cross-sliding head. This is a principle of universal application to work of this kind, and it should always be observed.

The reamer shown in the fourth position carries a back-facing tool through its center. The inner side of the hub is faced with this tool for a short distance before the reamer reaches the work. The production on this operation is from thirty-four to thirty-six pieces per hour. The reason for back-facing the hub will be apparent by reference to Fig. 3, which shows the tool set-up used in completing the part in a Fay automatic lathe. The back-facing tool cuts slightly below the finished thickness of the hub and so provides a seat for the clamping nut of the arbor. On parts to be machined in this way, it would be well for a designer to specify back-facing on the drawing, but when this is not done, arrangements can usually be made for taking this cut.

Prior to the operation on the Fay automatic, the small holes around the hub center are drilled. These are utilized in the operation on the automatic lathe, dowel-pins being provided in the arbor which fit into the small holes for driving the part. On work of this kind, broaching, drilling, or keyseating should be done before turning, in order that adequate driving means may be obtained. There are two machines provided with the tooling shown in Fig. 3, and these are run by the same operator. One machine roughs the work and the other finishes it. The output is thirty complete parts per hour.

The writer is inclined to criticize this set-up on the score of having too short an arbor. While the shortness adds to the stiffness, it tends to displace the rim more for a given inaccuracy of centers or of the arbor. In general, the all-over length of an arbor ought to be at least twice the diameter of the work. The small size of the center hole, of course, makes it impossible to put two or more pieces on the arbor at a time. Camshaft gears are the most difficult to get running quietly of any of the gears used in automobile construction, and so every precaution should be taken to procure smooth running. The finishing of gears on a true arbor is a long step toward this end.

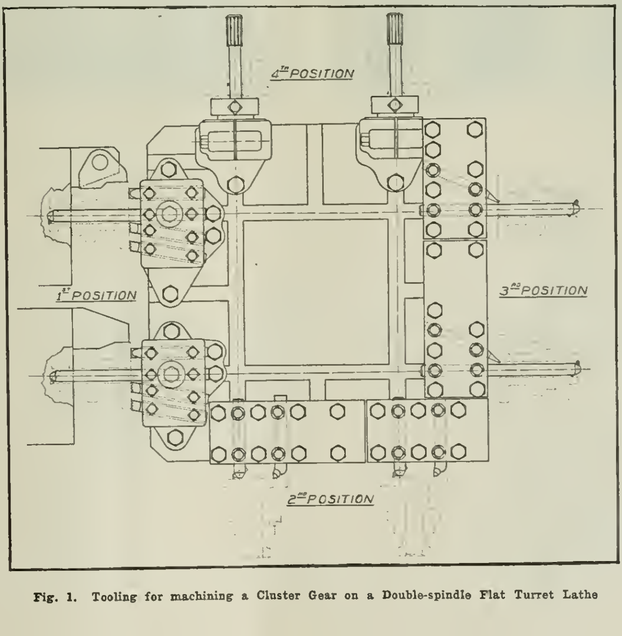


Fig. 1. Tooling for machining a Cluster Gear on a Double-spindle Flat Turret Lathe

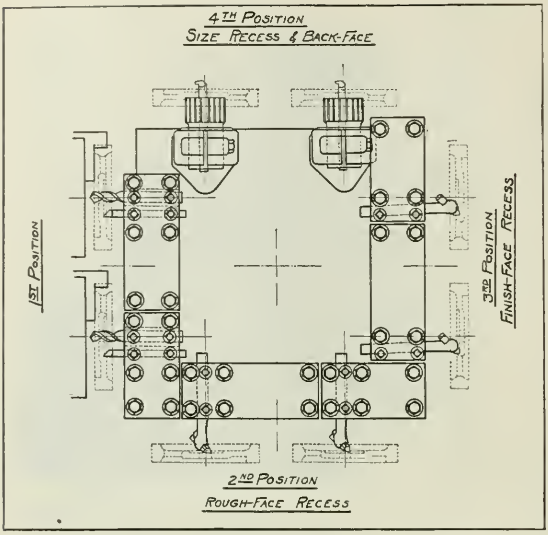


Fig. 2. Tooling used on a Double-spindle Flat Turret Lathe for producing a Camshaft Gear

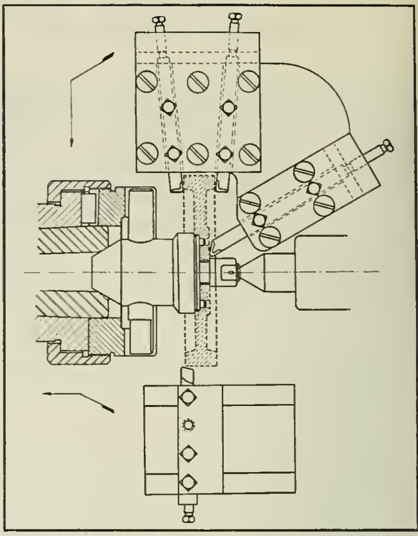


Fig. 3. Facing Hub and Rim Sides of Camshaft Gear on a Fay Automatic

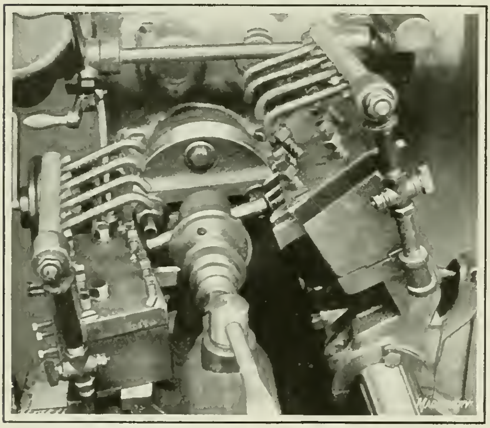


Fig. 4. Machine equipped for taking the Turning and Forming Cuts on a Cluster Gear

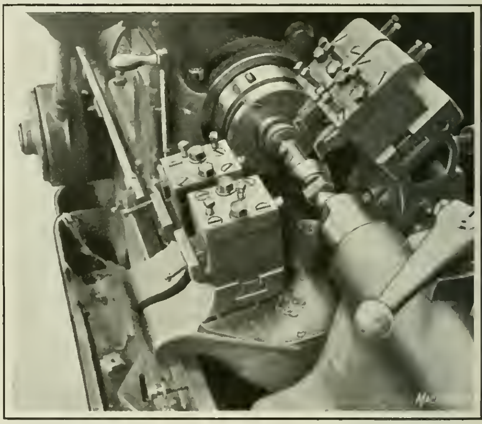


Fig. 5. Close-up View of Machine provided with the Tooling for a Small Bevel Pinion

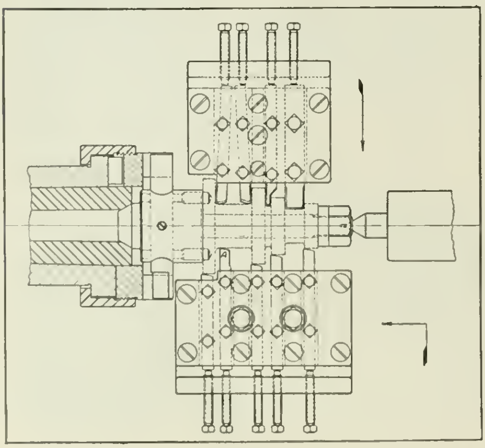


Fig. 6. Equipment for turning and forming the Cluster Gear shown in Fig. 1

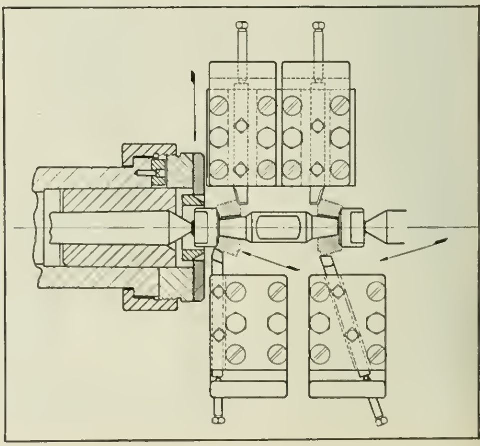


Fig. 7. Turning Small Bevel Pinion on a Special Double-carriage Fay Automatic Lathe

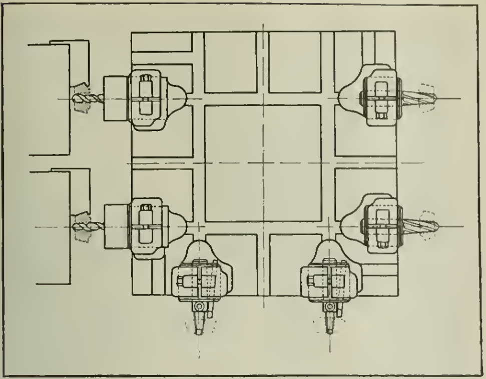


Fig. 8. Double-spindle Turret Lathe set up for machining the Taper Hole and butt-facing the Hub of a Bevel Pinion

The bend in the arrow at the side of the rear tool-holder indicates the feeding movements required for this tool to prevent the hub facing tool from coming in contact with the rim of the work.

Equipments for Machining a Cluster Gear

Another characteristic gear in automobile drives is the cluster gear commonly used on the transmission jackshaft in place of a set of separate gears employed in older practice. Improved methods of forging, machining, and gear-cutting have made possible this greatly simplified construction. In the process here dealt with, the forging first has the central hole rough-drilled in a heavy-duty drilling machine and then comes to a double-spindle flat turret lathe provided with the tooling shown in Fig. 1. On this machine the hole is rough-bored and the part is rough-faced at the large end by scale-breaking tools, as shown at Position 1. A straight longitudinal feed, under a heavy cutting power, is used for this operation. The tools in the second position finish-face the end, the total cut being divided between two tools on each piece in order to shorten the operation. One tool works from the periphery of the part toward the center, and the other cuts from the center toward the outside. The tools in the third position finish-bore and chamfer the hole, and the reamer shown in the fourth position takes the final cut in the hole.

The blank has two holes drilled in the faced end for driving purposes, in a later operation, and is then mounted on a vertical arbor on a drilling machine and has the small end butt-faced. The work is now ready for the outside turning, and this is done in a Fay automatic lathe furnished with the tooling shown in Fig. 6. The arbor construction provides two driving pins to engage the holes drilled in the face of the gear blank, as previously explained. The hole of this gear does not have a keyway, and so this special means must be taken to furnish a drive which will stand the heavy torque imposed by the large number of tools used. The front tool-holder rocks in rapidly and then feeds toward the left, tool *A* turning the neck and the other tools the outside diameters. The rear tool-holder rocks in and faces and forms the various surfaces as shown. Another operation very similar to this is illustrated in Fig. 4. Two machines are used, one for roughing and the other for finishing. The production with rough forged blanks is from twelve to fifteen pieces per hour. This requires up to 15 horsepower for driving the machine.

Production of Rear-axle Drive Bevel Pinion

The machining of a separate type of rear-axle drive bevel pinion is an interesting job on account of the high production possible. The blanks are forgings and have the taper holes machined and the rear hub butt-faced in a double-spindle turret lathe furnished with the tooling shown in Fig. 8. The output of this operation is from eighty-five to ninety pieces per hour, and it should be possible to increase this somewhat with the development of a production lathe having three tool positions on a cross-slide. The blanks go next to a drilling machine to be butt-faced at the small end in the same manner as described in connection with transmission gears in the article "Cost-reducing Tooling Equipment," in January MACHINERY.

The turning operation is performed on a special double-carriage Fay automatic lathe having the tooling illustrated in Fig. 7, the two front tool-holders feeding independently in the direction indicated by the arrows. The rear tool-holders form the back of the work to the angle shown. In one automobile shop where only one cut is taken over the gears, an output of 1100 pieces in eight hours has been obtained. One machine keeps an operator busy at this rate, and he requires a helper for loading the arbors. Ordinarily, of course, two machines would be used, one for roughing and the other for finishing the work. A machine set up for a similar gear is shown in Fig. 5.

Machining a Ring Bevel Gear

The first operation on a ring bevel gear is performed on a Hartness automatic, a machine which was designed especially to embody the principle of intensive tooling. Fig. 9 shows a gear of a conventional design being produced on this machine. The operation consists of rough- and finish-facing the back and the recessed seat, and back-facing the inside of the flange. All this is done by tools in the lower holder which swings to one side for the roughing cuts and to the other side for the finishing cuts. The upper tool-holder carries cutters for rough- and finish-boring, necking, and chamfering. The hole is rough- and finish-bored by one

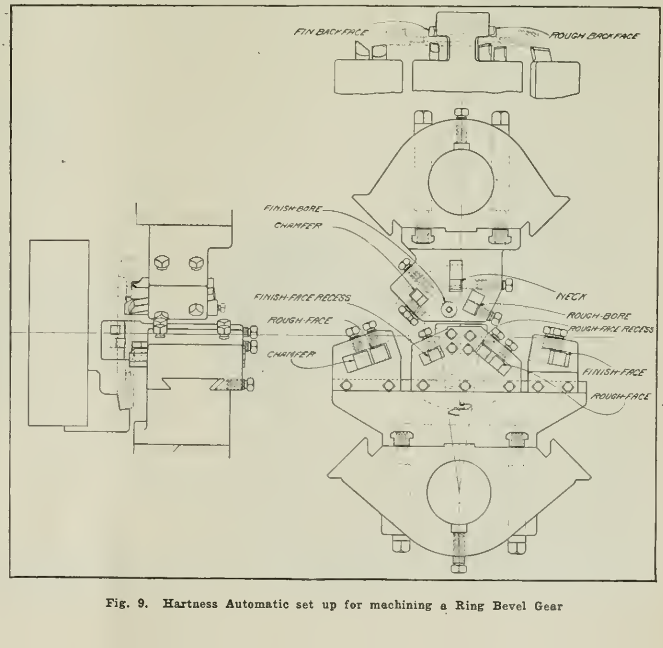


Fig. 9. Hartness Automatic set up for machining a Ring Bevel Gear

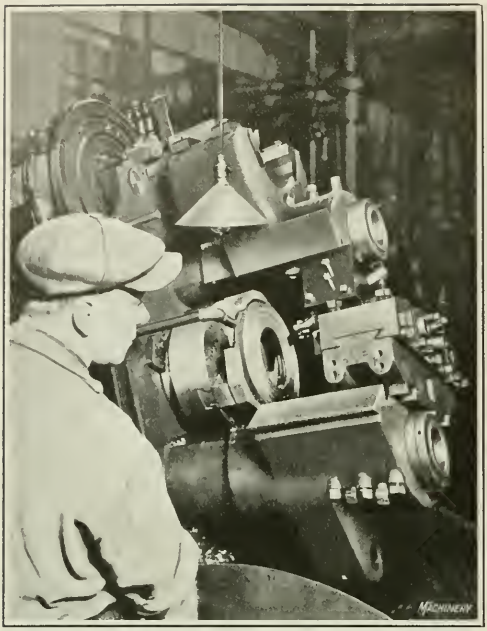


Fig. 10. Hartness Automatic provided with the Tooling for machining a Ring Bevel Gear, shown in Fig. 9

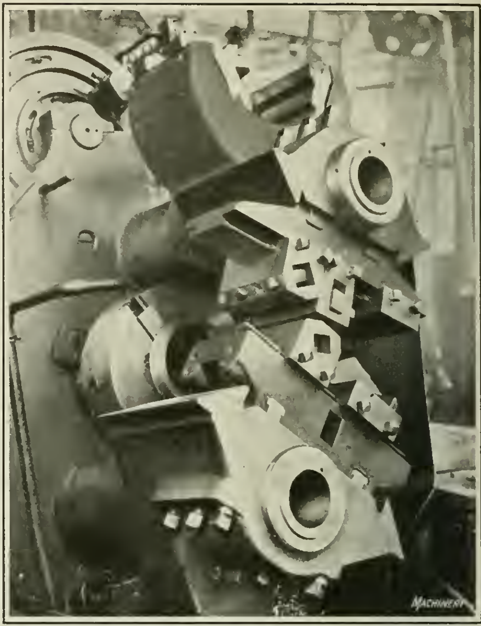


Fig. 11. Close-up View of the Equipment used in machining a Ball Bearing Race, shown in Fig. 13

feeding movement, the finishing tool following the roughing one. An accuracy of 0.001 inch can be constantly maintained in this operation. The output varies from twelve to twenty pieces per hour, depending on the size of the gear and the material from which it is made. The higher figure is obtained with a 10-inch drop-forged gear of mild steel, which is annealed, and intended to be carburized and heat-treated.

This set-up, which is also shown in Fig. 10, is an excellent example of concentrated tooling with idle movements eliminated. An operator is kept busy attending two of these machines on ordinary work. The blank next has holes drilled in the web and is then ready for an operation performed in a Fay automatic lathe provided with the equipment shown in Fig. 12 and in the heading illustration. Referring first to Fig. 12, it will be noted that the work is held in place against a hardened seat by a quick air-operated fixture, and is driven by dowels engaging the holes drilled in the web. The tools in the front holder rough- and finish-turn the outside diameter and finish-face the surface which will later be the inner end of the teeth. The tools in the rear holder rough the bevel face of the gear and round its back corner.

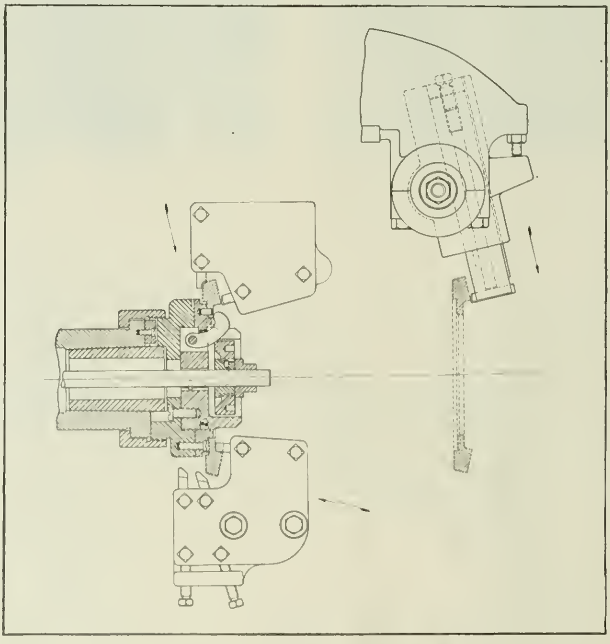


Fig. 12. Example in which the Work is held on an Air-operated Fixture and driven by Dowels engaging Holes in the Web

As plainly shown in the heading illustration, a tool is carried in an overhead slide provided for finishing the face of the gear. Since this slide is mounted independently of the arm on which the rear tool-holder is located and has a separate connection to the cam-drum, it is possible for the face finishing tool to follow right behind the roughing cut on this surface without its accuracy being affected by the heavy strains of the roughing cut. This arrangement, therefore, permits all cuts to be taken simultaneously, and in practically the time needed for the longest cut, which is that of rough-facing the bevel surface. The output per machine is from twelve to twenty gears per hour, depending upon the size and material. One operator can usually run two machines.

Tooling for Finishing Ball Bearing Races

The machining of an outside race for a large ball bearing is accomplished in Hartness automatics by the use of the tooling equipments shown in Figs. 11, 13, and 14. The blank is a forged ring made of a special steel alloy and is somewhat difficult to machine. In the first operation, the forging is held from the inside by the swivel jaws of a three-jaw chuck, as shown in Fig. 13. This gives six points of clamping in all, and makes it possible to tighten the jaws sufficiently for taking heavy cuts without distorting the work. From the tooling arrangement it will be seen that the part is bored half way through on this machine. The reason for this is that it requires no extra time, as it is done while the outside of the part is being turned, and it materially shortens the time necessary for the succeeding operation. A close-up view of this set-up is shown in Fig. 11. When the upper holder is fed in, it bores the hole and rough-turns the outside. It then swings to the left and finish-turns the outside while being fed back. The lower holder swings to the left and faces the part on one end, chamfers the hole, and rounds the outside corner. This completes the first series of operations on the part.

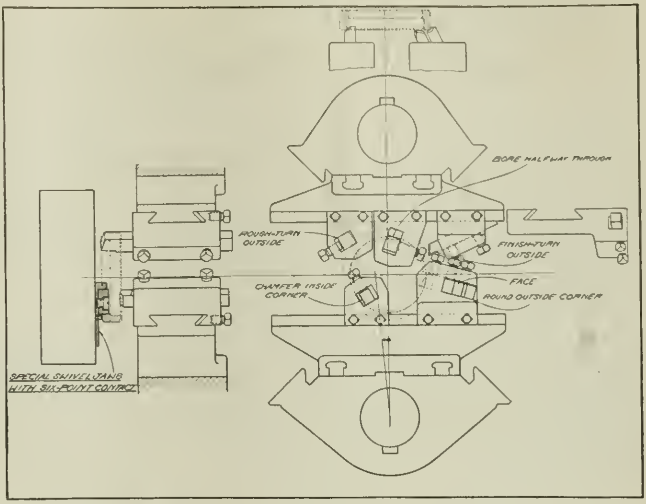


Fig. 13. Diagrammatic Illustration of the Tooling on the Machine shown in Fig. 11

Tooling for Second Series of Operations on Ball Bearing Races

Fig. 14 shows the tooling for the second series of operations. The work is held in accurately bored soft jaws which grip it on the finished outside. The lower tool-holder carries a facing tool only. The upper holder first feeds directly in and completes the boring of the unfinished half of the hole. It then swings toward the left and rough-grooves and finish-grooves the part, and chamfers and rounds the corners. The finish-grooving tool is mounted a greater radial distance from the center about which the holder oscillates than the rough-grooving tool, their relative positions being such that for a given angular swing of the holder, the finishing tool travels faster than the roughing tool and thus tends to overtake the latter. By this means, the roughing and finishing cuts are taken in one continuous movement by two separate tools mounted in the same holder.

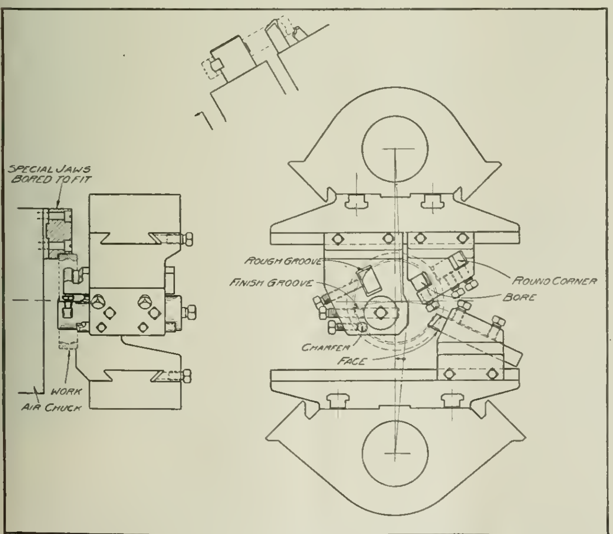


Fig. 14. Tooling employed in the Second Operation on the Ball Race which is also performed on a Hartness Automatic

MEETING OF AUTOMOTIVE ENGINEERS

At the annual meeting of the Society of Automotive Engineers held in the Engineering Societies' Bldg., 29 W. 39th St., New York City, January 10 to 13, a great many interesting papers were read. Those of especial interest to MACHINERY's readers were "Chrome-Molybdenum-Steel Application from the Consumer's Viewpoint," by C. N. Dawe; "Continuous Die Rolling," by G. R. Norton; "Drop-forging Practice," by J. H. Nelson; and "Pertinent Facts Concerning Malleable-iron Castings," by Enrique Touceda. These papers were all read at the Materials Session.

A Standards Committee meeting was held in connection with the annual meeting, at which sixteen divisions of the Standards Committee presented reports, including the committees on ball and roller bearings, chain, iron and steel, non-ferrous metals, parts and fittings, and screw threads. Other sessions of the meeting were devoted to airplane engines, body engineering, motor truck transportation, lubrication, research, fuel and engines, with a special session on passenger cars. The papers that were read before the meeting are published in the Journal of the Society of Automotive Engineers.

* * *

NEW CLASSIFICATIONS FOR EXPORT STATISTICS

Beginning January 1, the Department of Commerce will employ new classifications for its export statistics. The new classifications go into considerably greater detail as to the classes and types of machinery exported. In the metal-working machinery field, for example, the classifications will cover specifically lathes; boring and drilling machines; planers, shapers and slotters; bending and power presses; gear-cutting machines; milling machines; sawing machines; thread-cutting and screw machines; punching and shearing machines; power hammers; rolling machines; wire-drawing machines; polishing and burnishing machines; sharpening and grinding machines; foundry and molding machinery; and other metal-working machinery. In addition, there will be a sub-division for chucks; another for reamers, cutters, and drills; and one for pneumatic portable tools.

Aggressive Machine Tool Salesmen

By a Machine Tool Sales Manager

THE traveling of the machine tool salesman from shop to shop, calling upon his customers and those whom he hopes to make his customers, is the aggressive part of machine tool salesmanship—the very life of the business. The aggressive salesman realizes that the shop man buys a machine tool, not when the actual order is written out, but when he has been convinced of the desirability of acquiring a machine that he needs. Too many machine tool salesmen sit back comfortably with the thought that when their customers—their personal friends—are ready to buy, they will let them know. Such salesmen not only neglect their own personal interest, but they also fail to avail themselves of their opportunity to benefit both their customers and the manufacturers whose tools they are distributing.

A System of Successful Salesmanship

The system used by a successful machine tool salesman is an example of efficient salesmanship. This man keeps a memorandum book in which he divides his prospects into three classes: (1) Those ready for closing; (2) those active and interested; and (3) those worth cultivating. In the first list he keeps the names of all those for whom he has orders pending and who are ready for closing the sale. They receive his first attention. Every day he looks over this list, and asks himself if there is anything that he can do that day toward getting the final order; if so, he does it. He passes up other probable orders, if necessary, in order to devote himself to the actual possibilities of the day.

After the names in the first class have been attended to, he takes up the second list—the active prospects. These are concerns that he feels it will pay him to cultivate intensively, because there are machines that they should buy, because their industry is enjoying sufficient prosperity to make expansion likely, or because there is a probability of a change in the product, requiring new equipment. His efforts are devoted to bringing this second class of prospects into the first class of probabilities. If time permits, he takes up those on the third list, making a friendly call upon those that are merely prospects worth cultivating, with the aim of transferring them to his second list.

This salesman claims that his system produces very satisfactory results, and enables him to accomplish more each day than he would otherwise find time to do.

How Machine Tool Salesmen are Received

The writer of this article at one time occupied a position in which it was his duty to receive machine tool salesmen. It was the policy of the firm to receive everybody, and to answer every letter that called for an answer. Sometimes this policy becomes irksome to the man who has to receive all visitors with something to sell, and it is not carried out to the letter of the law.

The reception of a machine tool salesman depends largely upon the general condition of business. When a firm is quietly studying new methods or contemplating a change in design, the machine tool salesman is most welcome; but most of the tools bought when business is less pressing are selected because of the "missionary" calls made by salesmen at a previous time.

It is commonly stated by machine tool salesmen that when a concern issues a list, the tools are already selected, and in the experience of the writer, this is true. It may not always be true, but unless the sending out of the list develops some unexpected information, the tools in mind when the lists are circulated are generally the tools purchased. When the lists specify a 16-inch lathe of a given make, "or equal to it," it is almost certain that the prospective buyer believes that the machine made by the firm whose name he has quoted has no equal for his particular work.

Visiting New Prospects

It is the visits of the machine tool salesmen in apparently quiet times that actually build business for them. It is the "fill in" calls that start the ball rolling, and those calls require the greatest experience and diplomacy to prevent them from becoming irksome to the prospective purchaser because of their aimlessness. They are calls without an apparent reason. The salesman makes the prospective customer feel that he wants at least an inquiry, if not an order, at a time when there is no reason for either. There is no particular point to the talk. The customer is asked how his health is, how business is, and if he won't remember them when he is in the market for something.

Now, in justice to the machine tool salesman, it must be admitted that the hardest problem, when there are no immediate prospects of sales, is to find something to talk about. He sometimes will hesitate to call upon a prospect because he is unable to find the right subject to bring up, knowing that there is no immediate business. Nevertheless he should see the prospect. The average machine tool salesman makes a mistake in dealing with too many subjects at one time. It would be much better for him to stick to one theme in striving to make an impression on a prospect, considering the subject from different angles. The salesman can talk about his prospect's product. He can ask how this or that operation is performed in the customer's shop. In this way he gains much information, and he may be able to make suggestions that would prove of value. There are times when the customer does not feel like talking. It then becomes the salesman's job to arouse his interest.

Subjects of Interest to the Customer

There are many things that a salesman may speak of to interest his prospect, but he should avoid discussing all of them at one time. He makes a great many calls and can choose one subject for each call. The salesman can talk about his firm. He can explain the policy of the manufacturer he represents and the things that his firm is able and willing to do in an effort to help the customer. It is as important to impress upon the customer that the manufacturer's policy is a liberal one as that the machinery itself is of the right quality; but in order that such talk may be of value, it must be sincere and based upon the earnest convictions of the salesman. A testimonial letter from a reputable firm is a worthy means of creating a lasting impression. Automobile salesmen use such means effectively; why should not machine tool salesmen use them also? There is nothing that a customer likes to know more than that the machine he plans to buy has given satisfaction elsewhere. A point that salesmen should remember is that when they hand a prospective customer a testimonial letter to read, they should keep quiet while the prospect reads it.

Interesting incidents are often effective as a basis for an impressive interview. Back of the design or the evolution of most machine tools there is a story of how and for what reason they were designed. There is a personal interest in such incidents. Not only does one remember the tools because of the story, but one usually remembers who told the story. Hence, a double purpose is gained; the machine will be remembered and the salesman as well.

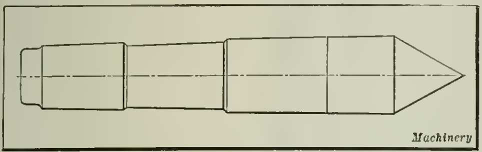
Actual increases in production effected in other plants with the machines offered for sale are always of interest, but the salesman should be careful to be accurate in all such statements and to avoid exaggerations. Reasons for the increase should be given, which leads to an explanation of the merits of the machine and special features of its design.

Briefly, a machine tool salesman, in order to make his calls worth while, must be able to use the prospective customer's time to some good purpose, and that can only be done by a thorough knowledge of the goods that he has to sell and a systematic distribution of that knowledge.

* * *

SHOULD CENTERS BE RELIEVED?

In the manufacture of "Red E" high-speed centers we are looking for improvements that will meet the needs of our customers. We have had under consideration for some time a change in design in which the centers would be relieved



Relieved High-speed Lathe Center

somewhat along the lines shown, slightly exaggerated, in the accompanying illustration. The method may have both advantages and disadvantages, and it would be of great interest to hear from the readers of MACHINERY as to their opinions of relieved centers.

THOMAS FISH
Bridgeport, Conn. President, The Ready Tool Co.

* * *

WAGES IN GERMAN MACHINE INDUSTRIES

The table below shows a comparison of hourly wages paid in the machine-building industry in Chemnitz, Germany, previous to the war and since January 1, 1922. In the present agreement on wages of workers in the metal industries, a basic hourly rate is fixed, and the worker receives a certain additional rate on account of the high cost of living. In the table these two items are added together. Furthermore, skilled workmen who are always employed at an hourly rate (not on piece-work) receive an additional amount which has also been included in the figures given. In figuring present exchange, 1 mark has been assumed to be equal to 0.6 cent.

Class of Worker	Age	1922		1914	
		Marks	Dollars, Present Exchange	Marks	Dollars, 1914 Exchange
Toolmakers, Patternmakers, Molders, Highly Skilled Operators	over 25	11.20	0.07	0.60	0.15
	21-25	9.85	0.06	0.60	0.15
	19-21	8.50	0.05	0.60	0.15
	17-19	6.29	0.04	0.60	0.15
Machine Operators	over 25	9.50	0.06	0.50	0.12½
	21-25	8.25	0.05	0.50	0.12½
	19-21	7.00	0.04	0.50	0.12½
	17-19	5.05	0.03	0.50	0.12½
Unskilled Labor	over 25	9.30	0.06	0.40	0.10
	21-25	8.15	0.05	0.40	0.10
	19-21	6.80	0.04	0.40	0.10
	17-19	4.75	0.03	0.40	0.10

Machinery

HAS THERE BEEN A DECLINE IN FOREIGN TRADE?

No figures are needed to show that there has been a decided decline in the foreign trade of machine tools and metal-working machinery during 1921, and it is generally believed that there has also been a decline in the foreign trade of the United States as a whole, which is thought by many to be one of the causes of the present industrial depression. The Federal Reserve Bank of Boston calls attention to the fact that for several months statements have appeared in the newspapers showing that the exports of the United States were several hundred million dollars less a month than during the corresponding month a year ago, a decline amounting to as much as 50 per cent or more. In order to ascertain whether our foreign trade actually is declining, when considered from the standpoint of volume rather than of value, an investigation was made which shows that the total volume of our exports is now actually higher than it was during the first months of 1920, although its value in dollars is considerably less. Therefore, instead of our exports actually falling off, they are really increasing, and furthermore the exports measured by physical volume have been materially higher in 1919, 1920, and 1921 than they were in 1913.

There are two factors which tend to confuse the foreign trade situation. The first is that there is a tremendous tonnage of shipping idle at the present time in our harbors. The other is that foreign exchange operates against most countries and in favor of the United States. As for the idle ships, notwithstanding the great amount of tonnage involved, the Government reports that the tonnage of vessels engaged in foreign commerce entering and leaving our ports at the present time is considerably more than a quarter greater than the average during the pre-war years of 1911 to 1913. This corresponds closely with the increase in the physical volume of both exports and imports as described in the foregoing. The reason for so many idle ships is thus seen to be not a decline in the amount of shipping actually engaged in commerce, but the fact that new tonnage came into existence during the war faster than it was destroyed; furthermore, there has been considerable construction since the armistice. There is, in fact, a greater tonnage of merchant shipping afloat today than ever before.

Increase in Volume of Exports

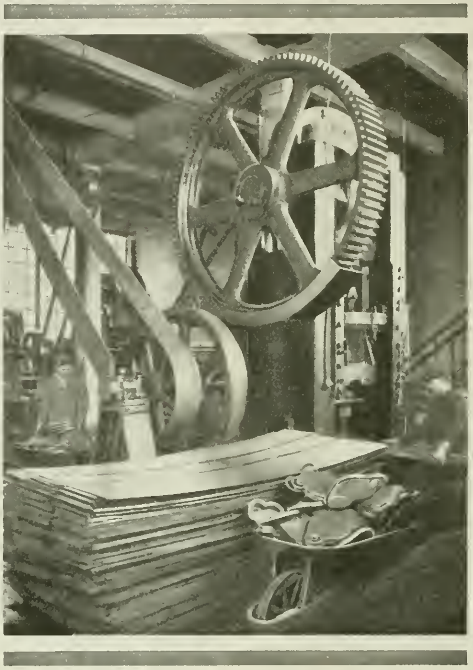
The physical volume of our exports to Germany during the year ended June 30, 1921, aggregated 66.8 per cent (two-thirds) of their pre-war total, and the tendency during the last few months has been for it to increase. An analysis of the volume of exports of specific commodities shows that Germany took 40 per cent as much cotton, 50 per cent as much copper and considerably more foodstuffs during the fiscal year of 1921 than in the corresponding year of 1913.

The United States' trade with Soviet Russia is much greater at the present time than is generally realized. The United States Department of Commerce has issued a statement based on official Soviet papers which shows that the United States supplies 16 per cent of Soviet Russia's imports, only Great Britain and Germany furnishing a larger proportion. Shoes, especially men's, represented more than half of the goods we shipped, the bulk of the remainder consisting of leather, white flour, binder twine, and agricultural machinery.

Our foreign trade situation is not discouraging when viewed broadly. Certain aspects of it, such as the decline in the exports of finished goods, have undoubtedly aggravated the depression in the manufacturing industries. The productive capacity of the latter was expanded more rapidly during the war than the normal growth of this country warranted. On the other hand, the increase in the exports of raw materials has had a tendency to relieve the stress somewhat in other fields.

Utility of Single-action Straight-sided Presses

By N. T. THURSTON, The Acklin Stamping Co., Toledo, Ohio



THE simplest and probably the oldest form of power press is the single-action straight-sided type which, because of its simplicity and general usefulness, is widely employed. This press is made in a greater number of sizes than any other one type. The heights range from 51 inches to around 18 feet, while the weights vary from 1400 pounds to 150 tons. The smaller sizes are of the single-crank type, and are driven directly from the flywheel. The intermediate sizes are also of the single-crank type, but are geared. Such a press is shown in the illustrations. The largest presses have two cranks and are double-geared.

Double-crank presses are used in work requiring considerable pressure, but this is not the only reason for employing the double-crank construction. The need of a large die space is often a more important factor than the power which these presses are able to exert. For example, in forming automobile fenders, hoods, bodies, and pans, a press of great strength is unnecessary, but a space large enough to accommodate the dies for forming these parts is an essential requirement. The space necessary for the die used in forming the engine pan of a popular automobile is 42 by 42 inches. A double-crank single-geared press is used for this work, but the press is required to use only one-fifth of its normal working power.

Construction of the Press Frame

The frame of heavy-duty presses is subjected to considerable strain, and this is compensated for by various constructions. In one design the frame sides are cast comparatively light and hollow, and are held to the bed by long tie-rods that extend to the top of the frame. These rods are threaded at both ends, and are provided with nuts that are screwed up while the rods are red hot at several points along their length. The shrinking of the rods, in cooling, puts the frame under a compressive stress greater than any opposing strain to which the press is subjected while in operation, and so keeps the frame rigid.

The heading illustration shows a press of the tie-rod construction being used in the production of gear covers. The blank is cut and the cover formed in one operation. The press is kept running continuously, and every stroke is effective except those lost while a fresh piece of stock is being put in place. The production on work of this kind is limited mainly by the speed of the press, and in the case illustrated is about 230 pieces per hour.

Classes of Work Done on Single-action Straight-sided Presses

Single-action straight-sided presses can be employed for blanking, piercing, wiring, flanging, lettering, embossing, forming, and drawing operations. Many of the difficult forming and drawing operations usually accomplished on double-action presses can be done on the single-action type if a series of proper reductions is made on the part by the use of dies having the proper radii, and when single-action presses are equipped with rubber or spring pressure attachments, they can perform the same sort of drawing work that is done on toggle or double-action presses. Also, when single-action presses are provided with some kind of air pressure attachments, drawing operations on stock which varies in thickness can be performed more successfully than on toggle presses.

This is true because the air attachment gives a constant and uniform pressure on the blank-holder regardless of the variation in the thickness of the metal being drawn, while a blank-holder actuated by means of toggles always assumes the same position on the downward stroke of the press ram and so variations in the thickness of the stock are not compensated for. The result is a pressure on the stock that is either too light or too heavy. An excellent example of the satisfactory manner in which work can be produced on single-action presses equipped with air pressure attachments is the United States Army steel helmet referred to in "Pneumatic Cushions in Metal-drawing Operations," which appeared in April, 1920, MACHINERY. Parts typical of the work handled by single-action straight-sided presses are gear covers, automobile engine pans, fan blades, muffler cones, and universal joint housings.

Feeding the Stock

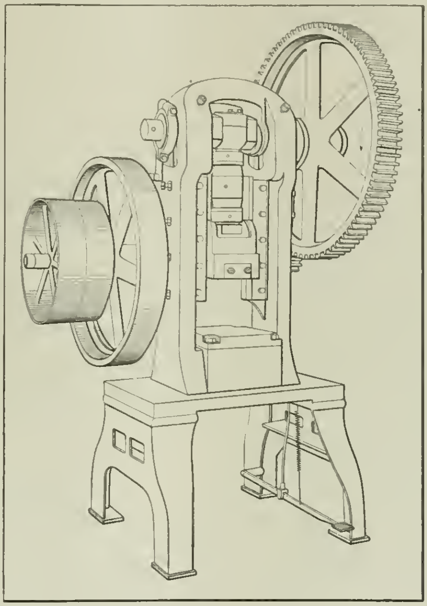
The front-to-back opening in straight-sided presses permits long strips or rolls of stock to be fed through the die. While this method of feeding has advantages, it is not as convenient as the cross-feed possible with inclinable presses. With the latter method the operator can remain seated directly in front of the press, while with the front-to-back feeding method the operator must sit or stand at one side of the press center, as will be seen by again referring to the heading illustration. The ideal job for a single-action straight-sided press is work which can be performed with a die that allows the stamping to fall through the die and bolster and into a pan beneath the machine.

Push-through operations enable the greatest production on this type of press, and a good operator protected by safety devices can keep the press running continuously on such work. On the large presses, which are double-geared and therefore slow-running, there is enough time to remove the work from the die and insert a fresh piece while the press is in motion. This is the procedure with the machine shown in the heading illustration, and it is not as risky as it may seem, because the large presses are equipped with friction clutches which enable the operator to stop the ram at any point along its stroke. Thus if a part is placed crosswise or in any other incorrect position on the die, the press can be stopped before the punch reaches the work.

* * *

PRODUCTION OF LIQUID AIR

The production of liquid air by the Hampson process in the plant installed at the Bureau of Standards is described in Technical News Bulletin No. 55 of the bureau. A four-stage steam-driven compressor delivers air at room temperature and under a pressure of approximately 3000 pounds per square inch; this air then passes through an oil and water trap and a purifying train containing reagents that remove the carbon dioxide and water vapor. The air thus compressed and purified is then delivered to the liquefier, and after it has passed through a coil of copper tubing, it is allowed to expand freely to approximately atmospheric pressure. When this drop in pressure takes place, there is a corresponding drop in the temperature of the air. The expanded air before leaving the liquefier circulates around the copper coil that contains the compressed air, thus cooling it, so that in continuous operation a cycle of progressive cooling is maintained until the temperature ultimately reaches the liquefying point. The liquefier is constructed so that the air that is condensed is delivered into a receiving vessel. The gaseous air exhausted from the liquefier is returned to the intake of the compressor for succeeding cycles because it has been purified, and when used repeatedly will be found to be much less exhausting on the purifying reagents that are employed to remove the carbon dioxide and water vapor.



Single-action Straight-sided Press with Geared Drive

* * *

STANDARDIZATION OF SUPPLIES FOR WAR DEPARTMENT

The supply branches of the Army have been directed by the Secretary of War to utilize, in connection with their specifications, the standards that have been or may be adopted by the American Engineering Standards Committee. This is part of the general policy of the War Department to coordinate its whole supply system with the best commercial practice, and to support a national program of engineering and industrial standardization, which represents the difference between being able to get the needed quantities of uniform articles of tested usability, and of being restricted by many varieties, the usable quantities of which are always insufficient. The importance of standardization of war supplies cannot be exaggerated. In times of war the united effort of an entire nation and the combined employment of all its principal industries are necessary. It is possible to harmonize the use of thousands of articles to a common end only by the adoption of a far-reaching and effective program of standardization. Both the business and military interests of the War Department can be greatly assisted by adopting the policy of standardizing supplies.

BIOGRAPHY OF GEORGE WESTINGHOUSE

The life of George Westinghouse is an inspiring record of achievement, and those interested in following the careers of outstanding men in the engineering profession will welcome the new biography of this remarkable man which has been brought out by the American Society of Mechanical Engineers. This book is one of a series of biographies of the great men in mechanical engineering, and is published by Charles Scribner's Sons of New York (price $2.50). It should be an inspiration for those in the engineering field and for business men outside of this field to read the fascinating record written by Henry G. Prout of the part the engineer plays in modern civilization as disclosed in the life of George Westinghouse.

The story is of the rise of a man from a modest early environment to the leadership of many great industrial enterprises, and a position of acknowledged pre-eminence among the engineers of the world. The activities of George Westinghouse were many and varied. He dealt with organization, financial, and executive affairs, commercial affairs and the engineering details of half a dozen companies in two hemispheres. His inventions, particularly that of the air brake, and his development of the use of the alternating current, have had an important influence on civilization. The first chapter of the book contains a brief review of his life, and each of the succeeding chapters is devoted to a distinct phase of his activities.

The book is written in a readable style, and even those outside of the engineering profession will undoubtedly be interested in reading the story of the invention of the air brake and the friction draft gear and their effect in advancing the art of transportation. George Westinghouse's electrical activities, his contributions to the development of signalling and interlocking systems, and his work in extending the use of natural gas, all form part of the interesting narrative. The last chapters of the book treating of his personality and relations to men show that he was as unusual in character and charm as he was in mechanical attainments.

* * *

ASSOCIATED TECHNICAL SOCIETIES OF DETROIT

The engineers, architects, chemists, and other technical men of Detroit have realized for some time the need of one central association to represent their combined interests, and as a result an organization has been formed, known as the Associated Technical Societies of Detroit, which includes twelve societies in the fields mentioned. The association will take an active interest in all matters relating to engineering, architectural, and technical subjects, will assist in furnishing definite and accurate information to the public, and will render assistance and advice to city and state officials when required. A temporary council was organized last June, and on December 13 a permanent council met and elected the following officers for 1922: Chairman, P. W. Keating; vice-chairman, A. A. Meyer; and secretary-treasurer, Walter R. Meier.

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MACHINE TOOL PRICES

In December MACHINERY a careful analysis was given of various factors in the cost of machine tools for the purpose of showing why a return to 1914 prices, or even an approximation thereto, apparently expected by some purchasing agents, is impracticable under present conditions. One or two cost items which have been considerably reduced are frequently used as a basis for requiring a reduction of the selling price; but the aggregate cost has not been reduced in a like proportion.

Machinists' wages at present are very nearly double the rates in 1914. Skilled foundry workers who were paid $3.50 a day in 1914 in one of the large machine tool centers are now, after a reduction in wages of 20 per cent, paid $7 a day. Although pig iron has been reduced to within 25 or 30 per cent of the 1914 price at the blast furnace, it still costs about 50 per cent more than in 1914 in the machine tool centers, owing to increased freight rates. Bituminous coal has been reduced in price, but when a carload of coal costing $70 at the mine becomes worth $178 delivered on the siding in Cincinnati, the manufacturer finds that it costs him about 100 per cent more than in 1914. Crating lumber, of which large quantities are used by machine tool builders, cost $17.50 a thousand feet in 1915, and now costs $30, which is probably the bottom price for some years, as lumber already has been materially reduced from the peak price and the supply is decreasing.

The general result of complaints about high prices affects public opinion in the machinery industry unfavorably and often works an injustice to manufacturers, when the facts mentioned are not taken into account. Those who expect to buy machine tools as cheaply as before the war and are deferring necessary purchases until prices approach the pre-war level will wait a long time before buying new machinery, and in the meantime will lose the saving represented by the use of new and efficient machine shop equipment.

* * *

A NEW MACHINE TOOL MARKET

The increasing use of machinery and mechanical appliances everywhere, upon the farms as well as in industrial centers, is opening up an entirely new field for men who have the training, a small capital, and the inclination to go into the repair shop business. The old blacksmith shop is gradually passing out of existence, but its place is being taken by small modern repair shops, equipped with good machine tools, and there will soon be work for such shops all over the country.

These shops are required to keep in repair automobiles, tractors, agricultural machinery and other mechanical devices in general use. To function efficiently they should be equipped with at least lathes, drilling machines, shapers and cylinder grinding machines; and as these repair shops grow in size and importance, some of them will add other tools.

The machine tools required for this class of shop differ from those needed in a manufacturing plant. Production is of secondary importance, but the machines must be comparatively inexpensive, easily adapted to a wide variety of work and of quite large range, even though not powerful. Here is a field that has not yet been fully covered by machine tool builders—a market which will gradually expand.

NOW IS THE TIME FOR REPAIRS

Many manufacturers see that now is the best time for thoroughly overhauling their shop equipment and eliminating obsolete and worn out tools and equipment. Old machines are being sold either for junk or to the second-hand dealers, and although some manufacturers may not yet be financially able to replace them, it is evident that new equipment must soon be installed to keep pace with competition. The amount of old machinery that has been scrapped indicates that buying will be active when business revives, because there are many empty spaces in factories left for the installation of new machine tools of higher productive capacity.

In addition to the elimination of old machinery in many plants, the entire equipment is being overhauled and "remade." This is especially true of the machine tool building plants; but judging by the orders for repair parts received by machine tool builders, this overhauling is being carried on in many other shops throughout the country. The forward-looking manufacturer knows that the depression is nearing its end and shows his wisdom by using the present time to re-condition his equipment. Not only will his money go further now than when normalcy returns, but deliveries are prompt, the labor costs less and the productive work of the factory is not interfered with.

Manufacturers who defer this work until good business is actually upon them will lose time, money and opportunity.

* * *

EVER-INCREASING FIELD FOR MACHINE TOOLS

The universal use of machinery in the industries at the present time apparently does not leave much opportunity for designing improved machinery to replace hand labor—at least not in the metal-working field. Yet six machines were installed recently in a large plant in one of our greatest industrial cities that, although operated by but two men, replaced seventeen skilled mechanics. The cost of the entire machine equipment was $3600, and it is not difficult to calculate how long it will take to pay for these machines simply by the saving in the wages of fifteen skilled men. The machines are fed by magazine attachments and turn out a more uniform product than has been possible by hand.

There is a lesson to be learned from the result of this installation. The machines in this case cost $600 each, but if they had cost $1000 or $2000 it still would have been economical to buy them to replace such a large number of skilled men drawing high wages. In other words, they were not worth buying only because they were low priced; but because of their productive capacity.

At the present time, when so many men are out of employment, it may seem heartless to replace skilled labor by machinery, but the reduced selling price of the product in question, which is fixed by competition and yielded no profit by the old method, would have made it necessary for several of the plants to close down had not a cheaper production method been devised. Ultimately, no one would have gained by continuing the hand labor at a loss.

The results of this installation show that great opportunities still wait for saving in production costs by the use of improved machinery, and that we are still far from the limit of productive capacity.

The Machine Tool Market in Asia

By C. F. MEYER, Landis Machine Co., Waynesboro, Pa.

The author of this article has recently completed a trip around the world for the purpose of studying the machine tool markets in India, Java, China, Japan, and Australia. He brings back with him much valuable information, some of which is made available to American manufacturers in this article. The definite information given by Mr. Meyer should prove of great value to manufacturers who are interested in developing their export trade in the Far Eastern countries.

THE market for American machine tools in Asia has had a phenomenal growth since prewar days. Prior to 1914 the majority of the Far Eastern countries were satisfied with their antiquated methods of manufacturing, but things have changed now. The mysterious forces connected with the war have aroused the Far East from her slumbers. The Orient, during 1913, absorbed approximately $200,000 worth of American machine tools. The sales increased yearly until 1919, when the high peak was reached. During that year the sales amounted to nearly $9,000,000. The preliminary returns for 1921 indicate that the exports of American machine tools to the Orient will reach $6,000,000.

This is certainly a very creditable showing, considering the current exchange rates and the price reductions that have been made during the last six or eight months. The Chinese and Japanese rates of exchange have been normal for practically the best part of the year. The present rates in the Dutch East Indies and British India are still unfavorable, but not to the extent that they were in 1919, when the peak was reached. An analysis will show that the value of the sales for 1921 is thirty times the value for 1913. Considering the recent price reductions and the improvement in the exchange, it is safe to assume that the total volume of sales to the Far Eastern countries for 1921 is not much, if any, below the volume for 1919.

Probable Future Demand

The Orient is awake industrially. Japan has for a long time appreciated up-to-date machine tools, but there is still room for improvement. It is said that India learned to use machine tools during the war when she took up her share of the manufacture of munitions. China needs equipment badly, but at present is short of funds. Java may be considered a limited market, but there are good prospects for doing business with the government railways and shipyards and with the sugar mills and mines for certain classes of machine tools.

Labor is also undergoing a change. The workman is demanding a greater return for his labor. To meet this the manufacturer must have greater production. Naturally he turns to production machinery to solve his problem. The demand of the Oriental workman for a higher standard of living has already had its effect on the machine tool business.

In India the industrial development has been much more rapid than in the other Oriental countries. Prior to the World War, India was regarded as a repair shop for reconditioning ships and repairing rolling stock. Her unlimited supplies of raw materials were shipped to England and converted into finished products. Now things have changed. The policy today is to establish industries throughout the land. In the vicinity of Calcutta, jute mills line both banks of the Hugli, the principal delta mouth of the Ganges River. These mills are equipped to spin the raw material, weave the burlap, and manufacture gunny sacks. Practically all the burlap and gunny sacks used in the entire world come from this district. These jute mills have up-to-date machine shops for plant maintenance, and several are equipped to manufacture their own spinning machines and looms.

At Tatanaga, close to the coal and iron mines, stands the Tata Iron & Steel Works. This plant covers a very large area and compares favorably with the best steel mills in the Pittsburg district. It has both Bessemer and open-hearth furnaces and a rolling mill equipped to roll rails and structural steel. It was founded by J. N. Tata, a Parsee, but is now managed by American and British engineers.

Other industries are springing up on every hand. It is impossible to foretell the outcome, but it is safe to say that India with her unlimited supply of natural resources is destined to become one of the greatest manufacturing countries of the world. India's one handicap is her railroads, which have not kept pace with her industrial development. Her greatest need today is rolling stock and motive power to transport the raw materials and coal from the mines to the industrial centers.

How to Secure Far Eastern Trade

The American manufacturer seeking Far Eastern trade should first make a careful study of the various markets. He should proceed with caution. He should not act hastily, as did a certain wall paper house which sent its representative into the Far East for business. Had it taken the trouble to investigate, it could have easily learned that wall paper, due to climatic conditions, will not stick to the walls in British India, Burma, the Straits Settlements, the Dutch East Indies, and some parts of China. The representative encircled the globe and had a wonderful time, but he secured no business.

Practically all the American machinery sold in the Far East is sold through machinery dealers. This is the best and only way to handle the proposition. The largest and most desirable machinery dealers in the Orient have offices in New York City where the preliminary arrangements can be made. These include American, British, Dutch, Chinese, and Japanese houses. The manufacturer should get in touch with the New York offices of several of the machinery dealers in each country where there is a market for his product. He should obtain particulars re-

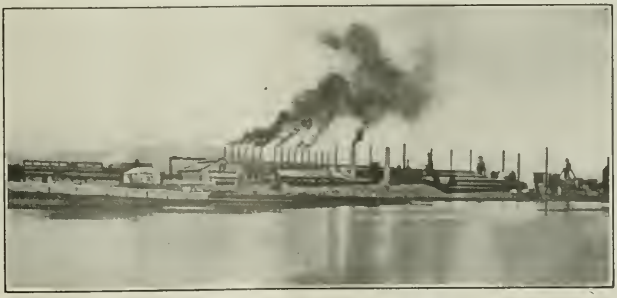

Fig. 1. The Tata Iron & Steel Works at Tatanaga, India

garding their organizations and at the same time find out whether or not they are in a position to handle his line without conflicting with a competitive line. The manufacturer is then ready to weigh the merits of the several dealers and make his choice for each country.

As soon as the connections have been made, the manufacturer should see that each dealer is supplied with descriptive literature, price lists, and advertising matter. No attempt should be made to print these in the native language, as English is read by almost everyone holding an official position. In fact, it is preferred by the majority of the Orientals whose languages are void of technical terms. The shipment of printed matter should be followed by a shipment of machines and accessories for stock.

The Manufacturer's Representative

The next move is to send a representative, preferably an engineer, into the new territory to get the agents started on the right track. Great care should be exercised in picking the right man. He should have a pleasing personality and should understand the art of making friends. Above all he should know his line. Do not consider a man who will boast of his own country and belittle the country he is visiting. This will react against all American manufacturers and consequently will injure America's foreign trade.

Travel in the Far East is expensive, and much of the traveler's time is unproductive. A year's trip with an itinerary including British India, Burma, the Straits Settlements, the Dutch East Indies, China, and Japan will make it necessary for the traveler to spend from three to four months on the seas. He can handle two or three lines, either through the same or different agents, almost as easily as he can look after one. Thus several manufacturers can, by pooling the expense, secure their share of the Far Eastern business at a comparatively low cost.

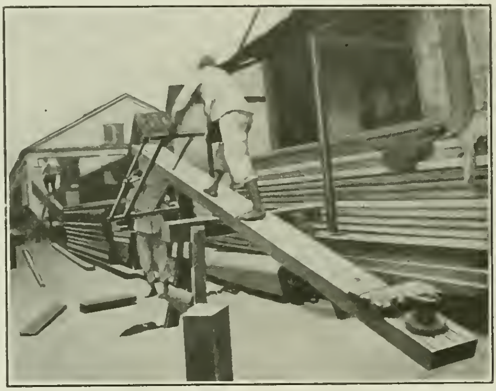

Fig. 2. Chinese Woodcutters sawing Lumber at the Government Arsenal near Shanghai, China

Methods of Selling

The traveler should remain in each country long enough to enable him to call on the most important prospects. He should also take time to instruct the salesmen and arouse in them an enthusiasm for his line. This is very important, as the Oriental salesman will not push the sale of a machine tool he does not know well. He prefers to remain silent rather than run the risk of "losing face."

The majority of the engineers met in British India are British. In the Dutch East Indies the engineers are Dutch. The Dutchman is a born linguist and generally speaks four or five languages. The Chinese and Japanese engineers usually understand some English even though they are unable to speak it. Besides, the traveler is always accompanied by either a foreign or native salesman who is ready at all times to act as his interpreter.

In planning a business trip to the Orient, it is very necessary to know that all the railways, the telegraphs and the telephones in British India, the Dutch East Indies, Japan, and some of the railways of China are under government control. All the government plants in these countries do their buying during the months of December, January, February, and March. Each year they make application to their respective governments for sufficient funds to take care of the coming year's requirements. The appropriations, if granted, are available early in December and must be spent before the last day of March. These shops, together with the government dockyards and arsenals, make up a large portion of the industries of the Orient, and serious consideration must be given to their business methods.

The most extraordinary phase of the government buying system is the requirement that no order can be placed with an agent unless the goods are in the country or en route. The law requires that delivery must be made and all invoices paid on or before the last day of March; otherwise, delivery is refused and the money returned to the government.

The wide-awake dealer keeps in touch with the engineers of the government plants with the view of getting a line on their requirements. He then orders a sufficient stock far enough ahead of time to insure delivery during the buying season.

The Itinerary for a Far Eastern Business Trip

To go back to the traveler and his itinerary, the ideal arrangement would be for him to arrive at his destination a little before the buying begins and remain until the season closes. This fits in very nicely with the cool weather, but unfortunately the buying seasons are the same in a number of countries.

The monsoon or rainy period in India begins about the first week in July and continues until the end of September. During this time the heat is almost unbearable. The best plan is to proceed to the Orient via England and Suez and spend the months of November, December, January, and February in India. Allowing a month to travel from Calcutta to Batavia, the traveler will be in Java by the first of April. April and May are very hot and rainy months in Java. This, however, cannot be avoided. A side trip of several months to Australia and New Zealand will give the traveler a taste of cool weather, the seasons in the southern hemisphere being just opposite to our own. He can then work north by way of the Philippine Islands to either China or Japan, arriving there just prior to the opening of the buying season.

The American engineer is well received in all quarters of the Orient. The visitor is always welcome, especially if he is traveling in an out-of-the-way district where news of the outside world is scarce. He is frequently entertained in a most hospitable manner at the home of the engineer on whom he is calling. During one of my visits to a large steel works in British India I was invited to spend a day and a night with a high official of the company. On another occasion, when I was calling on one of the railway shops in the same country, I was met at the railway station by the chief engineer who had come up from the shops some three miles distant on a push-car. It was a new and strange experience for me to go spinning along the rails on a contraption similar to a hand car, which was pushed along by two half-naked Hindus, each running on top of the rails.

Types of Machine Tools Used in the Orient

The average Oriental workman is lazy and naturally opposed to work. Furthermore, he is afraid of a machine tool and looks upon some of the more complicated types as objects possessed of evil spirits. This is particularly true of the Hindu workmen and has a very important bearing on the types of machine tools used in British India. The Hindu operator always runs his machine at the slowest speed possible. He seems to fear that it will fly to pieces and cause him bodily injury if he speeds it up.

On one occasion, when I was being shown through a large railway shop in British India, my attention was directed to a Landis threading machine. At a glance I noted that the Hindu operator was threading ½-inch bolts at the speed intended for 1¾-inch and 2-inch sizes. I spoke to the engineer who accompanied me regarding this. He was on the job in a second; he grabbed the Hindu by the back of the neck and poked his nose against the high-speed pulley of the cone, remarking at the same time in Hindustanie that for the hundredth time he wanted it understood that the machine must be speeded up. The poor Hindu took this gentle hint and stepped the belt up to the proper speed. My sympathy was with him until, some fifteen minutes later when I passed the same machine on my way out, I observed that he had put the belt back on the slow-speed pulley. I had no desire to see murder committed, so I made no mention of the fact to my friend the engineer.

It would be absurd for American manufacturers to ship multiple-spindle machines into British India, because neither the Hindu nor the Mohammedan will operate more than one spindle of a multiple-spindle machine. This applies to drills, tappers, and threading machines. In British India a machine of this type would require an operator for each spindle; this is a bad condition from the production standpoint. The operators either converse or fight and the output of each suffers. If but one operator is assigned to a multiple-spindle machine, he will work one spindle only and let the remainder run idle. I saw evidence of this in many of the shops which I visited, particularly among operators of multiple-spindle drilling and tapping machines.

Fig. 3. The Author and the Chief Engineer of the B & N Railway enroute to the Shops of the B & N Railway near Calcutta, India

The Effect of Religious Beliefs in India

Two very important items which should be given consideration are the recommendations for belting and cutting lubricant. The cow is sacred to the Hindu and consequently he is opposed to the use of leather belting for driving machinery. On the other hand, the pig is sacred to the Mohammedan and he will not use a cutting lubricant having animal lard oil for a base.

During the war, when the engineering firms in British India introduced automatic and semi-automatic machines for the manufacture of munitions, they found themselves face to face with a peculiar condition. They picked their best native mechanics for these machines. These operators had hardly started when they quit work in a body. They claimed that machinery capable of doing the work that these machines would do must be possessed of evil spirits and flatly refused to operate them. The engineers in charge were then forced to go out and round up natives of the coolie class, who were too ignorant to bother about evil spirits, and train them for this work. These men soon learned that the movement of certain levers was necessary to perform the several operations in the proper sequence. They became expert operators, but without any knowledge of real action of the machinery.

The Prospective Market in China

The Chinese market seems to prefer cheap machinery. This may be attributed to several causes, but one of the most important is that Chinese labor is opposed to labor-saving machinery. They cannot see that they will be benefited by increased earnings and that the introduction of labor-saving machinery into their country will stimulate manufacturing and create work enough for them all. They take the stand that labor-saving machinery requires fewer men and would therefore cause large numbers of their class to be thrown out of employment.

Another obstacle to the introduction of up-to-date machinery into China is the cheapness of labor. I was told that the average mechanic receives in the neighborhood of $12.50 a month and that common labor is paid as low as $3 a month. The apprentice works for a period of three years with no pay except his daily ration of rice. A certain American company attempted to introduce a line of tractors into China by lending them to the farmers in different districts. A demonstrator was sent with each machine. The results obtained by the demonstrators showed the operating cost of the tractor to be approximately $25 a month. This figure seemed low enough to the firm's representative to insure a good business, but the farmers both surprised and disappointed him by claiming they could hire eight farm hands to do the work for the same amount of money.

Still another obstacle to the use of machine tools by the Chinese is the time-honored custom of using their hands. They apparently prefer to stick to the antiquated practice of making everything by hand. During a visit to a large engineering firm in the city of Tientsin, I was invited by the manager to inspect the works. I found the machine shop well equipped with first-class machinery of American and British make. On entering the pattern shop, I was impressed with the absence of woodworking machinery. I made a careful inspection and could find nothing that resembled a machine, not even a wood turning lathe. In answer to my inquiry regarding this, I was told by the manager that he had made several attempts to install suitable machinery, but that his Chinese patternmakers preferred to make the patterns by hand. I was shown patterns of an eight-ton flywheel and a one-cylinder gas engine frame, together with some of the most intricate patterns I have ever seen, all fashioned by hand. It was difficult for me to believe that the cylindrical portions of these patterns had not been turned in a lathe.

In the foundry I found the workmen pouring a 3500-pound casting. There was no tackle for handling the huge ladle. Aside from the head molder, I counted twenty-four coolies assisting in carrying the molten metal from the cupola to the mold. I was told that the head molder would receive the equivalent of $45 for the job and that he would pay his coolie assistants at the rate of 25 cents per day.

I was told that there are only a few sawmills in the whole of China. This means that practically all the lumber used in the country is cut by hand. If one wishes to build a home or a factory, it is necessary to have the rough logs hauled to the site and woodcutters engaged to come and saw them up into studding, joists, rafters, flooring, etc. These men are experts who will do the work just as well as it can be done at the sawmill; and their wages compare favorably with the prices charged by the sawmill.

Until recently, a great deal of the manufacturing in China was done in the homes of the workmen. Even today there are still several hundred machine shops in the city of Shanghai occupying either the front or rear rooms of dwelling houses. These shops, as a rule, operate on a very small scale. The equipment consists of a lathe, a drilling machine and, in a very few instances, a shaper. These machines are principally of Chinese make and are very crude. In one of these shops which I visited, I found them using the lathe to saw off stock. The saw was mounted on the live spindle of the machine and the piece of stock was gripped in the cross-slide. In another place, they were using a lathe to mill a slot in a piece of steel.

Creating a Demand for Machine Tools in China

Before we can look upon China as a good market for machine tools it will be necessary to create a demand. This can be accomplished by educating the masses to use machinery. A well-known oil company created a demand for kerosene in China in a most satisfactory manner. The company knew that the Chinese are very fond of artificial light, but to get them to discard their antiquated lamps which would not burn kerosene was the problem to be solved. A large quantity of tin lamps painted blue (the favorite color of the Chinese) were made. The lamps were filled with kerosene and handed out to the Chinese population in certain districts. These lamps were far superior to the Chinese lamps. John Chinaman was very much pleased with his new possession, and when the oil which was furnished with the lamp was burned up, he immediately purchased more.

The market for up-to-date machine tools might be created in several ways. The first thing to do is to make the Chinese acquainted with the machine and then prove to them that it will turn out a superior quality of work at a lower cost than the cheap and crude equipment with which they are familiar. This can be accomplished by placing machines in the engineering colleges and trade schools in China, and educating the coming engineers and mechanics. This does not mean that the machines should be presented to these institutions. The plan adopted by a large number of American manufacturers is to make their prices fit the pocketbooks of the colleges and schools. Some have even gone so far as to sell their products to these institutions at half price. They hope by this means to induce a portion of the graduates of the engineering and trade institutions to affiliate themselves with the industries of China and replace the present crude equipment with up-to-date machinery.

Educating the Chinese Student in America to Use our Machine Tools

The demand for American machine tools can be helped along in still another way. Each year the Chinese Government picks by competitive examination one hundred Chinese boys and sends them to this country to be educated in our engineering colleges and universities. These students return to China after graduation and are given important positions with the railways and other branches of the government service. They become more or less familiar with American machine tools during their stay here, but the manufacturer can help his particular machine along either by arranging lectures before the foreign student bodies in the engineering colleges, or by extending invitations to these students to visit and inspect his plant.

I am told that it is impossible for a Chinese graduate of an American engineering college to obtain practical training in our factories, except without pay. This is due to our immigration laws and also to the ruling of the labor unions. The result is that the young Chinese engineers are going to England and France for their practical training. Thus they unconsciously develop a leaning toward British and French machine tools. I do not wish to convey that China is totally ignorant of high-class machine tools. On the contrary, there are some fine plants in China, and credit is due the machinery agents who are responsible for what has been done.

Japan is much further advanced than the rest of the Oriental countries and is a well developed market for all classes of machine tools. The Japanese, however, have begun the manufacture of machine tools, and have thus created additional competition not only in their own country, but throughout the whole of the Far East.

INDUSTRIAL CONDITIONS IN FRANCE

By MACHINERY'S Special Correspondent

Paris, January 12

Business conditions in the machine tool field showed a decided improvement during the month of December, many new orders having been placed. Inquiries are becoming more and more frequent, and often lead to the placing of orders. The feeling exists that this is not a temporary improvement, but that the condition will continue and that the year 1922 will witness the end of the great business depression which has swept over the metal-working industries. So far the plants in the vicinity of Lyons have benefited the most by the improved conditions. The machine tool activities are in general the result of furthering the development of the water power resources, increased manufacture of locomotives and railroad cars, and overhauling of railway equipment.

Improvements in Associated Industries

Boiler manufacturing and similar establishments are profiting from the renewed activity in the chemical industry, which has created a demand for tanks and large metal containers. The manufacture of boilers, however, is at a complete standstill. Rolling mills and foundries continue to receive orders, and there is quite a good deal of activity in these fields. Copper and brass foundries have also experienced a decided improvement.

In the automobile field the manufacture of the higher priced touring cars and small commercial cars continues to be active. One automobile plant is running the same as in normal times. There is no great demand for large motor trucks, however, and as a consequence one of the principal truck manufacturers had to close down on January 1. The bolt-manufacturing and wire-drawing fields continue quiet.

Present Prices of Machine Tools

American-built machine tools are still in little demand in France on account of the exchange rates. The prices of a number of machine tools built by French manufacturers are:

Lathes—Gap bed type, 15-inch swing, 40 inches between centers, with all accessories, 6200 francs (about $500, present exchange); another lathe of the same type and swing as the foregoing, but with a distance of 60 inches between centers, 6500 francs (about $530); engine lathe, 14-inch swing, 36 inches between centers and weight about 2000 pounds, 8000 francs (about $650).

Crank Shapers—Maximum stroke of ram 16 inches, horizontal traverse of table 22 inches, dimensions of table 18¾ by 12 inches, and weight about 2650 pounds, 9350 francs (about $760); maximum stroke of ram 24 inches, dimensions of table 25 by 16 inches, and weight about 4700 pounds, 13,600 francs (about $1100).

Planers—Width between housings 24 inches, stroke 5 feet and weight 6600 pounds, 17,150 francs (about $1400); another machine of the same width between housings and the same stroke, weighing 5500 pounds, 13,500 francs ($1100).

Drilling Machines—Sensitive, capacity for drilling holes up to ⅝ inch in diameter, spindle diameter ¾ inch, vertical movement of spindle 8 inches, and weight 500 pounds, 1500 francs (about $120); upright drilling machine with stationary head, normal drilling capacity of 1½ inches when provided with gear-box, and 1¼ inches without gear-box, diameter of spindle 1½ inches, No. 3 Morse taper socket, and weight about 1100 pounds, with gear-box 3600 francs (about $290), without gear-box, 3150 francs (about $255); radial drilling machine, normal drilling capacity 1¾ inches, diameter of spindle 1½ inches, and weight 4000 pounds, 10,000 francs (about $810).

Milling Machine—Single-pulley drive, longitudinal traverse of table 20 inches, transverse movement 6 inches, vertical movement 14 inches, the longitudinal traverse only being automatic, weight 2000 pounds, 9450 francs ($765).

Arc-welding of Cast Iron

Use and Application of Methods for the Welding of Cast Iron by the Electric Arc

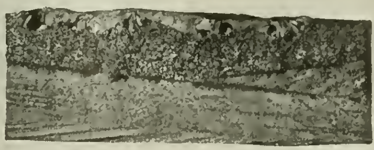

Fig. 1. Structure of Cast Iron welded by the Carbon Arc Method

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East Pittsburg, Pa.

THOSE familiar with the merits and limitations of the electric arc welding process for making welds in cast iron recognize the need of a better understanding of the application of the art. It is necessary to understand thoroughly certain fundamental facts concerning the metal and the relation that its ingredients bear to the actual welding process, if satisfactory results are to be obtained. These and other important facts are discussed in the following.

Carbon Arc-welding Process

Carbon arc-welding is probably the oldest and easiest, in point of manipulation, of the arc methods of welding cast iron. It consists of drawing an electric arc between a carbon pencil and the cast-iron part, causing the metal of the casting and the filler rod to become molten at the point of heat application. Cast iron melts at 2300 degrees F. and volatilizes at 3300 degrees F., and becomes fluid under the heat of the arc. This characteristic limits the use of the method to such work as may be welded in a horizontal plane and to metal of sufficient thickness to prevent the intense heat of the arc from melting through. To facilitate the welding operation by this method, a backing of refractory material is often built around the work.

Many metals have a characteristic known as the critical welding heat at which point the metal suddenly changes from the plastic to the fluid state and above which the further application of heat for extended periods causes burning of the metal. Pure iron is more easily welded by the arc than any other metal, and the method becomes more difficult of accomplishment with increasing percentages of carbon until about 2.25 per cent carbon content is reached, which produces cast iron. Cast iron, when held at a red heat for long periods, deteriorates considerably, and if held at high temperatures will disintegrate and become worthless. When the carbon arc method is used, the metal is quickly brought to the molten state at the surface, and the carbon of the metal becomes dissolved in the iron. When the heat of the arc is removed, the cold sections of the casting quickly dissipate the heat from the molten section, thus producing chilled cast iron, the structural formation of which has the appearance shown in Fig. 1. The action is analogous to that which occurs when pouring molten metal into a steel chill. Care must be taken in manipulating the carbon pencil, for if the carbon comes in contact with the surface of the casting it will usually produce a hard spot.

The Steel Metallic Arc Method

Another electric arc method which is quite intensively used for certain applications of cast-iron welding is the metallic arc method. By this process an arc is drawn between the cast iron and a metal electrode of suitable composition, causing the electrode wire to melt and be deposited in the pocket melted in the cast iron by the heat of the arc. Owing to the doubtful nature of the union of the metals obtained by this process it is customary to insert steel studs in the work in order that the filler material may unite with them and aid in anchoring the deposited metal to the cast iron. When this method of welding is used for repairing fractures in containers for steam, liquids, or gases, the seams or edges of the weld may be calked to obtain tight joints. When welding cast iron by this method, using steel wire electrodes, the fusion of the two metals is dependent upon the state in which the carbon exists. It is known that the closer the carbon in the cast iron approaches the graphitic state, the less dependable will be the union of metals, and that the closer it approaches iron carbide the stronger will be the weld. This condition is due to the fact that as carbon approaches the graphitic state there is less continuity of the iron matrix and less cohesion between the iron crystals, due to the laminated structure of graphitic iron.

In addition to this characteristic of the process, there is also the likelihood of producing a layer of residue of slag between the two metals at the line of fusion,. which will prevent a good union. This condition becomes more serious as the carbon approaches the graphitic state. The layer of residue forms as the steel matrix of the cast

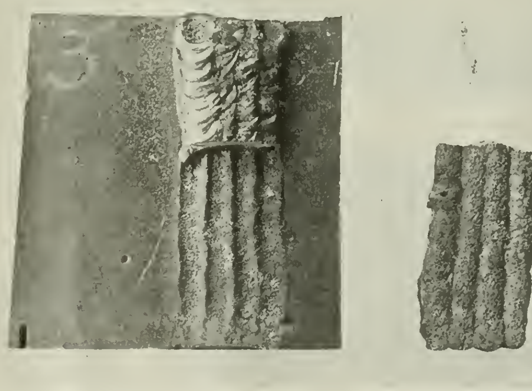


Fig. 2. Appearance of a Cast-iron Weld made by the Metallic Arc Method, showing the Slag Layer at the Line of Fusion

iron becomes molten, and in a molten state is attracted to and unites with the layer of metal already formed and partly solidified. As this movement of metal occurs, due to molecular attraction, most of the graphite in the laminated structure is left without its supporting matrix and settles to the bottom of the depression left by the movement of the metal. This deposit of graphite is a good conductor of electricity, and so concentrates the action of the electric arc, which results in partly oxidizing it and packing it into a layer with the dirt and oxide. The appearance of this accumulated layer of slag is shown in Fig. 2.

The quality of the union can be foretold by the application of the electric arc to a small area of the casting or by a visual examination of a fracture of the casting. This may be seen in Fig. 3, which shows two views of a wedge-shaped casting. The wedge shape enables metal in various physical states to be presented, so that the effect of the application of the carbon arc may be observed. It will be seen that the casting has a fine grain structure at the apex and that the development of the graphitic structure increases with the thickness of the section. The flat deposits in the lower part of the illustration were made with the carbon arc. In cases where the deposited metal spreads over the parent metal to the line of fusion making a smooth appearance, as it does at the left of these deposits, instead of receding at the line of fusion as it does more and more as the graphitic structure increases toward the right, then good fusion can be expected. The string of deposited metal on the upper part of the casting was made by the metallic arc, and in this case also the degree of fusibility and penetration decreases with the graphitic structure.

Factors in Welding Cast Iron

Upon examination of a weld made by the steel metallic arc process, even though good amalgamation of the metals has resulted, numerous small gas pockets are discovered, particularly in the layer adjacent to the casting. These pockets are formed by the gas produced in applying heat to the layer of residue previously mentioned, and by the volatilization of the molten carbon and silicon. There is also a tendency for cast iron to absorb moisture from the air when heated, which upon being gasified may also produce pockets at the joining surfaces.

With this method of welding there exists between the layers of deposited metal and the cast-iron parent metal, a hard carbide area, which cannot be cut except by grinding. This area usually consists of a layer of chilled cast iron adjacent to the layer of slag, and located on the cast-iron side of the weld. On the opposite side of the layer of slag and adjacent to it there is formed a layer of chilled high-carbon steel, produced by the alloying of the carbon in the cast iron with the added steel of the wire electrode or filler rod. This layer of high-carbon steel is of varying thickness, depending on the character of the cast iron and the depth of penetration. It will readily be seen that the deeper the cast iron is liquefied by the application of the arc, the greater will be the amount of molten high-carbon steel to unite with the deposited metal.

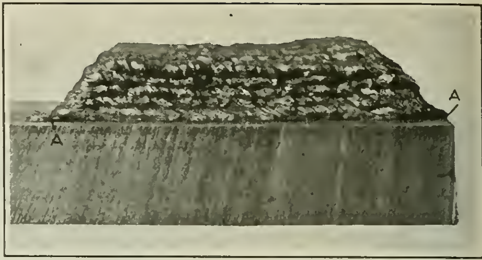


Fig. 4. Steel Filler Material deposited on Cast Iron, showing the Separation of the Deposit from the Original Metal

Difficulty in securing satisfactory welds with the metallic arc is sometimes due to the separation and fracturing of the metals, caused by the shrinkage of the molten metal upon solidification. This trouble is not always due to the difference in coefficient of expansion of the deposited and parent metals, although quite generally attributed to this cause. Contraction and expansion cause more trouble and failure in the welding of cast iron than all other causes combined. Every physical and chemical change in metal is accompanied by internal stresses, and when these exceed the strength of the metal it is not difficult to understand the failures produced by these stresses in a metal that is as rigid and brittle as cast iron. When using a steel filler material in welding cast iron with a metallic arc, the difference in contraction between the two metals usually causes trouble. The strength of the added steel is greater than that of the cast iron, which results in the steel pulling away from the cast iron when contracting, in the manner indicated at *A*, Fig. 4. In some cases, if good fusion has been secured, the cast iron itself will become fractured. The separation usually occurs at the layer of slag, or at the point of contact of the two metals, since this is the line of creepage, and is due to poor fusion. Even though good fusion of the metals has been obtained, separation may occur in the vicinity of this layer of slag and on the cast-iron side of the weld.

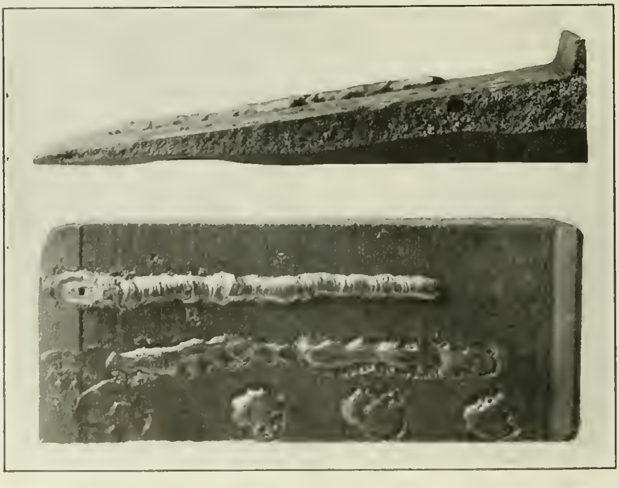


Fig. 3. Effect of a Graphitic Carbon Structure on the Fusibility and Penetration of Metal deposited by the Metallic and Carbon Arcs

The steel metallic arc process of electric welding is the only method adaptable to certain classes of work. Examples of this method are frequently found in castings which permit the use of only a limited amount of heat in performing the weld, and also in jobs which require the operation to be performed by overhead manipulation of the arc. The latter is extremely difficult of accomplishment with any other welding process.

Making a Weld with a Metallic Electric Arc

After cleaning the casting by chipping or sand-blasting the entire surface to which metal will be fused, a square groove is chipped along the line of breakage. The size of this groove depends upon the thickness of the casting, but is usually from 1/4 to 1/2 inch square. The groove is then filled with metal until it is flush with the face of the casting, and a stud is next located in the casting as close to the crack as practicable. The location of the first stud is determined by the thickness and shape of the casting. The amount of studding necessary depends on the volume of added metal required to give sufficient strength. The studs, should be long enough to extend through the first layer of deposited metal, so that good fusion may be obtained between them and the second layer, and they should be set a distance from the edge of the fracture equal to at least twice their diameter.

In welding, the first stud should be surrounded with a sufficient number of rows of deposit to extend to the center of the crack, as shown at *A* in Fig. 5. This procedure will aid in locating the spacing of the remaining studs, which are then set in rows as required to complete the job. Grooves should be placed between the rows of studs, if more than one row is used, and also at the outside edge of the weld area. The preparation as to grooving and studding, as well as the method of depositing the metal, is diagrammatically shown in Fig. 5. All grooves are filled flush with the face of the casting before depositing the first layer around the studs, in the manner followed with the first stud. The outside rows of the pads of adjacent studs are not united at this time except where they merge at their point of tangency. The second layer is deposited around all studs in such a manner as to build up the pads into a cone shape, which will leave a vee to be filled when uniting the pads. As many additional layers as required are then added, in the manner indicated in the illustration. In uniting the pads, those at the line of the break are left until last, in order to permit the greater part of the shrinkage to occur before this union is completed. When more than one layer of deposited metal has been welded around a stud, it is best to follow the circular contour of the pads when filling in between them.

The operation of welding cast iron by the steel metallic arc method should proceed very slowly, each addition of metal being small so that there will be a gradual absorption of the heat by the work. The practice of drilling holes at the end of the fracture is optional, and should not often be required because the casting should never be allowed to get warm enough to expand and extend the break. The use of small wire, low current and straight-line welding, without weaving or oscillating the electrode, will assist in keeping the work cool and in minimizing the stresses which in some measure are bound to occur.

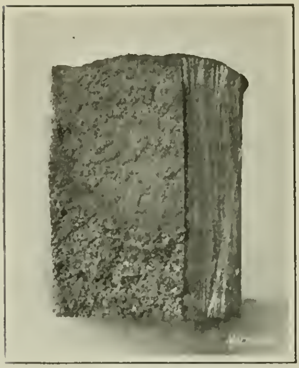


Fig. 6. Part of Cast-iron Section showing Characteristics of the Weld and the Original Metal

One of the errors frequently made in the application of steel metallic arc welding is the practice of building up heavy layers of metal adjacent to the cast iron. When good fusion is obtained, the section of a deposited metal can be safely limited to one-half that of the cast-iron section.

The metal added in the square groove at the break offers a projection against which the adjacent sides of the fractured casting are drawn by the shrinkage of the subsequently added material, thereby overcoming one of the greatest troubles encountered in the welding of cast iron. The other grooves furnish additional strength and insurance against leakage of gases and fluids when welding cast-iron cylinders and containers. The method of "veeing out" the casting at the break was adopted from the practice followed in acetylene gas welding, and may be followed in cases where the carbon is found to be in the state which will permit good fusion between the casting and the added metal. The heavy sections of graphitic cast iron, as usually encountered, should not be veed, as the original surface of the casting offers a better quality of metal upon which to weld than that exposed by cutting below the surface. A less suitable condition is encountered as the cut is made deeper, because the farther from the surface the greater the amount of graphite in the cast iron.

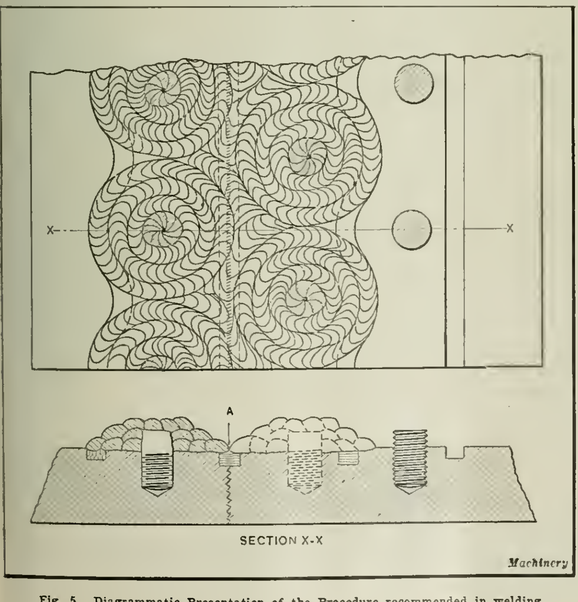


Fig. 5. Diagrammatic Presentation of the Procedure recommended in welding Cast Iron with an Electric Arc

Another disadvantage of the beveling method of preparation is the shrinkage of the filler material, which occurs no matter how carefully the work is done. This shrinkage draws the bevels of the vee against the boss formed by the filled-in metal, with the result that the pressure exerted tends to lift the added metal from the casting. This, in fact, actually occurs in many cases.

By following the practice here recommended, which is the one most widely understood, the effect of shrinkage strains will be kept at a minimum by affording means of equalizing, balancing, and taking advantage of those stresses which cannot be entirely eliminated.

Metallic Arc Process Using Cast-iron Electrode

It is the usual procedure in welding to use filler material which has the same characteristics as the material of the work and which will respond to the same treatment. It is obviously necessary that the amount of expansion and contraction of the parent and added materials be the same, and that good fusion of metals be secured. It is a logical procedure, then, to use filler material having a similar analysis to that of the part being welded, with a suitable allowance in the physical condition of the filler material to compensate for losses of its constituents caused by the effects of the arc. Electrode material for welding cast iron by the use of an electric arc should therefore consist of a cast iron high in carbon and silicon and containing small percentages of manganese, silicon, sulphur, and phosphorus. Cast-iron electrodes of various compositions have been successfully used in conjunction with preheating the casting. The standard filler rods made for acetylene gas welding usually give very good results when protected by a coating of lime.

Fig. 6 illustrates a cast-iron section preheated to 1500 degrees F. and built up by the metallic arc process of welding, using a cast-iron electrode. The section was cut with a hacksaw to show that it can be easily machined, and was then broken to show the characteristics of the weld and the original metal. Note the dense, fine-grained structure of the added metal and the graphitic structure of the original casting. The added material is stronger than the original casting and is easily machined.

Preheating

Preheating is considered necessary in connection with arc-welding of cast iron if the best results are to be secured. Preheating relieves residual strains and compensates for expansion and contraction; it eliminates gas pockets and holes by holding the metal in a plastic or fluid state long enough after deposit to enable the gas to escape and the foreign matter to be released and floated to the surface; it aids in securing good cohesion of metals and reduces to a minimum the formation of the layer of slag; and it prevents chilling of the deposited metal and assists in the desirable slow cooling process.

In connection with preheating to relieve residual strains caused by expansion and contraction, it should be pointed out that breakage caused by these stresses does not always occur at the point where the greatest amount of stress is applied, but at a point where the strength of the section is less than that required to withstand the same stress if applied at that point. If the casting is of simple construction it is usually only necessary to preheat it at the points of stress application. The problem becomes greater as the intricacy of the casting increases, until it becomes necessary to preheat the casting all over in order to compensate for the liberation of the residual stresses. In addition to preheating, it is often necessary to reheat the casting following the operation. Reheating relieves strains caused by welding and anneals hardened sections of the deposited metal. In some cases very good results will be realized by thus annealing the weld in addition to preheating the cast iron before depositing the metal. One advantage of preheating is that the welding operation may proceed rapidly, while if the welding is done by depositing molten metal on cold castings the operation is exceptionally slow and tedious, since it is only practicable to add the metal a little at a time in order to confine the heat and shrinkage to a minimum.

Conclusion

A few years ago results obtained by the use of electric arc methods of welding cast iron were questioned. The progress made within the last few years has been such, however, that at present excellent results are obtained on the better grade of castings and a fair job is possible on castings of almost any kind. As a better understanding of the condition under which cast iron can be welded by any process is reached, the practice will become more general and will rapidly advance. The development of arc-welding cast iron will probably depend largely upon the developments in the use of certain methods of procedure here defined, in the applications of preheating, and in the development of an electrode for use in welding cold castings which will deposit a metal having a minimum coefficient of expansion.

* * *

The American Society for Testing Materials and the United States Forest Service have been designated by the American Engineering Standards Committee as joint sponsors for developing standard methods of testing wood. This action resulted from a canvass of the principal national bodies interested.

SCIENTIFIC PRINCIPLES OF COST REDUCTION

By J. H. LINDSAY, Master Mechanic, Armor Plate Machine Shop, U. S. Naval Ordnance Plant, South Charleston, West Virginia

It is obvious that any material gains in effective cost reduction must result from a systematic application of the records of past experience rather than from mere assumptions. It is an unfortunate fact that a great many executives are carried away by the glibness with which young and inexperienced students are able to recite academically stated principles and the ease with which they construct upon and around these principles a system that has the outward appearance of being the real thing.

The scientific principles of industrial organization are within easy reach of the man who has come up through the shop, and are the most valuable of any stock in trade that he can have. They are fundamental to economic production. An understanding of the factors and principles of industrial organization is a force that can be utilized by anyone, regardless of how humble his position may be.

A great many shop supervisors resent the interference and dictation of what they call "office men and book learning." This resentment is reciprocated. The two forces become radically opposed to each other, and cooperation and coordination is prevented. Whether shop executives like it or not, recorded data relative to all phases of production has come to be a potent factor in bringing about efficiency. Loose guesswork methods are no longer adequate. Executives who wish to hold their own and to advance must grasp those fundamentals that enable them to compare and determine the value of different methods and developments.

Recently a prominent executive stated that he had greater respect for the man who had worked himself up to a position of responsibility than he had for the technically educated man holding a similar position. The reason for this is obvious. This executive and others like him have come to learn that the man with a broad practical experience, supplemented and strengthened by an understanding of fundamental principles as they apply to practical work, can strip a theory of all its superfluities and make the practical part of it work.

What we need in order to put our industrial plants on a sound economic basis is to give more time to conscientious study of fundamental conditions. Every idea and suggestion relating to cost reduction should be given consideration. If those who control and direct the organizations that make use of American-made machine tools, of which we are justly proud, are wise in economics as well as in shop practice, we need have no fear of foreign competition.

The foregoing paragraphs have been written with a view to emphasizing the necessity of a thorough grasp of the fundamental principles upon which all system should be based. A ready-made method or system that is locally effective is the result of a close study of local conditions and needs, and the application of recorded data and original thinking to them. Such a system may or may not fit other conditions wholly or in part. If it fits other conditions, it may only bring about a result that is comparable with results obtained elsewhere, whereas leadership implies excelling results obtained elsewhere by the application of fundamental principles in a more thorough manner than has previously been done.

* * *

A joint investigation of the fatigue of metals under repeated stress has been conducted during the last two years by the National Research Council, the Engineering Foundation, the General Electric Co., and the Engineering Experiment Station of the University of Illinois. The results of this investigation have just been published in bulletin No. 124 of the Engineering Experiment Station of the University of Illinois, Urbana, Ill., copies of which may be obtained from the director of the Engineering Experiment Station.

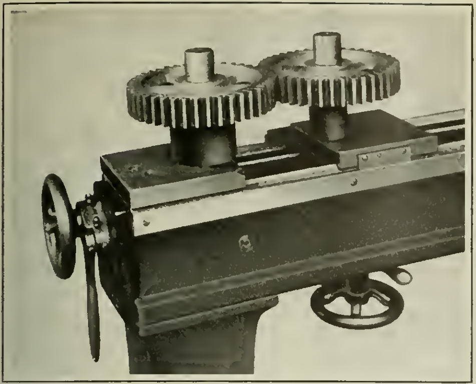


Fig. 1. Fixture for testing the Concentricity of Spur Gears

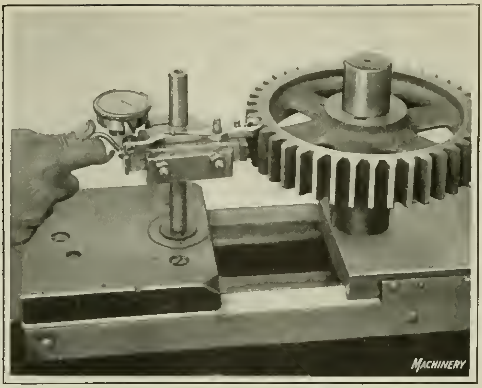


Fig. 2. Method of determining Uniformity of Tooth Spacing

Inspection of Spur Gears

By D. VAUGHN WATERS, Mechanical Engineer, Gould & Eberhardt, Newark, N. J.

CERTAIN qualities are required in spur gears, as well as in other types of gearing, for satisfactory service; these are uniform rotary motion, long life, and reasonably silent operation. In order to obtain these qualities, the following conditions must be met as closely as possible in manufacturing: The tooth curves should coincide with the basic involute for each gear; the pitch circle should be concentric with the axis of the blank; and the teeth should be of uniform thickness. Cutters are now made with a knowledge of basic principles and an accuracy of manufacture that enable a gear tooth contour to be selected and a cutter made which will produce this contour with a high degree of precision. Testing fixtures have also been developed to measure the accuracy of the involute curves on gear teeth. These fixtures have measuring elements which describe theoretically correct involute curves, and any deviation of the gear tooth therefrom can be instantly detected and measured.

In shops with an output of gears sufficient to justify their systematic inspection, certain standards should be established to define just how far a gear may depart from the fundamental requirements given in the foregoing: This article presents a short description of the practice of Gould & Eberhardt, Newark, N. J., in inspecting spur gears, with particular reference to the uniformity of tooth spacing and concentricity of the pitch circle relative to the axis of the gear.

The gears manufactured by this firm are component parts of the machine tools built by the concern, and are held to close limits of error. The inspection operations that do not relate to the spacing or concentricity of gear teeth are not within the scope of this article and therefore will not be dealt with.

Testing for Concentricity

The first operation is the testing of the blanks for concentricity, this, of course, being done before the teeth are cut. Each blank is rotated on a true arbor mounted in the centers of a testing machine. The anvil of a dial gage is brought to bear against the periphery, and any eccentricity can readily be seen. The cut gears are put on the studs of the gear-testing machine shown in Fig. 1, either in pairs or with a master gear, and when rolled carefully by hand, a slight eccentricity of the pitch circles is easily detected. This machine consists of a base somewhat resembling a lathe bed, a bracket near one end holding a vertical stud which can be changed for different sized holes in gears, and a movable slide with another stud mounted on it. There is also a scale and vernier for use in adjusting the studs to the correct center distance of the gears being tested. A screw and a nut inside the bed enable the movable slide to be adjusted, this mechanism being actuated by the handwheel seen at one end of the machine.

Testing the Uniformity of Tooth Spacing

The uniformity of tooth spacing is inspected by means of the fixture shown in Figs. 2 and 3. This consists substantially of a base, a slide, and a dial gage secured to the slide. On one end of the slide is fastened a fixed finger *A* which can be adjusted to different pitches, and at one side of this fixed finger is a movable finger *B* terminating in a lever, the end of which bears against the anvil of the dial gage. The ratio of the length of the lever end to that of the finger is such that each division on the dial of the gage indicates 0.0005 inch in tooth thickness.

This fixture is mounted on the gear-testing machine mentioned in connection with the rolling test. A gear to be tested is mounted on one of the vertical studs and the fixture secured in such a position relative to the gear that the fixed finger *A* enters a tooth space. The slide is next advanced by means of the attached handle, causing the movable finger *B* to enter the space on the opposite side of the tooth from the fixed finger. The dial reading is then taken, the gear rolled around, and the next tooth tested. This cycle is repeated until each tooth has been inspected and the error determined. It will be noted that this process does not check the circular pitch dimension of a gear, but insures uniform spacing around the blank. Fig. 2 shows the gear in place, being tested for uniformity of tooth spacing.

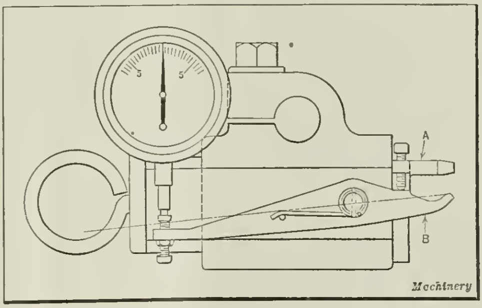


Fig. 3. Diagrammatic Representation of Fixture employed in Fig. 2

Ascertaining the Concentricity of the Pitch Circle

The inspection which closely checks the concentricity of the pitch circle with the axis of the blank is accomplished with the fixture used for the spacing test. For this operation, however, the fixed finger is replaced by a simple stop for the movable finger. The gear to be tested is mounted on a stud on the testing machine, as shown in Fig. 4, and held from rotating by means of a plunger entering a tooth space. This plunger is mounted on a bracket which can be adjusted to accommodate different sizes of gears. The testing fixture is then clamped on the machine so that when the slide is moved by hand, using the small handle referred to in the description of the previous operation, the movable finger will enter a space and bear on one side of the tooth about 180 degrees from the fixed plunger. The reading of the dial gage is then taken, the gear indexed one tooth, and the operation repeated. After all the teeth have been tested, if they have been cut eccentrically relative to the axis of the gear, the dial readings will increase and diminish uniformly from a mean value.

When an arbor is mounted in a lathe and it is desired to test its truth, this may be accomplished by bringing the anvil of a dial gage against the periphery of the arbor. The reading thus obtained is equal to twice the eccentricity, or the diameter of the circle described by the eccentric center rotating about the true center. With the gear-testing method just described, the result is the same as if a dial gage were brought to bear against the work-arbor upon which the gear was cut, thus providing a check upon the care exercised by the machine operator in setting up the work. Attention is called to the fact that if T equals the diameter of the circular path described by the eccentric center, the difference in the reading will be $2T$.

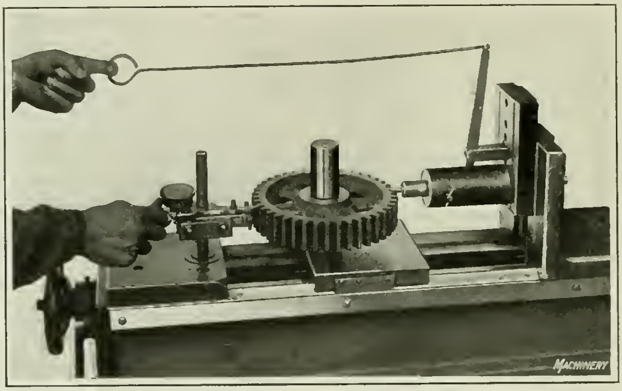


Fig. 4. Arrangement used for checking the Concentricity of the Pitch Circle

If the point of contact of the movable finger and the tooth flank does not lie on a line intersecting the axis of the gear and the fulcrum of the finger, the dial gage will indicate a difference in tooth position slightly in excess of that actually obtained. This discrepancy is so slight and the total difference in dial reading such a small amount, never exceeding 0.003 or 0.004 inch, that the testing fixture may be located in position as nearly as can be judged with the eye, and the possible error resulting from a slightly incorrect setting safely disregarded. When the high point on the gear comes opposite the testing fixture, the tooth is nearer the fixture by an amount equal to T than when the high point is opposite the plunger. This movement, taking place at the mid-position of the finger, will not affect the maximum and minimum dial readings, and may therefore be ignored. Denoting the difference in the dial readings from maximum to minimum as D, the value of T, or the variation a dial gage would show if it were possible to apply it to the pitch circle of the gear, would be $D \div 2$.

* * *

A study of the melting losses in aluminum metallurgical practice and the comparative efficiency of various types of furnaces has been completed by the Pittsburg Experiment Station of the United States Bureau of Mines, and the complete results will soon be available in bulletin form.

PRODUCTION OF MACHINE TOOLS IN THE UNITED STATES

The table on the opposite page, which has been compiled from information furnished by the Bureau of Census, shows in detail the production of machine tools in the United States for 1919. In that year, there were 496 establishments engaged in the manufacture of machine tools and accessories. Of this number, 403 plants were directly engaged in the production of machine tools, and 93 manufactured accessories. The total value of the product manufactured was $222,504,654, of which $212,224,708 worth was produced directly by the machine tool industry.

For a great many years Ohio has led all other states in the production of machine tools. In 1919 that state had 112 manufacturers, producing $65,521,575 worth of machines. Massachusetts came next with 56 plants, producing $23,885,863 worth of machine tools, while Rhode Island, with 18 plants, manufactured machine tools to the value of $23,080,978.

The table gives the total number of machine tool plants in the United States as a whole, and also the totals for the leading states engaged in this industry, together with the value of the machines produced in each. The table is further subdivided to show which states manufacture certain machine tools, giving not only the number of plants in the various states, but also the number of machines manufactured and the total value in each state of the different types produced. While some of the states lead in manufacturing one product or another, it will be noted that Ohio has the greatest number of machine tool plants, and also produces more individual machine tools than any other single state.

In another table compiled by the Bureau of Census, but not published here, it is shown that during 1919 the United States produced a total of $36,347,616 worth of metal-working machinery other than machine tools. Of this total Ohio produced only $4,180,531, while New York led with $9,250,240 worth of metal-working machinery. Illinois came second with $7,904,031 worth, and Connecticut ranked third, with $5,701,238.

* * *

PAMPHLET ON DEPRECIATION

The fabricated production department of the Chamber of Commerce of the United States has published a pamphlet entitled "Depreciation—its Treatment in Production," which should be of considerable interest in view of the fact that depreciation is one of the most important problems in costs and general accounting. The material presented is based on extensive experience, and has been prepared in cooperation with many leading authorities in the accounting field, industrial engineers, manufacturers, etc. The topics treated are as follows: The need of charging depreciation into everyday cost; the relation of insurance and depreciation; adjusting depreciation to production; the controlling effect of obsolescence; advantage of standard rates of depreciation; and how the property ledger operates. The publication of pamphlets of this kind is part of the educational plan of the department, and copies will be supplied to those interested upon request.

PRODUCTION OF MACHINE TOOLS IN 1919

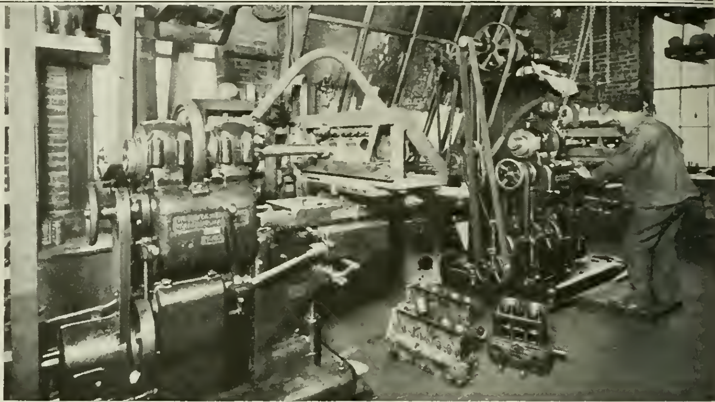
	Number of Establishments	Number of Machines	Value
Total number of establishments and value of products	496	......	$222,504,654
Machine tool industry	403	......	212,224,708
Subsidiary machine tool products from other industries	93	......	10,279,946
State Totals			
Ohio	112	......	65,521,575
Massachusetts	56	......	23,885,863
Rhode Island	18	......	23,080,978
Connecticut	44	......	18,911,363
Pennsylvania	41	......	18,089,791
Illinois	35	......	15,728,950
Michigan	37	......	13,324,988
Vermont	7	......	9,669,745
Wisconsin	30	......	9,637,254
New Jersey	18	......	7,333,048
New York	37	......	5,710,714
Indiana	19	......	4,496,898
Kentucky	8	......	1,280,706
All other states	34	......	5,832,781
Totals for Different Types of Machine Tools			
Lathes			
Engine lathes	62	17,395	23,700,862
Ohio	22	6,806	12,673,981
Pennsylvania	6	134	1,759,737
Massachusetts	7	1,411	1,670,023
New York	5	2,010	1.394,223
Kentucky	4	675	626,101
Illinois	5	1,080	431,286
All other states	13	5,279	5,145,511
Turret lathes	23	4,724	10,285,484
Indiana	4	861	1,470,910
Massachusetts	4	218	584,849
All other states	15	3,645	8,229,725
Bench, and other lathes	56	7,603	4,739,116
Massachusetts	13	2,224	903,247
Illinois	6	1,302	870,638
New York	7	987	477,418
Connecticut	4	297	97,632
All other states	26	2,793	2,390,181
Milling machines			
Plain	34	8,531	7,386,734
Ohio	10	3,246	2,979,301
Wisconsin	3	2,022	1,835,280
New York	4	646	479,937
Connecticut	3	274	176,986
All other states	14	2,343	1,915,230
Universal	17	4,101	6.080.417
Wisconsin	4	1,814	2,154,976
Ohio	4	1,155	1,860,215
All other states	9	1,132	2,065.226
Vertical	13	1,146	2,375,742
Automatic	12	822	1.232.048
Other Types	21	1,751	2,989,793
Grinding machines			
Plain	52	9,352	12,999.651
Massachusetts	15	4,677	6,386.251
Pennsylvania	6	1,052	2,421,570
Ohio	8	1,073	1,005,377
Connecticut	6	762	491,074
Wisconsin	5	155	178.527
All other states	12	1.633	2,516,852
Universal	19	1.826	2,113,412
Massachusetts	6	771	520,307
Ohio	3	241	354,843
All other states	10	814	1,238,262
Other Types	28	4,244	1,956,064
Massachusetts	6	745	419.729
Connecticut	3	228	310.378
Ohio	4	350	238,303
Illinois	3	163	119,687
All other states	12	2,758	867,967

	Number of Establishments	Number of Machines	Value
Drilling machines			
Radial	28	2,993	$6,215,541
Ohio	14	2,416	4,635,136
All other states	13	577	1,580,405
Multiple-spindle	17	1,738	2,296,841
Ohio	4	359	500,542
All other states	13	1,379	1,796,299
Sensitive	19	7,189	2,081,850
Massachusetts	4	2,182	1,064,102
All other states	15	5,007	1,017,748
Upright	20	9,854	2,291,897
Illinois	5	3,804	891,188
All other states	15	6,050	1,400,709
Screw machines			
Automatic	14	3,897	8,445,222
Hand	11	3,047	3,159,710
Ohio	4	2,365	2,642,132
All other states	7	682	517,578
Boring machines			
Horizontal	25	852	4,565,720
Ohio	7	343	1,448,449
Pennsylvania	5	126	1,340,532
Massachusetts	3	97	445,864
All other states	10	286	1,330,875
Vertical	13	864	4,458,356
Ohio	3	248	2,410,446
Pennsylvania	4	258	1,136,029
All other states	6	358	911,881
Planers	28	1,525	8,355,390
Ohio	9	869	4,154,315
Massachusetts	5	193	808,196
Pennsylvania	3	20	600,987
All other states	11	443	2,791,892
Presses			
Punching	24	33,404	5,626,245
Ohio	9	31,457	4,530,299
All other states	15	1,947	1,095,946
Other Types	31	4,159	1,464,161
New Jersey	5	980	616,458
Ohio	5	381	161,802
Illinois	4	247	37,020
All other states	17	2,551	648,881
Gear-cutting machines, all states	15	2,949	6,162,426
Hammers, pneumatic and other	25	40,121	5,104,993
Ohio	4	7,348	807,977
New York	5	471	288,851
All other states	16	32,302	4,008,165
Shapers	31	4,602	4,347,838
Ohio	10	1,875	1,662,301
Michigan	3	217	308,856
Pennsylvania	4	13	81,947
All other states	14	2,497	2,294,734
Pipe machines	9	43,422	3,280,593
Ohio	4	40,290	1,282,140
All other states	5	3,132	1,998,453
Shears, all states	17	1,791	2,004,616
Broaching machines, all states	8	580	1,418,236
Bending machines, all states	10	516	954,444
Portable tools	44	......	10,913,004
Michigan	7	......	2,882,729
Ohio	9	......	2,650,146
Pennsylvania	3	......	185,965
Connecticut	5	......	58,604
All other states	20	......	5,135,560
All other machine tools	184	......	30,845,316
Massachusetts	17	......	6,346,693
Ohio	31	......	5,646,693
Rhode Island	11	......	5,131,023
Connecticut	14	......	4,459,880
Michigan	18	......	2,523,745
Pennsylvania	18	......	1,354,358
Illinois	14	......	1.258.778
Wisconsin	13	.....	1.033,122
New Jersey	11	......	735,506
New York	15	......	686,641
Indiana	7	......	590,683
All other states	15	......	1,078,194

Machinery

Machining Pistons in the Repair Shop

Second of Three Articles Describing Methods and Equipment Commonly Used in Automobile Repair Shop Practice



THE methods used in the Frostholm Bros. shop in Syracuse, N. Y., for machining pistons require only standard machine tools in connection with some special fixtures. This company manufactures cast-iron pistons in standard sizes and in sizes from 0.001 to 0.062 inch oversize. However, the use of aluminum alloy pistons with a split skirt having from 0.001 to 0.002 inch clearance in the cylinder bore is recommended for some motors. These lightweight alloy pistons can be fitted with less clearance than cast-iron pistons, and special features of design provide for expansion, so that the fit is not affected by cold or warmth.

Turning a Recess on the Insidé of a Rough Casting

For the cast-iron pistons a complete line of patterns is carried in stock, and the rough castings are first machined by turning a recess on the inside of the skirt to form a seat for plugs used in locating the piston during the subsequent lathe operations. The set-up of the Hendey lathe in which this operation is performed is illustrated in Fig. 1. The work is chucked in a four-jaw chuck and the recess is turned by a high-speed bit held in an Armstrong tool-holder.

Boring Wrist-pin Hole and Turning Piston-ring Grooves

Fig. 2 shows two lathes, arranged back to back so that the pistons may first be drilled and bored for the wrist-pin in the American lathe shown in the foreground, and then passed to the Worcester lathe at the rear, in which the ring-grooving and turning operations are performed. For wrist-pin boring operations, a fixture of similar design to that shown in Fig. 2 is used in various repair shops. The fixture is keyed to the faceplate of the lathe, and on its main casting are two projecting lugs, one of which has provision for attaching a finished plug of the size required to fit in the turned recess of the piston. A central line is scribed on the piston and a similar line on the locating plug, so that when these two lines are brought into coincidence the work is centrally located. The lug at the closed end of the piston carries a square-head screw for securely locating the work against the plug while the hole is being drilled and bored. An Armstrong boring-bar with a high-speed bit is the tool used in the boring operation.

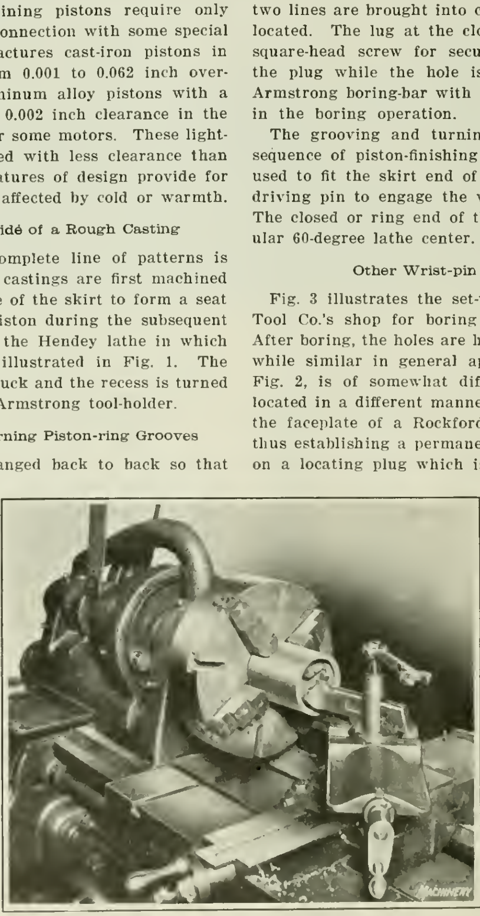


Fig. 1. Turning an Internal Recess on a Rough Piston

The grooving and turning operation is the next in the sequence of piston-finishing operations. A special center is used to fit the skirt end of the piston which also carries a driving pin to engage the wrist-pin lugs within the piston. The closed or ring end of the piston is supported by a regular 60-degree lathe center.

Other Wrist-pin Hole Boring Fixtures

Fig. 3 illustrates the set-up used at the Nixon Broach & Tool Co.'s shop for boring the wrist-pin holes in pistons. After boring, the holes are hand-reamed to size. The fixture, while similar in general appearance to that illustrated in Fig. 2, is of somewhat different design, and the work is located in a different manner. An angle-plate is attached to the faceplate of a Rockford tool-room lathe by dowel-pins, thus establishing a permanent location. The skirt end seats on a locating plug which is fitted in the fixture to accommodate different sizes of pistons. An arbor *A*, one side of which is milled flat, extends through a sleeve *B* in the angle-plate and is prevented from turning during the boring operation by a slab attached to the inside of the sleeve by two machine screws. The arbor extends through and into the piston and at its extreme end carries a V-block which operates against a coil spring interposed between its back surface and a shoulder on the arbor. The V-block seats on the wrist-pin bosses and holds the piston firmly while it is clamped from the closed end by a screw in strap *C* carried at the extremities of two tie-

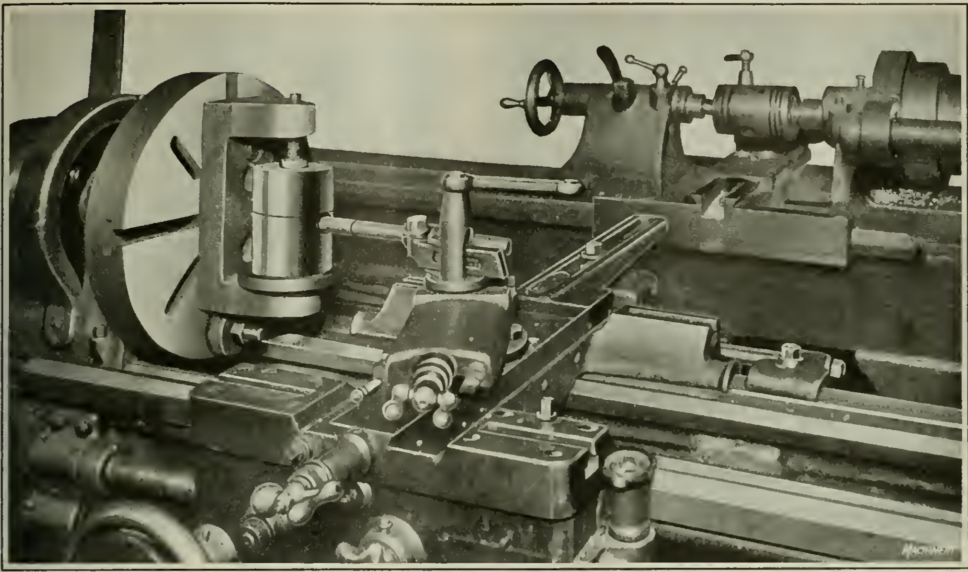


Fig. 2. Two Lathes, One equipped for boring the Wrist-pin Hole in Pistons and the Other for turning the Piston-ring Grooves

rods attached on each side of the angle-plate. This fixture, with proper locating plugs for the skirt end of the pistons, constitutes a self-centering device for any size piston.

The practice followed in the Saucke Bros. repair shop for finishing wrist-pin holes is not materially different from that in the two preceding cases. In Fig. 4 is shown a Davis lathe, to the faceplate of which a V-block fixture is attached. The piston is located in this V-block and adjusted by screws at the ends as required for centering it. A strap and two tie-rods are employed to secure the work in the V-block. The piston holes are first drilled, then finish-bored with a high-speed bit boring-bar, and finally finished by hand-reaming. The pistons furnished on repair work by this concern are manufactured from soft gray iron, the castings being made from their own patterns and afterward seasoned and heat-treated by bringing to a cherry red in a charcoal fire and allowing to cool with the charcoal embers.

Facing the Wrist-pin Bosses on a Drilling Machine

Inasmuch as the refitting of cylinders with over-size pistons sometimes involves the complete machining of the piston from the rough casting, it may be well to follow through some of the other operations in the Frostholm Bros. shop where this practice is followed. In Fig. 5 the operation of facing the bosses which surround the wrist-pin hole on the inside of the piston is illustrated. This work is done on a Barnes drilling machine, equipped with a sub-press type of V-block fixture. The posts of the base of this fixture carry a cast-iron clamp, which may be raised and lowered to suit different diameters of pistons, and clamped by knurled nuts. The clamp contains a finished central hole in which the shank of the piloted cutter-bar is guided. The cutter is a double-facing tool and is fed in alternate directions as required to face each boss. The bar extends beyond the cutter and acts as a pilot at the lower end to assure parallelism between the faces.

Finishing the Outside Diameter

The outside diameter of the pistons is first finished by rough-turning. They are then heat-treated, after which they are machined to within 0.010 inch of size. The skirt of a piston is usually ground straight, and at the head, where

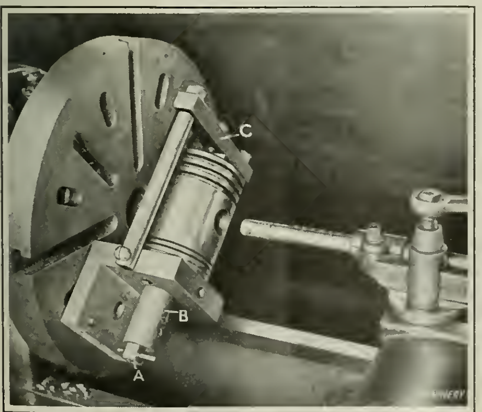


Fig. 3. Fixture for holding Pistons while finishing Wrist-pin Hole

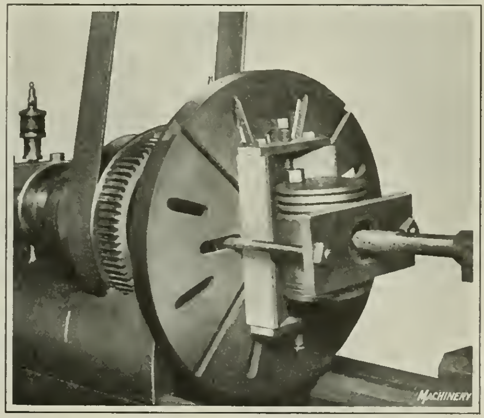


Fig. 4. Method of holding a Piston while boring the Wrist-pin Hole

Fig. 5. Drilling Machine and Fixture used for holding Pistons while facing the Wrist-pin Bosses

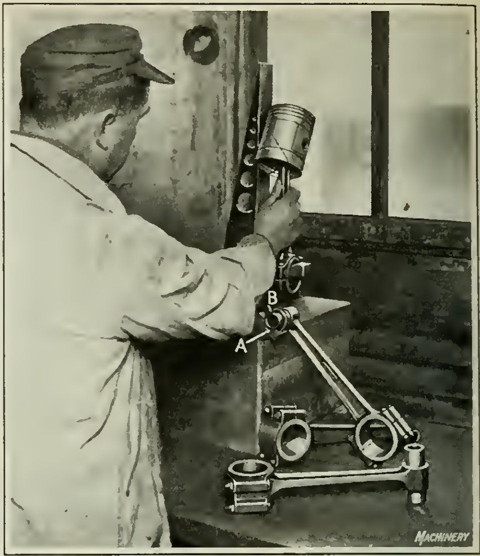


Fig. 6. Testing the Alignment of the Assembled Piston and Connecting-rod

the ring grooves are, it is necessary to grind to smaller diameters, reducing the size in steps toward the top of the piston. As there is more metal in the top, it is natural that it will expand more. The grinding is done on a No. 2 Brown & Sharpe cylindrical grinding machine, on the driving head of which a special taper center is used to engage the skirt end and drive the work, as shown in Fig. 7. For this operation a 12-inch diameter, 1¼-inch face aloxite wheel, made by the Carborundum Co., 24-36 grit, N grade, is used.

The practice followed by the Nixon Tool & Broach Co. in machining pistons is first to turn them to within 1/32 inch of the required finished diameter and then heat-treat them to remove the strains. After heat-treatment, they are finished by grinding on any standard cylindrical grinder, the rough-grinding operation removing stock to within 0.003 inch of the finished size. For both the finishing and roughing a 36-J Norton grinding wheel is used.

Testing Pistons and Connecting-rods

After the pistons have been finished and before they are reassembled in the motor, they are fitted with the proper size wrist-pins and assembled on the connecting-rod preparatory to testing for alignment. For this work Frostholm Bros. use a Dyer piston aligning gage in the manner indicated in Fig. 6. This illustration also indicates how the connecting-rod is tested before the piston is assembled. There are a number of connecting-rods shown on the bench with the piston-pins in place, and one of the piston-pins carries a parallel A, in one side of which a V-groove is cut in which the wrist-pin is seated by a coil spring *B* looped over it. This simple device is slipped on the end of the pin, and the connecting-rod placed on the fixture, as illustrated, in the same manner as when the piston is assembled.

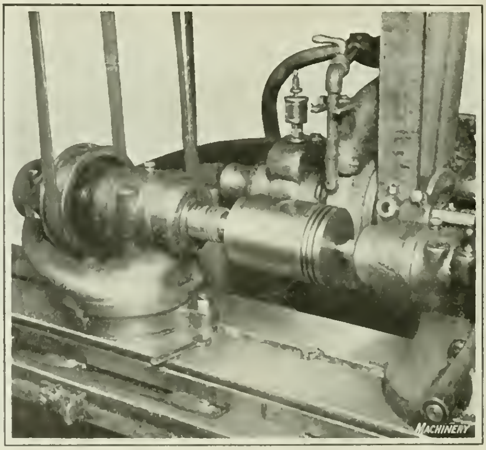


Fig. 7. Finishing the Outside of a Piston on a Cylindrical Grinder

If the test of parallelism and twist of the crankpin and wrist-pin holes is satisfactory, the surface of the piston is tested relative to the crankpin in the manner shown. By tipping the piston and moving the connecting-rod so that the surface to be tested passes by the vertical gage surface, and watching for the appearance of light as the two surfaces are brought into contact, the amount of deviation from perpendicularity with the crankpin hole is readily detected. For straightening the connecting-rod to overcome any inaccuracy that may exist, either a vise with special jaws or an arbor press may be employed, according to the equipment available in the repair shop.

* * *

STATISTICS ON MACHINE BUILDING FOR 1921

The Census Bureau has begun to collect statistics for the year 1921 covering machinery of various classes, including machine tools and metal-working machinery. The 1921 statistics will be made very complete, provided the Department of Commerce obtains the necessary cooperation from the various manufacturers in this field. The success and value of the statistical information will depend largely upon the rapidity and accuracy with which manufacturers make the reports asked for by the Department. Blanks will be sent out to all the manufacturers in the field to be filled in and returned to the Bureau of Census. The information thus obtained, when collected and tabulated, will be of value to everyone in the entire machine-building field, and for that reason the data necessary to compile these statistics should be freely given.

The French Machine Tool Market

By W. P. MITCHELL

Paris, January 10

RECONSTRUCTION of industry since the armistice has demanded all the new equipment that economic conditions would permit; but it has been the French policy to discourage purchases from abroad, assuring buyers that the French machine tool industry would be capable of furnishing equipment equal to that imported either from the United States or Germany, the two chief sources for both metal-working and woodworking machinery in France.

It was for this reason that after the armistice extensive transformations were made in many war industries with a view to supplying both the home and the export market with machine tools of French manufacture. Since that time these transformed war plants have produced—in some cases merely attempted to produce—in addition to metal-working and woodworking machinery of all classes, a great variety of mechanical accessories to modern life and industry, from sewing machines and typewriters to molding machines for foundries, and grain- and coal-loading equipment for docks and warehouses. Today there is a list of at least two hundred French manufacturers, making some types of machine tools, advertising their product in the technical and daily press, each competing with a product hitherto imported.

Since the armistice there has also been a great increase in the imports of machine tools. The market of France has proved itself susceptible of a development hitherto not believed possible. Yet many French manufacturers would have added still further to their machine tool equipment had they not been prevented from making any but the most urgent purchases by the present high cost, because many manufacturers realize the necessity of modernizing their plants. American machine tools, to be paid for by what the Frenchman calls a "three-dollar dollar," suffered more than the substitute home product when the latter was available, but even the home product price, as compared with the price before the war, was based upon at least a "two-dollar dollar," and often more. There remained the possibility of finding what was wanted in Germany. With a natural aversion to pouring gold francs into Germany to take the place of paper marks many French manufacturers would not buy from across the Rhine, but turned to Switzerland, Denmark, and Holland, often even then obtaining a German product.

French Trade with Germany

Germany, for the moment, is the natural source of supply for the varied industries of France. Owing to the low value of the mark as compared with American and English money, obviously that is where France will buy, and the recent Wiesbaden conference has aided this tendency.

During the first six months of 1921 France imported from Germany machinery and tools to the value of nearly 400,000,000 francs, whereas from the present almost inexhaustible resources in iron ore, France sold to Germany in the same period only 100,000,000 francs worth of iron ore, pig iron, and semi-finished iron and steel products. On the face of it, Germany profited, on this one item alone, to the extent of 300,000,000 francs.

French Trade with the United States

A comparison is made in the following between the imports into France from the United States during the first six months of 1920 and the first six months of 1921; and also between the exports from France to the United States for the same period. The values are given in francs.

IMPORTS INTO FRANCE FROM THE UNITED STATES

	1920 Francs	1921 Francs
Machinery of all kinds	351,835,000	259,587,000
Tools and hardware	84,650,000	22,869,000

EXPORTS TO THE UNITED STATES FROM FRANCE

	1920 Francs	1921 Francs
Machinery of all kinds	1,750,000	4,154,000
Tools and manufactures of metal	3,277,000	27,200,000

These figures should be carefully studied. Exports from the United States to France decreased more than 150,000,000 francs, while French exports to the United States increased in a remarkable ratio. France exported in 1921 more tools and manufactures of metal to the United States than she imported. The low figures for the exports of machinery to the United States indicate that France is not equipped to produce machinery to compete in price with American products. That this is true is evident from the fact that France still continues to import many classes of machinery from the United States, paying 50 per cent or more over the price of the French product. The main cause for the falling off of American imports is undoubtedly German competition.

French Machine Tool Requirements

There is a greater appreciation of up-to-date and efficient machine tools than ever before. The French customs figures indicate the change between yesterday and today. The importation of machine tools in 1913 amounted to 48,000,000 francs, or 23,735 metric tons. Of this, 12,512 tons came from Germany.

In 1919 the imports of machine tools into France rose to 226,000,000 francs, or 33,504 metric tons. In 1920 the imports were 384,000,000 francs, or 56,940 tons. During the first eight months of 1921, the latest for which complete figures are available, a falling off due to the general economic conditions is noted, yet the imports were 49 per cent above the imports in 1913, the comparison being on the basis of tonnage. While there has been a drop in the imports, it is not believed that this is caused by the absorption point of the French market having been reached. It is partly due to the French manufacturers' supplying the domestic market.

There are no statistics available to show the quantity or value of French machine tools actually produced, but the export figures give some indication of the status of the industry in 1913 and its later growth. In 1913 the exports of French machine tools amounted to 4600 tons; in 1919 to 3600 tons; in 1920 to 8700 tons; and in the first eight months of 1921 to 5250 tons (or the equivalent of about 7900 tons for the entire year).

With high tariffs intended definitely to protect this new industry and the low value of the franc as compared with the dollar, it is easily seen why American machine tools are not readily sold in France. The French manufacturers, in spite of the high cost of raw materials and wages, transportation, and fuel, have taken advantage of the situation, and are not likely to give up their competitive position in the future. France, with the reannexation of the mineral resources of Lorraine, and the acquisition of the admirably built German steel plants there, must develop home industries for utilizing all of this to the best advantage. This means to sell, not raw materials or unfinished iron and steel, but the highly finished product. This is the keynote of the French policy in the metal-working field. In the machine tool industry, the results may already be noted.

Assembling Watch Pinion Bearings

Methods and Equipment Employed by the Waltham Watch Co., Waltham, Mass.

THE bearings for the pinion staffs of a watch consist either of nickel composition bushings and jewels for the cheaper grade of watches or of jewels entirely for the better grade. The bearings are staked into the pillar plate to support the lower pivoted end of the staff, while the upper bearings are assembled into the top plates. Before the assembling process is performed, it is important to so grade the staffs and the jewels in which the pivots have their bearing that the least possible amount of play is produced, and yet so that the pinions can run freely.

Some interesting methods are employed for this assembling process in the plant of the Waltham Watch Co., Waltham, Mass. First, a special dial gage, shown in Fig. 2, is used to measure the diameter of the staff at the point where the bushing or jewel is to fit. The gage has a stop for locating this point, and a staff carrying a wheel *A* is placed between the jaws of the gage and against the stop for determining the measurement. In connection with the inspection work, a blank form is used, which is ruled into squares, there being one square for each of the two bearings of every staff that is to be assembled. There are ten vertical rows of squares to accommodate lots of ten watches which go through the assembling process at once.

The selective assembling methods used are as follows: The plates, wheels, and other parts are delivered to the assembling bench in trays such as shown at *B*, each of the compartments being numbered. As soon as the diameter of a pivot has been determined, it is entered in a square of the blank form referred to, this square being in the vertical column corresponding to the compartment of the tray from which it was taken and opposite the name of the staff. Thus, if the upper pivot of a balance staff were gaged, and if this pivot wheel were taken from the first compartment in the tray, the entry would be made in the square at the upper right-hand corner. After all the pivots have been thus gaged, recorded, and placed back in the tray, the work is delivered to another bench where the jewels are selected for each pivot bearing. The special forms, with the entries made at the previous bench, accompany the tray, and when the proper jewels have been selected they also are placed in small compartments of the tray and passed on to be assembled.

The jewels are contained in small glass vials, as shown in the illustration, each of which is properly labeled to designate the staff for which the jewels are to be used and the size of the hole. All the jewels which are to be used for a particular set of bearings are graded by steps of 0.0005 centimeter (about 0.0002 inch) and by following the notations previously made on the form, the proper vial from which to select the jewel can be determined. After the jewel has been taken from the vial, it is gaged by a graduated needle gage *C* for diameter of hole, after which it is placed on the particular square which will indicate a running allowance between the hole of the jewel and the gaged pivot of the staff of 0.001 centimeter. The unit of measurement used at the Waltham Watch Co.'s factory is the centimeter. Fig. 2 shows a number of these jewels properly located in the squares of the blank form referred to.

Fig. 1. Presses on which Watch Jewels and Bushings are staked in the Plates

In addition to the determination of the running qualities between the pivot and the jewel hole, the degree of fit between the outside diameter and the hole in the plate in which the jewel is assembled is also inspected. The jewels, or bushings, as the case may be, must fit into the hole and still be free to move up or down. This establishes only one limit, that is, the upper limit, but if the jewels are too loose this will be discovered when they are being staked into the plates. Some of the jewels are set into the plate by being screwed in, while others are staked by the use of small bench presses, as shown in Fig. 1.

Staking Jewels and Bushings

The jewels in the lower plate are staked first, an air-operated press such as shown at *A* being employed. The punch must, of course, be long enough to extend through the bearing holes in the upper plates and reach the lower plate. The holder for locating the watch plate and its assembled parts consists of a flat disk with posts by means of which the watch assembly is positioned. After the watch has been thus located, a ring is screwed down to hold it securely in place. One of these holders is shown on the bench at the right of the press with the ring removed, and another on the table of the press at *B*, in readiness to have the bearings staked. The vertical posts of the main disk of this holder are of such height that they form the locating surfaces against which the jewels are pressed while being staked into position. Au air pressure of fifteen pounds is used in this operation.

For the upper plates a foot-operated press *E* is used. This press is equipped with a sapphire punch so as not to abrade the jewel when pressure is exerted during the staking operation. It is necessary to predetermine the distance between the face of the sapphire punch and the jewel, and this is done by locating the assembly on a disk by means of posts, as in the staking of the lower jewels, and then safeguarding against crushing the jewel by the use of a special stop for the punch which is independently set for each bearing. This adjustment is secured by pressing down the knob shown at

Fig. 2. Equipment used for inspecting Watch Staff Pivots and Jewels

the top of the press, against the tension of a coil spring until the sapphire punch seats firmly on the vertical post of the locating disk, in which position it is secured by swinging the yoke *C* into position for locking the punch at the predetermined height. When the foot-treadle is depressed, pressure is transmitted through a toggle lever which bears against a stop-pin *D*, and raises the table to keep the amount of pressure within the crushing strength of the jewel. A graduated dial *F* is used to set the stop-pin accurately. The connecting-rod which joins the toggle lever to the foot-treadle is shown extending through the bench at the rear of the press.

* * *

SETTING UP LARGE WORK FOR PLANING

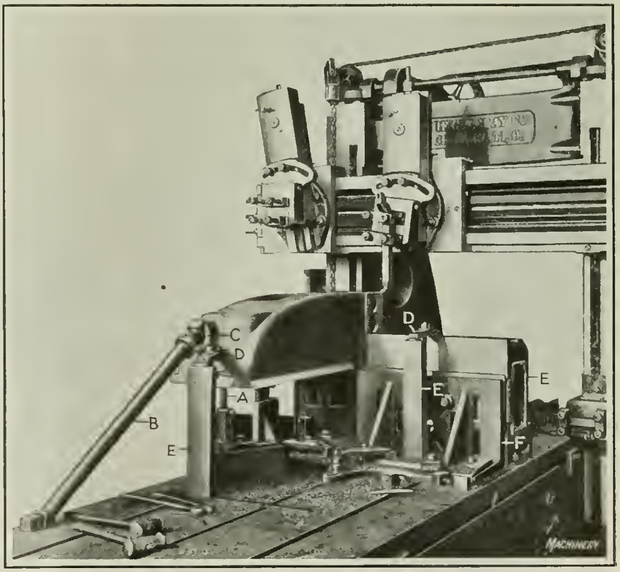
There are few types of machine tools that are required to handle as wide a range of work as planers. The methods of setting up these different classes of work naturally vary according to the size and type of the pieces to be planed. In setting up large castings, a considerable amount of ingenuity is often required to provide a sufficiently rigid support for the work in order to prevent it from springing.

Cast iron and other metals may sometimes be sprung out of shape through the application of relatively small loads. Such a deflection of the work produced by the pressure of the cutting tools on a planer may assume the form of either a temporary strain or a permanent set, but in either case the dimensions of the planed piece are almost sure to be seriously affected in cases where a high degree of accuracy is required; and to avoid trouble from this cause, it is necessary to take the greatest care to see that all overhanging parts of the work are well supported to prevent deflection. The accompanying illustration shows a good example of a set-up in which adequate provision is made for the support of the work. Here the body of a gear-cutting machine is shown set up on a G. A. Gray planer in the Brown & Sharpe plant. When the casting is delivered to the machine, the bearings have been planed for the cutter-head slide and for the work-holding spindle-head slide, in addition to some other surfaces, so that these may be used as locating points.

As set up on the planer the column that supports the work-spindle head of the finished gear-cutting machine overhangs in a manner that would be likely to cause serious deflection, if especial care were not taken to support the casting at this point. For this purpose there is a jack-screw *A* which may be adjusted under the casting to carry the weight of the overhanging part and any additional load imposed by the pressure of the tool. The work is further supported by an inclined jack *B*, at the lower end of which there is a wedge-shaped block that bears against a plug set in one of the table clamping bolt holes, while at the upper end there is a screw-operated V-block that enters hole *C* in the work. This inclined jack serves the double purpose of supporting both the vertical load and the horizontal thrust of the planer tool. The casting is held down on the planer table by two bolts and straps *D* arranged in such a way that one end of each of these straps bears on the work, while the opposite end is carried on a vertical strut made of a piece of 2- by 4-inch timber *E*. The bearing for the cutter-spindle head is bolted against angle-plate *F*, which is secured to the table by straps.

* * *

According to Census figures, 246,139 tractors were in use on farms in the United States at the end of 1919, and the farm equipment production and sales statistics of the Department of Agriculture show that 162,988 tractors were sold in 1920, so that a total of about 400,000 tractors are now in use in the United States. There are still 2,000,000 farms which represent prospects for the sale of tractors.



Method of setting up Large Castings for planing

Cutting Costs with Riveting Hammers

By FRED R. DANIELS

SEVERAL examples of cold-heading and rivet-setting operations performed on high-speed riveting hammers made by the High Speed Hammer Co., Inc., Rochester, N. Y., are illustrated in this article. One of the reasons that a high-speed riveting hammer is a valuable cost-reducing factor in metal-working plants is that the machine is easy to operate and regulate, so that boys and women are able to turn out as satisfactory a product as the more skilled machinist. The riveting hammer referred to consists of three main units—a pedestal, an attached hammer-head, and an adjustable anvil support. The hammer head carries a friction drive on one side and a pulley that revolves the spindle of the machine on the other, both being mounted on the crankshaft that actuates the hammer movement of the heading tool. The shock of the blows delivered is absorbed by the use of a hickory helve and large rubber bumpers.

The principle of hand riveting is incorporated in this machine in that the cold metal is caused to flow under repeated blows. The force required in delivering these blows for different classes of work is under the control of the operator through the friction clutch and foot-treadle by means of which the machine is operated.

The applications of the riveting hammer mentioned in the following are only examples of the wide field in which this type of hammer is in common use. For the delicate work required in typewriter construction and in the manufacture of camera parts and electrical apparatus, the high-speed hammer is regularly used. When parts are riveted with a hinge joint and freedom of movement is the prime requisite, the possibility of controlling the force of the blows permits rivets to be set without closing the hinge and causing the leaves to bind.

When rivets are pressed into place before riveting, two operators may be employed for the assembling and the riveting operations, one to press or hammer in the rivets and the other to do the riveting. Often the rivets are not a press fit, but may be assembled by hand in the parts to be riveted, and the work thus assembled passed to the riveter. In this case a boy can do the assembling work and keep the riveting machine in constant operation.

Riveting Rear Axle Drive Shaft Caps

The work being done in the set-up shown in Fig. 1 is the cold-riveting of forged steel hub caps to high-carbon steel rear axle drive shafts, 1 1/4 inches in diameter. The nature of the work performed in this operation is indicated at *A* in Fig. 3, from which it will be seen that the shaft extends 3/16 inch beyond the end of the cap, this metal being cold-riveted into the countersunk hole in the cap. This is an example of heavy cold-riveting, the work being done in the plant of the Reo Motor Car Co., Lansing, Mich. For work of this kind it will be readily understood that the peen must be properly shaped to fit the curvature of the cap so that as the tool revolves the rapid elastic blows will set the end of the shaft down even with the curvature of the cap. The work is seated on a special fixture and chucked from within

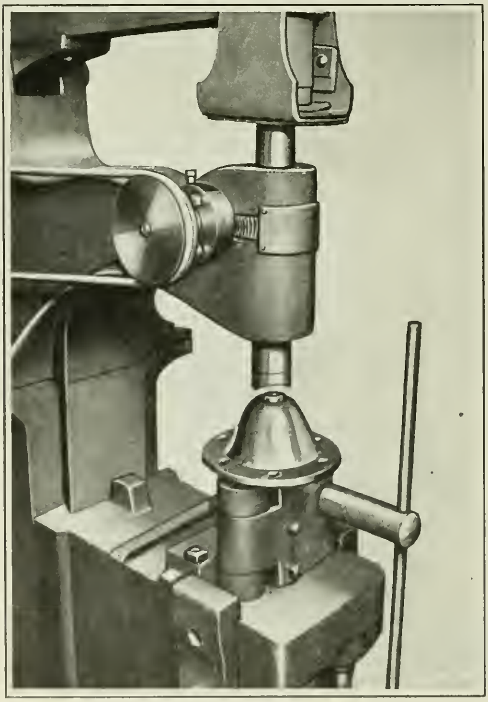


Fig. 1. Set-up for riveting Rear Axle Drive Shafts over Hub Caps

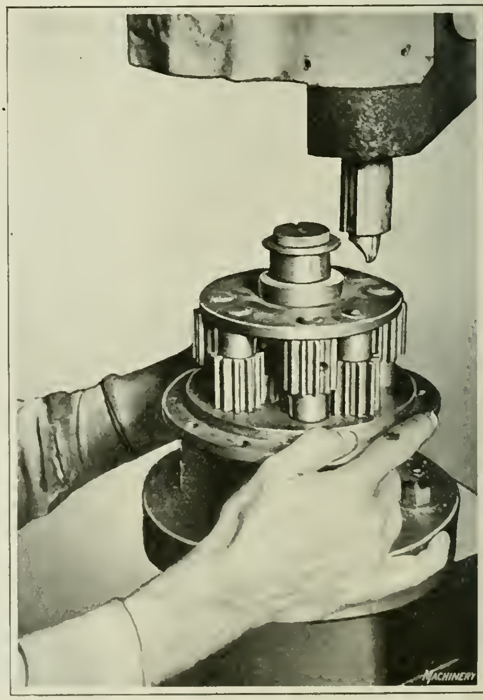


Fig. 2. Riveting Pins in Gear-case on a Power Riveting Machine

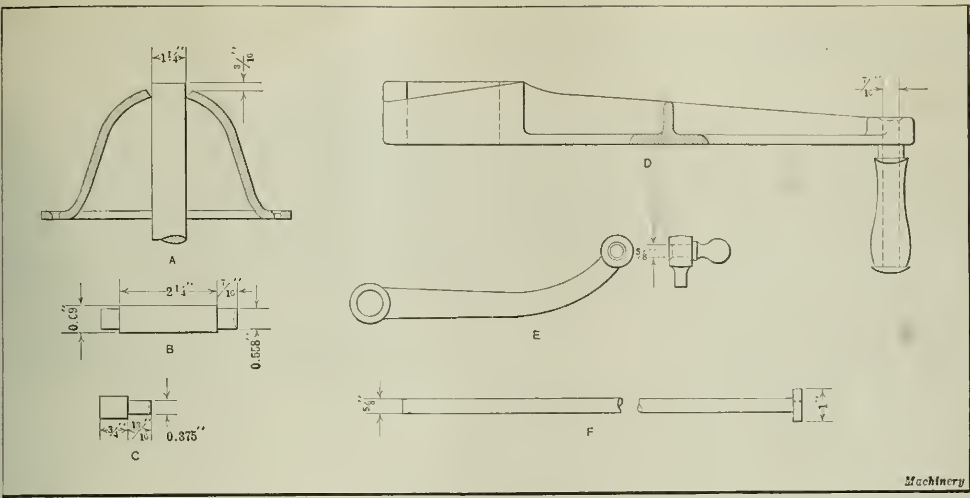


Fig. 3. (A) Shaft and Hub Cap before riveting; (B) Pin used in Differential Gear-case; (C) Wire Wheel Hub Flange Pin; (D) Automobile Crank-handle; (E) Pitman Arm; (F) Drill Rod with Cold-rolled Steel Head

by simply turning the lever-handle a part revolution. The work was formerly done by hand, by which method neither uniformity of product nor speed were realized. Using the sledge hammer the production time was four minutes per shaft; with the machine and set-up illustrated, the time is one minute per shaft.

Operations on Differential Gear-cases

Another manufacturing operation in the automotive industry is illustrated in Fig. 2; this is the riveting of eight heat-treated steel studs in automobile differential gear-cases. This also is a heavy riveting job. The work, which is performed in the New Process Gear Corporation's plant, Syracuse, N. Y., consists first of loosely assembling the side plates, pinions, and studs. These studs are 0.558 inch in diameter on the end to be riveted, as shown at *B*, Fig. 3. With the gears and studs loosely assembled in the plates, the work is placed on a fixture and a locking pin inserted through the central hole to align the gears while the first stud is riveted. After the first stud is set, the locking pin is withdrawn and the differential gear-case turned around to rivet a second stud located diametrically opposite the first stud. The operation continues from side to side in pairs until eight rivets have been headed over on the upper side of the case; then the work is reversed and the sequence repeated on the opposite side. During the riveting operation the gears are constantly manipulated by the riveter to detect any tendency for them to bind. The production for one man is from eight to ten completely assembled gear-cases per hour or an average of 144 headed studs.

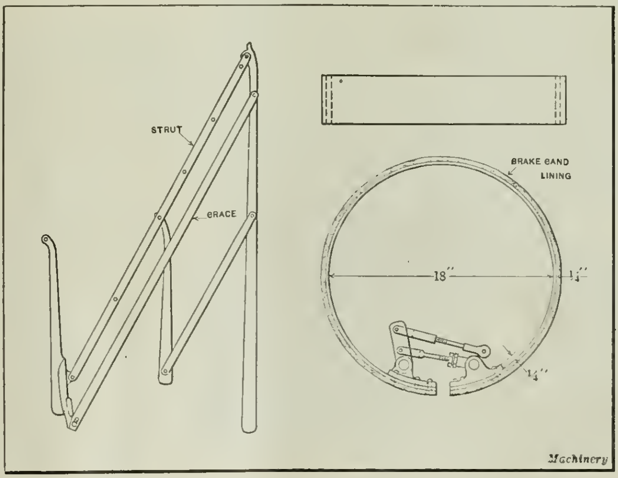


Fig. 4. (Left) Side Frame for an Automobile Top; (Right) Friction Brake-band

Application to Wire Wheel Manufacture

Many of these hammers are in use in the manufacture of automobile wire wheels in which their most common application is for riveting the six steel pins in the hub flanges. In one shop this job is handled by two men, one driving the pins into the flanges, and the other setting the rivets. In this way a satisfactory production rate can be obtained.

In another shop, the work is performed by one workman, the operation consisting of cold-heading six steel pins such as shown at *C*, Fig. 3. It will be seen that the end to be riveted is 3/8 inch in diameter. A fixture plate may be used to hold the rivets in the hub flange in the correct position for riveting after they have been pressed into the holes. The pins are set flush with the face of the flange which, of course, requires a straight-end peen. The production with one man working alone, is 75 hubs per hour, not including the assembling of pins, or 450 pins headed in one hour.

Riveting Crank-handles and Levers

At *D*, Fig. 3, is shown an engine starting crank on which the riveting operation is the setting over of the pin that passes through the wood handle. These steel pins are 7/16 inch in diameter, and some time is consumed in assembling them in the handles. The riveting operation is slowed up, because of the fact that more attention must be given to holding the overhanging end of the crank up at right angles to the face of the peen. The production is 75 cranks an hour.

The riveting of a nickel steel ball-end into a forged steel pitman arm for an automobile steering gear requires the use of a large size hammer. The hammer used for this purpose in one plant is equipped with a special anvil in which the ball-end fits while the head is being set. A diagrammatic view of the assembly of a ball-end and pitman arm of the type referred to is shown at *E*. The diameter of the shank to be riveted is 5/8 inch and it is pressed into the arm on an arbor press, leaving about 1/8 inch projecting to form the rivet head. The head is rounded to 3/4 inch diameter, using an oval-head peen, at the rate of 440 per hour.

The setting of a cold-rolled steel head 1 inch in diameter on the end of a 5/16-inch drill rod is a good example of machine riveting. This unit, which is shown at *F*, forms a driver used in the construction of nailing machines for box manufacture. It will be noticed that the drill rods are comparatively long and slender, and they must be firmly clamped on end during the riveting operation. The type of vise used for this purpose encloses the rod and is split longitudinally, being readily tightened on the rod by a hand-lever.

Riveting Brake-brands

The brake-band shown at the right in Fig. 4 is made of steel 1/4 inch thick, and is 18 inches in diameter. It is covered with a brake lining which is assembled to it by copper rivets, this being a hand operation. The brackets that hold the lever-and-link device have a foot 1/4 inch thick through which the brackets are riveted to the steel band. The illustration shows the position of these brackets after assembling. Steel rivets 1/4 inch in diameter are used, sixteen of these being required to assemble both brackets. The production is 304 headed rivets or 19 brake-bands per hour.

Power Riveting in Chain Manufacture

Riveting the ends of pins on which the steel links of silent chains are assembled is regularly performed on the high-speed riveting hammer. The pins used in the particular size of chain illustrated in Fig. 5 are 9/32 inch in diameter, and the width of the chain is 4 inches. The riveted head is set over a washer and the operation must, of course, be so performed that freedom of movement is obtained between the links and spacers of the chain. The average production on this kind of riveting is 600 pins per hour.

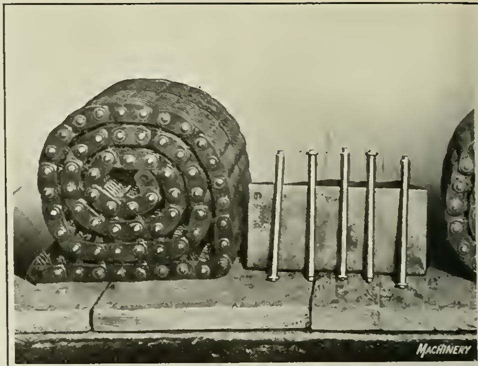


Fig. 5. Coil of Link Chain and Pins on which the Steel Links are assembled

Automobile Top Frame Riveting

The braces, posts, struts, etc., which go into the side frame of automobile tops are assembled by riveting, and practically all this work is done on power-driven machines. One example of work of this type is shown in Fig. 6 which illustrates the operation of riveting malleable iron forged clips to a frame post. This post goes into the frame of a Chevrolet automobile top, the work being performed in the American Forging & Socket Co.'s plant at Pontiac, Mich. The post is made of sheet steel with beaded joint, and is prevented from collapsing during the riveting operation by inserting a mandrel by which one end of the work is held, while the post rests on the specially formed anvil. Two flat-head rivets, 7/32 inch in diameter by 7/16 inch long are used to assemble these clips, the rivets being inserted in place by a boy or woman who then hands them to the riveter to be set down. In operations of this kind when it is necessary to handle the work in this way, a production of 2000 pieces in a nine-hour day is considered very satisfactory.

At the left in Fig. 4 is shown the assembly of the side frame for an automobile top. The operation to which attention is here directed is setting the seven long rivets in the strut and the short one in the lower end of the brace. Rivets of different lengths are headed without changing the dies. This is accomplished by the use of two anvils which are operated to bring them into alignment with the peen by a foot-treadle. Two of these side-frame assemblies constitute a set, and the production is 250 sets per nine-hour day, or a total of 4000 rivets daily. This operation shows the possibilities of riveting work of an irregular or peculiar shape by the use of special mechanical devices and fixtures for holding the work.

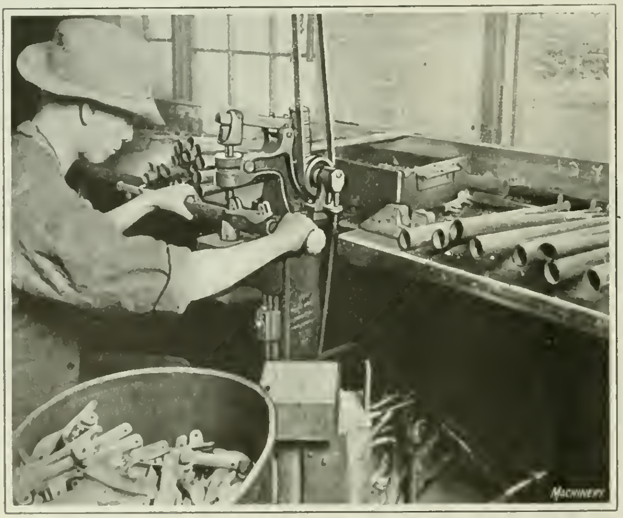


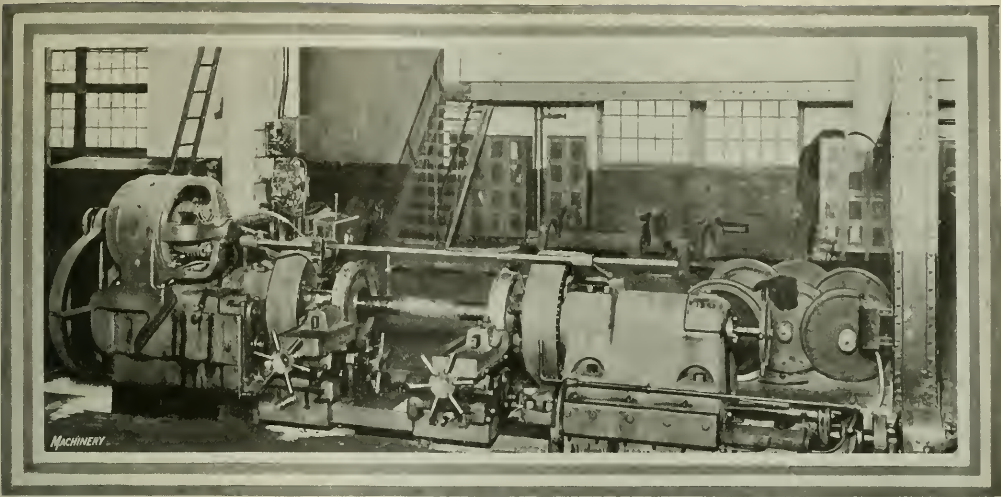
Fig. 6. Using Power Riveting Machines in the Manufacture of Automobile Top Frames

Power Riveting on Agricultural Implements

The riveting hammer is a common machine in the agricultural machinery plant. It is used in the making of malleable iron chains, shoe runners, mowing machine pitmans, and various other parts. In the plant of Henry & Allen, Auburn, N. Y., malleable iron ends are riveted to mowing machine pitman arms using eight 1/4-inch rivets, four in each side. The heads are set at the rate of 400 per hour, 50 pitmans being completed every sixty minutes.

* * *

The use of treated wood block floors in factories, machine shops, foundries, and mills of various kinds, showed an increase in 1920 of over 80 per cent as compared with the 1919 figures, according to the Service Bureau of the American Wood Preservers' Association, Chicago, Ill. Creosote oil and creosote coal-tar paving oil were used as preservatives.



Electric Drives in Railroad Shops

Selection of Motors—Types of Motors—Application on Different Kinds of Machine Tools

By BERTRAM S. PERO, General Electric Co., Schenectady, N. Y.

INDIVIDUAL electric motor drive becomes practically a necessity in a railroad shop, because of the various machine tools required, and the nature of the work performed. This form of drive allows free use of overhead cranes, unrestricted location of machine tools, low maintenance, and provided the correct electrical equipment is used, high efficiency. As an illustration of the advantages, two views of the same woodworking shop are shown in Figs. 1 and 2. These might be called "before" and "after," respectively. The transformation has really enlarged the shop and increased the possible production of each machine, because the belt slip has been eliminated.

Selection of Motors

In selecting the electrical equipment for any shop, it is well to keep in mind a few general principles. A system using alternating-current motors on all constant-speed machines, with direct current for the remainder is probably the best. The second choice is direct current, because any machine tool can be successfully driven by this type of motor. If alternating current only is available, individual drive is still most desirable, even though there is no satisfactory commercial adjustable-speed alternating current motor, and gears must be used to obtain different spindle speeds.

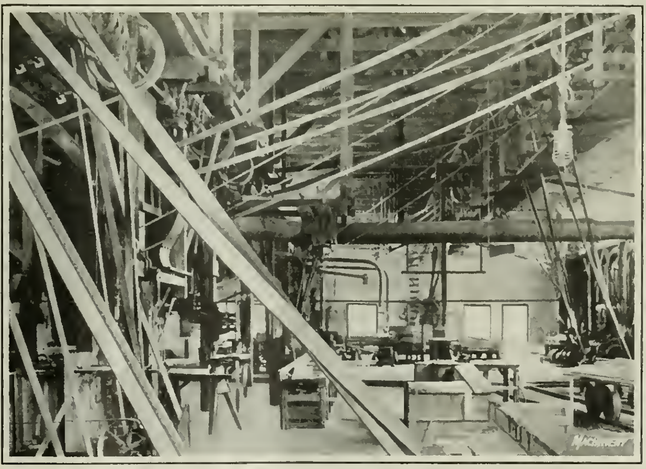


Fig. 1. View of Woodworking Shop before Installation of Motor Drives

Many machine tool manufacturers provide for speed changes through gears built as an integral part of the machine. This scheme allows a constant-speed motor to be used in many applications, but to obtain the speed increments possible with a direct-current, adjustable-speed motor would require an absurd gear combination. Very often, a simple gear change is used with an adjustable speed direct-current motor to obtain a wide speed range.

The squirrel-cage and wound-rotor alternating-current motors are the two forms generally used. The squirrel-cage motor is practically a constant-speed machine, and should be used for driving machine tools producing a constant load. The wound-rotor motor is capable of exerting greater starting torque with less current than the squirrel-cage type. The so-called "high torque" squirrel-cage motor is similar in appearance to the standard constant-speed machine, the only difference being in the rotor resistance.

Common Types of Direct-current Motors

The three types of direct-current motors generally used are the shunt, compound, and series. The series motor is not employed as extensively as in the

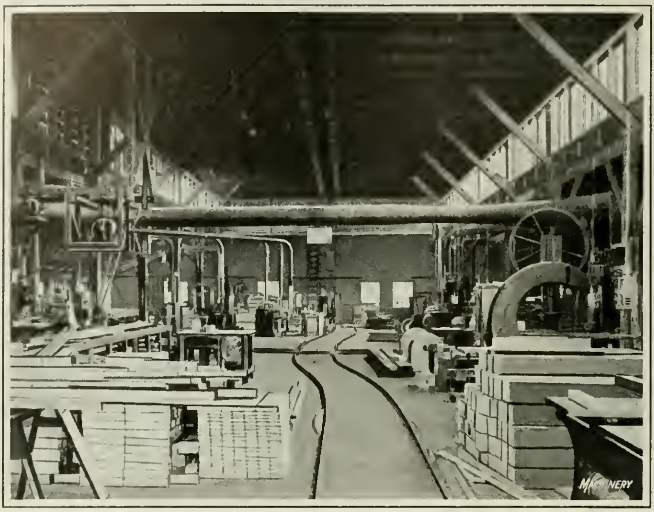


Fig. 2. Shop illustrated in Fig. 1 after Electric Drives were installed

decreased. The horsepower output of an adjustable-speed motor is constant in that the rating at high and low speeds is the same.

Compound-wound Motors

Compound-wound motors, which have a part of the field energized by the armature current, slow down under overloads, and speed up with light loads, due to the varying field strength. This produces a motor with a higher slip than the shunt machine, which is an advantage for certain drives. The average compound-wound motor has fields of which 80 per cent is shunt, and 20 per cent series. This means that with full load there is full field, while with 25 per cent overload, the series portion becomes 0.20 × 1.25, or 25 per cent. This added to the 80 per cent part, which is constant, makes a total of 105 per cent, causing a speed reduction.

High-torque Alternating-current Motor and Wound-rotor Type

The high-torque alternating-current motor is comparable to the compound-wound direct-current machine. This motor to all appearances is like the constant-speed squirrel-cage type, but the rotor is designed to have a greater resistance, producing greater slip at full load and higher torque at starting. When resistance is introduced in the rotor, there will be heat generated proportional to this resistance, and in the larger motors this heat becomes quite a factor; therefore, it is a good plan to use the wound-rotor type, connecting a permanent resistor outside the rotor, so as to obtain an equivalent slip, with the minimum heat inside the motor.

The wound-rotor or slip-ring type of motor is used for variable-speed service as required by cranes, bending rolls, etc. It is brought up to speed by connecting the motor to the source of power and gradually short-circuiting the external resistor connected in the rotor circuit, through collector rings mounted on the rotor shaft. This type of motor is well adapted to starting heavy loads, because the torque per ampere throughout the starting period is greater than that of a squirrel-cage machine. This is because the resistance in the rotor circuit can be adjusted to produce the best torque conditions for each speed during acceleration, whereas the resistance in the squirrel-cage machine is fixed

past. Because the compound-wound motor does not attain as high light-load speeds, it is preferable for general use. The shunt-wound direct-current motor is essentially a constant-speed machine, the slip or reduction in speed from no load to full load being about 5 per cent for the average motor. This factor is inherent in any motor, whether of the alternating- or direct-current type. The speed of any direct-current motor is governed by the rate at which the armature conductors pass through the flux set up by the field magnets. This rate is a product of armature conductors per unit time and flux, and is constant, under definite conditions, in any particular motor. Therefore, in a motor where the field strength is constant, the speed will be constant, and the current will increase rapidly if the load tends to lower this speed.

When the field strength is varied, as for the shunt-wound adjustable-speed motor, a speed variation is obtained, because to maintain the particular "product" or "rate" with a varying field strength, will require a change in the number of armature conductors passing through the flux, per unit time. It is obvious that the armature speed must change to accomplish this. The squirrel-cage induction motor is comparable to the shunt-wound, constant-speed, direct-current motor.

Variable-speed and Adjustable-speed Motors

Variable speed must not be confused with adjustable speed. So-called "variable" speed is obtained (usually with a constant-speed motor) by introducing resistance in the armature circuit. The reduced speeds obtained by this method will vary with each change of load. This is not an economical scheme, because a certain part of the power taken from the line is wasted in heat generated in the resistor. This loss is dependent on the speed reduction, being equal to the output of the motor, when the speed is reduced to one-half. Besides the energy loss in the resistor, the motor output is reduced. The adjustable-speed motor uses a resistor in the shunt field circuit, and while there is a loss in this resistor, it is negligible, because the total energy input to the field is only about 3 to 4 per cent of the input to the motor; furthermore, since the field current is reduced at the higher speeds, this loss is

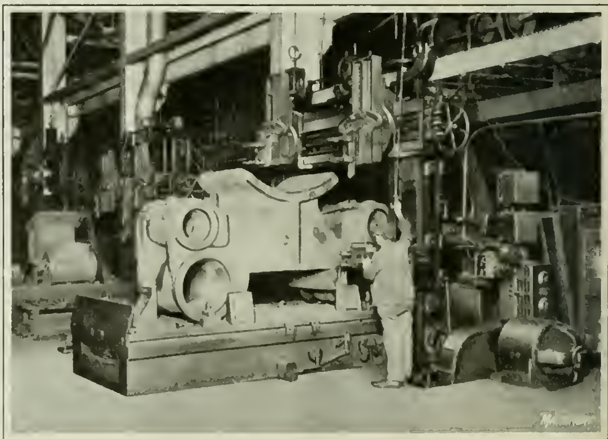


Fig. 3. Planer driven by 25-horsepower Adjustable-speed Reversing Planer Motor

and is comparable to the wound-rotor type of motor at one speed only.

Series Motors

In the series motor, all the field is produced by armature current. It is obvious that with a very light load there is practically no field, and the armature will run at a very high speed to maintain the "product" or "rate" referred to above. Also, with a 25 per cent overload, the field will have a strength of 125 per cent instead of 105 per cent as for the compound machine, and a lower speed will result. Commercial series motors do not produce the same speeds or torques on overload that a theoretical motor would, because the iron used in the fields becomes saturated after a certain flux is produced, and any current in excess of that which will saturate the fields has practically no effect on the field strength. Because of this condition, it has been found more desirable to use a motor with 50 per cent shunt and 50 per cent series on many of the machines heretofore driven by a series motor. The "50–50" motor will produce nearly the same torque per ampere, and has the advantage of a lower no-load speed. Approximately 150 per cent full load speed is obtained on light load.

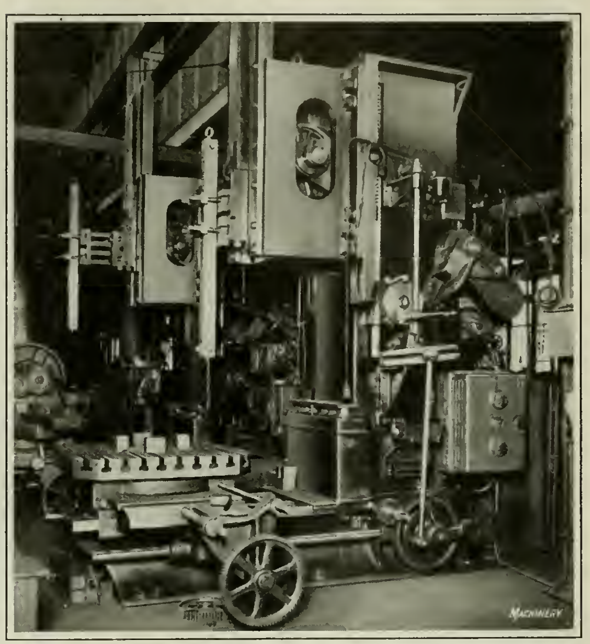


Fig. 4. Slotter driven by 15-horsepower Adjustable-speed Reversing Planer Motor

Motors for Different Types of Machine Tools

In general, machine tools, can be classed in two groups. The first group includes those machines that are used for the purpose of removing metal by cutting tools or abrasives, such as lathes, boring mills, grinders, etc. Practically all machines of this group produce a continuous load, requiring a constant torque for any given condition of speed and cut. These machines should be driven by shunt-wound direct-current, or squirrel-cage induction motors. Because of its freedom from sliding contacts, the squirrel-cage induction motor is desirable for driving woodworking machines; if direct-current motors are used for service of this kind, the fire hazard is increased.

The second group of machine tools includes those machines used for forming or shearing metal, such as punches, bending rolls, etc. Generally, compound-wound motors should be used for driving this class of machines. There are exceptions to this, however, as for example, rotary beveling shears and punch presses used on rapid cycle work, where the load is practically constant for a certain operation, and in such cases a shunt-wound motor can be applied.

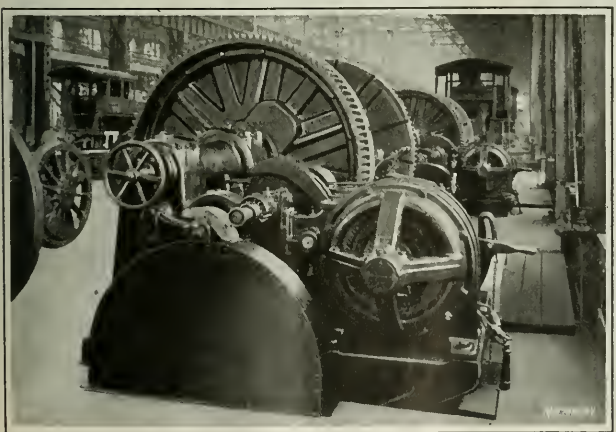


Fig. 5. Wheel Lathe driven by 75-horsepower Wound-rotor Alternating-current Motor

Type of Motor for Machines Having Flywheels

In general, all machines having flywheels which deliver energy during the working period, or machines requiring high torque intermittently, or for "break away" conditions, should be driven by a compound-wound motor. The reason for this application to flywheel machines is to allow the use of a smaller motor, and therefore greater efficiency. We have shown that the compound-wound motor has a greater slip or speed reduction, from no load to full load than the shunt-wound motor, and since the energy delivered by a flywheel is dependent on the speed reduction, a motor with a tendency to slow down with load, will allow a greater reduction in flywheel speed, without injurious overload currents on the driving motor, and enable the flywheel to furnish more energy for the work. After the work stroke is completed and before the next stroke, the motor accelerates the flywheel, thereby restoring the energy consumed. When a motor is correctly applied, it will be delivering a non-injurious overload at the moment the work is completed. This overload decreases as the flywheel attains speed, and then the motor furnishes only the power required for windage and friction load, until the next cycle.

The loads on presses and similar machinery usually last only a very short time, and even though the power required might be high for this time, a comparatively small motor, with several seconds to replace the energy in the flywheel, would take care of the load. Obviously, when the time between strokes decreases, there will be less time to restore the energy to the flywheel and the motor must be of greater capacity, up to the point where the work strokes are so rapid that the flywheel is of very little use, the motor delivering all the energy.

When a load demands high torque for "break away," such as for large lathe carriages, cross-rails, etc., the compound-wound or series motor should be used, because, since the torque developed by a motor is a function of the field strength and armature current, and it has been shown that the field strength of a compound or series motor increases beyond 100 per cent for overload currents, the torque per ampere input is greater in these motors than in a shunt-wound machine. Series motors should never be belted because, should the belt break and remove the load, the motor would attain dangerous speeds.

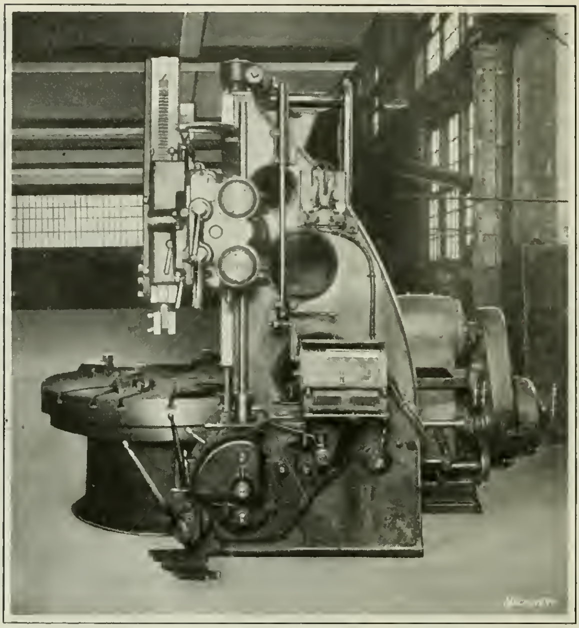


Fig. 6. Boring Mill driven by a 15-horsepower Adjustable-speed Motor

The Type of Control

In selecting the control for any application, it is good practice to arrange to have all control, such as starting, stopping, reversing, and speed changes from one handle or station. This is especially important on machine tools where the operator should watch his work while starting, such as with lathes, boring mills, etc. The controlling station should be convenient to the operator, when he is in the most advantageous position to watch his work.

Open type control should never be used when there is any chance of chips or other foreign matter coming in contact with any of the working parts. Automatic control is applicable to machines performing repeated cycles, such as planers, slotters, etc., or for motors driving pumps, air hammers, wheel lathes, milling machines, etc., but for engine lathes, bending rolls, or any machine tool where a set, or predetermined, speed is not applicable, manual control has been found to answer the requirements best. A control that allows the operator to change to the most efficient operating speed without leaving his work will usually permit the greatest production to be attained.

Under-voltage protection should be provided by the control. This means that if the voltage fails, the motor will not start unexpectedly when the power returns. An equipment without this protection might easily cause an accident. Under-voltage release, which means that the motor will restart, should not be confused with under-voltage protection.

Dynamic braking, which is generally used on reversing equipments, and sometimes on non-reversing control, causes a motor to come to rest, because the motor, driven by the stored energy in the rotating parts of the machine, acts as a generator, and changes the stored mechanical energy to electrical energy, which is transformed into heat in the brake resistor.

Examples of Motor Drives for Machine Tools

The direct-current reversing planer drive shown in Fig. 3 employs an adjustable-speed motor with a speed range of 250 to 1000 revolutions per minute. The motor is direct-connected, which thereby eliminates the losses caused by belt slip. By actual test, it has been found that with

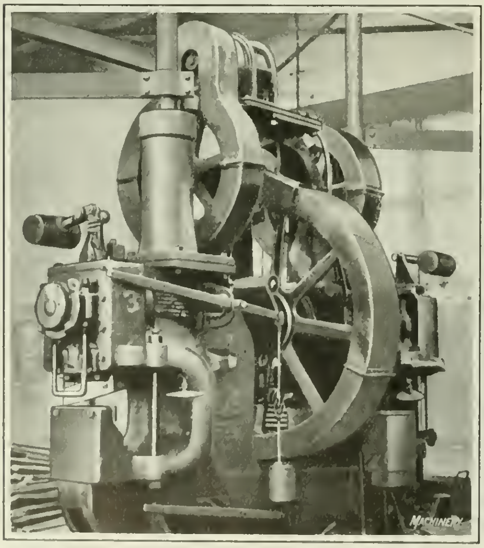


Fig. 7. Punch and Shear driven by a 10-horsepower Alternating-current Motor

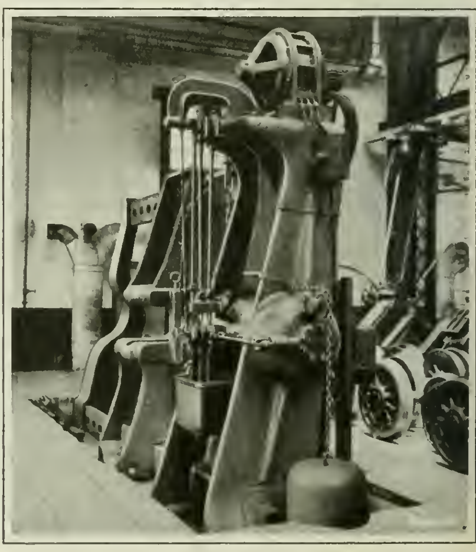


Fig. 8. A 660-ton Wheel Press driven by a 25-horsepower Alternating-current Motor

80 per cent load on a belted planer, the slip reduced the cutting speed 12½ per cent, and with slightly over 100 per cent load, the limit of the pulling power of the belt was reached. The control for the reversing equipment starts, stops, and reverses the motor in the shortest practicable time, and allows independent adjustment of either the cutting or return speeds. The cutting speed range is from 250 to 500 revolutions per minute, and the return speed, 500 to 1000. The same equipment is applicable to rack and screw driven slotters. The slotter shown in Fig. 4 is driven by a 15-horsepower reversing planer motor having a speed range of 250 to 1000 revolutions per minute.

The electrical equipment on the wheel lathes shown in Fig. 5 provides automatic acceleration and manual slow-down when hard spots are encountered. With the direct-current equipment, an adjustable-speed motor is used. It is possible to set the speed at some value within the range, and the control will cause the motor to accelerate to this predetermined speed each time. By means of a portable push-button, the operator can slow down the motor to at least 50 per cent speed, when the tool approaches the hard spot. After this is past, releasing the button allows the motor to accelerate to the set speed. When the stop-button is depressed the motor is brought to a quick stop by dynamic braking. A switch is mounted on the panel for emergency reversing.

Fig. 6 shows a motor-driven boring mill equipped with a drum controller and a 15-horsepower motor, having a speed range of from 550 to 1650 revolutions per minute. Boring mills of the larger sizes are generally provided with magnetic control. The punch and shear shown in Fig. 7, and the wheel press shown in Fig. 8, are driven by continuous-running, alternating-current motors, while the straightening rolls, Fig. 9, are driven by a wound-rotor motor with drum type control. The guide grinder illustrated in Fig. 10 is driven by a 10-horsepower induction motor. The methods of mounting these motors and the general arrangement of the transmission of power from motor to machine, are clearly illustrated. With the installation of new equipment in railroad shops, more electric drives may be expected.

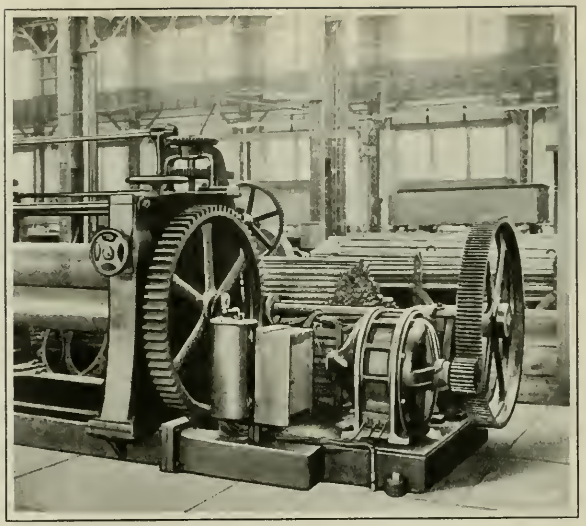


Fig. 9. Streightening Rolls driven by a Wound-rotor Motor having Drum Type Control

ESTIMATED DEMAND FOR AUTOMOBILES

Since 1916, the increases in the annual output of automobiles have largely been accounted for by the increased output of Ford cars and of other relatively inexpensive makes. The total number of higher priced cars built annually since 1916 has not materially exceeded the number built in that year. Up to the present time the actual replacement of automobiles is estimated never to have exceeded 500,000 cars in a year, but it is believed that shortly the replacement market will mount to at least 1,500,000 cars per year. It is interesting to note that the present productive capacity of the automobile industry is more than 1,000,000 cars per year greater than would be required to replace the number of cars annually worn out or destroyed. In a pamphlet issued by Leonard P. Ayres, vice-president of the Cleveland Trust Co., Cleveland, Ohio, the statement is made that unless the exports of cars increase very much, the present productive capacity of the automobile industry is sufficient to double the number of cars in use within the next five or six years. It appears extremely doubtful if the foreign or domestic markets can be sufficiently expanded to take care of this capacity, and if they can, it seems probable that some motive power other than gasoline will have to be developed. Furthermore, it seems probable that very considerable price adjustments will have to be made within the next few years, as manufacturers must compete for purchasers whose buying power is comparatively limited.

* * *

HARDENING HIGH-SPEED CUTTERS

The best method for hardening high-speed form cutters is to use a muffle gas or oil furnace for heating the cutter. The cutter should first be preheated to a temperature of from 1600 to 1700 degrees F., and then placed in a muffle furnace and heated to a temperature of 2200 degrees F. As soon as the cutting edges have attained the latter temperature, the cutter should be removed from the furnace immediately and quenched.

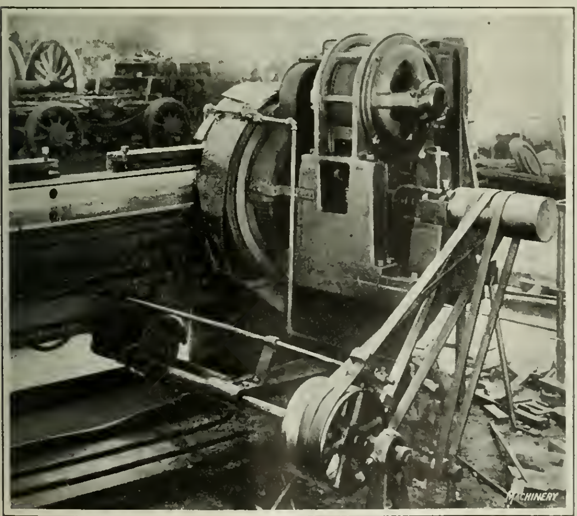


Fig. 10. Guide Grinder driven by 10-horsepower Induction Motor

The German Machine-building Industries

From MACHINERY'S Special Correspondent

Berlin, January 7

CONDITIONS in the industrial life of Germany at the beginning of 1922 are encouraging. Many firms give lower figures of idleness and larger numbers of orders on hand than ever before in the history of the various industries. Yet manufacturers and industrial leaders look into the future with deep concern, because they fear that, due to the increased costs of many raw materials which must be imported and the continual falling in value of the mark, the prices of all industrial products will soon be so high as to prevent German competition in the markets of the world and even sales at home.

Low Percentage of Unemployment in the Metal-working Industries

The small number of unemployed is directly due to the present favorable selling conditions. Within the workmen's organizations connected with the metal-working industries, the unemployment is only 1.31 per cent, this figure being the same as in March, 1907. Even in 1917 and 1918, when war materials were being turned out, the unemployment figure was 0.7 per cent. The maximum percentage of unemployment in the past has been 22.4, which was the figure in August, 1914, just after the outbreak of the war.

In a report for the week of November 6 to 13, covering 27,762 establishments and 2,052,900 workmen, 27,398 plants having 2,032,325 employes were working full time; 208 plants with 15,600 employes were working part time; and only 156 plants having 4975 employes were completely shut down. Whole industrial districts are working full time, and in the district of Essen only three plants having 855 workmen are operating on a reduced time basis. In the district of Cologne, three establishments with a total of 157 employes are shut down. In Berlin, one of the greatest industrial centers of Germany, there are 3213 plants with 251,775 employes. Of these, according to official reports, only 61 plants with 20,600 employes are running at reduced time. The figures given in the foregoing refer only to organized employes in the metal-working industries.

Orders Ahead for Machine Tool Builders

The statements concerning unemployment are reflected in the reports of industrial leaders relative to orders on hand. The management of J. E. Reinecker Aktien Gesellschaft of Chemnitz, recently announced that business is extremely brisk, there being more orders booked than ever before in the history of the works. All contracts for machines and tools are at fixed prices. "Sliding" prices could not be obtained, and consequently the prices of machines to be shipped abroad have been greatly increased in order to avoid risk of losses. This concern has declared a 20 per cent dividend to stockholders. These conditions may be considered typical of those existing in many machine tool plants.

Business Prospects in Allied Industries

In order to give an idea of the prosperous business conditions in industries closely allied to that of machine tool building, it may be mentioned that many brass works are so busy that only orders calling for delivery after the next four or five months are accepted. The price of brass sheets has been increased to 80 marks per kilogram (about 40 cents per pound, present exchange).

In the automobile field orders on hand will enable operation at full capacity during the next five months. Demands steadily increase, and come not only from home dealers but also from abroad. The various plants ask terms of delivery in from two to six months. The great increase in prices, especially of the important raw materials and of semi-finished products required in the manufacture of automobiles, is, however, a factor of great uncertainty which may considerably influence the future of this industry. For this reason, the leading firms, in order to avoid dangerous risks do not accept orders at fixed prices, and the buyer must therefore reckon with price advances during the weeks and months prior to delivery that were scarcely imagined at the time of placing the order.

The metal-stamping industries also report that the orders on hand are sufficient to keep most plants fully occupied during the coming months. However, the high prices of sheet metal will probably cause many shutdowns in this field in the near future. These high prices are principally due to the fact that Germany imports as much as 80 per cent of its iron ore.

In the world's commerce Germany now shares only 5 per cent, as compared with 20 per cent in 1913. Its exports in iron and steel products dropped from 6.5 million tons in 1913 to 1.7 million tons in 1920. These figures speak for themselves.

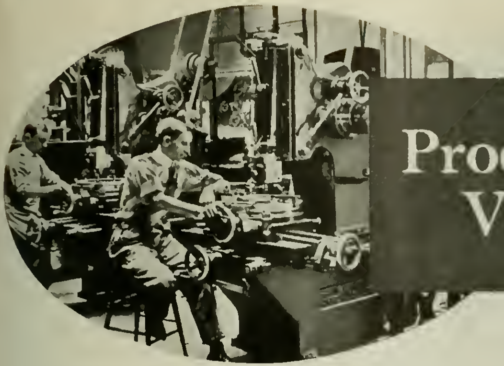
No Great Technical Progress During the Year

There has been little progress in methods and equipment in the machine-building industry during 1921, as the industry did not need to increase its production by building new and modern plants or by introducing improved working processes in order to compete with foreign manufacturers. The depreciation in the value of the mark has made wages in Germany, already low before the war, still lower in comparison with other countries. Thus German manufacturers can produce at much lower costs than foreign competitors. This fact secured for the machine tool industry a monopoly in the home markets, and gave sufficient protection against competitors abroad. German manufacturers, although able to under-bid foreign producers, still make good profits.

News Notes of the German Machine Tool Industry

The Zimmermannwerke Aktien Gesellschaft, of Chemnitz have paid a dividend of 12 per cent for the year, and have sold the greater part of their stock which had been on hand for a long time. This company has increased its productive capacity considerably and spent large sums in organizing its selling force. It has founded the Industrie-Lloyd, a selling organization which a number of other firms have also joined. Max Hasse Aktien Gesellschaft, of Berlin, manufacturers of turret lathes, have paid a 10 per cent dividend and have orders on hand to keep the establishment busy for four months. Wotanwerke Aktien Gesellschaft, of Chemnitz, have paid a dividend of 40 per cent; the Werkzeugmaschinenfabrik Union, of Chemnitz, 25 per cent; Sondermann & Stier Aktien Gesellschaft, of Chemnitz, 15 per cent; Schiess Aktien Gesellschaft of Düsseldorf, 16 per cent; and Bernhard & Alfred Escher, Ltd., of Chemnitz, 20 per cent. Many machine tool builders have greatly increased their capital, and several large stock companies have been formed.

Statistics are not yet available showing the total exports of machine tools from Germany during 1921, but it is expected that the figures will be quite large. France, especially, has bought a great deal of German machine tools, and considerable shipments have also been made to Holland, Spain, Switzerland, Italy, and the Scandinavian countries.



Production Work on Vertical Shapers

Operations Advantageously Performed on Shapers of the Vertical Type

By EDWARD K. HAMMOND

VERTICAL shapers built by the Pratt & Whitney Co., of Hartford, Conn., would scarcely be classed as machines that find wide application for the performance of manufacturing operations. However, there are numerous examples of detail work required in producing small and medium sized metal parts, for which a vertical shaper will give more satisfactory results than other machines. Such a case is shown in Fig. 3, where it will be seen that a slot *A* has been milled in work of the form shown. It is required to square the ends of the slot where they have been left curved by the milling cutter. To secure this result, the vertical shaper is equipped with a vise having its jaws in a vertical position, an end-bar *B* being placed under the work to support the downward thrust of the tool. Held in this manner, it is an easy matter for the shaping tool to square up one end of the slot, after which the work is traversed to bring the opposite end under the tool.

Shaping a Hexagonal Hole

When it is required to perform such an operation as shaping a square, hexagonal, or other shaped hole in a quantity of duplicate parts, the usual method is to handle the work on a broaching machine, provided the quantity of pieces is great enough to justify the making of a special broach. But if only a moderate number of parts have to be machined, the cost of a broach would make an excessively high tool charge against each part. For this reason it will be found more advantageous to handle a job of this kind on a vertical shaper.

An example of such a job is shown in Fig. 1. In this case it is required to produce a hexagonal shaped opening *A* in a moderate number of short cylindrical pieces. For this purpose, the work is laid out with carefully scribed lines, showing the exact shape and size of the hole; and the opening is started by drilling a round hole of a diameter slightly less than that of the inscribed circle of the hexagon. The work-holding fixture has a pocket in it to receive the piece to be shaped, and the bottom of this pocket is made with a shoulder to support the work, but open at the center to allow clearance for the tool under the work and to permit the chips to fall through. The piece is held down in the pocket by means of the straps shown in the illustration at *B*.

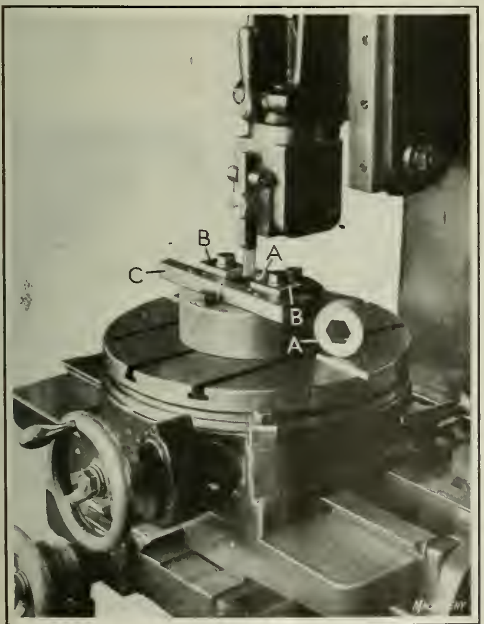


Fig. 1. Vertical Shaper equipped with a Fixture for Use in shaping a Hexagonal Hole

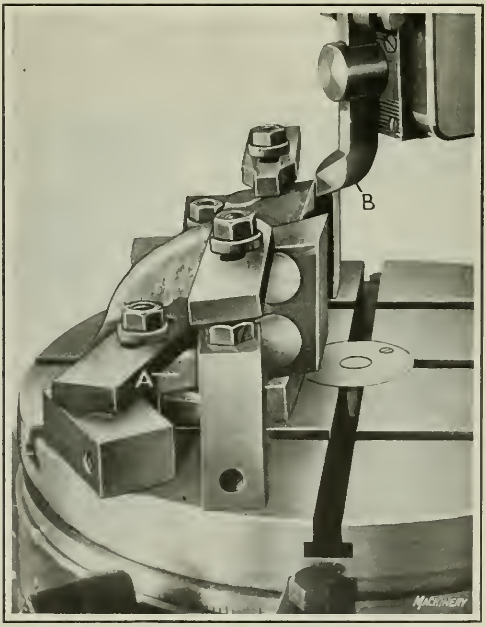


Fig. 2. Planing the Inclined Sides of a Dovetailed Bearing on a Vertical Shaper

In setting up this job, care is taken to align strip *C* accurately with the longitudinal travel of the table, by the use of a dial indicator mounted in the toolpost, and the work is then placed with one side of the hexagon parallel to strip *C*. The shaper tool is made of a width equal to one side of the hexagon, and is started in the round opening, the work being fed up to it until one side of the hexagon has been formed. After one side is finished, the work is indexed through 60 degrees, so that the next side of the hexagon can be formed, and this process is repeated six times to finish the job. The rotary table of the machine is graduated, which facilitates indexing the work.

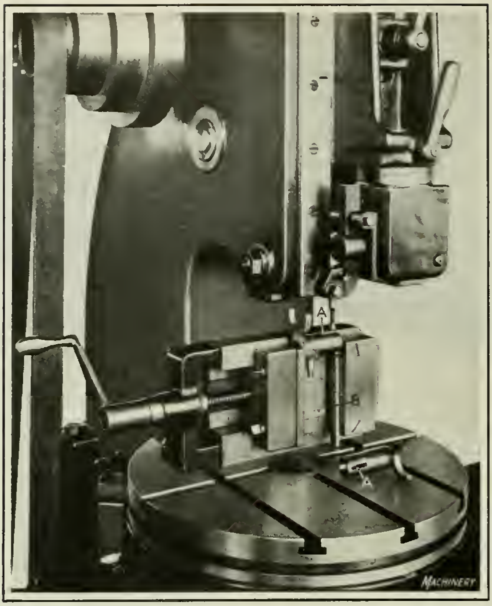


Fig. 3. Use of a Vertical Shaper for squaring up the Ends of a Milled Slot

Shaping a Short Dovetailed Bearing

Another application of the Pratt & Whitney vertical shaper in handling a production job is illustrated in Fig. 2, where it will be seen that the work consists of shaping a short dovetailed bearing. At the time when the casting *A* comes to this machine, the lower face has been finish-planed, and this surface is utilized as a locating point in setting up the work which is strapped down to the shaper table. Held in this way, the bottom of the dovetail is elevated sufficiently so that clearance is provided for the tool and chips under the work. The work consists of taking roughing and finishing cuts. The tools are offset as shown at *B*, so that they may be used in a ram that reciprocates vertically.

Shaping Plane and Cylindrical Surfaces

The universal shaper and milling machine built by the Cochrane-Bly Co., Rochester, N. Y., was primarily designed for use in tool-rooms, but machines of this type are demonstrating their adaptability for production work. A case in point is shown in Fig. 4, which illustrates a machine of this type engaged in shaping the outer surface of the swivel worm bearing for use on the Cochrane-Bly rotary table. As a clear understanding of the form of this piece is important, in order to grasp the possibilities of the combination of a vertical shaping machine and a rotary work-holding table in generating cylindrical surfaces and planes tangent to such surfaces, an illustration showing three views of the swivel worm bearing is presented in Fig. 6. It will be seen that there are two plane surfaces *A* which are tangent to the semi-cylindrical surface *B* at each side. In shaping this piece, the casting is mounted on the rotary table with a bolt extending through the hole *C* to secure the work in the desired position, the location of this bolt corresponding to the axis of rotation of the rotary table.

The method of procedure is to generate one of the plane surfaces by using the straight traverse movement of the table in conjunction with the reciprocating action of the vertical ram. When the tool point reaches the position of tangency of the plane and semi-cylindrical surface, longitudinal traverse of the table is discontinued and the rotary feed of the table is employed. This provides for generating the semi-cylindrical surface, and when the tool point reaches the position where the plane surface becomes tangent to the cylindrical surface at the opposite side of the work, longitudinal traverse movement of the table is substituted for the

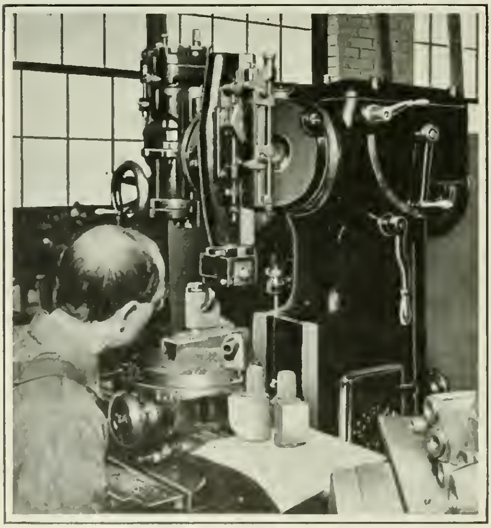


Fig. 4. Utilizing Straight-line and Rotary Feed Movements for shaping an Irregular Piece

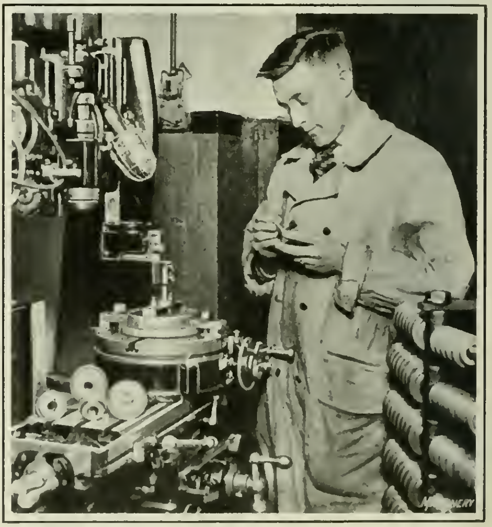


Fig. 5. Cutting Three Equally Spaced Spline Grooves on the Vertical Die Shaper

rotary feed movement, to generate the second flat side of the work. A high degree of accuracy is required on these pieces, it being especially necessary to maintain the cylindrical surface concentric with the bore *C*. With this method of machining, practically all hand work is eliminated, and the entire job is completed at a single setting within limits of ± 0.001 inch.

Shaping Three Keyways in a Tapered Bore

At the Gleason Works, Rochester, N. Y., there were 10,000 chrome-nickel steel gears in each of which it was required to cut three keyways in a bore tapering 2.4 inches per foot. The form of the work and its dimensions are shown in Fig. 7, where it will be noticed that the small end of the tapered hole is only 0.488 inch in diameter. The cutting of these keyways is a difficult job, as they are required to be parallel with the bore and all dimensions must be held within limits of ± 0.001 inch.

After giving this problem careful consideration, the planning department of the Gleason Works decided to put the job on a Cochrane-Bly universal shaper, as shown in Fig. 5. A special holder was provided to clamp the gear blank to the indexing table, and the shaper head was inclined at the proper angle for the taper of the bore, by the micrometer adjustment. With this equipment it was possible to cut the keyways with satisfactory results at the rate of six gears per hour, which corresponds to a cutting time of 3.33 minutes per keyway.

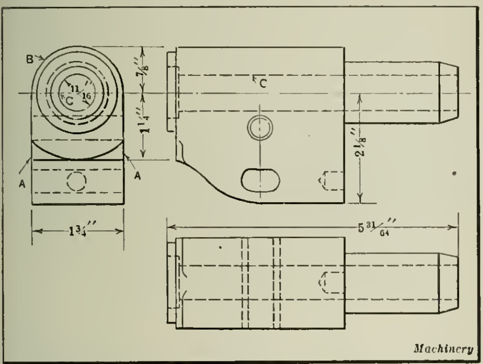


Fig. 6. Design of Piece to be shaped on the Machine shown in Fig. 4

* * *

EARLY DISCOVERY OF THE RECALESCENCE POINT IN HEATING STEEL

In a publication issued in 1778 by one of the industrial associations of that time in Sweden, there is an article on the hardening of steel, written by J. F. Angerstein, in which the author mentions that he has observed a means whereby the correct hardening temperature for steel may be accurately determined. He points out that at the right hardening temperature there is a sudden shadow or lack of brightness in the object being heated. This shadow is evidently caused by the temperature reduction which takes place when the steel passes the recalescence point. It was not possible for the early observer to understand the exact reason for the loss of brightness or shadow in the heated steel, but he had learned that this was the point when the right hardening temperature had been reached, and by observing it he was able to harden at a temperature determined by the same principle as is employed in modern means of determining the recalescence point. It has generally been believed that the earliest observer of this phenomenon was the Russian, Chernoff, who about 1860 called attention to this characteristic of steel when heated. The practical value of these observations was finally clearly laid down by Brinell.

ROTATION OF BALLS IN BALL BEARINGS

On page 330 of December MACHINERY, a description is given of a ball-bearing grinding spindle of unusual construction. It is stated that each ball revolves on its own axis approximately once in every 365 revolutions of the bearing. Is it meant that the balls twist like a bullet once in 365 revolutions, with a motion sometimes called "corkscrewing"?

The test of correct rolling is to assume gear teeth on the contacting surfaces. In fact, we must assume all contacting surfaces having relative motion to be gears with an infinite number of teeth. If a device will not roll correctly with gear teeth on the contacting surfaces, it will not roll at all; in other words, sliding and grinding will take place.

A ball bearing, if assumed to have gear teeth on the contacting surfaces, is simply a planetary transmission. As shown in Fig. 1 in the article referred to, each ball would make about 1.3 revolutions about its axis for each revolution of the bearing. This is decidedly different from one revolution for 365 revolutions of the bearing. Actually, at 10,000 revolutions per minute of the bearing, each ball would make approximately 13,000 revolutions on its axis.

Aurora, Ind. L. LANGHAAR
Vice-president, Langhaar Ball Bearing Co.

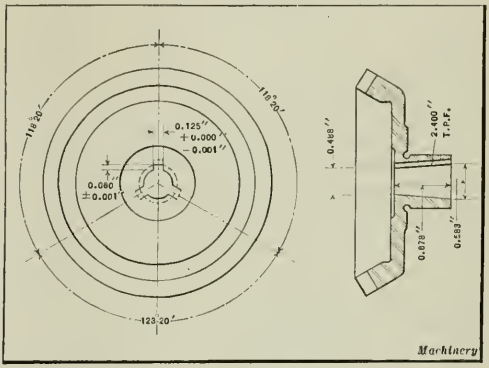


Fig. 7. Design of Work to be shaped on the Machine shown in Fig. 5

Reply by the Ex-Cell-O Tool & Mfg. Co.

We believe that your correspondent does not understand the construction of our ball races. In the second paragraph of the article, beginning with the second sentence, the difference in angle is explained. Perhaps a better way of expressing the true condition would be as follows:

In this design the point of contact of a ball on one race is farther from the axis of rotation than on the other, and this condition causes the balls to revolve about their own axes at right angles to the axis of the device, as well as in the same direction as the device. The number of right-angle revolutions is dependent upon two factors—the diameter of the balls and the difference in the angles of the race.

The ball must necessarily revolve about its own axis in the same direction as the race, and this condition is the same as in a planetary transmission. However, we cannot understand how the figures given in the preceding are arrived at, inasmuch as the number of revolutions of the ball about its own axis in the same direction of rotation as that of the race is dependent upon the size of the balls used and the diameter of the races.

Detroit, Mich. N. A. WOODWORTH
Manager, Ex-Cell-O Tool & Mfg. Co.

* * *

It is reported that the Ford Motor Co. is planning to install the largest steel-melting furnace ever built. The capacity will be 9000 kva., which is said to be three times the size of any previously installed furnace.

Exports of Metal-working Machinery before and after the War

A REVIEW of the foreign markets for American machinery shows that as far back as 1910, the United States exported more machine tools and metal-working machinery than any other country in the world, nearly $6,000,000 worth being exported during the twelve months ended June 30, 1910. These exports have gained steadily since that time up to the present period of depression. The decrease during the last two years is a natural result of the general industrial depression; but in comparison with the pre-war figures, these exports show a decided advance, the demand in all countries of the world for American machinery having increased considerably, particularly in non-European markets. During the twelve months ended June 30, 1921, the United States exported machine tools and metal-working machinery amounting approximately to $34,000,000 as compared with a total of $14,000,000 for a similar period ended June 30, 1914. This gain was not actually as great as the figures would seem to indicate, because the prices of metal-working machinery of all kinds had increased approximately 100 per cent since 1914; yet, there is a definite gain. The exports amounted to $58,000,000 in 1919, and $44,000,000, in 1920. With the return to normal conditions, the exports in this line are likely to be substantially above the pre-war level.

TABLE 1. VALUE OF EXPORTS TO JAPAN, CHINA, INDIA AND DUTCH EAST INDIES FOR 1914 AND 1920

Countries	1914	1920
Japan	$120,166	$4,250,583
China	17,668	932,351
India	17,953	1,374,068
Dutch East Indies	20,216	326,086

Machinery

The Market in Asia

Asia presents the most interesting feature in the expansion of our foreign markets in metal-working machinery, the demand for the American product there having increased steadily since before the war, rising from about $207,000 for the year ended June 30, 1914 to over $7,000,000 for the calendar year 1920, a gain of over 3300 per cent in less than seven years. The rapid industrialization of Asia, particularly of such countries as Japan, China, India, and the Dutch East Indies, has helped materially to increase the Asiatic market for machine tools and metal-working machinery. Of these countries, the greatest gain is found in India, where the market for American machines increased nearly 7600 per cent during the period mentioned. Table 1 gives the value of machine tools and metal-working machinery exported to these countries for the year ended June 30, 1914, as compared with the calendar year 1920.

American Machines in Great Britain

For the fiscal year ended June 30, 1914, Great Britain imported $376,000 worth of machine tools from the United States, or 88 per cent of her total imports in this line. For the calendar year 1920 American exports of machine tools to Great Britain totaled $6,000,000. In 1914 the total value of machine tools and metal-working machinery exported to England was approximately $3,000,000 as compared with more than $10,000,000 in 1920. The extensive use of American machines in Great Britain during the war no doubt did much to establish a permanent market in that country for many types of American tools.

Exports to France and Germany

In France a similar increase has been manifested. During normal times, previous to the war, there was a rise from $307,000 in 1909 to a total of nearly $2,000,000 worth of machine tools and metal-working machinery for the fiscal year ended June 30, 1914. The market, of course, was greatly inflated during the war, rising to a peak of $29,000,000 in 1917, and receding to $7,500,000 for the calendar year 1920. This figure, however, is much larger than the immediate pre-war total of $2,000,000.

The German market presents an entirely different situation. Previous to the war, for the twelve months ended June 30, 1914, Germany imported over $2,000,000 worth of machine tools and metal-working machinery from the United States. At that time the German market for American machines was second only to that of Great Britain. Since the war, however, the market has been very poor, reaching a total of only $144,000 for 1920.

Table 2 gives the value of exports of machine tools and metal-working machinery from the United States for the years 1914 and 1920, together with the value of the exports to the leading European countries and Asia. Attention is called to the fact that the per cent of increase relates to the total value of the exports and not to the increase in tonnage. As the price of machine tools has practically doubled during the last seven years, the number of machines exported has not increased in so large a proportion as their value.

TABLE 2. VALUE OF EXPORTS TO ENGLAND, FRANCE, GERMANY AND ASIA FOR 1914 AND 1920

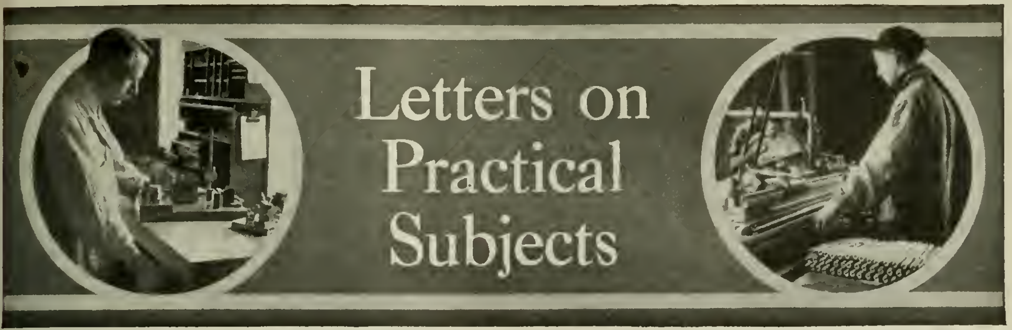
	1914	1920	Per Cent Increase
Total Exports	$14,011,359	$44,312,233	215
Exports to England	2,988,684	10,760,957	260
Exports to France	1,771,525	7,595,733	329
Exports to Germany	2,167,240	144,192	...
Exports to Asia	207,389	7,181,435	3369

Machinery

Comparison of Machines Manufactured and Exported

In 1919 the value of the machine tools and metal-working machinery manufactured in the United States was $212,000,000. Of this amount $58,500,000 worth or 27½ per cent were exported to the various countries of the world, England absorbing $15,000,000 worth, France $15,000,000 worth, and Asia as a whole, $8,500,000 worth of these machines. In comparison with the pre-war figures, however, this percentage shows practically no change. During the twelve months ended June 30, 1914, the manufactures of machine tools and metal-working machinery totaled $48,000,000, the exports amounting to $14,000,000 or 29 per cent of the machines manufactured.

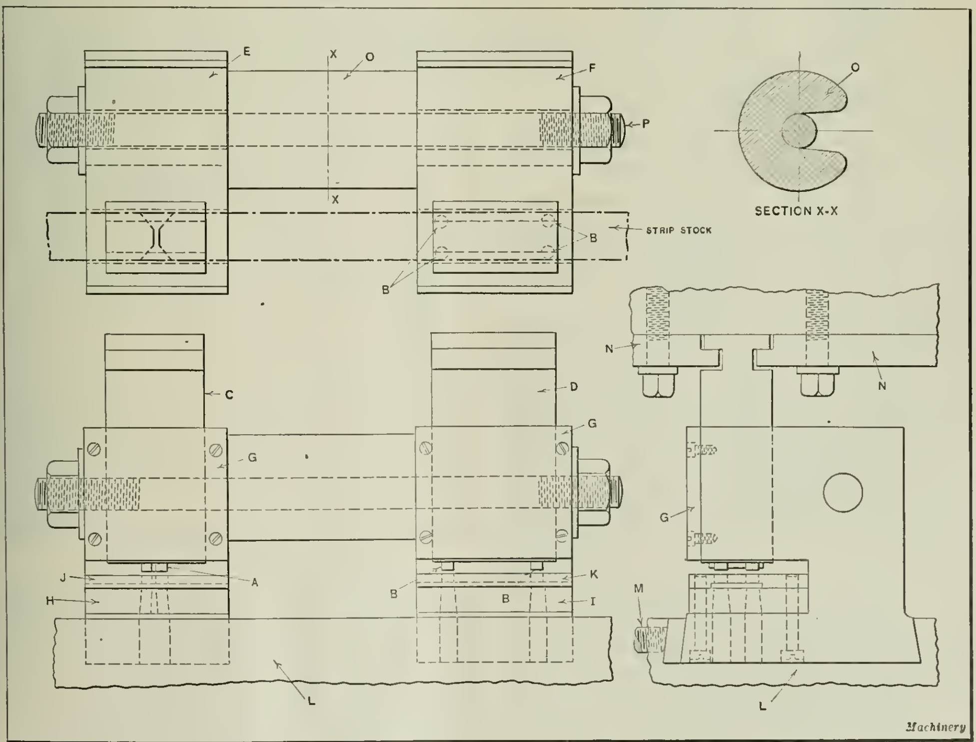
The figures quoted show that, even allowing for the difference in prices in 1914 and 1920, the exports in the latter year were so much greater that it would not be reasonable to expect them to remain at those figures continuously. The exports of 1920 may be greatly reduced, and yet our metal-working machinery exports will exceed the pre-war exports.



DIES OF UNIT CONSTRUCTION FOR GANG PUNCHING

Where adaptable, dies of unit construction, such as the one shown, will be found particularly satisfactory from the point of view of economy. In many cases it is possible to build up a die by combining a number of die units, thereby avoiding the necessity of making a complete die or sections of a die. The units of sub-press dies formed in this way are, of course, separable. Each unit contains punches for one group of holes or perforations. It is therefore an easy matter to arrange the units for the production of parts made by piercing, perforating, and cutting off strip stock. The illustration shows two units set up for the production of perforated straps from the strip stock indicated by dot-and-dash lines. The die unit at the right contains the punches used to pierce a group of four holes in the stock, while the unit at the left is equipped to cut off the stock to the required length. It will be noted that the cutting-off punch *A* is designed to cut the corners of the stock at an angle of about 45 degrees.

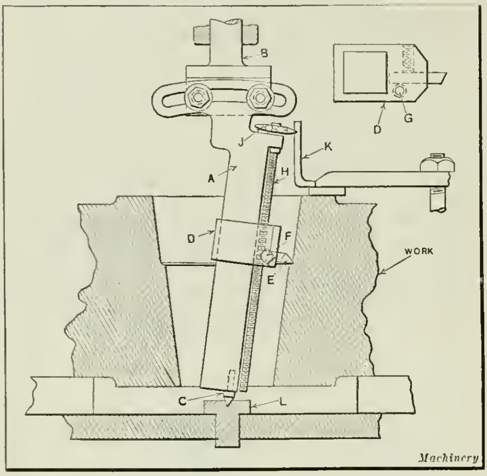
The cutting-off punch *A* and the perforating punches *B* are held in blocks *C* and *D*, respectively, which slide in cast-iron holders *E* and *F*, being held in place by plates *G*. The die members are shown at *H* and *I*, and the stripper plates at *J* and *K*. The material being worked is fed through the slot cut in the stripper plates. The entire assembly, consisting of the punch-holder, holder slide-block, die, and stripper plate, is slid into a die base *L*, in which it is clamped by means of screws *M* while punch-holding slides *C* and *D* are clamped to the ram of the press by strips *N*. Thus it will be seen that the usual up-and-down movement of the press causes the four punches in holder *D* to perforate the stock while the cutting-off punch in holder *C* cuts off the previously punched stock. A pin or block (not shown) at the left of die *H* serves as a stop for determining



Gang Punch of Unit Construction for perforating and cutting off Strip Stock the length to which the stock is to be cut. A spacer *O*, placed between blocks *E* and *F*, locates the dies the proper distance apart. A screw *P* with nuts at each end completes the equipment. Instead of the two units shown in the illustration, as many as six or more may be used with spacers of the proper length placed between them. It is obvious that a great many set-ups can be provided by this arrangement. One of the chief advantages of the unit construction is that work of many lengths having the same general lay-out of holes or openings can be produced by merely changing the spacing blocks *O*. F. SERVER

TAPER BORING ATTACHMENT FOR DRILLING MACHINE

The taper boring tool described in the following can be used on a drilling machine or on a horizontal boring mill. The swiveling action of the tool-carrying bar *A*, which can be clamped rigidly to the taper shank *B*, held in the drilling



Taper Boring Attachment for Drilling Machine

machine spindle, permits a wide range of adjustment, so that the tool can be used for boring cylindrical holes as well as holes having steep tapers. Holes in large castings, such as side frames, etc., and jobs too large to be bored on the lathe, as well as rush jobs for which extra machines must be rigged up can be handled with this tool.

As will be apparent from the illustration, the tool is simple and designed to secure accurate results. The head of the tapered shank *B* is planed off square with the center line of the shank, in order to form a clamping surface for the head of bar *A*. The tool-bar is made from an iron casting of the form shown. It is shaped or planed square and true, and is drilled at the bottom to receive a small center *C*. This center must be exactly in the center of rotation when the tool-carrying bar is set vertical.

A small carriage *D*, which is slotted to hold a square tool bit *E*, is mounted on the squared end of bar *A*. The tool bit is held in position by a set-screw *F*. The carriage is made of cast iron or steel, and must be a close sliding fit on bar *A*. A hole *G* in the carriage, at the rear of the tool, which is shown in the view in the upper right-hand corner of the illustration, is tapped to fit the feed-screw *H*. This feed-screw extends down from the top bearing, and carries at its top end a star-wheel *J*. The star-wheel is operated by setting a finger *K* so as to rotate it one space every revolution of the tool. If a heavy feed is desired, as when using a square-nosed finishing tool, two fingers may be employed instead of one.

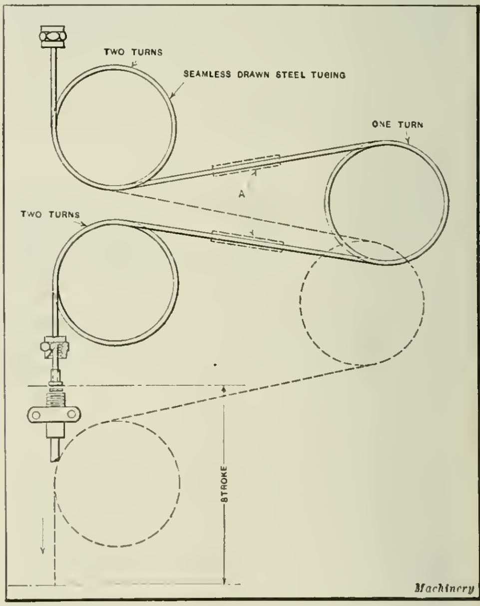
When using this tool, the center *C* rests and rotates in a hardened female center *L*, set into a tight fitting hole in the drilling machine table. The work is centered by clamping a wire finger or pointer to the tool-bar and rotating it around the outside of the job, or over a line scribed on the work. When used on a horizontal boring mill a suitable center hole in a block or clamp can be used in place of center *L*. Care should be taken in making the tool to have the forward edge of the tool slot exactly on the center line, and also to grind the tools accordingly; otherwise the taper will not be true. Most tapers are given on drawings as inches per foot, or in degrees, in which case a bevel protractor is used to set the angle of the tool.

Allentown, Pa. JOE V. ROMIG

SPRING PIPE CONNECTION FOR HYDRAULIC PRESSES

The spring pipe connection here illustrated was designed by the writer for use on a hydraulic press in place of a telescope pipe. The telescope pipe connection was employed to supply the water pressure required to move the table back and forth. The rapid wear on the packing, the tendency for the telescope pipe to buckle under high pressure, and the frequent breaking at the point where it was screwed into the bracket made this type of connection a source of annoyance.

The breaking and buckling was overcome by using a telescope pipe of larger size, but the packing still had to be frequently renewed. With the large pipe it was necessary to use throttle washers in the fittings to reduce the amount of water delivered, so as to decrease the speed of the back-



Spring Pipe Connection for Hydraulic Presses

and-forth movement of the table. Finding that a very small opening in the throttle washers gave the desired result, it occurred to the writer that a small size spring pipe connection of seamless drawn steel tubing might be employed in place of the telescope pipe. Accordingly, some tubing of suitable size was obtained, and experiments were made which resulted in the development of the connection shown.

The seamless drawn steel tubing, coiled and bent to the shape indicated, was found to be capable of withstanding the fluctuating pressures and consequent vibration of the hydraulic press and accumulator pipe-line system, and to be capable of being sprung back and forth from the position shown by the full lines to that indicated by the dotted lines. This arrangement gave little or no trouble.

It will be noted that two turns are made in the coils next to the unions and one in the middle coil. It was found that one coil next to the unions would not withstand the strain of opening and closing, combined with that produced by vibration. An extra turn, however, overcame this difficulty and eliminated breakage at the unions. The complete set of coils in the pipe seemed to float, and did not vibrate as might have been expected. The satisfactory action of the connection is due chiefly to the fact that the coils can move in all directions. This device or a similar one could probably be used to advantage on many types of machines where a flexible pipe connection that will not whip when subject to fluctuating pressures is required. Unions attached to the ends of the coil tube make them readily detachable in case of breakage, so that a renewal can be made quickly, but this is seldom necessary. If it is difficult to obtain seamless steel tubing of sufficient length to make a complete coil, two or three lengths of tubing may be used. The joints should be made as indicated by the dotted lines at *A*.

Lyells, Va. W. R. Ward

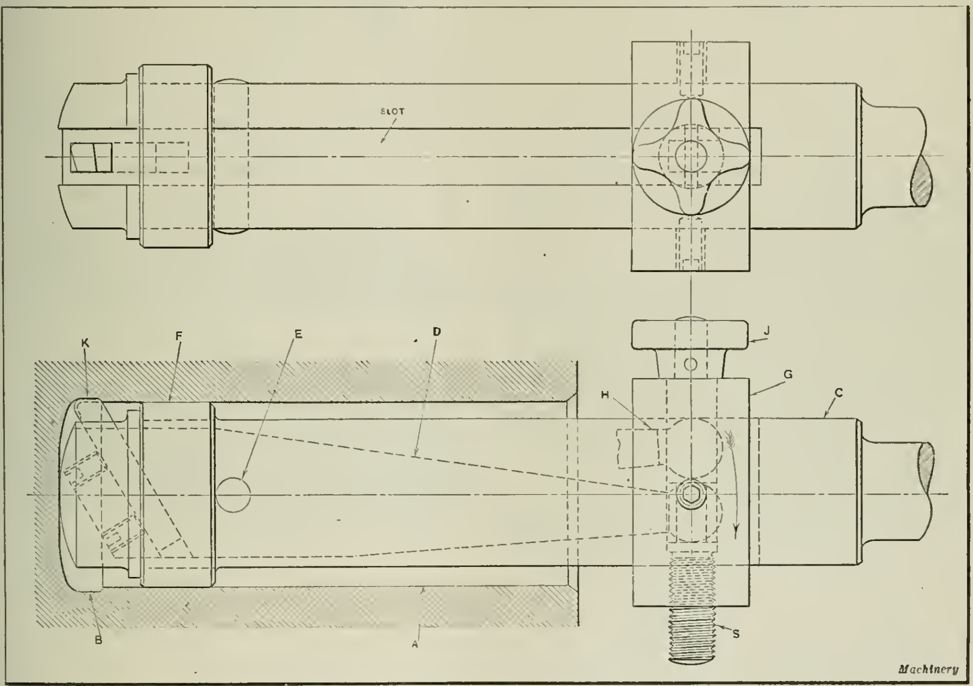
DEEP-HOLE RELIEVING TOOL

The tool shown herewith was designed for cutting a recess *B* in the combustion chamber of an automobile engine cylinder *A*. This recess is made to provide a clearance for the grinding wheel when finish-grinding the bore. As the cylinder block for which this tool was designed had four bores and was 25 inches long, it was found impractical to perform the recessing operations on a lathe or boring machine. It will be noted, however, that only one bore of the cylinder block is shown in the illustration. The depth of the recess *B* is 1/16 inch, and its length is ½ inch.

The tool is provided with a heavy shank *C* which has a taper at one end that fits the drilling machine spindle. A slot is machined at the opposite end of the shank for the tool-arm *D* which is pivoted on pin *E*. The ring *F*, pressed on the shank, is made a running fit in the cylinder bore, and provides a means of guiding the end of the tool. This ring also prevents the split ends of shank *C* from spreading. The ring *G* is pinned to the shank, and carries the feeding mechanism of the tool-arm.

The tool-arm must be adjusted to the position indicated by the dotted lines at *H* before it can be lowered into the cylinder bore. When the tool-carrying end of the shank rests on the head of the combustion chamber, the machine is started. The knob *J*, pinned to screw *S*, is turned at intervals in order to feed the right-hand end of tool-arm *D* in the direction indicated by the arrow. Cutter *K* is thus fed outward a sufficient distance to cut the recess to the required depth. The knob *J*, coming in contact with ring *G*, serves as a stop for determining the depth of the cut. When the recess *B* has been cut to depth, the machine is stopped, after which screw *S* is turned back by means of knob *J* until cutter *K* is drawn back into the shank, thus permitting the tool to be removed and inserted in the bore of the next cylinder. This tool has proved accurate, can be operated rapidly, and eliminates considerable heavy lifting and setting-up work.

Pittsburg, Pa. William Owen



Tool for cutting a Recess in the Combustion Chamber of an Automobile Engine Cylinder

A COUNTERSHAFT TEMPLET

The installation of a heavy overhead countershaft which is in any way complicated requires the personal supervision of a foreman or master millwright. Some machines have several pairs of hangers, or, several countershafts, which must be in close alignment with each other and with the machine in order to function properly.

In some factories the plan has been adopted of laying out beforehand, a temporary wooden templet of any counter-

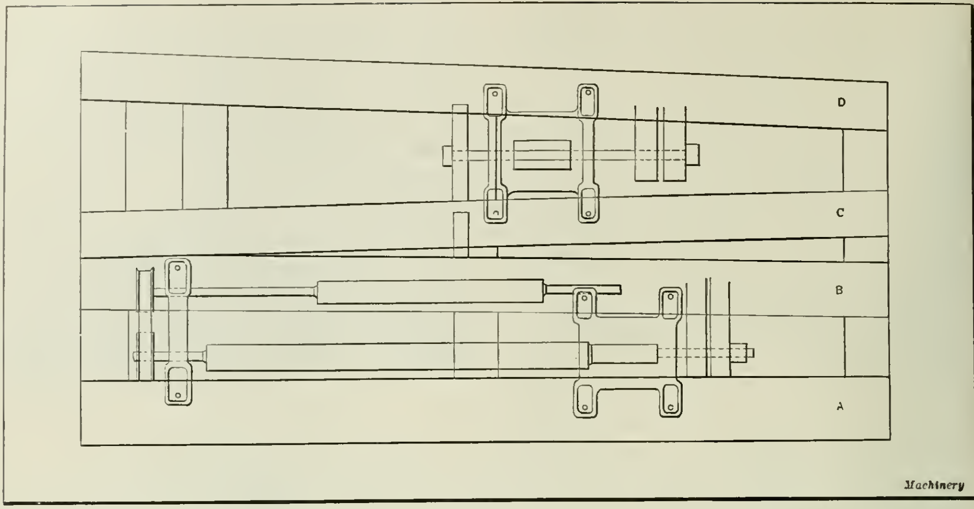


Fig. 1. Ceiling Plan of Countershaft Equipment installed by the Aid of the Templet shown in Fig. 2

shaft which promises to give trouble. It has been found that such a templet enables the workman to put the countershafts in their proper places without the constant supervision of the foreman, and thus enables the latter to attend to work elsewhere in the factory.

In Fig. 1 is shown a ceiling plan view of the overhead countershaft equipment of a grinding machine. The wheel-speed countershaft with its hangers, and the work-drive drum and the table-drive drum with their hangers and countershafts are shown. The positions of the stringers on the ceiling, as obtained from the dimensions given on the erecting print of the machine are indicated at *A*, *B*, *C* and *D*. The master mechanic's templet, Fig. 2, which is made up from the dimensions given on the erecting print is used by the workmen as a guide in placing the stringers in their proper positions on the ceiling.

The templet should be made from ⅞- or 1-inch stock. When in use, it is placed on the ceiling beams, or ceiling-insert plates in a cement constructed building. The straight-edge *E* of the templet is aligned with the main lineshaft and an outline drawn on the beams or ceiling to give the location of the stringers. The templet is next removed and the stringers bolted in place, after which it is clamped in position on the stringers to locate the holes for the hanger bolts. These holes, three of which are shown at *F*, *G* and *H*, are, of course, accurately laid out and drilled, in the templet, according to the dimensions shown in Fig. 2. R. J. S.

* * *

It is stated in a recent Commerce Report that about 62.7 per cent of the world's shipbuilding is being done in British shipyards. Of this amount nearly all is constructed in the United Kingdom; yet there is a serious depression in the shipbuilding industry. Of the 3,500,000 tons of shipping now building, 2,750,000 tons are almost completed. Only about four months full time work is in sight.

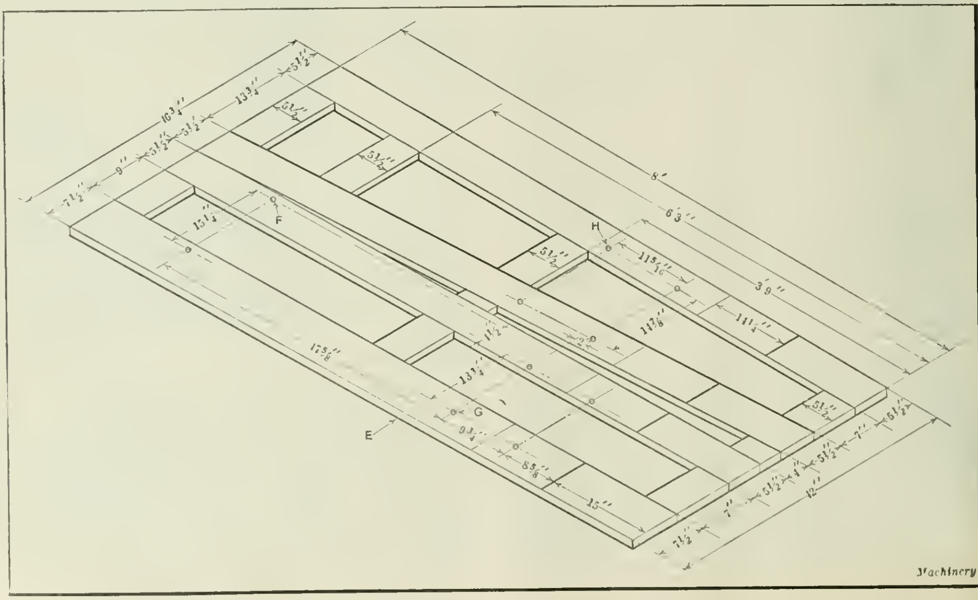


Fig. 2. Details of Templet used in putting up Countershaft shown in Fig. 1

HOW AND WHY

QUESTIONS ON PRACTICAL SUBJECTS OF GENERAL INTEREST

DRAWING A DEEP WIDE-FLANGED SHELL

J. E. J.—I want to draw a flanged cup from 1/16-inch sheet steel, 1½ inches deep, 1 inch in diameter, and having a 3½-inch diameter across the flange. What is the best way to make the dies, and how many operations are necessary?

A.—Specific information regarding drawing die work is difficult to furnish, because no matter what procedure is recommended, the practice is dependent on the equipment with which it is intended to do the job. Press work is always more or less of an experimental proposition. In the present case, the problem is a difficult one, because in addition to the deep cup to be drawn there is a very wide flange. It will probably require four operations to produce the shell. As regards the design of the dies, the information contained in the article published on page 964 of June 1920, MACHINERY will prove of value. The stock used is much heavier than mentioned in the present case, but the design of the dies will be helpful in designing similar ones.

DETERMINING DIAMETER OF DISK TANGENT TO THREE OTHER DISKS

G. R. P.—Can someone give me a formula for finding the diameter of disk X in Fig. 1, when the diameters of the other disks and the distances between their respective centers are known?

ANSWERED BY W. W. JOHNSON, CLEVELAND, OHIO

A.—This is the problem of four tangent circles. It is a special case in which the diameters of two of the circles are equal, but it can be solved by the general solution which is as follows: Referring to Fig. 2, let L, M, and N be the centers of the three given circles whose radii are a, b, and c, respectively, and let $MN = x$, $LN = y$ and $LM = z$; then find r. An equation of the second degree can be obtained as follows:

Let $LO = p$, $MO = q$, $NO = s$, and angle $LOM = \theta$, angle $MON = \phi$, and angle $NOL = \alpha$.

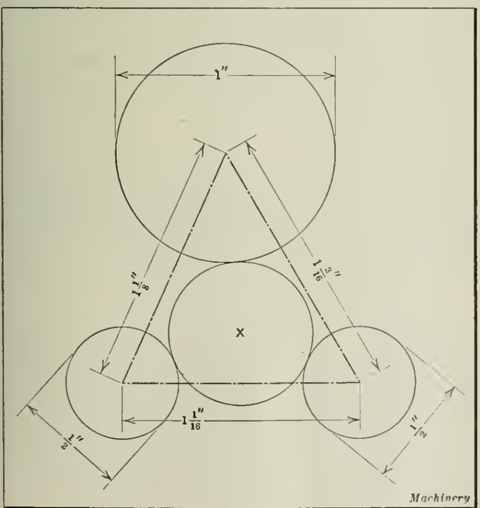


Fig. 1. Diagram illustrating Problem to find Diameter of Disk X

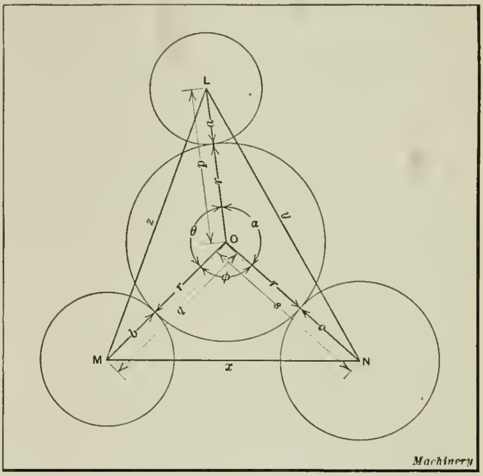


Fig. 2. Diagram used in Solution of Problem presented in Fig. 1

Then

$$\theta + \phi + \alpha = 360 \text{ degrees}$$
$$\theta = 360 \text{ degrees} - (\phi + \alpha)$$
$$\cos\theta = \cos(\phi + \alpha) = \cos\phi\cos\alpha - \sin\phi\sin\alpha$$
$$\cos\theta - \cos\phi\cos\alpha = -\sin\phi\sin\alpha$$

Squaring both sides,

$$\cos^2\theta - 2\cos\theta\cos\phi\cos\alpha + \cos^2\phi\cos^2\alpha$$
$$= \sin^2\phi\sin^2\alpha$$
$$= (1 - \cos^2\phi)(1 - \cos^2\alpha)$$
$$= 1 - \cos^2\phi - \cos^2\alpha + \cos^2\phi\cos^2\alpha$$

Hence,

$$\cos^2\theta + \cos^2\phi + \cos^2\alpha - 2\cos\theta\cos\phi\cos\alpha = 1 \qquad (1)$$

From the cosine formulas in trigonometry:

$$\cos\theta = \frac{p^2 + q^2 - z^2}{2pq} = 1 + \frac{(p-q)^2 - z^2}{2pq}$$
$$\cos\phi = \frac{q^2 + s^2 - x^2}{2qs} = 1 + \frac{(q-s)^2 - x^2}{2qs}$$
$$\cos\alpha = \frac{s^2 + p^2 - y^2}{2sp} = 1 + \frac{(s-p)^2 - y^2}{2sp}$$

Put, in the numerators, $p = r + a$, $q = r + b$, and $s = r + c$, and let A, B, and C represent certain expressions in the results; then,

$$1 + \frac{(p-q)^2 - z^2}{2pq} = 1 + \frac{(a-b)^2 - z^2}{2pq} = 1 + \frac{A}{2pq}$$
$$1 + \frac{(q-s)^2 - x^2}{2qs} = 1 + \frac{(b-c)^2 - x^2}{2qs} = 1 + \frac{B}{2qs}$$
$$1 + \frac{(s-p)^2 - y^2}{2sp} = 1 + \frac{(c-a)^2 - y^2}{2sp} = 1 + \frac{C}{2sp}$$

By substituting these values in Equation (1), performing the operations indicated, clearing of fractions and cancelling, the following equation is obtained:

$$A^2s^2 + B^2p^2 + C^2q^2 - 2ABsp - 2BCpq - 2CAqs - ABC = 0 \qquad (2)$$

Putting $p = r + a$, $q = r + b$, and $s = r + c$, in Equation (2), performing the operations indicated, and combining,

$r^2 [A^2 + B^2 + C^2 - 2AB - 2BC - 2CA] + 2r[A^2c + B^2a + C^2b - AB(a + c) - BC(a + b) - CA(b + c)] + [A^2c^2 + B^2a^2 + C^2b^2 - 2ABca - 2BCab - 2CAbc - ABC] = 0$ (3)

This is a general quadratic equation, from which two values for r are always found; one applies to the circle making internal contact with all three circles, and the other to the circle making external contact with all three circles.

From Fig. 1, a = ½ inch, b = ¼ inch, c = ¼ inch, x = 1 1/16 inches, y = 1 3/16 inches, and z = 1⅛ inches.

For convenience, reduce all values to sixteenths and use only the numerators in carrying out the calculations; this is the same as multiplying the roots of Equation (3) by 16. Then, a = 8 inches, b = 4 inches, c = 4 inches, x = 17 inches, y = 19 inches, and z = 18 inches; and

$$A = (a - b)^2 - z^2 = -308$$
$$B = (b - c)^2 - x^2 = -289$$
$$C = (c - a)^2 - y^2 = -345$$

Inserting these values in Equation (3), and solving, the different coefficients can be found as follows:

Coefficient of $r^2 = A^2 + B^2 + C^2 - 2AB - 2BC - 2CA = -292{,}544$

Coefficient of $2r = A^2c + B^2a + C^2b - AB(a + c) - BC(a + b) - CA(b + c) = -1{,}590{,}960$

Absolute term $= A^2c^2 + B^2a^2 + C^2b^2 - 2ABca - 2BCab - 2CAbc - ABC = +23{,}998{,}500$

This gives the quadratic equation,

$$292{,}544r^2 + 2(1{,}590{,}960)r - 23{,}998{,}500 = 0$$

Dividing by 4, this equation reduces to:

$$73{,}136r^2 + 2(397{,}740)r - 5{,}999{,}625 = 0$$

Solving for r,

$$r = \frac{-397{,}740 \pm \sqrt{397{,}740^2 + (73{,}136 \times 5{,}999{,}625)}}{73{,}136}$$

Using this equation with the plus sign before the radical to find the radius of a circle making external contact with all three circles,

$$r = 5.1262$$

Since the roots of the equation were multiplied by 16, divide the value of r by this number. Thus, r = 0.3204. Therefore, the radius of the disk X in Fig. 1 is 0.3204 inch, and the diameter is twice that or 0.6408 inch.

STRAIGHT PIPE THREADS

C. H. B.—Has any standard been adopted for straight pipe threads, and where are such threads generally used?

A.—The following information conforms to the American Standard pipe threads and to the standard approved by the National Screw Thread Commission:

The straight pipe thread has the American or Briggs tapered pipe thread in regard to pitch and depth of thread. The basic pitch diameter for straight pipe threads equals the pitch diameter at the gaging notch of the tapered plug gage. In the report of the National Screw Thread Commission a table of the pitch diameters for straight pipe threads is given, and other tables relating to different classes of screw threads with recommended allowances, tolerances, etc.

Occasionally it is advisable to use a straight pipe thread of the largest diameter it is possible to cut on a pipe. This thread has also been standardized and is designated in the report mentioned as the "maximum external and minimum internal lock-nut threads." The pitch of this lock-nut thread is the same as the pitch of a standard taper thread of corresponding size. To illustrate the difference between a straight lock-nut thread and the straight pipe thread first referred to, we shall consider the difference between the diameters of the 1-inch normal size. In the case of the straight pipe thread the basic pitch diameter is 1.2386 inch, whereas, in the case of a lock-nut thread, the maximum pitch diameter for an external thread is 1.2603 inch.

The straight external pipe threads are recommended only for special applications, such as long screws and tank nipples. In gaging, the tapered working plug gage for the American or National standard is used, allowing the same tolerance for the notch as for a taper thread.

LENGTH OF QUARTER-TURN BELTS

C. M.—Is there any formula for finding the length of a quarter-turn belt?

ANSWERED BY D. C. PAGE, FITCHBURG MASS.

The standard handbooks do not give formulas making it possible to determine the length of a quarter-turn belt. Several years ago, therefore, the writer developed the formula given below, which has proved satisfactory in practice.

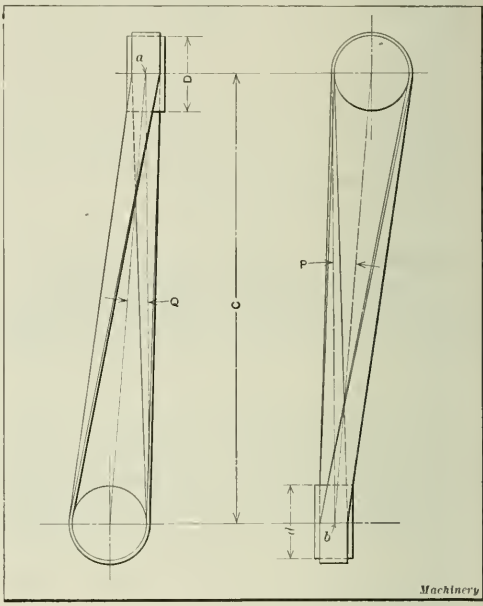


Diagram used in Connection with Formula for finding the Length of Quarter-turn Belts

Referring to the accompanying illustration,

C = distance between centers of pulley shafts;
D = diameter of one pulley;
d = diameter of other pulley;
L = total length of belt;
½ $D \div C$ = cot P;
½ $d \div C$ = cot Q.

The values of C, D, d, and L must, of course, be given in the same unit of measurement; that is, they must all be given in inches or feet. Employing the above symbols, the length of the belt is found by the formula

$$L = 2C + \frac{(D + d)\pi}{2} + 0.01746D\ (90 - P) + 0.01746d\ (90 - Q)$$

In working out this formula it was assumed that the belt leaves pulley D at point a, and pulley d at point b, as indicated in the illustration. Actually, however, the belt does not leave the pulleys at exactly these points. For this reason the formula will give a result which is slightly in excess of the exact length. This error, however, is so slight that it does not affect the operation of the belt provided that distance C is always greater than $4(D + d)$. It is obvious that the amount of error decreases as the distance between the pulleys is increased.

Charting the Conditions of Business

By ERNEST F. DuBRUL, General Manager, National Machine Tool Builders' Association, Cincinnati, Ohio

THE chart shown in the accompanying illustration, if kept for each line of product made by a manufacturer, will assist him to control his production in accordance with the actual demands. The great variations in economic cycles occur because of maladjustments between supply and demand, and the greater the number of firms that control their own business in accordance with the demands of the market, the healthier will all business be. In this chart the lines are made up on the cumulative plan. This means that by simply adding the monthly increments of each item, it is possible to measure upward on any vertical line on the chart to obtain the total amount of that item up to date.

The lowest line, which represents consumers' sales, starts at zero. The line which represents shipments starts at the figure above zero that shows the amount of stock of a given machine in the hands of dealers at the beginning of the year. The line marked "Production Finished" starts with the figure plotted above the line marked "Factory Shipments" showing the amount of manufacturers' finished stock on hand at the beginning of the year. The line marked "Production Started" begins with the figure plotted above the line designated "Production Finished" showing the number of units in process but unfinished at the beginning of the year.

The line marked "Net Orders" is a composite line. It starts with the number of machines on unfilled orders at the beginning of the year, plotted above the starting point for the shipment line. It represents the result obtained by deducting the month's cancellations from the new orders received during the month. The order line is the only line that can cross the production or process line. None of the other lines can cross each other, although some might meet and diverge. The order line is also the only line that can show a dip from a previous high point. This would occur only in months during which cancellations were greater than the new orders received. The amount of dip would therefore be the minus quantity resulting from this condition.

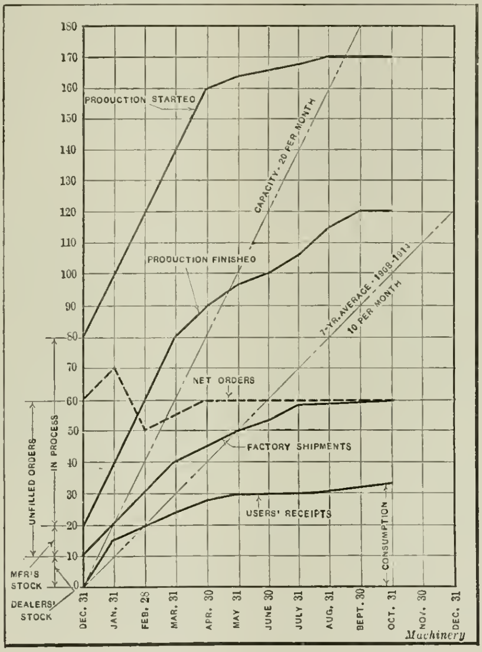


Chart for controlling Production to suit Actual Demands

Two faint dot-and-dash lines are shown running diagonally. The upper one of these represents the accumulated monthly economic capacity of the plant for producing this particular type of article, due account being taken of the quantities of other production which normally accompany the type for which the chart would serve. The second dot-and-dash line represents the monthly average shipments of this particular type, taken over a period covering, say, the pre-war years 1908 to 1914 inclusive, if that would seem to be the highest standard figure that this industry could reasonably expect to count on for some time to come. In this chart these two lines show quite a divergence on their cumulative rise, due to an excess of capacity. The spaces between the various curves on the chart correspond to the balances at the end of the month. The dip in the order curve shows an excess of cancellations during one month.

The chart as drawn shows the situation in the plant of a supposititious manufacturer who has allowed conditions to get out of balance. It will be noted that at the beginning of the year he had ten units of finished product on hand, corresponding to half of one month's capacity. Plotted above this is the amount in process—sixty units, representing three times the capacity, and it may be assumed that the process required three months. His unfilled orders of fifty units were plotted that many points above the dealers' stock. At the beginning of the year these covered not only what he had on hand, but also forty in process. The fact that he had finished product on hand and unfilled orders in addition would indicate that some of these unfilled orders were suspensions.

In the month of January net orders and shipments from the factory showed a rise, but so did the balance in stock in the hands of the dealers. As the shipments went out at only half the production rate, the number of parts finished during the month amounted to as much as would be shipped in two months. The line of actual shipments to the consumer flattened out faster than the line of total shipments, due to the dealers' stock gradually getting larger and larger. With production going straight ahead, the manufacturer's finished stock also grew larger.

For three months the "Production Started" and "Production Finished" lines ran parallel. Supposedly, after February cancellations, and poor sales in March, the manufacturer began to slow down the amount of work completed, although in April he started the usual amount of new work.

The executive using the chart illustrated did not control production with an eye on the actual sales to users, and he greatly over-anticipated sales. The users actually took thirty-three units in ten months, while the manufacturer finished 120 units, counting his own and the dealers' stocks. An over-anticipation of this kind means at the least a period of idleness for the producer. When the whole industry is in the same condition, it indicates such a serious maladjustment between actual supply and demand that loss to someone is inevitable. A chart of this sort is good not only for individual concerns but also for the industry as a whole.

The Metal-working Industries

REPORTS on conditions in the machine tool field vary considerably according to the line of machines built. Some manufacturers say there has been a decided improvement during the last three months, while others find insufficient change to warrant making definite plans as yet, based on increases in their business. But the fact is that there has been, on the average, a marked improvement. There has been more actual buying of machine tools during this period than in any other three consecutive months of 1921. This can be stated with certainty, and is confirmed by machine tool dealers, some of whom have done enough business during the last three months to pay running expenses and overhead, which very few found possible during the early part of the past year.

The small tool business shows a greater degree of activity than the machine tool trade, and while these shops also are all running on very much reduced schedules, it is interesting to note that, compared with pre-war sales, the present business is not abnormally low. One manufacturer of small tools is doing 70 per cent of his pre-war business, and another confidently expects to equal his pre-war sales during the coming year. Even in the machine tool field there are instances where present output is equal to 40 per cent of present capacity, which in many cases is equal to the manufacturers' pre-war business.

General Outlook in the Machine Tool Field

The prospects for 1922, upon which manufacturers generally agree, is that business will improve slowly during the first eight months or so, and the pace will be more accelerated during the last four months of the year. Many manufacturers and dealers expect that 1923 will be a normal year in this field, meaning by normal, a business that will sustain the industry as a whole, although by no means demanding the entire capacity at present available for machine tool building—a capacity expanded to meet the extraordinary demands of the war period, and, therefore, far in excess of peace requirements.

It is not unreasonable to expect, however, that in a few years even this excess capacity will be absorbed; at least, the history of the machine tool industry in this country warrants the belief that it will be. Time and again, during periods of depression, it has been generally held in the industry that capacity greatly exceeded the requirements for many years, but as soon as the business pendulum swung back to prosperity the machine tool plants found themselves working to full capacity and under the necessity of increasing their facilities. Periods of extreme depression and of unusual activity are now recognized as inevitable in the machine tool industry, for the reason that this basic industry is active only when other industries are expanding.

Demand for Cost-reducing Machinery

It is interesting to note that even though very little of the present machine tool equipment is employed, manufacturers are, nevertheless, buying certain types of high-production machinery and discarding the less productive in order to reduce manufacturing costs. With this object in view, orders have recently been placed for some highly automatic machinery, and machine tool manufacturers are concentrating on the development of types that will increase production and reduce labor costs. One of the machines recently completed doubles production without increasing labor costs, while the first cost of this equipment is increased by only 15 per cent. In another case the rapidity of performing a certain operation on automobile parts has been so improved within the last two years, through the efforts of two competing manufacturers, that the output is now three times what was formerly considered extremely good production. It is believed that the next two years will see some remarkable advances in machine tool design, and particularly in the field of automatic and semi-automatic machinery.

The Iron and Steel Industry

The iron and steel industry—the basic industry and the barometer for the entire metal-working field—is definitely looking toward better business during 1922, and is justified in this by steady markets and the slightly improved percentage of operation during the month of January. The United States Steel Corporation is operating at about 45 per cent capacity, and the independent companies, on an average, at nearly this percentage. Pig iron production for December was the largest since last February, and additional furnaces have been blown in. Taking an average of all iron and steel products, the output in 1921 was about one-half that of 1920. The exports of iron and steel products have steadily increased since September.

The Automobile Industry

During 1921, 1,535,000 passenger cars were built, and approximately 145,000 trucks. The export trade fell off heavily, as compared with 1920. In that year 140,000 passenger cars and 30,000 trucks were exported, as against 31,000 passenger cars and 8000 trucks in 1921. The figures show that the output of automobiles and trucks in 1921 was approximately 80 per cent of the output in 1920, the banner year in the automobile industry. The production for 1921 was far in excess of expectations in the automobile trade a year ago, and this great industry may be considered to have made a very rapid and quite remarkable recovery from what was expected to be not only a severe but a rather lingering depression. For 1922 it is estimated that practically the same number of cars will be built as in 1921.

The General Price Situation

The Federal Reserve Bank of New York regularly computes the average price of twelve basic raw materials, and the most recent compilations show that this price has remained close to the 1913 average ever since last July. This not only indicates stability in the prices of raw materials, but also a basic price level upon which to establish prices in all other industries at levels likely to restore confidence and encourage activities in all fields.

In machine tools there have been decided reductions, and the best thing for this industry now would be the establishment of prices based upon present labor and material costs and a strict adherence to these prices. Until definite price levels are generally maintained, manufacturers will have difficulties with buyers, who naturally seek bottom prices when there is no stability.

MACHINERY on many occasions has stated the reasons why there is no possibility of a return to pre-war prices for machine tools. The improvements made in all kinds and types of machines increase their manufacturing costs as well as their efficiency. The skilled labor employed in the manufacture of machine tools is also on a permanently higher wage level than before the war, and selling expenses have materially increased as a result of increased freight rates, passenger fares, hotel expenses, and similar items on which the advances have been very great and the reductions relatively insignificant.

NEW MACHINERY AND TOOLS

THE COMPLETE MONTHLY RECORD OF NEW AMERICAN METAL-WORKING MACHINERY

The New Tool descriptions in MACHINERY are restricted to the special field the journal covers—machine tools and accessories and other machine shop equipment. The editorial policy is to describe the machine or accessory so as to give the technical reader a definite idea of the design, construction, and function of the machine, of the mechanical principles involved, and of its application

Heald Automatic Ring Grinding Machine

CONSIDERABLE interest was manifested at the automobile show held in New York City the early part of January, in an automatic surface grinding machine developed for grinding the sides of such circular parts as piston-rings, ball and roller bearing races, collars, washers, gears, and valve seats, on a quantity production basis. This machine, known as Style No. 25, was exhibited by the Heald Machine Co., 16 New Bond St., Worcester, Mass., and was set up for the grinding of piston-rings which were automatically fed to the wheel. In addition to the applications mentioned, it may also be employed for general work. One of the unusual features of the machine is that the wheel-slide is driven through a simple hydraulic arrangement operated by oil, which enables any speed from zero to maximum to be instantly obtained, and allows the table to be reversed instantly at any point without shock. This hydraulic arrangement may be seen in Fig. 1, attached to the front of the column.

The automatic feeding of the work to the grinding wheel is effected by means of a patented device, it being only necessary to load the magazine and take away the finished product. As will be seen by reference to Figs. 3 and 4, the device consists of a feeding plate having five holes bushed to take rings up to 5 inches in diameter. As the plate indexes, a ring is slid from the magazine to the center of the magnetic chuck, where it is ground by the wheel and then slid from the chuck. The feeding plate is indexed by a lever connected to a crank disk at the back of the machine, which

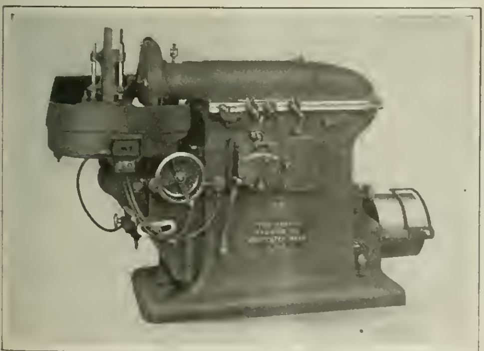


Fig. 1. Automatic Surface Grinding Machine developed by the Heald Machine Co.

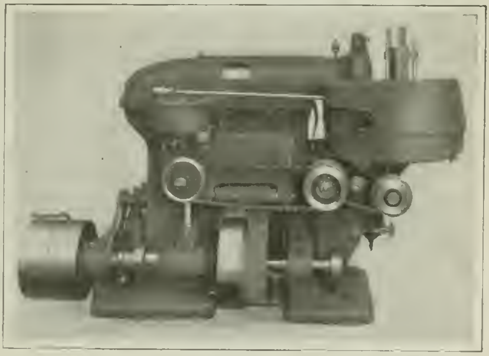


Fig. 2. Rear View of Grinding Machine, showing the Main Driving Shaft

is operated by a simple friction device. This disk is held stationary by a latch while the wheel-slide moves forward to enable the wheel to grind the ring on the chuck, but as the wheel-slide returns, the latch is tripped, allowing the crank disk to revolve and thus index the feeding plate one-fifth of a revolution. A guard placed over the ring being ground prevents any danger of flying parts in case the ring should break.

The wheel-spindle is made of chrome-vanadium steel, and it is mounted in an adjustable bearing at the wheel end. Adjustment of this bearing can be readily effected through an opening in the top of the wheel-slide. The rear end of the spindle is mounted in a self-aligning ball bearing. The main driving shaft is located at the rear of the machine, as illustrated in Fig. 2. It is mounted in roller bearings and has a two-step cone pulley giving two speeds to the grinding wheel, thus enabling the wheel to be run at an efficient surface speed throughout its entire life.

The chuck spindle is mounted in ball bearings and driven through spiral gears, the spindle housing being absolutely tight so that the bearings and gears may always be immersed in oil. When the machine is used for general work without the automatic feeding device, the chuck bracket can be adjusted to permit concave and convex surfaces to be ground. A diamond located on the chuck pan can be readily adjusted to true the wheel so as to obtain the desired thickness of the work. In order to bring the wheel in position for dressing, the left-hand reversing dog, seen on the wheel-slide in Fig. 1, is thrown up to allow the slide to travel toward the back of the machine until the reversing lever engages a safety latch-dog. The latter controls the reciprocations of the slide past the diamond. The dogs on the front of the machine, besides controlling the travel of the wheel-slide, also govern the action of the feeding device.

A disk at the rear of the machine equipped with an electrical contact, furnishes current for the chuck at the time that the work is being ground. However, as the disk revolves the current is automatically shut off for an instant and reversed, thereby demagnetizing the chuck and the work before the latter is removed. By the time the next ring is slid into place over the chuck, the current is automatically switched on again. An automatic vertical feed can be furnished with this machine when it is to be used for general work, but this device is not adaptable to a machine furnished with the ring-feeding device. A water equipment, including a pump, tank, water guard, and connections, can also be furnished when desired.

This machine can be equipped with an 8-, 12- or 16-inch magnetic chuck, but the automatic feeding device for rings can be furnished only with the 8-inch size. Some of the

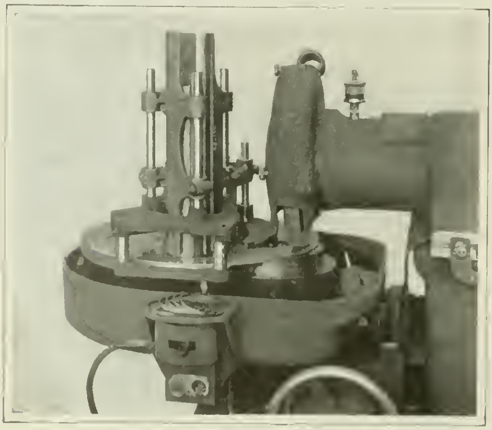


Fig. 3. Close-up View of the Grinding Wheel, Magnetic Chuck, and Automatic Feeding Device

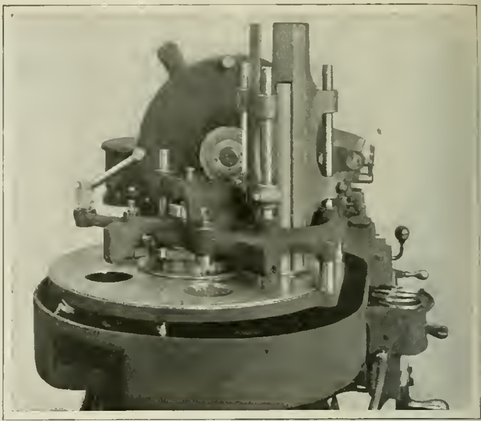


Fig. 4. Another View of the Automatic Feeding Device, looking directly toward the Grinding Wheel

principal dimensions of the machine when equipped with an 8-inch chuck are as follows: Maximum and minimum distances from top of chuck to center of grinding wheel, 12 and 4¾ inches, respectively; vertical adjustment of chuck, 7¼ inches; maximum diameter of work automatically handled, 5 inches; and maximum thickness, 2 inches. When the machine is to be driven directly by a motor, a 10- to 15-horsepower size is recommended, depending on the nature of the work.

ABBOTT BALL BURNISHING BARREL

The principal feature in which the ball burnishing barrel shown in the accompanying illustrations differs from other burnishing barrels manufactured by the same concern is in holding the articles to be burnished stationary on the inside of the barrel body and carrying them through the mixture of balls, soap, and water, whereas in previous designs the work was placed in the barrel loose and allowed to tumble in the mixture. This machine was brought out by the Abbott Ball Co., Elmwood, Hartford, Conn., to enable large work to be burnished without the different pieces coming in contact with one another in such a way as to scratch their surfaces. The periphery of the barrel is eight-sided, each side having a hinged hand-hole cover over an opening into the barrel.

The edges of the openings are beveled to an angle of 45 degrees, and a lid machined to suit these bevels fits into each opening. This lid is held in place by the hinged cover coming in contact with a flat spring on the top of the lid, which also serves as a handle to facilitate the removal of the lid. The hinged covers have packing rings which prevent the mixture from leaking out of the barrel. On the inside face of each removable lid is attached a fixture for holding the work it is desired to burnish. Fig. 2 shows a barrel with a portion broken away to show the manner in which it is equipped for burnishing parts of hacksaw frames.

The machine is designed primarily for the use of manufacturers having large quantities of one or more classes of work to be burnished. Two or three sets of lids may be provided, equipped with fixtures suitable for the different classes of work. Then, in operating the machine, while eight fixtures filled with one class of work are being revolved in the barrel, another set of fixtures can be unloaded and loaded. After the work has been finished, it is removed from the barrel by lifting each hinged cover in succession and raising the corresponding lid and work-holding fixture. Of course, another fixture with unfinished work is put into place in each instance before the next hinged cover is raised, so that the mixture is retained in the barrel.

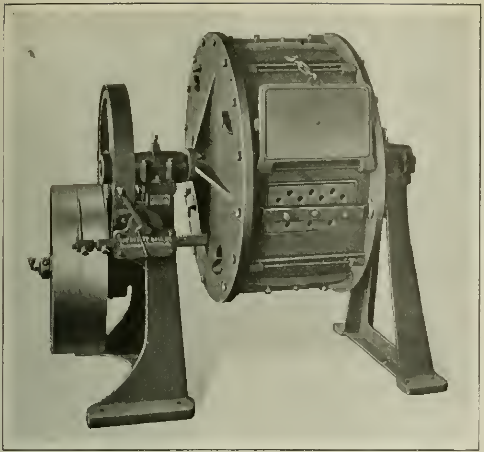


Fig. 1. Ball Burnishing Barrel which is a Recent Development of the Abbott Ball Co.

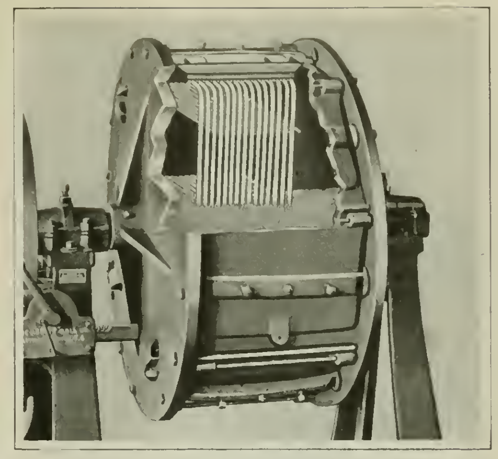


Fig. 2. Close-up View of Barrel broken away to show Manner of holding the Work

With work that is to be plated, it will be found advantageous to have at least three sets of fixtures so that when the work is removed from the barrel ready to be plated, it may be left on the fixtures while being put through the plating operation and then brought back to the burnishing barrel for the final burnishing. Fig. 1 shows the method of holding the hinged cover in a raised position and also shows a lid fitted up with wire screening. This screening is of a mesh that will not allow any of the balls to come out, and is for the purpose of furnishing an easy method of keeping the inside of the barrel and the balls clean. In cleaning the barrel, it is first filled with water, then the strainer cover is put in place, and the barrel revolved. The inside of the barrel and the balls are satisfactorily rinsed in this way.

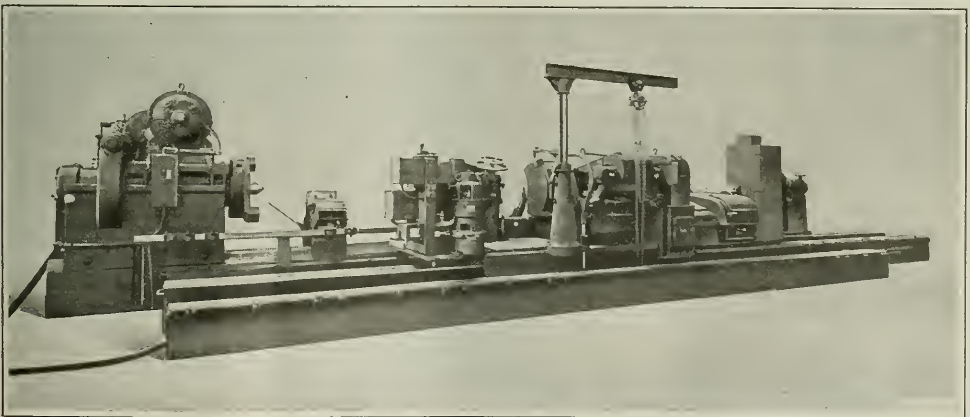
NORTON ROLL-GRINDING MACHINE

Two cylindrical grinding machines of the single-wheel type, designed for dressing steel-mill rolls up to 54 inches in diameter and 28 feet in length, have been recently installed in the shops of the Jones & Laughlin Steel Co. by the Norton Co., Worcester, Mass. These machines are among the heaviest of their class ever built, weighing about 50 tons, and are quite similar in design to other Norton machines built in the past for the same purpose. Each machine is electrically driven and controlled throughout. Four Westinghouse motors are provided, a 40-horsepower unit being mounted on the wheel carriage for revolving the grinding wheel and traversing this carriage, a 20-horsepower motor on the headstock for revolving the work, a 3-horsepower motor on the footstock for traversing this member along the ways of the work-base, and a 3-horsepower motor on the wheel carriage for driving the pump and traversing the grinding wheel at right angles to the work.

The operation of the machine is governed by magnetic controllers, the position of the operator being on the wheel carriage and beside the grinding wheel, where he may look down between the work and grinding wheel faces and observe the grinding process.

The rolls may be rotated either between centers or on specially constructed adjustable bearings. Within the reach of the operator are all the handwheels and levers necessary for starting and stopping the wheel, starting or stopping the roll, reversing the traversing wheel carriage either by hand or by power, moving the wheel carriage for slight adjustments by hand, moving the wheel toward and away from the work either by hand or by power, starting or stopping the traverse of the wheel carriage, changing from the maximum to the minimum speed of the wheel-carriage traverse, and controlling the amount of water or coolant flowing over the wheel and work.

Changes in the speed of the work are accomplished at the headstock by means of a drum controller and change-



Cylindrical Grinding Machine built by the Norton Co. for Rolls up to 54 Inches in Diameter and 28 Feet in Length

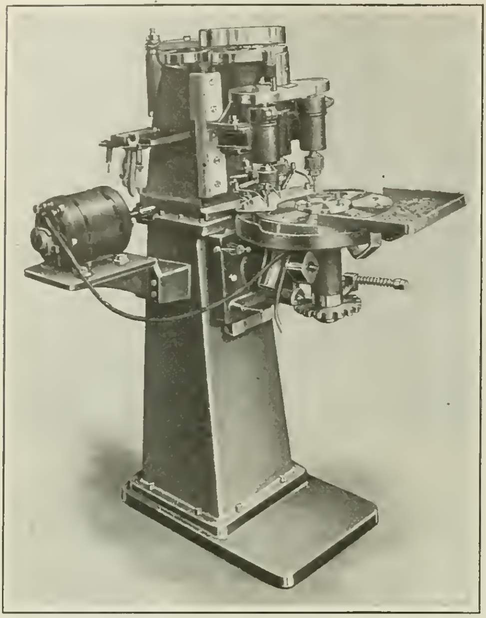


Fig. 1. Dial-feed Multiple-spindle Tapping Machine which is a Recent Development of the Anderson Die Machine Co.

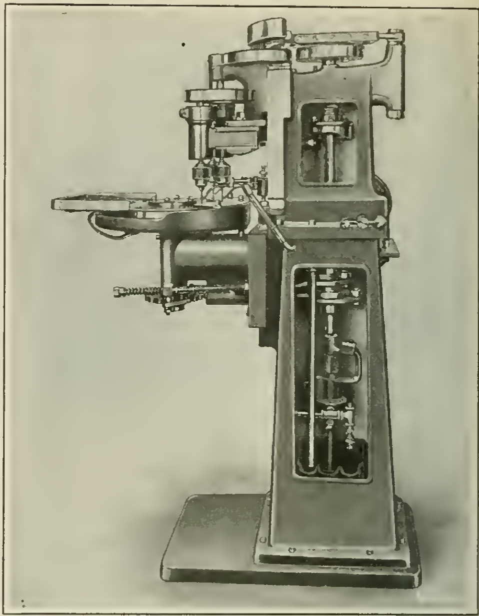


Fig. 2. Left-hand Side of Machine with Various Covers removed to show the Operating Mechanism

gears, while four speed changes for the traverse of the wheel carriage are effected by means of a lever on the front of the carriage. Eight speed changes are possible for this unit through the use of back-gears. An attachment adjustable to any radius up to 3½ inches is furnished for forming the corner of the grinding wheel to suit the grinding of fillets, while the truing device maintains the face of the wheel.

ANDERSON DIAL-FEED MULTIPLE-SPINDLE TAPPING MACHINE

To make possible high rates of production in the tapping of small steel and brass parts used extensively in the construction of electrical appliances, or in tapping nuts and other small pieces requiring a number of tapped holes, the Anderson Die Machine Co., Iranistan Ave. near Admiral St., Bridgeport, Conn., has produced a dial-feed multiple-spindle tapping machine which has a number of novel features incorporated in its design. The general appearance of the machine is shown in Figs. 1 and 2, from which it will be seen that it is equipped with three tapping spindles, while Fig. 3 shows the mechanism employed for alternately rotating the spindles in opposite directions. This alternate rotation is obtained by means of a crank disk mounted on the top of a vertical shaft located at the center of the machine and extending to the top. The crank disk moves a large gear tooth segment to and fro, the teeth of which engage a train of gears connecting with pinions at the top of the spindles.

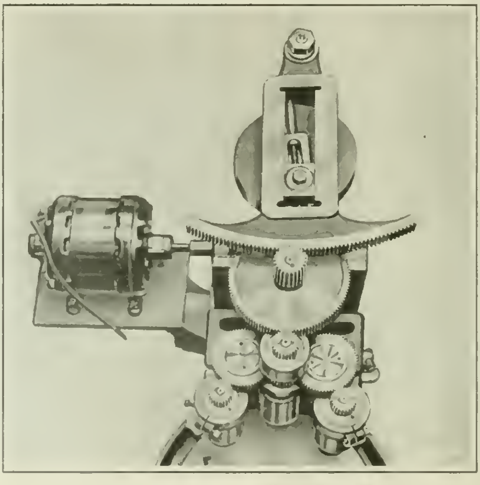


Fig. 3. Plan View of Tap-spindle Reversing Mechanism

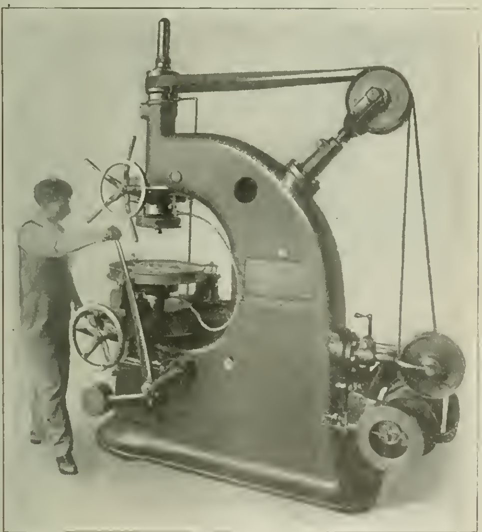
The work-holding dial is indexed by means of cams mounted near the middle of the vertical shaft, which lock the dial in position after each indexing. The ratchet that controls the dial operation is regularly furnished with eighteen teeth to correspond with the number of openings usually supplied around the dial for the work. The dial is made of relatively thin material, and the openings are made to fit the particular pieces to be operated on. Parts of various shapes may be accommodated by simply substituting a dial with openings of the necessary contour. Any piece requiring one, two, or three tapped holes can be tapped at one movement of the dial past the spindles, and on account of the construction of the spindles, three taps of entirely different leads may be employed at the same time.

The two end tapping spindles are adjustable so that holes in various positions may be tapped. Each dial is designed to suit the fixed central spindle and then is located and indexed in such a way as to make one hole register with the fixed spindle, the two auxiliary spindles being finally adjusted to suit the location of the other holes to be tapped. When the machine is used for tapping holes of the general sizes met with in electrical work, namely from No. 4 to 10, the taps are operated at the rate of fifty-six strokes per minute, which gives an hourly production of 3360 pieces having either one, two, or three holes.

On pieces where only one hole is to be tapped, it is possible to increase the production 100 per cent by doubling the number of work slots in the dial, which can be conveniently done by staggering them, and adjusting one of the auxiliary spindles to suit the work held in the staggered openings. With this provision, the production on single-hole tapping is approximately 112 pieces per minute. By furnishing a cam and slide which will work in conjunction with the dial, the machine may be modified so that round pieces can also be tapped without difficulty. Ball bearings are provided for all shafts that run at comparatively high speeds, and all gears are accurately cut. The machine is driven by a direct-connected motor mounted on a bracket attached to the left side of the column.

BLOMQUIST-ECK DOUBLE-FACING AND BORING MACHINE

The Blomquist-Eck Machine Co., 1146 E. 152nd St., Cleveland, Ohio, has designed the double-facing and boring machine shown in the accompanying illustration. The machine, as illustrated, is used for facing and boring automobile wheels at one setting, to insure that both sides of the wheel will be parallel. There is one cutter-head above the work and another below it in the base of the machine. After the wheel to be operated upon has been chucked, the hand-lever being actuated by the operator in the illustration brings up the lower head, which faces the under side of the wheel. As the spindle of this head moves upward, it brings a gage with it, which the operator locks upon the completion of the lower facing operation. He then brings down the upper facing spindle, which bores the hole and faces the hub simultaneously. As this spindle is brought down, a rod controlled by it strikes the gage referred to, at the time when the wheel has been faced to the right thickness, and prevents further downward movement of the spindle. The spindles are then moved to their original positions, the gage released, the wheel removed, and another wheel put in place, after which the operation is repeated.

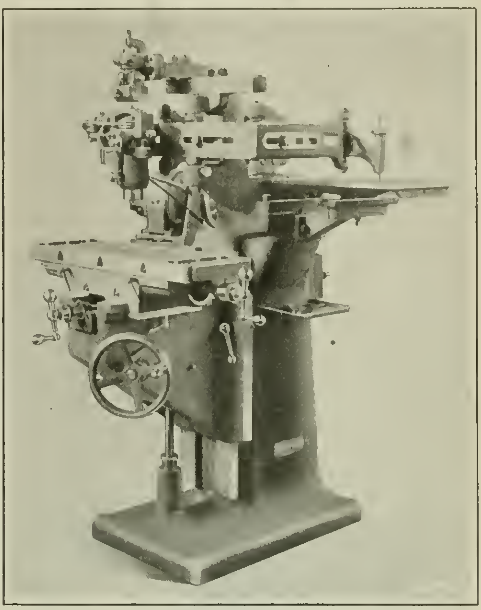


Machine developed by the Blomquist-Eck Machine Co. for boring and facing Automobile Wheels

The oiling system provides for lubricating the upper drive-pulley bearing, the upper spindle quill, and the lower spindle quill by one continuous flow of oil, a flexible tube connecting the upper and lower spindle quills. The pump can be adjusted to supply any necessary amount of oil. The machine is provided with S K F ball bearings throughout. The drive from the countershaft in the back of the machine to the spindle quills is through 3-inch single-ply belts.

GORTON HEAVY ENGRAVING MACHINE

To meet the demands for a heavy engraving machine suitable for cutting dies, steel stamps, and large-size letters, and for handling other similar jobs in steel, brass, and cast iron, the George Gorton Machine Co., Racine, Wis., has developed the No. 1-S engraving machine, which is heavier and has a greater capacity than the machines previously built by this concern. On the new machine the pantograph may be set for various reductions of from 1 to 1 down to 6 to 1. Both radial and thrust ball bearings are provided for the pivots, all other pantograph bearings consisting of hardened, ground, and lapped male and female cone-point centers. The tracing style is held in a ½-inch collet and the adjustable scales are mounted on the top surfaces of bars. The scales have engraved figures giving the settings for the various reductions, and are graduated the full length with twenty graduations to the inch.



Heavy Type Engraving Machine developed by the George Gorton Machine Co.

The cutter-head is an integral part of the heavier of the pantograph bars. Its spindle is mounted on ball bearings and regularly has a range of from 1800 to 8000 revolutions per minute, thus enabling small cutters to be used for fine work and finishing up corners. However, spindle speeds down to 600 revolutions per minute may be obtained by using special driving pulleys. The spindle nose has a straight hole ⅜ inch in diameter, and a collet nut for holding cutters. Extra bushings can be supplied for taking drill-rod cutters less than ¼ inch in diameter.

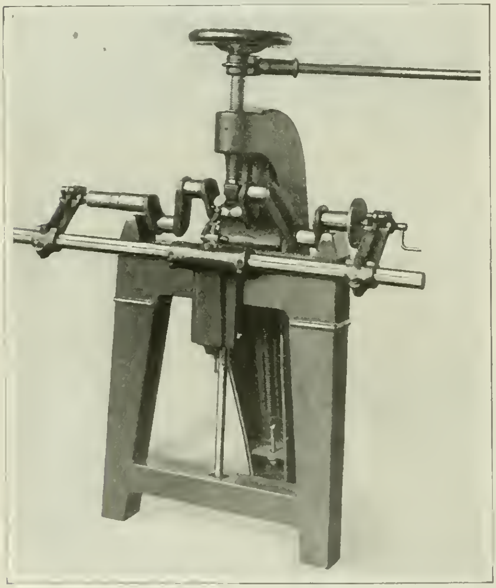
A heavy spindle running in bronze bearings and at slower speeds than those specified can also be furnished in place of the ball-bearing spindle or as an addition to the regular equipment. The table is 10 inches wide, 30 inches long, and provided with three T-slots. An oil-groove planed along each edge allows the cutter lubricant to drain into pockets at the ends of the table. This member is gibbed to take up wear, and a lock-screw provides for holding it in the desired position.

When engraving work of curved or irregular contour, the forming attachment used has six different adjustments which permit it to be set quickly and accurately relative to the work to be engraved. The lower member of the attachment is located directly over the center of the spindle and carries the former block, which is a hardened piece of steel of the same shape as the engraved surface except in the reverse. This block controls the vertical movements of the spindle. The copy-holder is mounted on a bracket at the right-hand side of the machine and is adjustable to compensate for changes in the reduction of the pantograph. The machine is regularly equipped with a copy-holder to suit the work to be handled, and a considerable variety of these can be furnished. Those who have smaller machines built by this concern can utilize any of their copy-holders on this machine through the use of an adapter.

Some of the important dimensions of the machine are as follows: Longitudinal feed of table, 17½ inches; cross-feed of table, 8¼ inches; minimum distance from nose of spindle to top of table, ½ inch; and maximum distance from nose of spindle to top of table, 16 inches. The approximate weight of a belt-driven machine is 1800 pounds, and that of a motor-driven machine 1950 pounds.

GEIER PRODUCTION STRAIGHTENING PRESS

A No. 2P straightening press intended for handling large quantities of parts without removing them from between centers has been recently developed by the P. A. Geier Co., Cleveland, Ohio. The round bar on which the center brackets are mounted is fitted to a sliding head provided with a roller bearing. The bar can be moved freely to the right or left to permit the straightening or bending of work at any point along its length. The sliding head unit is pivoted to the



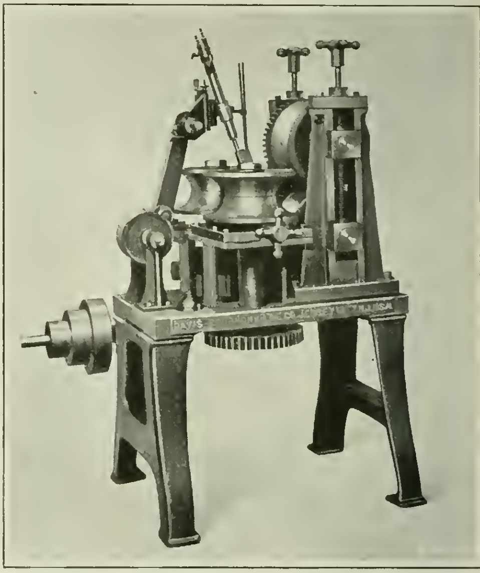
Production Straightening Press placed on the Market by the P. A. Geier Co.

frame of the press and held in a horizontal position by a vertical shaft equipped with a compression spring on both sides. The head also has an up-and-down movement obtained by means of a spring in the rear leg, which is connected by a cable. An adjustable stop-screw enables set-ups to be made that permit the work to clear the blocks.

The handwheel is graduated in twenty-five equal spaces and by turning it through one space a 0.0001-inch up or down movement of the pressure screw is obtained. The amount that a part is out of truth can be read in thousandths of an inch from a dial indicator supplied with the machine and used with the work placed between the centers. This indicator has a ¼-inch stroke. A few of the principal dimensions of the press are as follows: Length of bed, 26 inches; distance from center of screw to frame, 4 inches; maximum distance from bed to thrust block on screw, 8 inches; minimum distance, 2 inches; and maximum distance between centers, 40 inches. The net weight of the machine is about 500 pounds.

DAVIS-BOURNONVILLE TUBE-WELDING MACHINE

An oxy-acetylene tube-welding machine designed for the quantity production of large-diameter thin gage tubing has just been brought out by the Davis-Bournonville Co., Jersey City, N. J. This machine is especially intended for use in tube manufacturing plants where it will be set up and used



Quantity-production Tube-welding Machine added to the Line of Equipment built by the Davis-Bournonville Co.

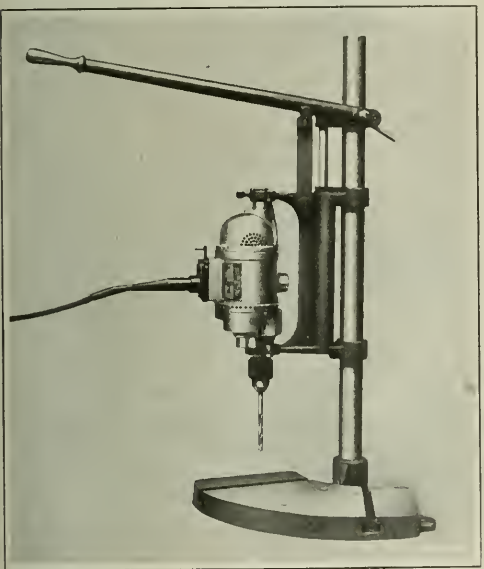
for long runs on one size of tubing. It has two pairs of rolls, one for feeding and the other for welding. The drive is by belt to a three-step cone pulley mounted on a shaft at the rear. This shaft also carries a pinion which drives a spur gear keyed to a shaft having two worms. Motion is transmitted to the feed and welding rolls through a worm-wheel on one spindle of each pair. The worm-wheel driving the feeding rolls is in a vertical position, and that for the welding rolls is in a horizontal position.

The back welding roll is fixed in place, while the one in front is adjustable, its spindle bearing being in a slide, the position of which is controlled through a screw and hand-wheel. The mating gears of the rolls have involute teeth of a comparatively large diametral pitch, which permit adjustments within the range to be made without affecting the smoothness of the tooth action. The upper and lower feeding rolls are geared together, and in this case adjustment is also made by moving one of the rolls and its mating gear. The welding rolls have annular depressions on top to receive cooling water, and a circulatory system can be provided when essential.

The welding torch is of the Davis-Bournonville multiple-jet water-cooled type. Both the tip and the barrel of the torch are cooled by the circulation of water to maintain the conditions necessary for successful continuous welding. The torch-holder permits vertical and horizontal adjustments of the torch and varying of the angle at which the tip is presented to the seam to be welded. The maximum capacity of the machine is for tubing 6 inches in diameter, made from No. 10 gage. Although designed and built for the quantity production of one size and gage of tubing, as previously stated, the machine can be set up for any diameter and gage of tubing within its capacity by employing rolls grooved to suit the desired tube diameter. All rolls, whether for large or small diameter tubes, are the same size over all, and the normal center distances of their mating gears are the same.

UNITED STATES DRILL STAND

To accommodate portable electric drills so that they may be used as bench machines, the United States Electrical Tool Co., Sixth Ave. and Mount Hope St., Cincinnati, Ohio, has



Stand for Electric Portable Drills made by the United States Electrical Tool Co.

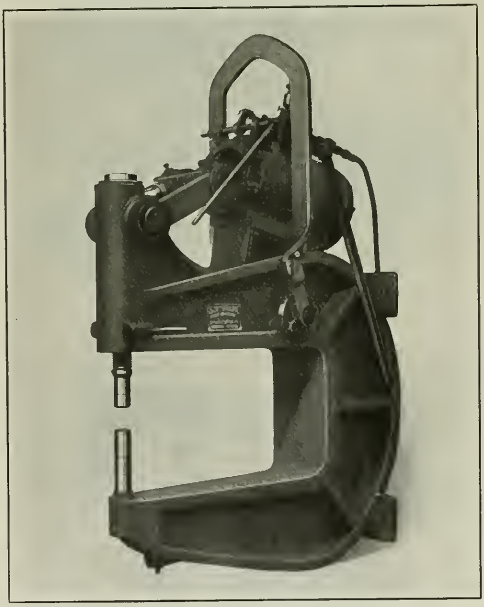
placed on the market the improved drill stand shown in the accompanying illustration. The unit to which the drill is attached may be clamped in various positions along the vertical bar to meet the requirements of the job. The drill is then raised and lowered for the operation through the manipulation of a long lever. The stand will accommodate the 3/8- and 1/2-inch drills manufactured by this company, and without a drill weighs approximately 68 pounds.

MILBURN OXY-ACETYLENE WELDING OUTFIT

An oxy-acetylene welding unit, which is also provided with a tube that adapts the apparatus for burning carbon from automobile cylinders, has been placed on the market by the Alexander Milburn Co., 1420-1428 W. Baltimore St., Baltimore, Md., for use in machine shops and service garages. In addition to the carbon-burning tube, the equipment consists of a welding torch, five welding tips, single-gage oxygen and acetylene regulators, oxygen and acetylene hose, and several other parts used in welding. The outfit is contained in a fiber case. The welding torch is 16 inches long, and of the balanced pressure type operating on approximately equal pressures of oxygen and acetylene. All mixing takes place in the tip. The seats of the regulators close with the pressure rather than against it, thus enabling them to be closed by the exertion of several pounds pressure. The carbon-burning tube fits into the torch-head similarly to a welding tip. It may be conveniently attached and replaced as it becomes worn out.

SOUTHWARK PNEUMATIC RIVETING MACHINE

A line of pneumatic riveting machines made in various capacities from 10 to 150 tons is now being built by the Southwark Foundry & Machine Co., Philadelphia, Pa. On these machines movement is given to the die through a toggle action which causes the die to advance rapidly to the rivet at a decreasing rate of speed and an increasing tonnage, after which the movement is at a uniform speed and pressure for a sufficient distance to drive the rivet tight, drawing the plates together and following up the shrinkage of the rivet with full pressure. It is unnecessary to drive the rivet at the end of the die travel or piston stroke, it being intended that the die be set for any run of work so that the rivet will be headed when the piston has moved through about three-quarters of its stroke, thus allowing a sufficient die travel at full pressure on either side of this position to take care of variations in lengths of rivets, thickness of plates, dimensions of holes, etc., without necessitating further adjustment of the die screw to be made.



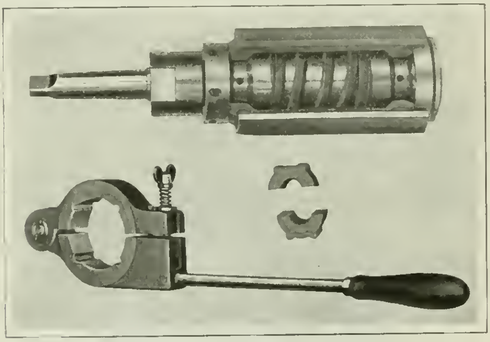
One of a Line of Pneumatic Riveting Machines developed by the Southwark Foundry & Machine Co.

The first inch of piston stroke results in a travel of 1 3/4 inches of the die, which, owing to the fact that the power delivered to the die is in inverse proportion to its movement relative to the piston, develops only four-sevenths of the power actually exerted on the piston. Thus, if a 5-ton pressure is exerted on the piston, only 2.85 tons will be exerted by the die in this position. In the second inch of piston stroke, the rivet die advances 7/16 inch, exerting a pressure of 11.4 tons, and in the third inch of piston stroke, the die advances 5/16 inch, exerting a pressure of about 16 tons. For the ninth and each succeeding inch of piston stroke, the die advances 1/12 inch and exerts a pressure of about 60 tons on the die, this pressure being maintained for ½ inch of die travel.

The operating valve is of the plain sliding type having a simple wick packing on the stem and a removable valve seat which permits ready regrinding. It is provided with means for using line pressure in the pull-back. Two separate pressures may be supplied to the rivet die by turning a plug cock in the valve plate to admit air at full pressure in the pull-back area. This reduces the pressure to the next lower tonnage rating, that is, a standard 50-ton machine will develop both 50- and 30-ton pressures on the die; a 75-ton machine, 75- and 50-ton pressures on the die, etc.

R & C INTERNAL AND EXTERNAL LAPS

The R & C Lap Co., Davenport, Iowa, has developed a line of internal and external standardized laps having interchangeable and replaceable soft metal shells charged with abrasive. The laps were designed especially for finishing parts of internal combustion engines, compressors, and similar apparatus. The shells are supplied in two grades to suit the speed of the operation and the type of work handled. It is stated that highly skilled labor and much experience are unnecessary in order to secure a satisfactory finish with these laps. They are made in various sizes above ¼ inch.



Cylinder and Crankshaft Laps brought out by the R & C Lap Co.

A cylinder lap is shown in the upper part of the accompanying illustration with one section of the shell removed to show the internal construction. This lap consists of a floating shank and expanding device that permits adjustment of the lap diameter and also adjustment to compensate for wear of the soft metal shell. While expanding the lap, the diameter is kept constant throughout the length to insure a true bore in the work. The lap is expanded to the required size by the adjusting nut, and this setting is maintained by a locking nut. The standard shank permits the use of the lap in lathes and drilling machines or by hand.

The lap shown in the lower part of the illustration is of the external type and is used for lapping crankshafts. Another interesting lap made by this firm is a small internal lap intended for tool-room use. The patented construction of this lap permits a slight contraction which prevents the lap from sticking while being used. After a contraction, it cannot expand beyond the original micrometer setting.

H & G SOCKET- AND RATCHET-WRENCH SET

The illustration shows a wooden carrying case containing ten wrench-sockets for hexagonal nuts, which accommodate all sizes of nuts from 7/16 to 1 inch, inclusive; adjustable T-handle; reversible ratchet; universal joint; extension piece; two screwdrivers; and a box wrench. This outfit is

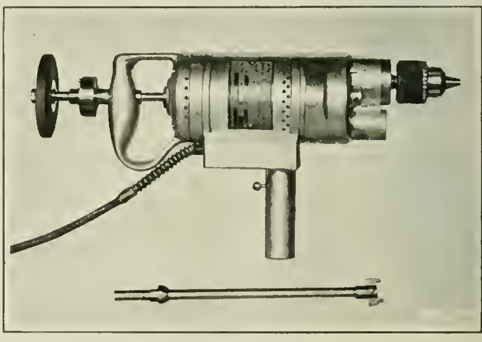
Socket- and Ratchet-wrench Set manufactured by the Eastern Machine Screw Corporation

now being introduced to the trade by the Eastern Machine Screw Corporation, 23-43 Barclay St., New Haven, Conn. Attention is called especially to the manner in which the sockets are manufactured. The hole in each one is first drilled to the dimension across the corners of the nut it is intended to fit, and then the hexagonal shape is formed by drawing in the surrounding metal. This procedure condenses the metal and produces a tough structure. The sockets are provided on top with hexagonal heads by means of which they are turned by the use of the wrench members.

The T-handle has an adjustable cross-bar which can be used in a central position or adjusted to obtain the maximum leverage. The ratchet may be set for use by either the right or left hand by simply raising and reversing the position of a ball-head pin. The extension piece is used between the T-handle and a socket to turn nuts that would otherwise be difficult to reach, or to bring the T-handle into a more favorable position, and the universal joint provides for turning nuts located at difficult angles. Each female part has a split-screw made from spring steel, which produces the necessary amount of friction to hold the parts together while being used.

LOUISVILLE COMBINED PORTABLE DRILL AND GRINDER

One of the distinctive features of the new ⅜-inch portable electric drill now being introduced to the industrial field by the Louisville Electric Mfg. Co., Louisville, Ky., is the grinding wheel attachment made to fit the armature shaft.

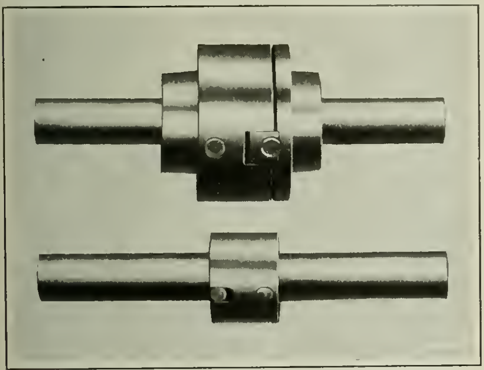


Portable Electric Drill with Grinding-wheel Attachment which is a Product of the Louisville Electric Mfg. Co.

This attachment extends through the handle of the drill into the body, and is equipped with ball bearings and a two- or three-inch grinding wheel running at the rate of 9000 revolutions per minute. The attachment can be inserted whenever the operator desires to sharpen drills or use it for grinding operations. The drill is adapted for use on a lathe. Built into the drill housing is an oscillating automobile-valve grinding device from which the bit holder can be removed at will. This provision makes the drill especially suitable for use in repair shops and garages. The drill motor operates on either direct or alternating current of 110 or 220 volts. The gears are made of heat-treated alloy steel, and aluminum castings are used throughout the construction in order to reduce the weight.

BARTLETT FLEXIBLE SHAFT-COUPLING

A patented flexible shaft-coupling which has a free turning motion around hardened steel pins and a sliding motion in a tongue and groove connection, is now being placed on the market by C. H. Breaker, 4226 Broadway, Indianapolis, Ind., under the name of the inventor, Bartlett. Two styles are shown in the accompanying illustration. The coupling maintains a uniform velocity ratio between the two shafts regardless of the amount of angular or lateral misalignment,



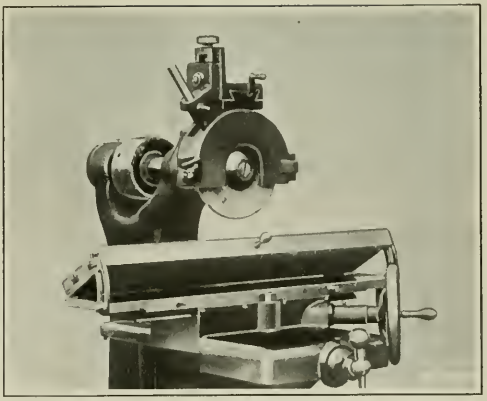
Two Styles of Flexible Shaft-coupling sold by C. H. Breaker

and allows the ample end float essential when couplings are used with alternating-current motor installations, the two sliding members of the coupling being simply pushed into or out of position as necessitated.

The style shown in the upper portion of the illustration consists of two hubs keyed to the shaft ends, two rings which engage each other by means of a tongue and groove construction, and bearing pins driven transversely into each hub. There is another style similar to this, except that the pins are driven directly into the shaft ends, and the hubs are omitted. With the style shown at the bottom of the illustration the pin in one of the shaft ends engages the slotted ring carried by the other shaft end. These coupling members are made of machine steel and heat-treated. With slight changes in the construction, a positive transmission can be had between shafts set at any angle up to 90 degrees.

WILMARTH & MORMAN SURFACE GRINDING MACHINE

In MACHINERY for December, 1921, was published an illustrated description of the No. 1 hand-feed surface grinding machine built by the Wilmarth & Morman Co., 1180 Monroe Ave., N.W., Grand Rapids, Mich., equipped with a swivel sub-table which adapted the machine for handling angular and irregular work. The same machine may now also be



Tilting Table now made for the No. 1 Surface Grinding Machine manufactured by the Wilmarth & Morman Co.

supplied with a tilting table, as here illustrated. Suitable T-slots are provided on this table to accommodate a magnetic chuck, vise, or other fixture. Graduations in degrees facilitate the setting of the table to the desired angle for the work in hand. This design of the table obviates the necessity of tilting or blocking up one edge of a magnetic chuck in order to grind work at an angle. The truing device is conveniently located on the wheel-head, which permits the grinding wheel to be dressed straight or at any required angle without removing the work from the table. A radial truing device operating from the table can also be supplied.

LOUISVILLE MOTOR-DRIVEN HACKSAW

The Louisville Electric Mfg. Co., Louisville, Ky., has added to its line of products a hacksaw driven by a motor which, together with its control switch, is built into the machine so as to be out of the way and at the same time be protected from injury. The slide of the hacksaw is located above the blade for the purpose of keeping the sliding surfaces free from chips and grit. The vise swivels and is provided with graduations to enable the convenient cutting of work at various angles. The stroke of the machine is adjustable from 5 to 7 inches, and there are two speeds, either 45 or 90

Motor-driven Hacksaw brought out by the Louisville Electric Mfg. Co.

strokes per minute. The machine takes a saw 16 inches long, the feed of the saw into the work being by gravity. The motor stops automatically when a piece of work has been cut through. Ball bearings are contained in the construction of the motor and it can be furnished for operation on any circuit. The machine may be equipped with an oil pump when desired, and may also be used as a portable equipment by mounting it on wheels. The weight of this hacksaw is approximately 450 pounds.

BROWN DUPLEX AUTOMATIC FORMING MACHINE

In the line of work classed as screw machine products there are many pieces that can be made most economically by the method known as "form and cut-off.". The duplex automatic forming machine shown in Figs. 1 and 2 has been developed by the L. P. Brown Machine & Tool Co., Attleboro, Mass., to produce parts rapidly according to this principle. The main feature of the machine is the use of two work-spindles which operate simultaneously as two separate single-spindle machines on different pieces of the same product. The machine will make any piece that can be produced with one forming and one cutting-off tool, or with a forming tool and a combined forming and cutting-off tool. This classification includes such parts as special shaped rivets, knobs, studs, handles, etc. By combining the productive capacity of two single-spindle machines in one machine, a saving in floor space, investment, and operating expense is realized.

The two spindles are placed side by side, and the duplicate sets of forming and cutting-off tools work together on two bars of stock so that two pieces are completed in the length of time that would be required for making one on a single-spindle machine. The tooling and setting-up of the machine can be accomplished quickly as a result of the adjustments provided in all directions. The members through which adjustments are obtained are graduated for the convenience of the operator. The rigidity of the machine enables heavy cuts to be taken at high speeds without vibration, and all parts are amply proportioned for strength and longevity. Simplicity was the keynote in designing the machine.

The spindles are hardened, ground, and lapped, and run in phosphor-bronze boxes provided with means of compensating for wear. Thrust is taken up at the rear end of each spindle by hardened steel and phosphor-bronze bushings. The spindles are driven from the shaft of a three-step cone pulley through spiral gearing, which is entirely enclosed and runs in oil. The pulley shaft is provided with roller bearings. Six changes of spindle speed in geometrical progression ranging from 240 to 1820 revolutions per minute are obtainable. The chucks are easily changed; they are adjusted by a nut at the rear end of each spindle, and are prevented from moving endwise when opening or closing.

The feeding mechanism is controlled by adjustable dogs conveniently located. It feeds the work rapidly in any length up to 3 inches, but by the use of extra dogs, lengths up to about 12 inches can be fed. The feeding may be accomplished at any time during the revolution of the camshaft. The forming tools are carried on cross-slides, and can be adjusted independently in any direction. The slides on which the cutting-off tools are mounted are set at an angle to provide clearance between the tools. These tools can be adjusted independently or in unison. Change-gears supplied with the machine enable a production of from 60 to 1800 pieces per hour, the rate, of course, depending upon the character and size of the part. The machine occupies a floor space 44 inches long and 26 inches wide.

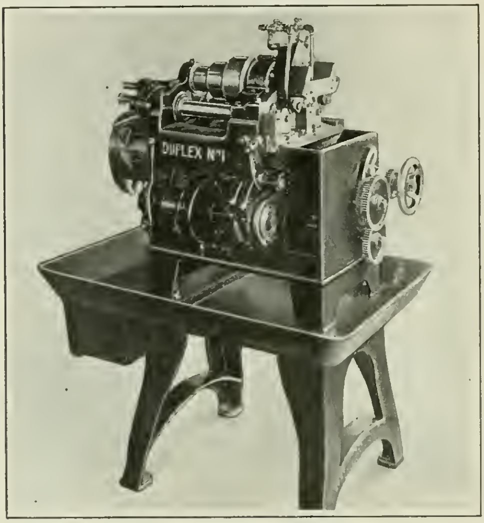


Fig. 1. Double-spindle Automatic Forming Machine made by the L. P. Brown Machine & Tool Co.

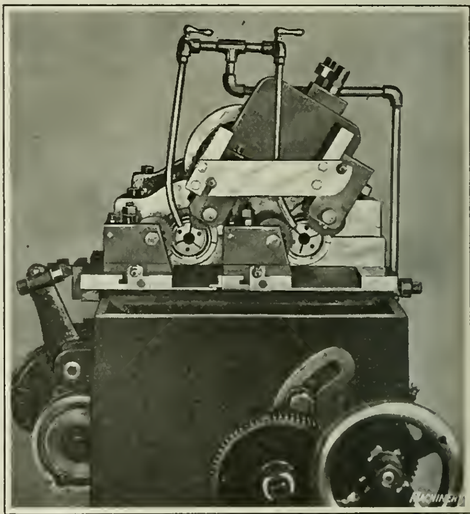


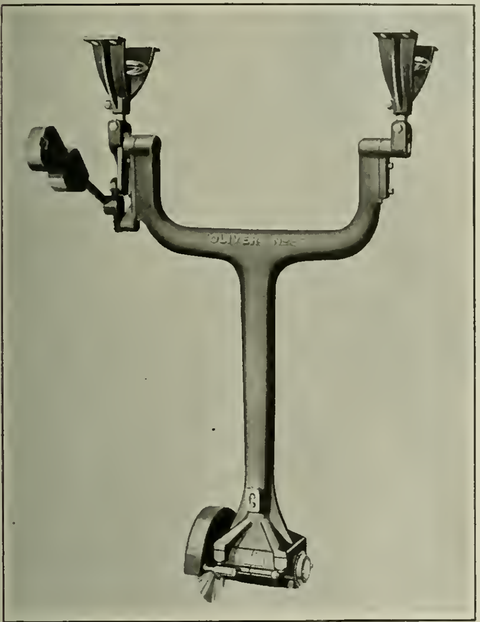
Fig. 2. Close-up View of Automatic Forming Machine showing Arrangement of the Two Work-spindles

OLIVER SWING CUT-OFF SAW

A swing cut-off saw which may be driven either by belt or by a motor directly mounted on the saw arbor has been placed on the market by the Oliver Machinery Co., Grand Rapids, Mich. The motor-driven type is shown in the illustration, from which it will be seen that the push-buttons used to control its operation are conveniently located directly above the motor. The motor-driven arrangement is supplied only for two- or three-phase, 60-cycle, 220- or 440-volt, alternating current. The motor is of 3-horsepower capacity, and operates at 3600 revolutions per minute. A 16-inch diameter saw is fitted to the end of the saw arbor when the machine is motor-driven, and an 18-inch saw when it is belt-driven.

The frame is a cored casting with a single arm centrally located. The arbor unit is attached at the lower end of the frame by a tongue and groove connection. The frame is made in three standard lengths, 5 feet 5 inches, 7 feet 5 inches, and 9 feet 5 inches, respectively. The saw arbor is made of crucible steel and machine-ground to size. It is mounted in two self-oiling split bearings, and has a speed of 2000 revolutions per minute. The arbor frame is detachable from the main frame, and is adjustable vertically for taking up the stretch of the belt on belt-driven machines. A handle is bolted to the arbor frame for the convenience of the operator.

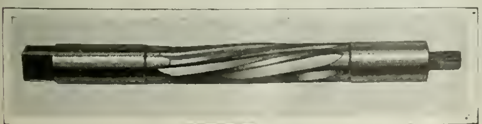
The saw is equipped with a counterbalance consisting of weights on a lever which tend to reduce the resistance of the equipment to the operator. On the belt-driven style, a countershaft extends between the bearings of the frame at the top, and a belt from one of the countershaft pulleys extends through the hollow arm of the main frame to connect with a pulley mounted on the saw arbor in place of the motor. June, 1921, MACHINERY contained a description of a table designed especially for use with a saw of the type described in this article, this table also being manufactured by the Oliver Machinery Co.

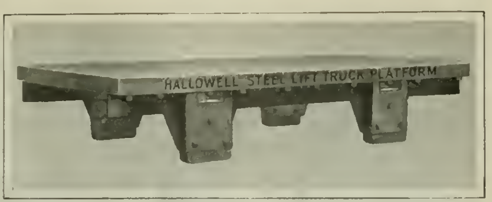


No. 36 Swing Cut-off Saw made in Motor- and Belt-driven Types by the Oliver Machinery Co.

MILLERSBURG HELICAL-FLUTE EXPANSION HAND REAMER

The helical-flute expansion hand reamer here illustrated has recently been placed on the market by the Millersburg Reamer & Tool Co., Millersburg, Pa. The cutting action of the teeth is said to be such that chatter is eliminated, and smooth and accurately sized holes are produced. A patent covering the construction of this expansion hand reamer has been applied for. It is made in various sizes.


Helical-flute Expansion Hand Reamer made by the Millersburg Reamer & Tool Co.



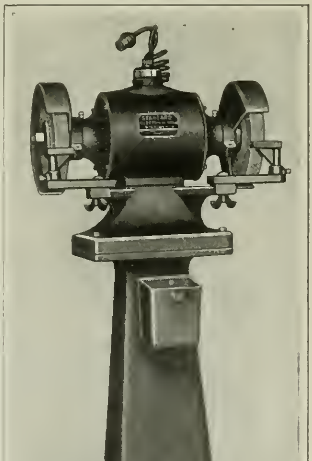
Steel-and-Wood Lift-truck Platform made by the Standard Pressed Steel Co.

"HALLOWELL" LIFT-TRUCK PLATFORM

A platform which may be adapted for use with either hand or power lift trucks is now being manufactured by the Standard Pressed Steel Co., Jenkintown, Pa., as shown in the accompanying illustration. The platform consists of wooden planks to the bottom of which are bolted two steel skids. Riveted to these skids are four steel brackets in each of which a wooden leg-block is bolted to support the entire platform. These blocks can be replaced as they become worn, and are made in different heights so that the clear height of a platform may be changed to suit the truck with which it is employed. An important feature of the skids is that they flare in an outward direction at each end, thus enabling a truck to be readily slid between them. There are also no projecting rivet- or bolt-heads or nuts that might come in contact with the truck.

BENCH AND FLOOR TYPE ELECTRIC GRINDER

A ½-horsepower alternating-current electric grinder of an improved type is now being manufactured by the Standard Electric Tool Co., Cincinnati, Ohio, in a bench style which may also be provided with a pedestal as illustrated. The grinder is fitted with double-row ball bearings and a Westinghouse motor suitable for operation on either 110- or 220-volt, single-, two-, or three-phase alternating current. The grinding wheels are 8 inches in diameter, ¾ inch in face width, and have a ⅝-inch hole. They are extended well away from the body of the motor to permit the grinding of comparatively long and irregular castings or bars. One coarse and one fine wheel are regularly furnished, the former being intended for castings and rough work, and the latter for tools and fine work. A quick make-and-break switch is located on top of the motor, in which position it is within easy reach of the operator. Ten feet of reinforced cord fitted with a plug is regularly furnished. The net weight of the grinder without a floor pedestal is about 110 pounds, and with a pedestal 225 pounds.


Grinder built by the Standard Electric Tool Co.

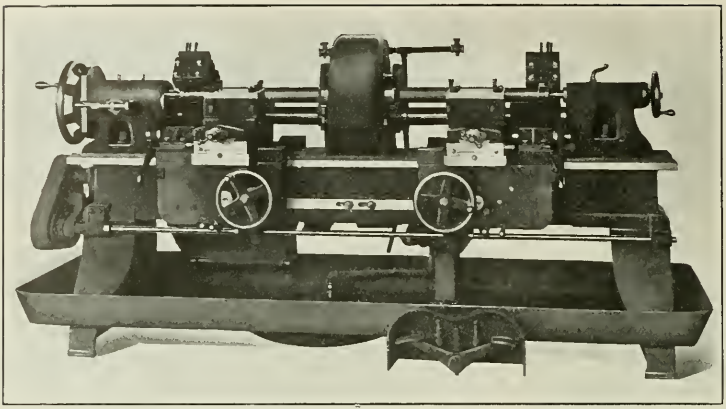


Fig. 1. Short-head Center-drive Lathe of an Improved Type built by the Reed-Prentice Co.

REED-PRENTICE CENTER-DRIVE LATHE

A lathe driven at the center, which was designed by the Reed-Prentice Co., 677 Cambridge St., Worcester, Mass., for turning both ends of Ford automobile driving shafts was described in an article published in May, 1918, MACHINERY. Another machine in which the same driving principle is employed has recently been built by this concern as shown in the accompanying illustrations. However, a considerable number of changes have been made in the general design. This class of machine has proved useful for turning both ends of axles and similar parts, the one limitation on such work being that the part to be machined cannot be turned at the middle portion, because it is held in the headstock at that point.

The headstock is equipped with two chucks, one at each end of the spindle, which are generally of the floating type. These position themselves relative to the outside diameter of the work when the jaws are tightened, at which time the chucks are securely clamped against shoulders on the spindle. By means of this construction the work is held rigidly, is positively driven, and maintains its natural position without deflection. In cases where the work is particularly short, one chuck is omitted to permit the carriages to come closer to the headstock.

The spindle is made of cast iron, has a large hole running its entire length, and rotates in cast-iron journals. It is driven by a motor of at least 7½ horsepower, which is mounted at the rear of the bed as shown in Fig. 2, and drives direct through a silent chain to a sprocket gear on the spindle. The driving mechanism is controlled by a foot-treadle at the front of the machine by means of which a clutch is actuated to engage or disengage the gearing to the headstock without stopping or starting the motor.

The left-hand tailstock has an extra large spindle with two holes running through its entire length, one of these holes being for the purpose of carrying a standard center, while the other is a clearance hole through which the work is telescoped in loading and unloading the machine. By withdrawing the index-plunger at the front of this tailstock, its spindle may be revolved to bring the clearance hole into proper alignment with the hole in the headstock spindle, after which work may be entered or withdrawn from the headstock. When work has been placed on the machine, the index-plunger is again released and the spindle rotated to bring the center once more into proper position for supporting the left end of the work. The withdrawal of the index-plunger is effected through the rotation of a large handwheel, there being a certain angle of free rotation during which a cam surface on the hub of the handwheel causes the plunger to be withdrawn. Then by continuing to rotate the handwheel the plunger picks up the motion and finally brings the center or the clearance hole into alignment with the headstock spindle.

There is no endwise adjustment for the spindle of the left-hand tailstock; however, the spindle of the right-hand tailstock may be moved longitudinally, the latter being similar to the standard type used on engine lathes. Either tailstock may be unclamped from the bed and moved along this member to the proper position to suit longer or shorter work than that for which the machine may be set.

The carriages have their bridges set off center to permit them to work close to the headstock, and their blocks are arranged to receive special magazine tool-holders. Each carriage is provided with an eccentric link motion, by means of which the operator feeds the tools to predetermined positions, at which points they are automatically locked. The longitudinal feed of the carriages is then engaged, and after turning the work to the desired length, a tripping mechanism automatically releases the link and cam actions, causing the tools to recede from the work so that they do not score the latter when they are returned to their starting positions. Each carriage has an individual automatic feed-trip, although they are both driven by a single set of feed gearing at the left-hand end of the machine. Both carriages feed simultaneously toward the headstock. On the particular machine illustrated, a back-arm attachment has been supplied for each carriage, so that the squaring of shoulders as well as the grooving of shaft ends can be performed simultaneously with the turning operation.

Several set-ups possible with this machine are as follows: (1) The machine may be arranged with front tool-blocks for diameter turning and rear blocks for shoulder and taper

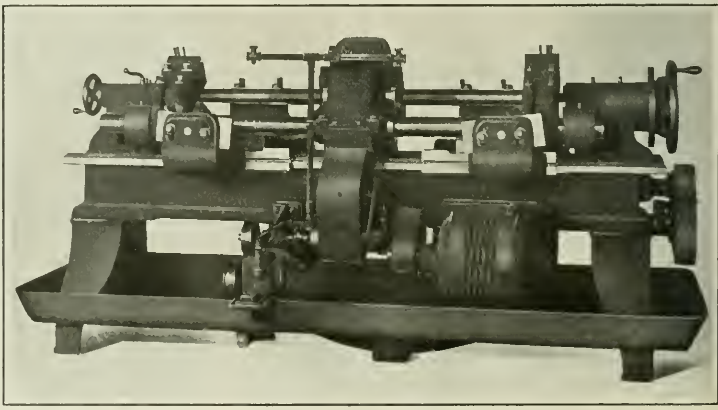
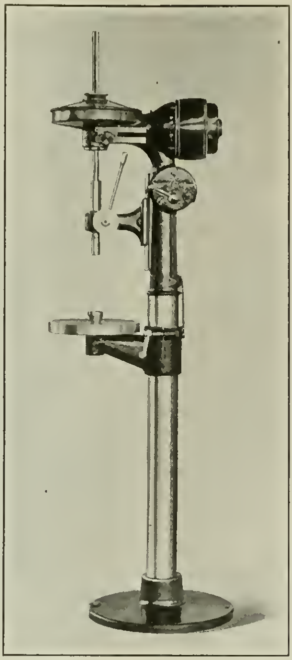


Fig. 2. Rear View of the Machine illustrated in Fig. 1 which is employed for turning the Ends of Shafts, Axles, etc.

turning, the rear blocks being brought into position by hand after the diameter turning has been accomplished; (2) front tool-blocks may be supplied for diameter turning, and a back arm for use in shouldering, necking, chamfering or grooving simultaneously with the turning step; (3) auxiliary hand-operated tool-blocks may be introduced at the rear for shaving fillets or chamfering corners. On a machine designed for turning shafts up to 2⅞ inches in diameter and having a 9-foot bed, the maximum distance between centers is 72 inches.

LOUISVILLE SENSITIVE DRILLING MACHINE

A 12-inch sensitive drilling machine equipped with friction drive to which power is transmitted by a motor built into the top of a column is a recent product of the Louisville Electric Mfg. Co., Louisville, Ky., which is here illustrated. The motor rotor and the friction disk are mounted on ball bearings. The frictional pressure of the drive is governed by the weight of the disk, thus being constant and requiring no adjustment. The friction drive members are completely enclosed and so constructed that their frictional surfaces are kept free from oil. The spindle is counterbalanced by means of a spring, and its speed can be easily adjusted from 450 to 1200 revolutions per minute. The table is also counterbalanced by a weight within the column. The motor can be furnished for all circuits. Its controlling switch is also built into the machine.



Twelve-inch Motor-driven Sensitive Drilling Machine produced by the Louisville Electric Mfg. Co.

This drilling machine is made in both bench and floor types and supplied with V-blocks and cup and point centers. Some of its main dimensions are as follows: Greatest distance from table to nose of spindle, 39 inches; vertical adjustment of table, 32 inches; vertical adjustment of spindle arm, 8 inches; maximum height with spindle raised, 76 inches; diameter of spindle in sleeve, 13/16 inch; and diameter of table, 11½ inches. The spindle socket is a No. 3 Morse taper. The motor runs at a speed of 1725 revolutions per minute, and has a rating of ½ horsepower.

PRATT & WHITNEY GAGES

A set of automobile engine spark-plug thread gages made to S. A. E. standard limits and consisting of a double-end limit thread plug gage of the "Trilock" reversible-end type, a "Go" and "Not Go" templet gage, and a setting plug gage for the templet which has two threaded plug members and one plain plug for checking its root diameter is illustrated in Fig. 1. This gage set is now being introduced to the trade by the Pratt & Whitney Co., Hartford, Conn. The pitch diameters of the thread plugs are 0.841 and 0.843 inch, respectively, the tolerance for tapped holes being 0.002 inch. The templet pitch diameters are 0.836 and 0.839 inch, respectively, giving a 0.003-inch tolerance on the spark-plug body threads and a neutral zone of 0.002 inch between a maximum size plug and a minimum size hole.

The templet is of an improved type having a taper screw permitting fine adjustment of the pitch diameter. The "Go" and "Not Go" holes are located close together for convenience in placing on work and in handling. The "Go" side of the templet is cut away to permit a quick identification when using the gage in rapid inspection.

September, 1921, MACHINERY contained an illustrated description of a line of plain and thread plug gages made by the Pratt & Whitney Co., which had reversible ends held securely to the handle by means of three prongs on this member and corresponding grooves on the gage ends. The plain style was made in sizes from 5/16 to 2 inches. Fig. 2 of the present article shows a plain plug gage of similar type but which is made in sizes of 2½ inches and larger. As will be seen in the broken detail, the gage ends consist of a hollow ring into which two disks are forced on tapered surfaces before grinding. These disks hold a central tube, and the entire end is secured to the handle by means of a washer and a machine screw. Three prongs on the handle are forced into corresponding grooves in the bushing to provide the three-point self-centering support embodied in the design of the gages referred to in the previous article. The "Trus-

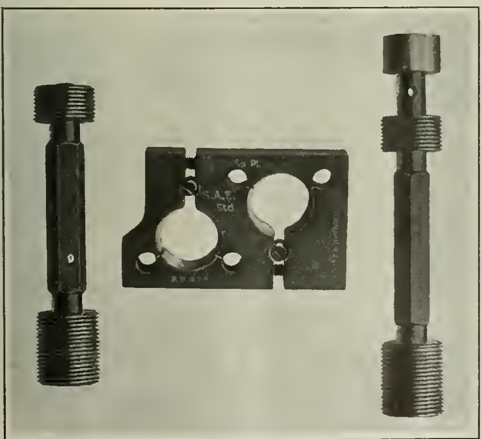


Fig. 1. Automobile Engine Spark-plug Thread Gage Set made by the Pratt & Whitney Co.

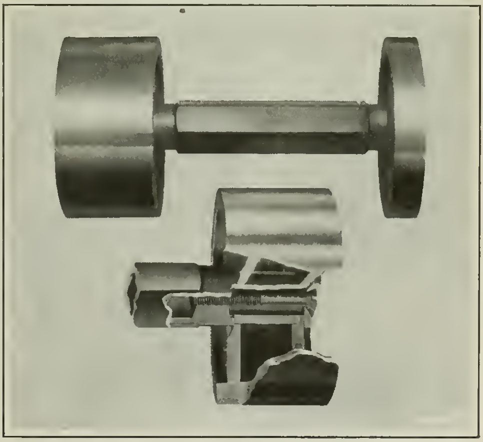


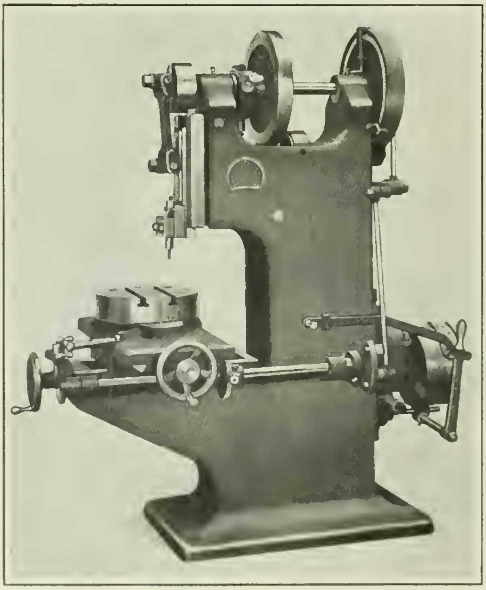
Fig. 2. Hollow- and Reversible-end Plain Plug Gage made in 2½-inch and Larger Sizes

form" adjustable-limit snap gages also manufactured by the Pratt & Whitney Company were described in July, 1921, MACHINERY. These gages were constructed along the general lines of a roof truss and had round-head anvils. They may now be obtained with square-head anvils which are interchangeable with the round-head type.

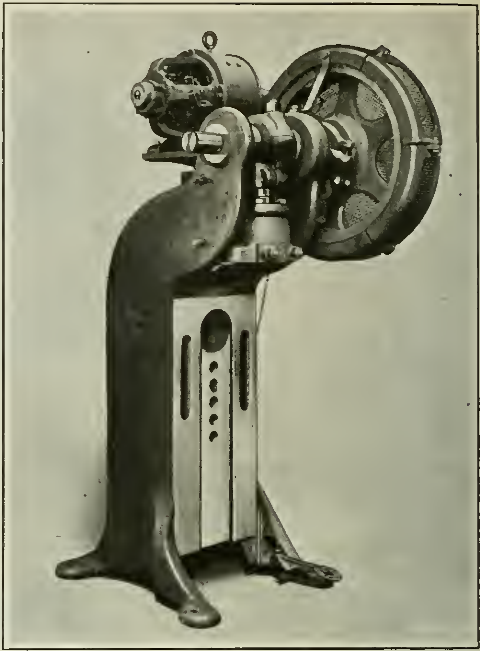
PETERS-BOSSERT DIE-SLOTTING MACHINE

A vertical slotting machine designed especially for machining round, square, and irregular shaped punches and dies has been recently developed by the Peters-Bossert Co., 617-619 E. Pearl St., Cincinnati, Ohio. As will be noted in the illustration, the ram is driven by a crank connected at the upper end to a crankpin on the main shaft at the top of the machine. This crankpin is adjustable so that any length of stroke up to 4 inches may be obtained. The member on which the ram slides, and to which it is gibbed, is hinged at the upper end in such a manner that it can be set at a slight angle relative to the face of the column in order to produce a clearance in die openings. The crank-arm at the lower end is attached to a pin located in a slot in the ram, the position of this pin being adjustable in order that the location of the ram path may be altered to suit the work in hand.

The lower end of the member on which the ram slides may be connected by the manipulation of a pull-pin to a toggle-joint mechanism operated by an eccentric on the main shaft. When connected, this mechanism moves the ram over a curved path on the down stroke, thus enabling curved cuts to be taken in dies. The mechanism also causes the tools to clear the cut on the up stroke, the amount of clearance being adjustable to suit requirements. When the toggle-joint mechanism is disconnected, the machine is set for taking straight cuts. Cross, longitudinal, and circular hand feeds of the work are each obtained through separate screws, but the machine can also be furnished with power feeds when these are desirable. A variable-speed gear-box mounted inside the column furnishes three changes of speed, which may be secured by shifting a lever on the outside of the column. The machine is supplied with tight and loose pulleys.



Vertical Die-slotting Machine built by the Peters-Bossert Co.



Special Horning Press built by the Ferracute Machine Co.

FERRACUTE MOTOR-DRIVEN HORNING PRESS

The Ferracute Machine Co., Bridgeton, N. J., has recently produced the special horning press illustrated herewith, which is driven by a motor mounted on a bracket bolted to the frame. The motor drives the press through a rawhide pinion which meshes with teeth cut around the flywheel. This method of driving is especially advantageous, as it is out of the way and economical as regards space. The flywheel is entirely surrounded by a guard, and, in addition, has wire mesh cast between its spokes so as to prevent any possibility of accidents when the press is in motion.

The hole provided in the frame for the horn is 7½ inches in diameter and located 43 inches above the floor. This is unusually high, but the press is intended for special work. The horizontal distance from the center of the ram to the planed surface on the front of the frame is 11 inches. Guides are machined on the planed front to enable an adjustable bed to be attached at different heights from the floor and square with the bottom of the ram. The connections are made by means of large bolts and dowels in a manner that insures parallelism between the bed and ram surfaces. The wide variation in the distance between the bed and the ram, together with the facilities for horning and the unusual height of the press, provide for a greater latitude of work than is customary with machines of this class. Presses of this design are also made in four other sizes.

HARRIS IMPROVED AUTOMATIC HOB GRINDING MACHINE

A few years ago a No. 815M motor-driven automatic hob grinding machine developed by the H. E. Harris Engineering Co., Bridgeport, Conn., was described in the technical press. A number of improvements have now been incorporated in the design of this machine, the more important of which will be enumerated in the following. The improved style is about 20 per cent heavier than the older machine, and

Hob Grinding Machine redesigned by the H. E. Harris Engineering Co.

the motor drive for the reciprocating parts is mounted on an integral bracket at the back of the machine instead of being placed on the floor as formerly. This new arrangement makes the machine self-contained. The maximum helix angle to which an 8-inch diameter hob can be ground has been increased to 47 degrees, in both right- and left-hand hobs.

In the old design, a sliding block was used to transmit the spiral action from an adjustable angular slide-way at the back of the machine, but ball bearings are now employed for this purpose. Heavy bronze bushings of oil-well construction, with a positive adjustment for wear are now supplied for the wheel-spindle. The overhang of the table from the bed of the machine at the end of its stroke has been decreased, the column is made heavier at the back, and the slides are longer. The overhang of the wheel has also been reduced to insure rigidity. The index-head is provided with larger bearings and has been redesigned so that, except for the heaviest hobs, it is unnecessary to support the outer end of the work-arbor by means of the tail-stock center. This possibility saves considerable time in changing from one hob to another.

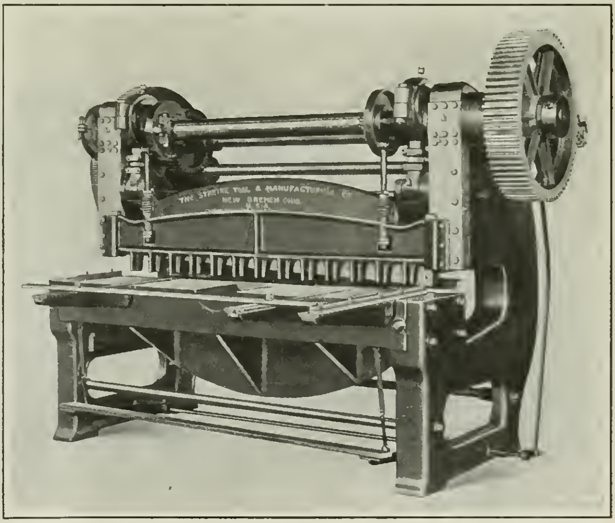
The arrangement for wet grinding has also been changed, larger valves and pipes and a deeper pan now being supplied so that about double the amount of the coolant can be used. The machine can be quickly set not only for radially grinding the faces of hob teeth but also to compensate for wear of the wheel. An adjustment provides for grinding hobs under-cut or with "hook" or top rake for the teeth. An improvement made in the arrangement of the control members enables all adjustments to be made by the operator while in position at the front of the machine. The majority of these adjustments can be made while the machine is running. The diamond truing device is now built into the head instead of being located on the work-table. The latter is driven by a clutch and gear mechanism connecting to a pinion meshing with a rack. Stops on the front of the table permit adjustments to suit the grinding of hobs of any length within the capacity of the machine.

STREINE GAP SHEAR

A newly designed shear having a gap in the housings which facilitates the splitting of long plates has been added to the line of shearing machinery built by the Streine Tool & Mfg. Co., New Bremen, Ohio. The illustration shows a 6-foot machine, but the same design is built in other lengths. It has a capacity for cutting annealed steel up to 3/8 inch in thickness. One of the features to which attention is particularly directed is the design of the cutter-bar, or, as it is commonly called, the cross-head. This cutter-bar is of double- and cross-ribbed box construction, and provided with long bearings fitted into the slides of the housings by means of adjustable hand-scraped taper gibs.

This construction obviates the necessity of providing a truss rod or some other similar device to keep the cutter-bar from springing or deflecting under strains. The long bearings by which the cutter-bar is attached to the housings, as previously mentioned, prevent the bar from tilting while cutting, and so enable sheets to be cut with a clean smooth edge. The cutter-bar is connected to the eccentrics by means of adjustable links; with this construction the shear knives may be set, by raising or lowering the cutter-bar, either to split long stock or to do plain shearing to the full length of the knives.

The eccentrics are double-keyed and shrunk on the eccentric shaft. The bearings of this shaft are split and can be readily adjusted or replaced. All shafts are of large diameter and all gears machine cut, the gears being made of semi-steel castings and the pinions of steel forgings. The clutch is also made of forged steel and fitted with a tool-steel clutch pin and finger. The hold-down or clamp is automatically operated and equipped with compensating springs to take care of unevenness of variation in the thickness of metal to be sheared. The bed of the machine can be adjusted to suit the requirements of the work.



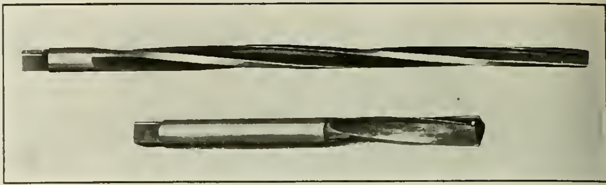
One of a New Line of Gap Shears manufactured by the Streine Tool & Mfg. Co.

A full set of front, side, and back gages is furnished, the back gage being of the parallel-screw and miter-gear operated type which is manipulated through a crank handle. The miter shaft is made in two pieces joined by means of a sleeve. This sleeve can be loosened and the gage set parallel with the blades or otherwise in a minimum amount of time. Parallel graduations in sixteenths of an inch are marked from the edge of the shear blades to the ends of the front gage supports to enable the operator to set the gages quickly and accurately. This shear can also be arranged with a motor drive and equipped with a long squaring arm. Some of the specifications of the size illustrated are as follows: Length of shear blades, 74 inches; size of flywheel pulley, 42 by 7 inches; speed of flywheel pulley, 280 revolutions per minute; strokes of cutter-bar, 18 per minute; and ratio of gearing, 16 to 1.

BICKFORD-SWITZER HELICAL-FLUTED REAMERS

The Bickford-Switzer Co., 50 Norwood St., Greenfield, Mass., is now manufacturing a line of "Cutwell" reamers, two of which are here illustrated. The taper pin reamer at the top of the illustration has three right-hand helical flutes on which the cutting lands are rugged and the hook or undercut generous. Two of the lands are relieved right up to the cutting edge, while the third land is relieved for only about two-thirds of its width, the remainder being a circular section which steadies the reamer and prevents the right-hand spirals and under-cuts from drawing the tool into the work. This reamer seems to work at its best in a drilling machine. and when used for cutting steel, the chips look like steel wool.

The principal claims made for this reamer are that it will not draw into the work, does not chatter, cuts similarly to a drill, and works best when used under power. The same principle of design has been applied to a chucking or hand reamer for straight holes, one of which is shown in the lower part of the illustration. In this case the reamer is made with three equally spaced and fully relieved cutting lands, and midway between two of these is a narrow and unrelieved land which steadies the reamer and keeps it from being drawn into the hole or chattering. It also serves, in connection with one of the cutting edges, to furnish a place for conveniently measuring the reamer diameter.



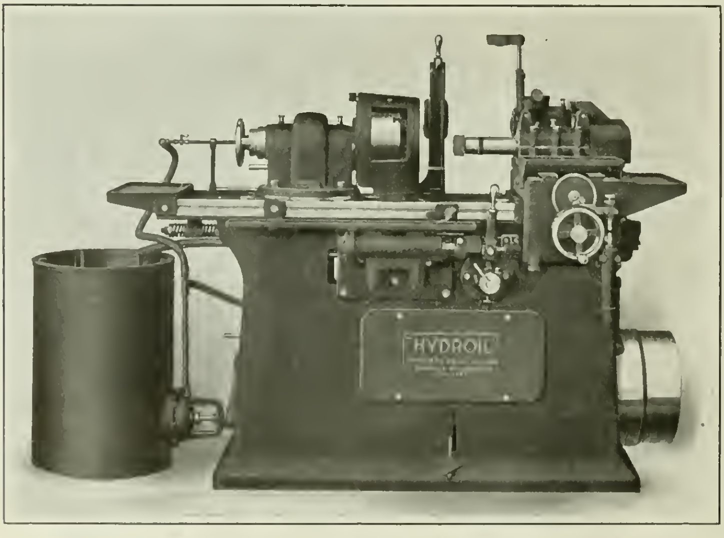
Two "Cutwell" Reamers made by the Bickford-Switzer Co.

GREENFIELD "HYDROIL" INTERNAL GRINDING MACHINE

A new internal grinding machine known as the "Hydroil" has been brought out by the Greenfield Tap & Die Corporation, Greenfield, Mass. The design of this machine is based on the principle of high traverse speeds. The wheel-spindle is carried on a slide controlled by a feed-screw which is calibrated for feed increments of 0.004 inch on the bore diameter of the work. The work-table reciprocates on ways located at right angles to the wheel-slide ways and carries a head for holding and rotating the work. The speed of the table traverse is controlled through a highly sensitive throttle valve, which admits oil under low pressure to a distributing valve controlled by table limit stops. From the distributing valve, oil is conveyed to either end of a double-acting cylinder-and-piston mechanism attached to a cross-head on the under side of the table. By the application of the hydraulic principle a flexibility of table control can be obtained which it is impossible to secure by mechanical means. The regular machine has a maximum speed of 50 feet per minute, although special designs provide for faster operation.

With the "Hydroil" control there are no definite stations of speed setting, and so minute differences of speed may be obtained without difficulty. The valve and piston designs provide for reversal of the table without shock, and the element of time involved in accomplishing a reversal is so small that on a ½-inch stroke the table will reverse 320 times per minute. A pressure-relief valve permits the table to stop without damage when overloaded. This feature also allows accurate positioning of the table for grinding against shoulders. A screw-adjusted stop is employed to locate the table, after which this member is held in place under oil pressure. By a combined use of reversing and locating stops, the table can be held to within limits of 0.0005 inch on reversal, without any sacrifice in the operating speed.

All table motions are controlled by a single lever. By pulling this lever toward the operator, the table is run back from the operating position. Another movement of the lever brings the table up to the operating position, where it automatically reciprocates between the working limit stops. A foot-treadle is employed to start and stop rotation of the work. The work revolves toward the operator at the top, the wheel turning in the opposite direction.



Internal Grinding Machine developed by the Greenfield Tap & Die Corporation, on which the Table Traverse Speeds are controlled by a Hydraulic Arrangement

The truing diamond contacts on the back of the wheel and so throws the dust downward. The fixture of the diamond-holder swings out of the way, but it may be quickly located in the truing position. Water is supplied for cooling the diamond.

The spindle bearing pressures are in the same direction whether the wheel is grinding or running free. The spindles provided on the standard machine are mounted in ball bearings so installed that a thrust adjustment eliminates vibration. Where an exceptional mirror finish is desired, the production rates are sacrificed to some extent, and special types of spindles are furnished. However, high operating speeds may be employed to advantage even in this class of work. The machine is especially suitable for removing stock rapidly in roughing operations. With holes three inches or more in diameter, at least one cubic inch of hardened steel can be removed per minute.

A special type of work-head is provided for large bearing races having straight holes. This head chucks several races end-to-end and holds them between a plunger operated by oil pressure and a mechanism similar to a camera shutter. The plunger ejects the load at the completion of an operation. By the use of loading pots this fixture may also be employed in grinding piston-rings and similar parts, a machine equipped in this manner having a capacity for grinding about 25,000 piston-rings per ten-hour day.

PRATT & WHITNEY HELICAL-FLUTED EXPANSION REAMER

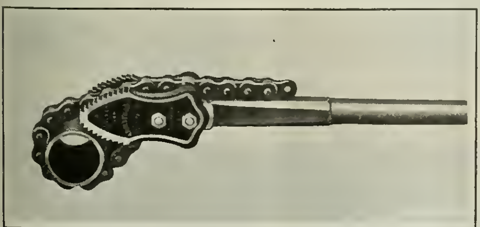
A recent addition to the line of small tools manufactured by the Pratt & Whitney Co., Hartford, Conn., is the helical-fluted expansion hand reamer here illustrated. Its adjustable feature enables one size to cover a range of diameters,

Hand Reamer of the Helical-flute Expansion Type made by the Pratt & Whitney Co.

it being possible to ream over- or under-size holes after making a simple adjustment. The reamer is equipped with a lock-nut to hold it to an adjusted size, and a safety stop which prevents over-expansion and indicates positively when the maximum limit is reached. The reamer is made in all regular sizes.

ARMSTRONG CHAIN PIPE WRENCH

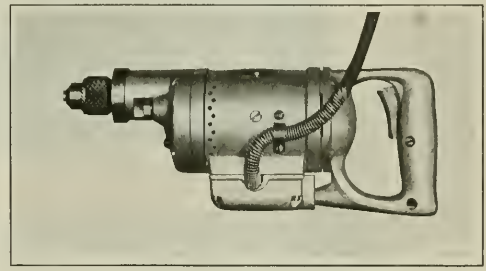
A chain pipe wrench having two drop-forged jaws and a length of either flat-link or cable chain is now being manufactured in seven sizes for pipes ranging from ⅛ to 16 inches, by the Armstrong Bros. Tool Co., 313 N. Francisco Ave., Chicago, Ill. The wrench shown in the illustration is provided with a flat-link chain. Through the use of hardened chrome-nickel steel bolts, the jaws are held solidly in place, the rear bolt being located directly under the chain socket where the strains tending to spread the jaws are most severe. Chain guides are provided on the jaws to protect the finished end of the bar from wear due to the action of the chain and to make the adjustment of the chain convenient. The handle is forged from high-carbon steel.



Flat-link Chain Pipe Wrench made by the Armstrong Bros. Tool Co.

"WILLEY" PORTABLE ELECTRIC DRILL

Under the trade name of "Willey" the James Clark, Jr., Electric Co., Inc., 522 W. Main St., Louisville, Ky., is placing on the market a portable electric drill made in 3/16-, ¼-, and 5/16-inch sizes, weighing 6½, 7 and 7¾ pounds, respectively.

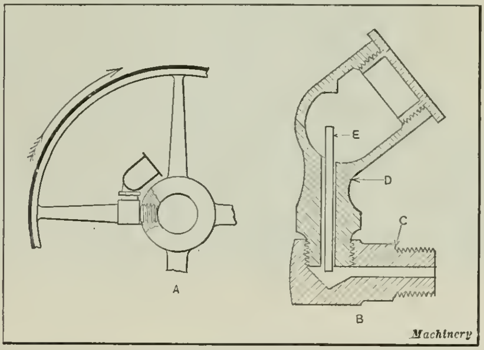


Portable Electric Drill made by the James Clark, Jr., Electric Co., Inc.

The drill is constructed of three units, consisting of the motor body, the drill spindle and gears, and the handle. The latter is provided with a mechanism for controlling the motor switch, which is actuated by the fingers of the operator in grasping the handle. By this arrangement the drill automatically stops rotating when hand pressure is released from the switch mechanism. All electrical connections and attachments are contained in the motor body. The tool is designed for use with high-speed drills only when drilling in steel or iron, it being intended that carbon-steel drills be used for the softer metals and wood.

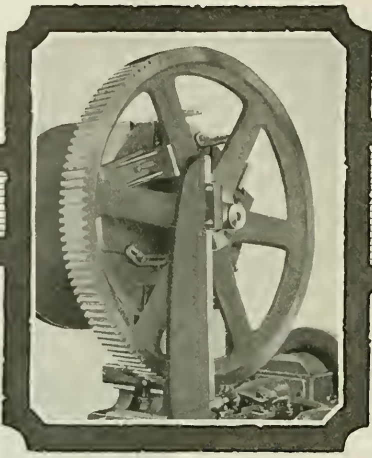
KAY LOOSE-PULLEY OIL-CUP

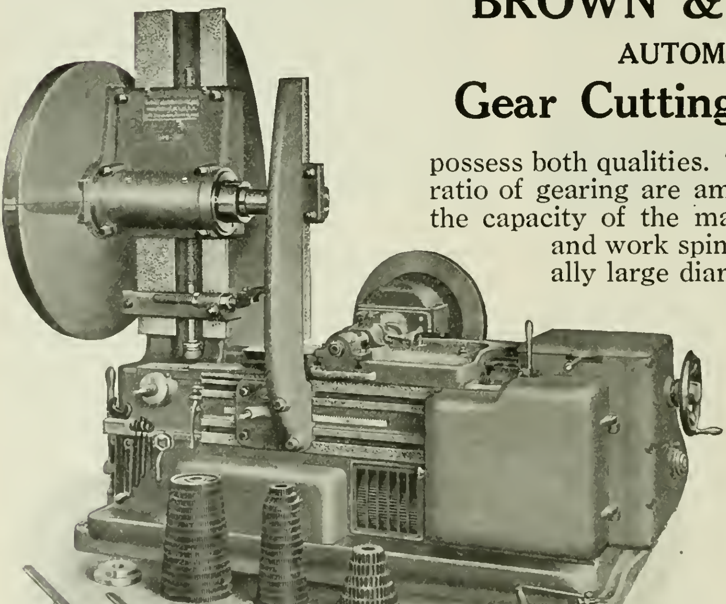
To accomplish the efficient and economical oiling of loose pulleys, Charles Kay, 5073 Burns Ave., Detroit, Mich., has brought out an oil-cup which is said to keep the pulley shaft well oiled while the pulley is revolving and does not allow the oil to empty from the cup and leak along the bearings when the pulley is stationary and the oil-cup is above the shaft center.



Loose-pulley Oil-cup manufactured by Charles Kay

The method of mounting the oil-cup on the hub of the pulley is shown at *A*, while the detail at *B* clearly illustrates the construction of the cup. The fitting *C*,



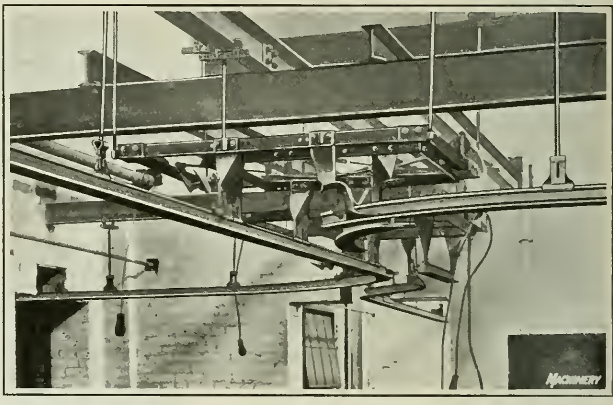


which has a hole drilled along its center line, is screwed into a hole that is tapped in the hub of the pulley, and the shank of oil-cup *D* is screwed into a tapped hole in fitting *C*. It will be seen that the hollow portion of the cup is at an angle to the shank, and that a sliding pin *E* is placed in a passageway through the shank. This pin has a movement in the passageway that is limited at one end by the pin striking against a lug on the wall of the cup, and at the other end by the pin coming in contact with fitting *C*. The pin is only moved when the pulley is started or stopped, serving to keep the passageway unobstructed and to regulate the flow of oil.

CLEVELAND TRAMRAIL OVERHEAD CARRYING SYSTEM

To reduce the time required for moving work from machine to machine and about the shop, the Cleveland Crane & Engineering Co., Wickliffe, Ohio, has developed a tramrail overhead carrying system in which the carrier may be operated by hand or electric power and the rail of which can be bent to a 4-foot radius so that practically all machines or locations in a shop can be reached. The rails are made of a special analysis high-carbon steel which can be bent cold on the job and are of a light section. The fittings employed in connection with the rail have been standardized to meet any requirements likely to be met with in wooden, structural or concrete buildings, and to permit the rail to be erected by the workmen of the plant in which an installation is made.

With the sliding switches furnished with this system, it is impossible for a carrier to run off the rail at an open switch, because of the provision of a safety stop which drops on the rail. The switches are locked in the closed position to prevent a carrier and its load from sliding the switch out of position. An additional safety feature can be added to make it impossible for an electrically driven carrier to run at full speed against a safety stop. This involves the use of trolley insulators which provide a dead section of the trolley wire that is energized only when the switch is in position to receive a carrier. Electrically driven carriers have ample power to carry a full load up a 12½ per cent grade.



Tramrail Carrying System developed by the Cleveland Crane & Engineering Co.

NEW MACHINERY AND TOOLS NOTES

Surface Grinding Machine: Badger Tool Co., Beloit, Wis. A surface grinding machine of the vertical-spindle type, which is equipped with a steel disk wheel, 42 inches in diameter, faced with a special abrasive compound, ½ inch thick. The machine is direct motor-driven, the shaft of the motor serving as the spindle of the machine. This machine is particularly adapted for grinding such parts as large tractor transmission cases and covers.

Spindle-type Grinding and Sanding Machine: Wonder Grinder Co., 612 W. 12th St., Erie, Pa. An internal grinding and sanding machine applicable to both wood and metal parts. The work-holding table is circular and can be tilted 45 degrees either side of the horizontal. It is automatically locked in position at right angles to the spindle. The spindle or roll for carrying the abrasive is mounted on a vertical shaft and driven directly from a vertical motor mounted in the base.

Hydraulic Forcing Press: Watson-Stillman Co., 192 Fulton St., New York City. A hydraulic press intended especially for forcing, pressing, and bending operations in railroad and large machine shops. The press is of the reversed cylinder type. The pump is employed only to actually apply the pressure, a handwheel being used to quickly bring the ram to and from the work. The pressure in pounds per square inch on the ram and also the total pressure in tons are indicated on a gage.

Burners, Furnaces, and Forges: Chicago Flexible Shaft Co., 1154 S. Central Ave., Chicago, Ill. A line of burners, furnaces, and forges for general shop use, including high-pressure, high- and low-pressure, and intermediate-pressure burners; a portable oil-burning rivet forge which employs compressed air for atomization; an oil-fired furnace designed for use in tempering punches, dies, tools, and knives; a crucible furnace employing either gas or oil as fuel and intended for use in lead or cyanide hardening, soft metal-melting, tinning baths, and galvanizing; a forge for use in welding and miscellaneous forging work; and a furnace for handling large forging work.

* * *

NEW BOOK ON PRODUCTION MILLING

PRODUCTION MILLING. By Edward K. Hammond. 278 pages, 6 by 9 inches; 177 illustrations. Published by THE INDUSTRIAL PRESS, 140-148 Lafayette St., New York City. Price, $3.

Recent years have witnessed the introduction of many improved methods of performing milling operations. On production work, where high rates of output are essential, the aim has been to reduce the non-productive time of the men and machines in the milling department. In the preparation of this treatise, attention has been given to methods of milling and the design of fixtures that will enable repetition operations to be performed economically. Information and illustrations relating to the latest developments in production milling practice have been gathered by personal studies of the methods used in many of the most progressive manufacturing plants; and acknowledgement is made to the large number of factory executives who have cooperated in this work. All the methods described have been successfully used under actual shop conditions.

It has been assumed that the readers of this book are familiar with the various types of production milling machines. Hence, only brief descriptions of the essential features of each type of machine have been included. It is the purpose of this book to explain the application of some of the more efficient methods of operating milling machines on repetition work, rather than to discuss milling machine design. In connection with the examples of machining operations performed on the various types of milling machines, information is included covering the speed and feed at which each operation is performed and the rate of production that is obtained. These data should prove of value to other manufacturers handling similar work. No attempt has been made to deal with work-holding fixture design, beyond explaining certain fundamental principles which must be observed in order to keep the ratio between the "loading time" and the "cutting time" down to a point where satisfactory rates of output can be secured.

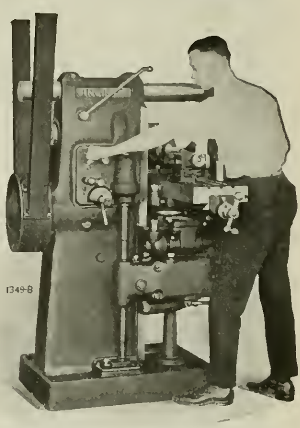
Who would expect it of a Universal?

The Cincinnati 1M and 2M Universals will take the same heavy cuts with the same quiet ease as the 1M and 2M Plains.

But more important is the story of the picture below. The toolmaker easily reaches the starting lever. The feed changes are at his finger tips. Feed changes are made while running. The feed trip is arranged to permit engagement of the feed forward or reverse without running off the dogs by hand. All controlled without leaving his seat.

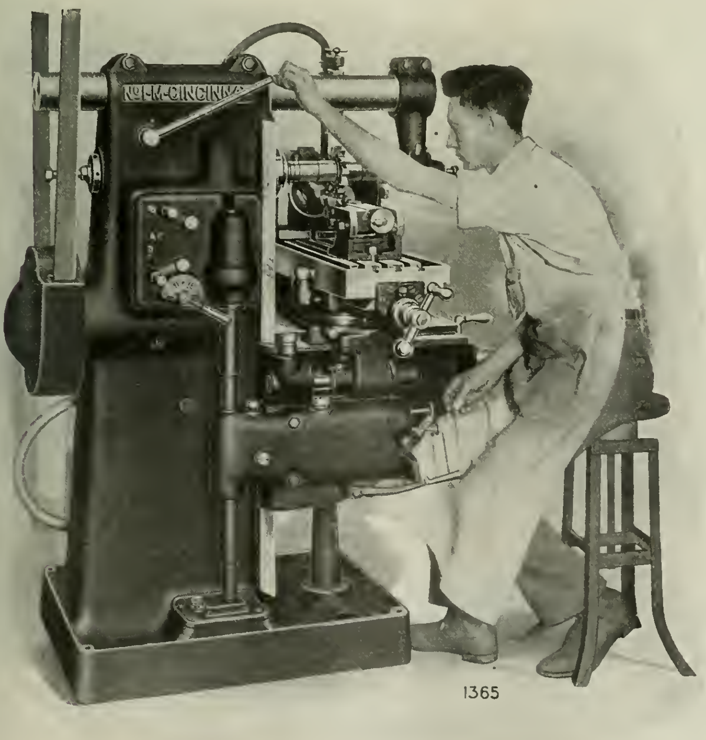
Do you know of any other Universal Miller that is so handy?

These are only a few of the good things in the Cincinnati. The catalog tells about all of them. Shall we send it?



The speed change levers can be reached from the operator's usual position. The belt is guarded 6 feet above floor. This meets the usual factory safety requirements.

Cincinnati 1M and 2M Universals



The Cincinnati Milling Machine Company
Cincinnati, Ohio
U. S. A.

The British Machine Tool Industry

From MACHINERY'S Special Correspondent

London, January 12

THE present outlook in the machine tool trade is encouraging. An effective stabilizing influence is the withdrawal of the 12½ per cent bonuses, effective January 1, which was referred to in the December article, as selling prices can now be calculated on a definite wage basis.

Demand for Machine Tools

There is a fair demand for certain classes of machine tools, for example, planers, punching and shearing machines, and three-operation automatics, and a few orders are being received from industries that have not been in the market for many months. Firms who make a specialty of tooling equipment and manufacturers of small tools report a slight improvement in the market, although naturally the actual amount of business is much below full capacity.

The continued disposal of surplus government stocks at prices that often are actually less than scrap value has led the Machine Tool Trades Association to send a committee to the Disposals Board with certain proposals, among which is the suggestion that the Government hold its stocks until any small demand there may be at the present time has been satisfied direct from the maker to the user and more normal conditions obtain. It is believed that there is some prospect that these proposals will be put into effect.

Conditions in the Automobile Industry

The automobile exhibition held at Olympia was of considerable importance from many points of view, as not only were the first real post-war designs in evidence, but the amount of business done came as a surprise to everyone. There are instances of makers whose whole output for 1922 has been spoken for. One large manufacturer is said to have disposed of cars to the value of over three million pounds, and it is anticipated that this particular firm will produce over ten thousand cars during the present year. The automobile manufacturers are beginning to take on additional help, and there is contemplation of an increase in the number of working hours.

As the automobile factories have represented, in the past, an average of as much as 50 per cent of the domestic trade of the machine tool maker, this revival of the automobile industry is of considerable importance. Automobile works are generally well equipped with machinery, but there are instances in which new equipment will be required to complete work started at the beginning of the general trade depression, but which has been held up until conditions should improve. Both Colonial and Continental markets are displaying great interest in buying, and inquiries have been received for machine tools and accessories, particularly from Australia and Czecho-Slovakia.

Iron and Steel Trade

In the iron and steel trades, British makers continue to receive their full share of orders. Costs are being reduced and a general expansion of business is hoped for. In all but a few instances British iron and steel makers are now offering their products at prices which successfully meet foreign competition, and substantial orders have been the result of this reduction in prices. British iron and steel makers are also finding it easier to obtain orders in the home market, although most buyers still find it necessary to limit their orders strictly to those called for by immediate needs. A feature of the general situation, which is basic to recovery in the machine-building trades, is the gradual improvement of the British output in pig iron. At the end of October there were eighty-two blast furnaces in operation, as compared with sixty-eight at the end of September. While Continental competition is still being experienced, the situation shows signs of improving, especially in view of the slight fall in transportation rates and fuel prices.

Whatever the ultimate advantage gained by the withdrawal of the orders for battleships, as the result of the negotiations that have taken place in Washington, there has been little short of consternation at the tentative suspension of work, and the iron and steel industry has felt the effect in common with the engineering and shipbuilding trades. Forging plants that were reopening in order to cope with the requirements of shipbuilders have again had to close down.

Exports and Imports

The overseas trade in machine tools during November shows some improvement over the previous month. The total value of exports rose to over £175,000 for a tonnage of 1250. The imports again are low, amounting to only a little over £18,000 for a tonnage of 112. The exports of small tools were valued at £44,000. Over £64,000 of the export value was represented by lathes, of which 197 were shipped to the overseas markets. More than £49,000 worth of the heavier type of metal-working machinery, such as bar-cutting and plate bending machines, steam hammers, ingot cropping and swaging machines were exported, while drilling machines, planing and shaping machines, and grinding machines were imported and exported in about equal quantities.

It seems likely that the year 1921 will show a total export of about 1¼ times pre-war exports in tons. Taken as a whole, imports are slightly below the pre-war level, so that the ratio of exports to imports has considerably improved, as compared with pre-war trade, the ratios being approximately 3 to 1 in 1914, and 4 to 1 at present. The export trade also shows signs of improvement in other lines besides machine tools.

Materials and Prices

Overseas buyers are generally taking more interest in the materials market, and, although orders are spasmodic, business of fair proportion is being done. The difficulty of obtaining reasonable delivery from Continental works increases, and the general opinion is that France, Belgium, and Germany are unlikely to be able to improve upon the situation in this respect for some time. Arrangements as to minimum prices fixed by the Scottish and English Tool Makers Association have been terminated, and a return has been made to the pre-war competitive system. It is expected that this will lead to the placing of orders which have been held in abeyance.

Compared with a month ago, the prices of most raw materials show a further decline. Pig iron generally has dropped 15s per ton, and finished steel also shows a drop of from 20 to 30s per ton. Castings are quoted at substantially lower prices than have prevailed for a considerable time; thus 16-inch lathe castings are now offered at 20 to 25s per hundredweight, and the lighter grades at 28s per hundredweight. Reeled bars have again dropped considerably, the price of £14 10s prevailing a month ago being now down to £12 10s.

ANNOUNCEMENT

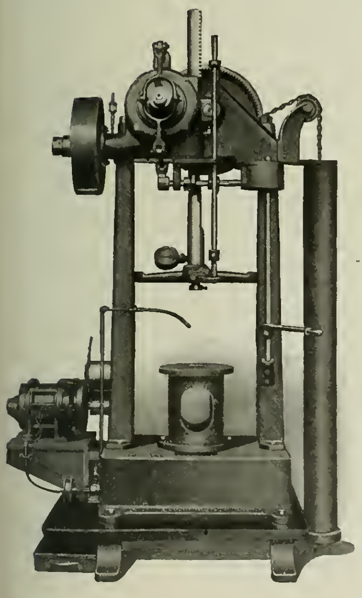
SOMETHING NEW

Yet tested and tried

The Lucas Vertical Push-Broaching Machine

(A modification of the Lucas Power Forcing Press)

Has been in successful operation for over two years on *vertical push-broaching* and *production assembling.*



Send for Special Circular C-26-M.

ADVANTAGES:

- Shorter, and therefore less expensive broaches.
- Better lubrication of cutting edges.
- Easier setting of work, easier manipulation of broaches.
- More production.
- A choice of fixed positions for the operator.
- Lever Control (adjustable for height).
- Less Floor Space Required.

WE ALSO MAKE THE

"PRECISION"

BORING, DRILLING AND MILLING MACHINE

LUCAS MACHINE TOOL CO. NOW AND ALWAYS OF **CLEVELAND, OHIO, U.S.A.**

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry. Societe Anonyme Belge, Alfred Herbert, Brussels. Aux Forges de Vulcain, Paris. Allied Machinery Co., Turin, Barcelona, Zurich. Benson Bros., Sydney, Melbourne. V. Lowener, Copenhagen, Christiania, Stockholm. R. S. Stokvis & Zonen, Rotterdam. Andrews & George Co., Tokyo, Japan.

OBITUARIES

James A. Brady, who was president and general manager of the James A. Brady Foundry Co., Chicago, Ill., up to the time of his retirement about ten years ago, died January 9, age seventy-four years. At the age of twenty-five he became connected with the foundry business at Beaver Falls, Pa., and in 1899 organized the James A. Brady Foundry Co. in Chicago.

George Baldwin Selden, inventor of the first gasoline-propelled vehicle and a pioneer in the automotive industry, died in Rochester, N. Y., January 17, aged seventy-seven years. Mr. Selden was president of the Selden Motor Co., of Rochester. He was graduated from Yale University in 1869 and later studied law, being admitted to the bar in 1871. Most of his legal work was in connection with patent legislation. Mr. Selden made his first gasoline driven engine in 1873.

T. C. DILL

T. C. Dill, president of the T. C. Dill Machine Co., Inc., Philadelphia, Pa., died suddenly on January 6 from heart failure, at the age of fifty-seven. Mr. Dill was well known in the machine tool industry, the slotting machine which bears his name being widely used in machine shops throughout the country. He founded the T. C. Dill Machine Co. in 1888 for the manufacture and sale of the Dill slotter. Prior to patenting his slotter, he had manufactured and marketed a connecting-rod, but the slotter business grew so rapidly that it became necessary to devote the entire efforts of the organization to this line. This growth of the slotter business was due largely to the efforts of Mr. Dill in developing a machine with unusual features, embodying the traveling head, which is the most striking feature of the Dill machine. These slotters are particularly well known in railway shops, and Mr. Dill's name will long be remembered in this field as well as in the machine-building industries in general, not only because of his mechanical achievements but also because of his attractive personality. The business will be continued by his widow, Mrs. Matilda J. Dill, who will become president of the company. His daughter, Mrs. Matilda Dill Moore, has been the company's secretary for several years.

THOMAS P. EGAN

Thomas P. Egan, president of the J. A. Fay & Egan Co., Cincinnati, Ohio, manufacturer of woodworking machinery, died January 10 at the Good Samaritan Hospital in Cincinnati, after a long illness. Mr. Egan was born in Ireland in 1848. Early in his life his family emigrated to Canada, where he obtained employment for a time. Later he came to the United States, going directly to Cincinnati and was naturalized there. Starting his career as a lathe hand in the employ of Steptoe, McFarland & Co., of Cincinnati, he rose to a position of leadership in the machine tool industry. The accidental loss of his arm caused him to be transferred from the shop to the office, where he advanced quickly and made a remarkable record as a salesman. In 1874 he went into the woodworking machinery business, and a few years later organized the Egan Co. which was consolidated in 1893 with the J. A. Fay Co. under the name of J. A. Fay & Egan Co. The firm grew steadily until it is now the largest woodworking machinery plant in the country. He was one of the founders of the National Association of Manufacturers and its first president, and when the association held its twenty-fifth annual meeting in New York a year ago, Mr. Egan was guest of honor. He is survived by his widow and seven children.

PERSONALS

Daniel Cushing, metallurgical engineer of Boston, Mass., has moved from 40 Court St. into larger quarters at 50 Congress St.

H. P. Losely, formerly industrial engineer with the James E. Morrison Co., Detroit, Mich., has gone into business for himself, having opened an office as industrial engineer at 414 Peter Smith Bldg., Detroit, Mich.

W. H. Patterson, who has been associated with the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., for the last sixteen years has become vice-president of the Kaestner & Hecht Co., Chicago, Ill., electric elevator builder.

Arthur Jackson, engineering representative of the Potter & Johnston Machine Co. in Japan, has been elected a regular member of the Japan Society of Mechanical Engineers. During the war Mr. Jackson was demonstrating Gridley automatics in Great Britain.

George C. Kimmel has resigned as mechanical engineer from the Cincinnati Grinder Co., Cincinnati, Ohio. Mr. Kimmel had been connected with this company since its inception in 1910 and previous to that was associated with the Heald Machine Co. and the Norton Co.

W. B. Wachtler, until recently manager of the Chicago district for the Industrial Bearings Division of the Hyatt Roller Bearing Co., has been promoted and transferred to the New York headquarters of the division at 709 Sixth Ave., as engineer in charge of general applications.

W. O. Renkin has become associated with the Hardinge Co., Inc., 120 Broadway, New York City, in the capacity of managing engineer of the Quigley pulverized fuel department, since this department of the Quigley Furnace Specialties Co. has been acquired by the Hardinge Co., Inc.

W. D. Blatz has been appointed general sales manager of the Bridgeport Brass Co., Bridgeport, Conn. Mr. Blatz joined the selling organization of the company in 1915, and during his connection with the company has made a thorough study of the brass industry in all its various branches, having traveled extensively.

A. H. Bauman has been elected vice-president and director of the Cleveland Duplex Machinery Co., Cleveland, Ohio. Mr. Bauman was formerly general foreman of the Gun Division of the American Brake Shoe Works, Erie, Pa. For the last three years he has been associated with the Cleveland Duplex Machinery Co. as sales engineer.

O. M. Rau, formerly consulting engineer to the Philadelphia Rapid Transit Co., has now become associated with the Hardinge Co., Inc., 120 Broadway, New York City, and will specialize in the handling of Quigley pulverized fuel systems as applied to boilers. This change took place with the acquirement by the Hardinge Co., Inc., of the pulverized fuel department of the Quigley Furnace Specialties Co.

James E. Gleason of the Gleason Works, Rochester, N. Y., was installed as president of the Chamber of Commerce of Rochester at a meeting of the Chamber on January 16. The principal speaker at the annual dinner, given in connection with the meeting, was Henry J. Allen, governor of Kansas who addressed the Chamber on the Kansas Industrial Court. A large number of factory foremen, who had been invited to attend, were present.

Zeno D. Barns has been appointed manager of the Cleveland office of the Ajax Metal Co., Philadelphia, Pa., to fill the vacancy made by the death of Louis E. Purnell. The Cleveland office, which is located at 429 Schofield Bldg., takes care of the business in the states of Ohio and Michigan. Mr. Barns has been connected with the Westinghouse Electric & Mfg. Co., and the Westinghouse Air Brake Co for some years past.

* * *

The University of Illinois maintains a number of research graduate assistantships in the Engineering Experiment Station to assist in the conduct of engineering research and to extend and strengthen the field of its graduate work in engineering. These assistantships, for each of which there is an annual allowance of $600, are open to graduates of approved American and foreign universities and technical schools who are prepared to undertake graduate study in engineering, physics, or applied chemistry. An appointment is made for two years, and upon the satisfactory completion of the work, the degree of Master of Science is conferred. There are now several vacancies to be filled, and applications should be sent to the director of the Engineering Experiment Station, University of Illinois, Urbana, Ill.

COMING EVENTS

February 13—Winter meeting of the American Boiler Manufacturers' Association at the Fort Pitt Hotel, Pittsburg, Pa. Secretary and treasurer, H. N. Covell, 191 Dikeman St., Brooklyn, N. Y.

February 14—Meeting of the Engineering Society of Buffalo at the Iroquois Hotel, Buffalo, N. Y. Secretary, N. L. Nussbaumer, 80 W. Genesee St., Buffalo.

February 20-25—Spring meeting of the American Institute of Mining and Metallurgical Engineers in the Engineering Societies' Bldg., New York City. Secretary, Frederick F. Sharpless, 29 W. 39th St., New York City.

February 22—Conference of practicing engineers under the auspices of the American Association of Engineers, in Chicago, Ill.; headquarters, Congress Hotel. Public information service of the American Association of Engineers, 63 E. Adams St., Chicago.

February 27-March 10—British industries fair in London and Birmingham, organized by the Department of Overseas Trade. Address of secretary for London, 35 Old Queen St., London, S.W. 1. Address of secretary for Birmingham, Chamber of Commerce, 95 New St., Birmingham. Further information can be obtained from the British Consulate General in New York City.

April 19-20—Annual meeting of the National Metal Trades Association in New York City; headquarters, Hotel Astor. Secretary, Homer D. Sayre, Peoples' Gas Bldg., Chicago, Ill.

April 22-May 2—Sixth annual Swiss sample fair at Basle, Switzerland, in the Great Exhibition Bldg. For further information apply to F. Dossenbach, Director of the Official Information Bureau of Switzerland, 241 Fifth Ave., New York City.

April 24-29—Annual convention and exhibit of the American Foundrymen's Association in Cleveland, Ohio; headquarters, Cleveland Public Hall, Lakeside Ave. and E. 9th St. Secretary, C. E. Hoyt, 140 S. Dearborn St., Chicago, Ill.

May 8-11—Spring meeting of the American Society of Mechanical Engineers in Atlanta, Ga. Assistant Secretary (Meetings), C. E. Davies, 29 W. 39th St., New York City.

June 26-July 1—Twenty-fifth annual meeting of the American Society for Testing Materials in Atlantic City, N. J.; headquarters, Chalfonte-Haddon Hall Hotel. Secretary, C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

NEW BOOKS AND PAMPHLETS

Fifth Biennial Report of the Department of Labor and Industry of the State of Maine for 1919-1920. 159 pages, 6 by 9 inches. Published by the Department of Labor and Industry, Augusta, Maine.

Structure and Related Properties of Metals. 104 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Circular No. 113 of the Bureau of Standards. Price, 25 cents.

Twenty-fourth Annual Report of the Bureau of Labor and Industrial Statistics of the State of Virginia for 1921. 139 pages, 6 by 9 inches; 10 charts. Published by the Bureau of Labor and Industrial Statistics, Richmond, Va.

The Distribution of the Forms of Sulphur in the Coal Bed. By H. F. Yancey and Thomas Fraser. 94 pages, 6 by 9 inches. Published by the Engineering Experiment Station of the University of Illinois, Urbana, Ill., as Bulletin No. 125.

Annual Report of the Director of the Bureau of Foreign and Domestic Commerce to the Secretary of Commerce for the Fiscal Year ended June 30, 1921. 148 pages, 6 by 9 inches. Published by the Department of Commerce, Washington, D. C.

NEW CATALOGUES AND CIRCULARS

Bausch & Lomb Optical Co., Rochester, N. Y. Price list of microscopes, microtomes, and accessories, effective January 2.

Whitman & Barnes Mfg. Co., Akron, Ohio, manufacturer of twist drills and reamers, is distributing a calendar for 1922 to the trade.

Wagner Electric Mfg. Co., St Louis, Mo. Bulletin 129, descriptive of the main features of the new Wagner polyphase motor known as the "Pow-R-full."

Goulds Mfg. Co., Seneca Falls, N. Y. Bulletin 123, descriptive of Goulds steam turbine driven centrifugal pumps, for use in paper mills, textile mills, steam power plants, mines, etc.

Rockford Milling Machine Co., Rockford, Ill., has recently issued complete circulars describing cutters, collets, arbors, and small tools, for use in connection with Rockford milling machines.

Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. Leaflet 1825, illustrating and describing applications of the arc-welding process for repair and reclamation work as well as for manufacturing processes.

Carrier Engineering Corporation, 750 Frelinghuysen Ave., Newark, N. J., is issuing a monthly publication known as the "Weather Vein," containing information relating to air conditioning, drying equipment, etc.

Holophane Glass Co., Inc., 342 Madison Ave., New York City. Bulletin 343, descriptive of the Holophane lightmeter, which is a portable instrument designed for the accurate measuring of light and for color matching.

Weimer Machine Works Co., Lebanon, Pa. Circular, 12½ by 11 inches, containing full-page illustrations of Weimer patent cinder cars, styles J and K, which may be operated either by hand power, steam, air, or electricity.

Ohio Cultivator Co., Bellevue, Ohio. Pamphlet descriptive of the Ohio automatic belt-power baling press, for use in salvage departments for handling all classes of compressible materials, including the lighter gages of sheet metals.

Hydraulic Press Mfg. Co., Mount Gilead, Ohio. Catalogue 43-B, covering the H-P-M line of hydraulic high-pressure valves and fittings. The pamphlet contains sixty-four pages of illustrations, descriptions, and tabular material. In addition to the standard line of valves a few special types are shown.

Wardwell Mfg. Co., Cleveland, Ohio. Catalogue of machinery and tools for sharpening woodworking and metal-cutting saws. Illustrations and data are given covering band-saw filing, setting, and jointing machines; band-saw grinders; lap grinders; circular saw setters and filers; circular saw grinders, etc.

Electric Controller & Mfg. Co., 2700 E. 79th St., Cleveland, Ohio. Bulletin 1016A, containing description, illustrations and tables of ratings for E. C. & M. automatic motor starters for non-reversing direct-current motors. New price lists have also been issued by the company effective December, 1921, covering E. C. & M. apparatus.

V & O Press Co., Glendale, Long Island, N. Y. Bulletin 6-B, containing illustrations and brief descriptions of automatic feeding attachments for power presses, including standard single- and double-roll feeds, grip feeds, and dial feeds. The illustrations show the wide field of application for which these attachments are adapted.

Union Switch & Signal Co., Swissvale, Pa. Pamphlet entitled "Forging Ahead," containing a large number of illustrations of typical forgings produced by this concern. A brief statement is made of the equipment and capacity of the concern, and a chart is included giving S.A.E. steel specifications and recommended heat-treatments for the steels listed.

General Electric Co., Rock Drill Department, Fort Wayne, Ind. Circular 68980 illustrating and describing the boom mounting designed by the company for the Fort Wayne electric rock drill, which is designed for installation on mine cars, to take the place of the tripod type of mounting and to reduce the manual labor of handling the drill to the minimum.

Arthur A. Crafts & Co., 125 Summer St., Boston, Mass. Catalogue 22, entitled "Diamonds Used in Tools," treating of the use of diamonds for truing carborundum, alundum, crystolon, and other types of hard grinding wheels. Price lists are given for this company's line of diamond tools, including grinding wheel dressers, lathe turning tools, drills, glass cutters, engine turners' tools, wire drawing dies, etc.

Joseph T. Ryerson & Son, 30 Church St., New York City, has made a change in its bi-monthly "Stock List," having added a magazine feature in the front and a machinery and small tools section in the back of the book, which doubles the number of pages. It is hoped that the magazine section will serve as an exchange for suggestions and ideas, as well as a clearing-house to assist customers in disposing of odd stock and used machinery.

Bastian-Blessing Co., 125 W. Austin Ave., Chicago, Ill., is issuing a monthly publication called "Sparks" which will deal with the subject of welding or cutting by the oxy-acetylene or oxy-hydrogen process. In the first number is described a new "Rego" outfit known as the "Rego Little Six," which is particularly applicable for welding, cutting, brazing and decarbonizing in garages or small repair shops. Copies will be sent to anyone interested in this subject.

Goddard & Goddard Co., Detroit Mich., is issuing a series of pamphlets entitled "Real Production Tools," the first of which gives data on the "Go & Go" half side-mill which is designed to be used in pairs, right and left. No. 2 of the series gives information on the "Go & Go" plain mill. The third pamphlet is on the "Go & Go" inserted-tooth mill which consists of an alloy steel body and high-speed steel blades, and is intended for work requiring cutters 10 inches in diameter or larger.

R. K. LeBlond Machine Tool Co., Cincinnati, Ohio. Catalogue containing a detailed description and a large number of illustrations of LeBlond heavy-duty crankshaft lathes for the rapid production of automobile, gas engine, airplane, air compressor and other crankshafts. These machines are built in universal and duplex types for finishing crankpins either singly or in pairs, according to the design of the crankshaft and the requirements of the customer. Complete specifications are included.

Norton Co., Worcester, Mass. Pamphlet entitled "Metal Polishing," containing an article giving considerable information on the polishing of metal, including the correct abrasives to use; methods of setting up grinding wheels; drying wheels; size of grain used for different operations; polishing wheels; balance of wheels, speed, etc. Pamphlet entitled "Factors Affecting Grinding Wheel Selection," containing a definite outline of the conditions governing the correct selection of grinding wheels. Four tables are given listing the factors influencing the selection of the abrasive, grit, grade, and process respectively. A valuable feature of the booklet is the tabular material giving the abrasive process and the correct grade and grain of wheel to be used for different classes of work and operations.

TRADE NOTES

Cutler-Hammer Mfg. Co., Milwaukee, Wis., has moved its Boston office from the Columbian Life Building to Rooms 403 and 404 Harvey Building, Chancy St. C. W. Yerger is manager of this office.

Nickel Engineering Works, Saginaw, Mich., manufacturers of agitator equipment for chemical tanks, have leased a portion of the Schemm Brewing Co.'s plant, 920 N. Hamilton St., for machine shop purposes.

W. S. Rockwell Co., 50 Church St., New York City, furnace engineers and contractors, announce that Gibbons Bros., Ltd., Dudley, Worcester, England, has been appointed representative of the company for the British Isles.

Surface Combustion Co., Inc., 366 Gerard Ave., Bronx, New York City, has been awarded the contract for an automatic heat-treating furnace to be installed at the Naval Ordnance plant in South Charleston, W. Va., for heat-treating 16-inch armor-piercing shells.

American Motors Service has been organized in Pittsburg, Pa., by G. E. Burroughs and I. V. Conneely, for the purpose of distributing motor parts, tools, machines, and appliances for the complete equipment of garages. The temporary address of the concern is Lock Box 447 N.S., Pittsburg.

C. F. Davis Machine Co., Inc., 133 Andrews St., Rochester, N. Y., announces that it is and has been a separate and distinct organization from the Davis Machine Tool Co., also of Rochester. The similarity of names has caused some misunderstanding in the past and the announcement has been made to clear the matter up.

Reed-Prentice Co. and associate companies, the **Becker Milling Machine Co.** and the **Whitcomb-Blaisdell Machine Tool Co.,** have removed their New York office from the Grand Central Palace, 480 Lexington Ave., New York City, to Room 536, Singer Bldg., 149 Broadway, New York. The New York office is under the direction of P. K. Dayton, New York sales manager.

McCabe & Sheeran Machinery Corporation, Singer Bldg., New York City, has been organized by Harry P. McCabe and P. Frank Sheeran to deal in new and used machine tools and to act as manufacturers' direct representatives. Mr. McCabe was associated for twenty-five years with the J. J. McCabe Lathe & Machinery Corporation, the last three of which he was vice-president. Mr. Sheeran was connected with the same concern for twenty-three years, latterly as treasurer and chief of sales and advertising.

Morley Machinery Corporation (successor to the W. A. Wilson Machine Co., and the Rochester Boiler Works), manufacturer of iron planers and special machinery, has recently purchased and is now located in the plant formerly occupied by the Defiance Check Writer Corporation at 792-814 St. Paul St., Rochester, N. Y. New equipment has been purchased, and as the new property has a railroad siding the plant now occupied offers excellent manufacturing facilities.

Reading Machinery Exchange, 437 Washington St., Reading, Pa., has changed its firm name to Reading Machine & Tool Co. This change has been made because of the fact that the company some time ago discontinued handling used machinery, and since then has been devoting its entire time to the sale of new metal-working and woodworking machinery and tools, electric motors, and industrial furnaces. The new name has therefore been adopted as being more descriptive of the firm's present activities.

Warren F. Fraser Co., Westboro, Mass., manufacturer of cylindrical grinding machinery, plain cylinder grinders, special machine tools, and metal products, has been reorganized. The officers of the reorganized company are as follows: president, Warren F. Fraser; vice-president, Frank H. McClaskey; general manager, Sidney Player; sales manager, Joseph N. Bethel; treasurer, Maurice J. Cashman; assistant treasurer, Richard S. Staples; consulting engineer, Herbert S. Indge; and factory superintendent, Alfred E. Box. Messrs. Player, Bethel, Staples, Indge, and Box have also become stockholders in the company.

MARCH MACHINERY 1922

Hot Swaging

Description of Swaging Operations, Based on the Practice and Recommendations of the Langelier Mfg. Co., Providence, R. I.

By FRED R. DANIELS

In Machinery for June and July, 1921, a description of the cold-swaging process was published, including the equipment used, the effect of the process on the quality of the material being swaged, and the manufacture of swaging dies. In the present article, similar information is furnished regarding the hot-swaging of metal, based upon the use of the equipment manufactured for hot-swaging by the Langelier Mfg. Co. The process has been found especially economical in the making of carbon steel drills and end-mills and for the manufacture of motorcycle pedal pins and spinning spindles used in the cotton industry.

Operation of Hot-swaging Machine

The rolls that impart a radial movement to the dies of a cold-swaging machine are carried by a cage having a floating or slow rotary movement. This construction causes a sliding blow to be delivered to the work, which is suitable for the cold-swaging process, but not for hot-swaging. Fig. 1 shows the design of a hot-swaging machine head in which the rolls rotate on their axes while held in a fixed position; as a result the blows are delivered directly and quickly to the work without producing any torsional effect.

Rolls *A* have fixed bearings in a gun-iron ring, which is forced into the head of the machine, and they are arranged diametrically opposite each other in pairs and in such relation to the center that as the hammer blocks *B* revolve, the rolls carried in the ends of these blocks will strike against the fixed rolls and close dies *D* which are held in a slot in each of the hammer blocks. As the hammer blocks pass from roll to roll, they are moved radially outward by centrifugal force until they again contact with the next pair of rolls. This operation is similar to that of the cold-swaging machine described in June Machinery, with the exception of the fixed-roll feature.

On a twelve-roll machine a spindle speed of about 170 revolutions per minute is employed, thus delivering approximately 2100 evenly distributed blows around the work per minute. These machines are built in a variety of sizes and are fitted for swaging both solid and tubular work, the maximum capacity for solid work being 2½ inches in diameter, and for tubing, 5½ inches in diameter.

There is one simple and important feature in connection with the adjustment of the dies to obtain the desired opening, to which special attention should be called. In setting up the machine, shims are used back of the dies at *E* to obtain the proper force of blow, and the die opening is adjusted by means of the two cone-point headless set-screws shown in the spindle plate *C*. The points of these screws enter corresponding conical holes in the hammer blocks, and to change the die opening it is only necessary to adjust these screws.

The amount of die opening is of great importance. For solid stock, ¼ inch in diameter, it should be about 1/32 inch; for ⅝-inch stock, about 1/16 inch; and for larger sizes, in proportion. The idea is to allow enough opening so that the stock can be fed easily through the dies. Restriction of feed movement will produce inferior work, and if the work is not gripped securely, it is likely to twist. Too great a die opening permits stock to be fed fast, and for solid work this will result in chewing the material or cracking it. A large opening on tubular work will cause it to be swaged out of round.

The severe service imposed upon a machine by the swaging of hot metal demands a heavily constructed machine and means for keeping the dies cool. In the Langelier type of machines this is accomplished by placing a water jacket around the head roll bearing, which enables the machine to be kept in continuous operation, and increases its productivity. The oil from the machine and the heat produced by the hot work cause smoke, which must be carried away. This is done by providing a flue in front of the machine above the dies, and running a jet of compressed air through the hollow spindle from the rear, which forces the smoke through the flue, and at the same time carries scale and oxide away.

Arrangements for Heating the Work

Obviously some convenient arrangement must be provided for heating the work prior to swaging. In the Langelier equipment this consists of a special rotary heating furnace, such as illustrated in Fig. 3. The oven is circular, and is supported in a framework so that the stock to be heated may extend up from beneath and enter the heating chamber a short distance. The blanks to be heated are held in suitable holders arranged in a circle. The furnace is equipped with a powerful gas burner *A* which drives the flame around the circular firebrick oven, and the feed-plate in which the work-holders are carried revolves at the required operating speed. This passes the blanks into the oven from an opening at one end and out of a similar opening at the other end where they automatically drop to a lower platform, and are then successively removed by the operator and placed in the work-holder of the swaging machine.

The speed of delivery of the heated blanks is regulated to agree with the time required for the swaging operation, so that the operator is constantly supplied with hot blanks and the swaging machine kept in continuous operation. This special equipment provides for handling work up to 20 inches in length and 1½ inch in diameter. For work of this size, the maximum distance that the blanks must be heated from the end is 5 inches. The furnace can be adjusted to heat the blanks to 1800 degrees F. and deliver the work at the same rate that the swaging machine operates. For example, on ¾-inch diameter blanks which require to be swaged 4 inches from the end, the output is about eight per minute, which is about the same as for the swaging operation.

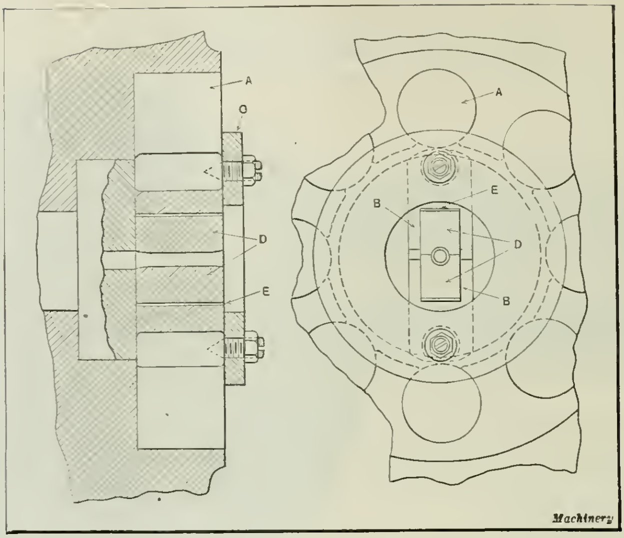


Fig. 1. Construction of the Fixed-roll Type of Swaging Machine Head

The circular opening on the inside of the furnace oven is narrow enough to accommodate the maximum diameter work and does not allow an excessive loss of heat. The rotary speed of the feed-plate is varied by suitable gearing at the lower end of the vertical shaft to which the feed-plate is attached. The furnace is located conveniently and in any position relative to the swaging machine that is best suited to the working conditions. The work is removed by tongs, placed in the work-holding chuck, and fed into the dies.

Work-holding Devices

Figs. 2, 6, and 7 show types of hot-swaging machines equipped with various designs of work-holding chucks and feeding devices. The chuck shown in Fig. 2 is of the self-opening spring type and is operated by compressed air. The compressed air forces the piston on the inside of cylinder *A* forward, resulting in a gripping action of the chuck. The work is firmly held by this means until the operation of swaging has been completed and the work withdrawn sufficiently from the dies to automatically shut off the air pressure and permit the spring to operate and release the jaws. The illustration shows the air connection *B* and the position occupied by the holder just before the automatic release of the air.

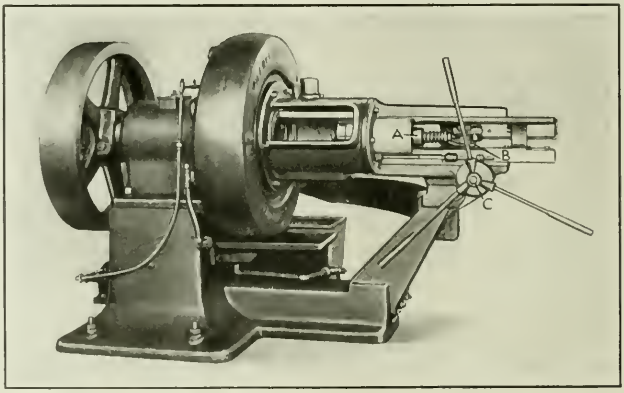


Fig. 2. Swaging Machine with Hand Feed and Compressed Air Work-holder

This machine has a hand feed, operated by a pinion on the capstan wheel shaft *C*, which meshes with a rack on the under side of the tubular holder in which the chuck is carried. The hand feed and automatic chucking device are particularly suitable for medium-sized work, but for the heavier work it is advisable to employ a more positive feed arrangement than that shown.

The holder and feed used on the machine shown in Fig. 7 are fully automatic in operation. The work is chucked pneumatically, the clamping jaws being bolted to a saddle which is fed forward and backward on the ways by hydraulic pressure, the feed being controlled by a hand-lever. The hydraulic feed is employed because it furnishes a steady movement for heavy work. The entire holding and feeding device is attached to the cover that encloses the swaging rolls, and this cover may be swung on its hinge to give easy access to the working parts of the machine.

Fig. 8 shows the cover opened, revealing the ends of the swaging rolls and the spindle plate *A* in which the two conical-point adjusting screws for obtaining the desired die opening are carried. When the cover is open, a support must be provided for the overhanging weight of the holding and feeding attachments. This is taken care of by a curved rail *B* which provides the necessary outboard support and permits the entire mechanism to be swung to the position shown. The holder is provided with a positive stop *C* for regulating the length to which the work is to be swaged.

The machine illustrated in Fig. 6 is furnished with a holder operated by a hand-lever *A*, and is extensively used on smaller classes of hot-swaged work. The feed is also hand-operated, and is of the rack and pinion type, the hand-lever for the feed being shown at *D*. This illustration also shows the smokestack *B* for the smoke caused by the hot dies burning the oil on the work, as well as the drainage receptacle *C* under the holder support into which this oil drips, and which contains a strainer for removing foreign particles from the oil, after which it drips back to the source of supply. In hot swaging operations considerable scale is produced by the rapid hammering of the hot metal, and it has been found necessary to provide for removing this foreign matter before the oil is fit to be used again.

Amount of Reduction in Hot Swaging

Small work cannot be reduced as much proportionately as larger work, due to the fact that the former does not retain the heat as well. The hot-swaging process is more particularly adapted to the production of large work than small work (which is better handled by cold-swaging), and for large heavy work a reduction of 1/8 inch on the diameter per pass is permissible, this being about twice that recommended for cold-swaging. The length of the blank also influences the amount of reduction permissible, because the distance between the dies and the holder must not be great enough to allow the work to twist due to the torsional strain produced by the die action.

In determining the length to which the blanks are to be heated, it should be borne in mind that it is not necessary to heat the blank as far from the end as it is desired to swage it, since the heat from the hot end radiates into the colder metal so that the blank is heated with a uniform decrease from the end, corresponding to the taper produced by the bell-mouthed entrance to the opening of reduction dies, or by regular taper-swaging dies. That is, the blank does not need to be as hot at the end of the swaged portion as it does at the end that is subjected to the greatest reduction. Practice must determine the length to which the blanks should be heated; other factors to be considered, besides the length of the blank, are the diameter, physical qualities of the metal, type of machine, etc.

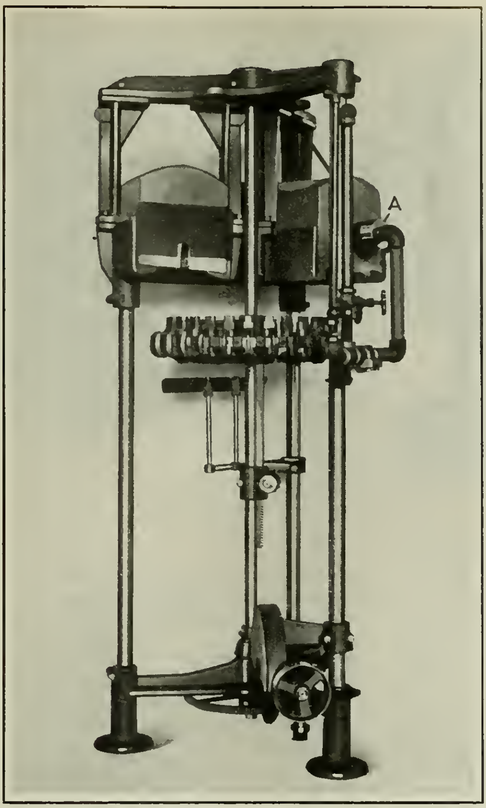


Fig. 3. Rotary Gas Furnace in which the Blanks are heated at the End prior to swaging

Examples of Hot-swaging

A number of examples of hot-swaged work are shown in Fig. 4. The piece shown at *A* is a bicycle pedal-shaft made from a piece of machine steel, 0.875 inch in diameter and 4 inches long. The length to be reduced by swaging is 1 3/32 inches, the first operation producing a diameter of 1/2 inch, and a length of 3 1/8 inches. Piece *B* shows the second operation on the bicycle pedal-shaft, in which the 3 1/8-inch length of the first operation is tapered to 5/16 inch at the small end. The length of the reduced portion is then 4 3/8 inches. Similar operations are performed on the opposite end of this blank, and the piece is then cut in two to make two bicycle pedal-shafts. The time required for the first operation is ten seconds and for the second operation seven seconds per piece. The piece shown at *C* was produced from a piece of drill rod, 1/2 inch in diameter, and swaged straight to a diameter of 0.290 inch for a length of 4 3/4 inches.

Example *D* is similar to that shown at *C* except that the straight reduction is 5 1/4 inches long, and this piece shows a second operation which consists of taper-swaging the 1/2-inch diameter end. It was made from a blank 4 inches long and is swaged with a standard Morse taper, at the rate of four per minute. This piece is a drill blank. The piece shown at *E* is a steel tooth for a hay rake, and is made of machine steel, tapered in one operation for a length of 1 1/2 inches to a blunt point. The production time is eight per minute. In connection with this operation, it should be mentioned that it is impracticable to attempt to produce a sharp point by hot-swaging, since a narrow die opening will tend to flatten the point rather than produce a uniform taper.

The swaged piece shown at *F* is a live axle end, made from axle steel 1 1/8 inches in diameter and 5 inches long. The taper is 2 7/8 inches long, the reduction being 0.74 inch in diameter at the shoulder. The small end is 1 3/32 inches long and 0.625 inch in diameter. Two operations are re-

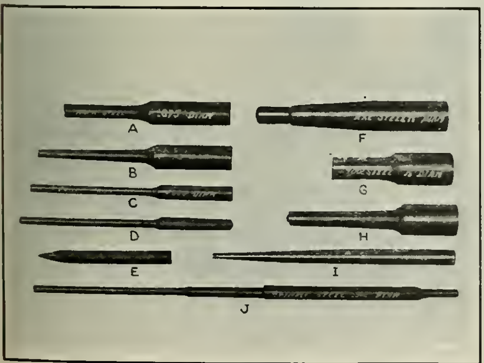


Fig. 4. Examples of Work produced by the Hot-swaging Process

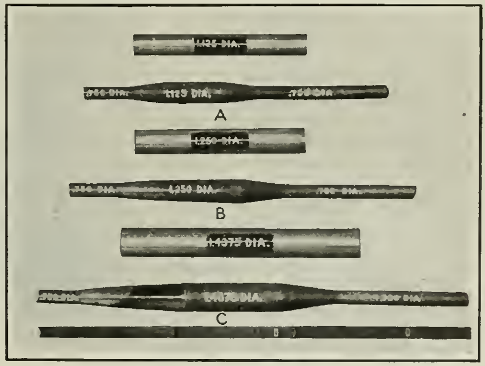


Fig. 5. Three Insulator Posts and Blanks from which they are swaged

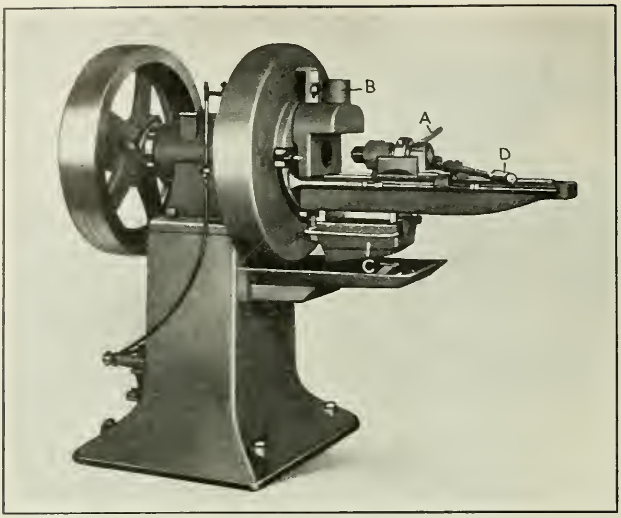


Fig. 6. Machine with Smokestack, Hand-operated Work-holder and Rack and Pinion Feeding Device

quired to produce this piece. The first operation in swaging an end-mill blank is shown at *G*, and the second operation at *H*. The material is tool steel, 1¼ inches in diameter by 3¼ inches long, and is reduced to a diameter of 27/32 inch, the length of the reduced section being 2¼ inches. In the second operation, the reduced end is tapered to 4 inches in length and a diameter at the small end of 9/16 inch. A butcher's steel is shown at *I*, this piece being made from a blank of 0.60 per cent carbon steel, 7¼ inches long and 9/16 inch in diameter. The two tapers are produced in one operation, the total taper length being 5 inches and the diameter of the small end 15/64 inch.

Example *J* is a spinning spindle used in textile machinery, and is made from special spindle steel. Three operations are required to produce this part from a blank 10 inches long and 0.562 inch in diameter, two of these operations being on the long end and one on the short end. The two diameter reductions on the long end are 0.40 and 0.27 inch, respectively, and the lengths 2⅞ and 5¾ inches. At the opposite end the stock is reduced to 5/16 inch in diameter for a length of 1½ inches. The increase in length from the original blank size is 5⅞ inches, that is, the spindle is elongated to 15⅞ inches during the three swaging operations.

Fig. 5 shows three sizes of insulator posts used for metal electric wire towers. The post shown at *A* is made from a piece of machine steel, 8¾ inches long and 1¼ inches in diameter, which is reduced at each end, in separate operations, to 0.750 inch in diameter, the short length being 1¾ inches and the long length 6 inches. The work shown at *B* is made from a 1¼-inch diameter blank, 8½ inches long in two operations, the left-hand end being tapered to 1 inch in diameter and reduced to 0.750 inch in one operation. The length of the straight portions on this insulator post is the same as in that shown at *A*.

The third example shown in this illustration is made from a blank 1 7/16 inches in diameter and 11¾ inches long, the length and diameter of reduction and the taper being the same as in the previous case. The various lengths to which these insulator posts are made may be determined by comparison with the extension rule shown below sample *C*. These posts were made on a machine of the design shown in Fig. 2 which was operated at a flywheel speed of 190 revolutions per minute, producing the three pieces of work in ten, eleven, and twelve seconds per operation, respectively.

Additional examples of work performed on the machine shown in Fig. 2 are illustrated in Fig. 9 at *A* and *D*. The spinning spindle *A* is reduced to the dimensions given at the rate of five spindles per minute for the two operations required to produce it. This rate of production is much greater than can be realized by forging these spindles in a trip hammer, the method frequently used on this kind of work. Under test it has been shown that a hot-swaged spindle is 9 per cent stronger than a hammered spindle. A drag-link socket used in automobile construction is shown at *D*, and is produced on the machine illustrated in Fig. 2 by equipping the holder for handling tubular work. The socket is swaged in one operation at the rate of four or five a minute, being made from a piece of steel tubing 1⅜ inches in diameter, having a wall thickness of 0.124 inch.

A sample of work produced on the machine and equipment illustrated in Fig. 6 is the case-knife blank shown at *B* in Fig. 9. The work is made from a blank of 0.60 per cent carbon steel, 2½ inches long by 0.518 inch in diameter, and swaged in two operations to the dimensions shown in the illustration. For this job, as for other jobs specifically referred to in this article, the rotary gas furnace described in connection with Fig. 3 is always used with the swaging machines, although it is not shown in the illustrations. In making the case-knife blanks by the hot process, the machine is operated at 375 revolutions per minute, the output from the first operation being seven or eight a minute, and from the second five or six a minute. The small diameter end of the work is the tang of the knife, and the large end is flattened between dies to form the knife blade.

Hot-swaging of Tubular Work

In swaging tubular work, it is advisable to use a mandrel to maintain the shape and the size, except on tubing with very thick walls. At *C*, Fig. 9, are shown two examples of tubular swaging, each of which was produced in one opera-

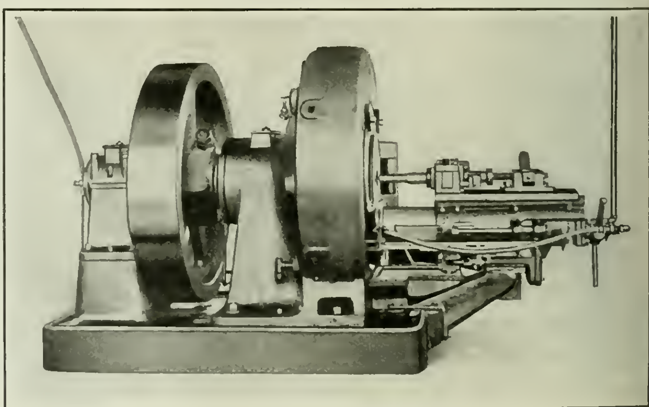


Fig. 7. Swaging Heavy Work on a Machine having a Pneumatically Operated Work-holder and Hydraulic Feeding Mechanism

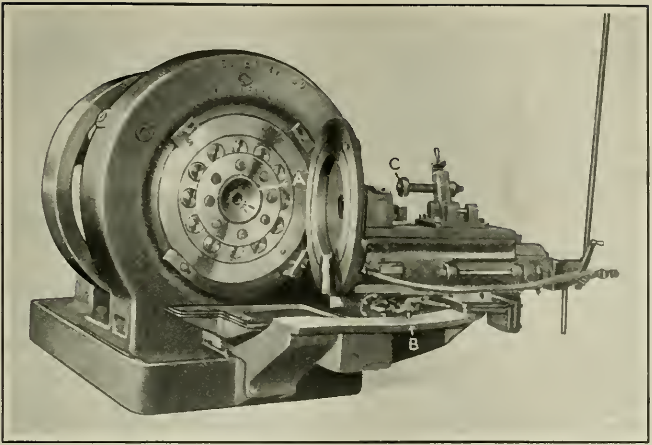


Fig. 8. View of the Machine shown in Fig. 7 with the Roll Cover and Attached Feeding and Holding Devices swung back

tion, the machine being equipped with an automatic holder and a hydraulic feed. With these attachments and with the spindle speed running at 150 revolutions per minute, the output was two pieces per minute for each part. The amount of reduction and the wall thickness are shown in the illustration. In testing the horsepower requirements for this job, it was found that 11 horsepower was required to start the machine, 5 horsepower to run without the dies, 14.8 horsepower to run with the dies without load, and from 24 to 26.5 horsepower for operating the machine under load.

A collection of tubes that have been swaged to various shapes at different times and with different equipment is shown in Fig. 10. The piece shown at *A* is produced in two operations, one being performed at each end, from tubing 21¾ inches long, with a wall thickness of ¼ inch. An example of heavy tube swaging work is shown at *B*, the wall thickness in this case being 21/32 inch. This piece was produced in one operation. An example of two-operation work is shown at *C*, the dimensions given on the sketches being self-explanatory. Three operations are required to produce the work shown at *D* from a piece of tubing 3¾ inches outside diameter, having a wall thickness of 5/32 inch. All the operations required to produce the various parts shown in this illustration were accomplished at the rate of about two pieces per minute. The type of feed and method of chucking the work will influence the rate of production as much as, if not more than, any of the other governing factors.

Making Hot-swaging Dies

The dies with which the Langelier swaging machines are equipped are made from a high grade of high-speed steel. It is proposed to outline briefly the procedure followed in making these dies, but the details will not be described here, as the manufacture of dies for hot-swaging does not differ radically from that used in making dies for the cold process, which was described in July, 1921, MACHINERY. The bars are squared up by planing, and then cut to convenient lengths on a power saw. They are next milled to die length and finished on the sides, and a pair clamped together preparatory to drilling the die groove or blade. For taper work, two or three sizes of drills are used successively to rough out the blade, so as to expedite the removal of the metal during the taper-reaming operation that follows.

For taper-reaming, a special six-flat reamer is used, similar in design to a watchmaker's broach. The rate at which the metal is removed by reaming is very slow, due to the lack of clearance on the tool, but it has been found that tools of this type produce a very accurate hole which requires little subsequent hand work when finishing the grooves or blades in the dies. Straight reduction dies are machined with an ordinary rose reamer. The tool marks produced in

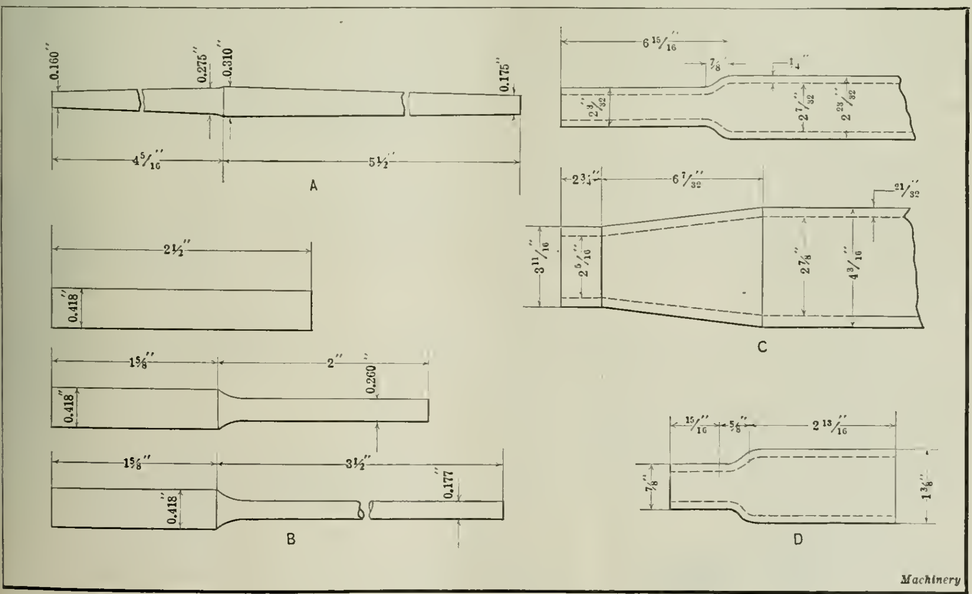


Fig. 9. Examples of Hot-swaged Solid and Tubular Work

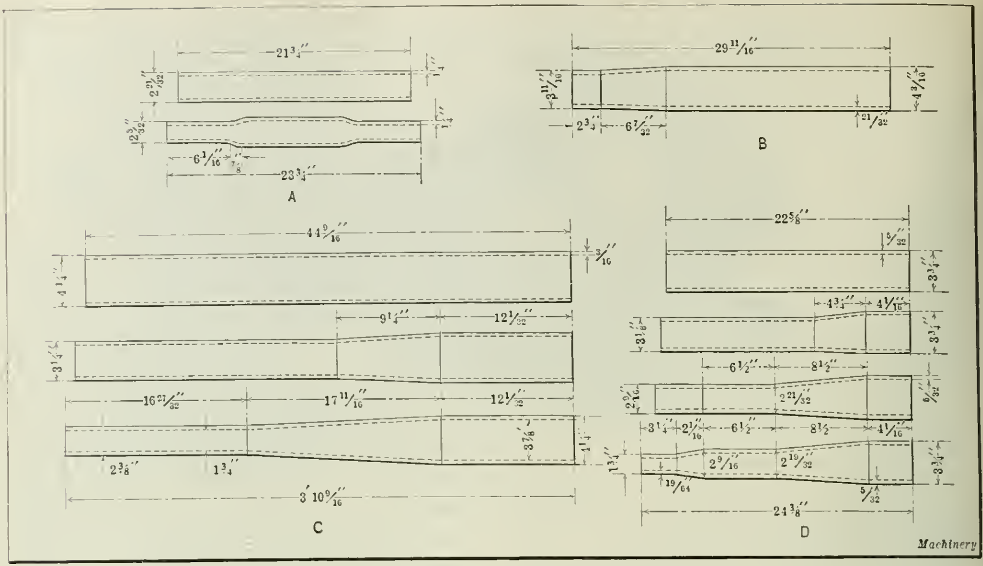


Fig. 10. Specimens of One-, Two-, and Three-operation Hot-swaged Tubular Work

reaming are then removed at the bench, and clearance at the sides of the groove is provided by means of a file. This clearance is of vital importance to allow the metal to flow as it is swaged, since the grooves are less than semicircular in contour, as was explained in describing the manufacture of cold-swaging dies in the July article.

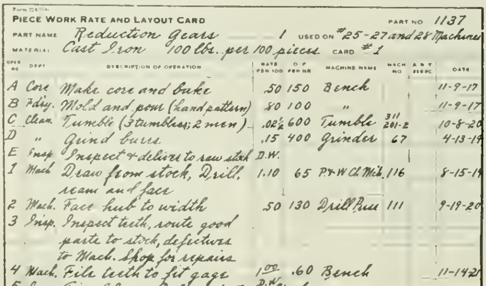
A brass lap, turned up at the same time that the reamers are made, is then used to lap the groove, the abrasive being a mixture of a very fine carborundum and oil. After the dies have been nicely finished they are hardened by preheating to 1600 degrees F. and then to 2300 degrees F. They are quenched in Houghton's No. 2 soluble oil which is kept at an atmospheric temperature, and are then drawn to a temperature of 1100 degrees F.

In making the dies for multiple-operation taper work, care is taken to see that the die grooves in successively used dies are of such size as to cause an overlapping of the operations. This maintains the desired taper and prevents ridges and uneven places from being produced.

* * *

ASSEMBLING WATCH PINION BEARINGS

Our attention has been called to the fact that the method described in the article "Assembling Watch Pinion Bearings," published on page 472 of February MACHINERY is a patented method, the patent rights belonging to the Waltham Watch Co., Waltham, Mass.



PIECE WORK RATE AND LAYOUT CARD — PART NO 1137

PART NAME Reduction Gears 1 USED ON #25-27 and 28 Machines

MATERIAL Cast Iron 100 lbs. per 100 pieces CARD #1

OPER NO	DEPT	DESCRIPTION OF OPERATION	RATE PER 100	O P PER HR	MACHINE NAME	MACH NO	A R T PER PC	DATE
A	Core	Make core and bake	.50	150	Bench			11-9-17
B	Fdry.	Mold and pour (hand pattern)	.80	100	"			11-9-17
C	Clean.	Tumble (3 tumblers; 2 men)	.02½	600	Tumble	311 201-2		10-8-20
D	"	Grind burrs	.15	400	Grinder	67		4-13-19
E	Insp.	Inspect & deliver to raw stock	D.W.					
1	Mach.	Draw from stock, Drill, ream and face	1.10	65	P.&W. Ch. Mch.	116		8-15-19
2	Mach.	Face hub to width	.50	130	Drill Press	111		9-19-20
3	Insp.	Inspect teeth, route good parts to stock, defectives to Mach. Shop for repairs						
4	Mach.	File teeth to fit gage	1.00	.60	Bench			11-14-21
5	Insp.	Final Insp. Deliver to Fin. Stock	D.W.					

Fig. 1. Front of Piece-work Rate and Lay-out Card

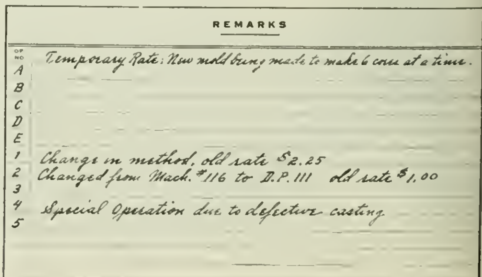
PIECE-RATE AND LAY-OUT CARD

By JOHN J. BORKENHAGEN

A piece-rate and lay-out card which the writer found of great help in his work as a rate-setter is shown in the accompanying illustrations. The front of the card, Fig. 1, contains information pertaining to the manufacture of the article, while the back of the card, Fig. 2, contains a record of changes made in the manufacturing methods and in piece rates. On the front of the card are given the part number; part name; material from which the part is made, and the weight of 100 parts; number of cards required to cover the operations; operation number; department in which work is done; description of operation; piece-rate per 100 pieces; production output per hour; name of machine and factory number; actual running time per piece; and date on which piece-rate was set. With these cards, cost data can be had on short notice. As the cards show the production labor costs and the weight per 100 pieces of material, it is only necessary to know the cost of the raw material and the overhead, to obtain the cost figures for any piece.

* * *

According to a recent Commerce Report, the Italian Government has reinstated the provisions of a decree admitting machinery and construction material for use in establishing new industries or for use in new industrial procedures, free of customs and consumption taxes.



REMARKS

OP NO	
A	Temporary Rate: New mold being made to make 6 cores at a time.
B	
C	
D	
E	
1	Change in method, old rate $2.25
2	Changed from Mach. #116 to D.P. 111 old rate $1.00
3	
4	Special Operation due to defective casting
5	

Fig. 2. Back of Piece-work Rate and Lay-out Card

Formed Milling Cutters and Hobs with Top and Side Rake

By HARRY E. HARRIS, President, Harris Engineering Co., Bridgeport, Conn.

COMPETENT mechanics and mechanical engineers have realized for years that it is essential, in designing cutting tools, to consider carefully the amount of top rake or hook, side rake or shear, (also known as the back and side slopes, respectively) and clearance that should be provided in order to enable the tool to remove the maximum amount of metal with the least heating and damage to itself, the work, and the machine members. Consequently no skilled mechanic would think of making a lathe, shaper, planer, or slotter tool without rake. Inserted teeth of high-power milling cutters are now also made with side and back slopes amounting to as much as 15 degrees and more, and, according to experiments recently made, milling cutters with a hook of as much as 30 degrees have a more efficient cutting action than cutters with a less angle to the hook.

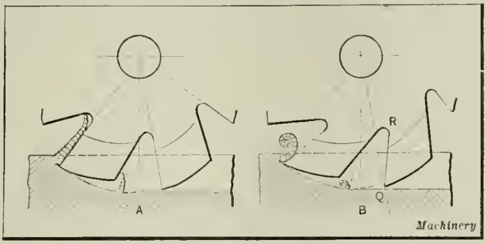


Fig. 1. Relative Cutting Actions of the Radial-tooth Hob at A and the Hook-tooth Hob at B

Instead of the chip consisting of a semi-fused distorted mass which presses against the top face of the tool, offering resistance and keeping the cooling lubricant away from the cutting edge, thus causing a severe rubbing action between the tool and the work, the chip is removed without undue distortion in the form of a curl. This results in a clean cut with much less tendency for the tool to chatter and with less power consumption. It also allows the lubricant to cool the cutting edge of the tool.

Since it is recognized that cutting edges properly ground with regard to hook and side rake have increased the efficiency of taps, face mills, broaches, lathe and planer tools, milling cutters, formed tools, reamers, counterbores, drills, etc., from at least twenty to several hundred per cent, the question arises as to why formed milling cutters and hobs without hook and side rake should be used in many shops otherwise up-to-date. Conservatism is perhaps the answer.

For instance, taking a similar case with taps, it was the general practice up to 1912 to make the face of the teeth radial to the center. With this design big losses resulted to tap users because the taps were broken, twisted, and worn out due to the hard cutting action and the jamming of chips. In a series of tests made by the writer, prior to the year mentioned, it was proved that a tap on which the teeth had top rake or hook required less power for a cut, made a cleaner job, and broke up the chips in small sections without jamming. The results of these tests were submitted to a meeting of the American Society of Mechanical Engineers at which the leading tap manufacturers were present. In a discussion following the presentation of the paper, the arguments were chiefly in favor of the practice that then prevailed of machining the taps with radial-face flutes, but in spite of the opposition, in the course of a few years there was practically no tap-maker of repute still manufacturing radial-face fluted taps.

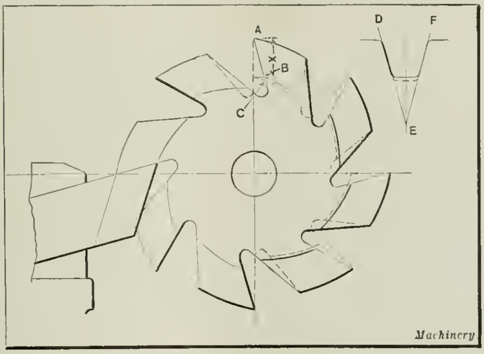


Fig. 2. Manner of tilting Cutter when relieving Under-cut or Hooked Teeth of Hobs and Formed Milling Cutters

The same thing may be expected to happen with regard to hobs and formed cutters, though some firms are now making their hobs with hook and side rake. The angle of the front face of the tooth from a radial line varies from 5 to 9 degrees in the practice of different concerns. The writer favors an angle within the limits of 7 and 8 degrees, but states that he does not know just how much greater this angle could be made with efficient results. There is no question but that an angle best suited for cutting one material under certain conditions might not be suitable for cutting the same material under different conditions or another material under the same conditions. The tooth-face angle of a hob should be made, if possible, to suit the general average of the work it is expected to do.

Fig. 1 shows at *A* an old-style hob in which the top faces of the teeth coincide with radial lines, while at *B* is shown a hob with hook teeth. The flanks of each tooth along line *QR* also have the shear or side rake feature. This is due to the fact that the hob tooth flank is angular and not truly perpendicular to the axis of the hob, and so there is actually a combined hook and side rake all along line *QR* producing an efficient cut on the working portion of the gear teeth machined by such a hob. This clean cutting action is almost impossible to obtain when the hob teeth are ground radial.

In some experiments it has been attempted to give the edge at *Q* a shearing action as well as a hook by using an even number of flutes and varying the angle of the flutes, that is, making every other flute have an angle less than the helix angle of the hob, and those in between a correspondingly greater angle. This has also been done with single gear-cutters by gashing the successive teeth at slight opposite angles. The writer has no definite data on the action of these alternate-angle cutters, but thinks that their advantage might be offset by the greater difficulty in making and grinding them, and while the action of one flank edge of the teeth would be improved by the increased angle of rake, that of the opposite flank edge would not be as good because the angle is obtuse.

It is as easy to produce hobs and cutters of the hook-tooth type as it is to produce radial-tooth hobs, when the hob is backed off by a relieving machine. The relieving tool merely has to be tilted about 7½ degrees to get the proper tooth shape for an 8-degree hook, instead of setting the tool to the center. The way the tool is tilted is shown in Fig. 2. This also gives the advantage of a hook and side rake to the cutting edges of the relieving tool itself. In hobs made without this allowance for hook, that is, with the depth and tooth angle correct in a radial plane, the effect of under-cutting the teeth is to give them a slightly greater depth *AC* instead of the proper depth *AB*. This will result in somewhat deeper teeth being cut in a gear than is necessary. The change in the resulting gear-tooth angle is so slight as to be ordinarily negligible, and some firms grind old stock hobs in this way without experiencing any disadvantages.

Another point for consideration is the fact that there seems to be no definite angle or amount of clearance adopted for hobs at the present time. Different manufacturers back off the same size hobs various amounts, and the same manufacturer will sometimes back off hobs of different diameters and pitches in amounts that do not vary in proportion to their size. In some cases manufacturers back off the same size hob different amounts at different times, probably because another machine is used or because a cam of a different throw happens to be in the relieving machine. It seems that since hobs and formed gear-cutters are fairly well standardized in other respects, the angle or clearance should also be standardized. If this were done, the correct tipping of the tool as illustrated in Fig. 2 could be worked out mathematically, as could also the exact foreshortening of the teeth, or the distance *X*, and the slight change in the angle *DEF*.

It is well known that cutting tools on which the teeth are hooked require less clearance than tools on which the teeth are not under-cut. The chief advantages of providing a hook on hob and cutter teeth may be briefly summarized as follows: Greatest possible production due to the ability to take heavier cuts at greater rates of feeds and speeds; more output between the hob grindings; less metal to remove from the hob when ground; smoother cutting action and less chatter; less power required and consequently less strain on the machine members and the hob teeth; and less clearance required for the teeth. Some materials on which it was found impossible to obtain a smooth finish when using radial-face hobs have been satisfactorily machined after grinding the hob teeth to the hook style.

* * *

FORMULAS FOR PRESSURE REQUIRED FOR SHEARING METAL

By D. C. OVIATT, D. C. Oviatt & Co., Cleveland, Ohio

The amount of shear or inclination necessary either for a shear blade or for shearing and trimming dies is variable and depends jointly on the physical condition of the metal being sheared or trimmed and the length of cut or distance around the die opening.

Shear may be expressed either as a fraction of the thickness of the stock to be sheared or as inclination of the shear blade in inches per foot. When expressed as a fraction of the thickness of the stock, the terms ¼ shear, ½ shear, 1½ shear, etc., are used. This is diagrammatically shown in the accompanying illustration. The thickness of stock is indicated by *X*, and the shear as a fraction thereof. For example, two cases are shown at *A* in which the shear blades are provided with ½ shear, that is, a rise of blade equal to one-half the thickness of the stock. Likewise, the blades shown at *B* are provided with ¾ shear. A blade having any given shear, as explained in the foregoing, will require the same pressure to force it through a plate, regardless of whether the blade presents one cutting edge or several. For instance, the pressure required would be the same for both cases shown at *A*, or for both shown at *B*, although the blades at the right have three points in contact, while those at the left have but one.

Pressure Formulas for Shear Calculation

When the shear is expressed as a fraction of the plate thickness, the following formula may be used to determine the pressure required to force the blade through the plate:

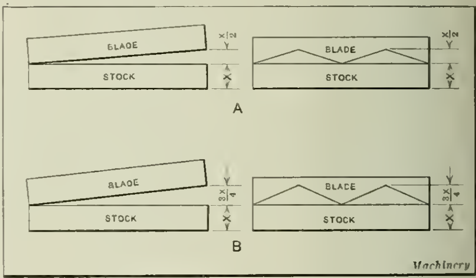
$$W = \frac{ldf}{c}\left(t - \frac{dt}{2}\right) \qquad (1)$$

When the shear is to be calculated without regard to the length of cut, or the boundary line of the die opening, but rather with relation to the inclination of the die face in inches per foot, the following formula should be used:

$$W = \frac{6dt^2f(2-d)}{s} \qquad (2)$$

In these formulas

- W = pressure in pounds required to force blade through plate;
- l = length of cut in inches in a straight line or in a line bounding an opening to be cut;
- f = ultimate shearing strength of material in pounds per square inch;
- t = thickness of plate in inches;
- c = shear, expressed as a fraction of the thickness of the flash;
- s = shear, expressed as inclination of the die face in inches per foot;
- d = constant.



Diagrammatic Illustration of ½ and ¾ Shear for Trimming Dies and Shear Blades

The constant d is that fraction of the plate thickness through which the shear blade must be forced before the shearing resistance of the material is overcome. The value may usually be taken as 1/3 for cold steel, but may vary from ¼ to ½, or even more, according to the condition of the shear blades or to the nature of the material being cut. Obviously this factor will be less for hot material than for cold, and greater for steels of higher shearing strength.

Application of the Formulas

Considering first the shear as expressed as a fraction of the plate thickness, what pressure will be required to shear a plate ¾ inch thick, 18 inches long, the blade being provided with ½ shear? The ultimate shearing strength of the material is 50,000 pounds per square inch.

The values for the different factors are: $t = 3/4$; $c = 1/2$; $d = 1/3$; $l = 18$; $f = 50{,}000$; so by applying Formula (1)

$$W = \frac{18 \times 1/3 \times 50{,}000}{1/2}\left(3/4 - \frac{1/3 \times 3/4}{2}\right)$$

$$= 600{,}000 \times 5/8 = 375{,}000 \text{ pounds.}$$

In applying Formula (2) to the solution of the same problem,

$$W = \frac{6 \times 1/3 \times (3/4)^2 \times 50{,}000\,(2 - 1/3)}{1/4}$$

$$= 7.5 \times 50{,}000 = 375{,}000 \text{ pounds.}$$

Planing Large Spur Gears

Application of Gear Planers which Cut Gear Teeth by Reproducing the Shape of a Templet

By FRANKLIN D. JONES

LARGE gears of coarse pitch may be cut either by planing on a templet or form-copying type of machine, by milling with a formed cutter, or by hobbing. Most gear manufacturers use the templet planer for the very large gears. One advantage of this type of machine is that simple, inexpensive tools are used, and this is very important, as often only one of these large gears is required, and the cost of making a formed cutter or hob would be prohibitive.

Gear-cutting machines of the templet type are also used for cutting large bevel and herringbone gears; in fact, gear planers of this class are used invariably for cutting very large bevel gears. Some gear planers are designed for cutting spur gears exclusively, but there are also combination types which may be applied to either spur or bevel gears.

A characteristic feature of the templet planer is the templet or master former which serves to guide the planing tool, thus causing it to plane teeth having the correct shape or curvature. When the planer is at work, a slide or head which carries the tool is given a reciprocating motion, and as the tool feeds inward for each stroke, the path it follows is controlled by the templet. The traversing movement of the tool-slide is derived from a crank on some gear planers, whereas others have a reversing screw. Still another method of traversing the head is by means of a rack and pinion, the latter being arranged to rotate in opposite directions.

There are two general methods of machining the teeth on one of these planers. One is to rough out the teeth with a single-pointed tool and then finish with a formed tool which removes the feed marks and gives the teeth a smooth finish. The other method is to take both roughing and finishing cuts with single-pointed tools. The use of the formed tool for finishing is impracticable for the larger pitches which are finished by a single-pointed tool. The number of cuts required depends upon the size of the tooth, amount of stock to be removed, and the kind of material.

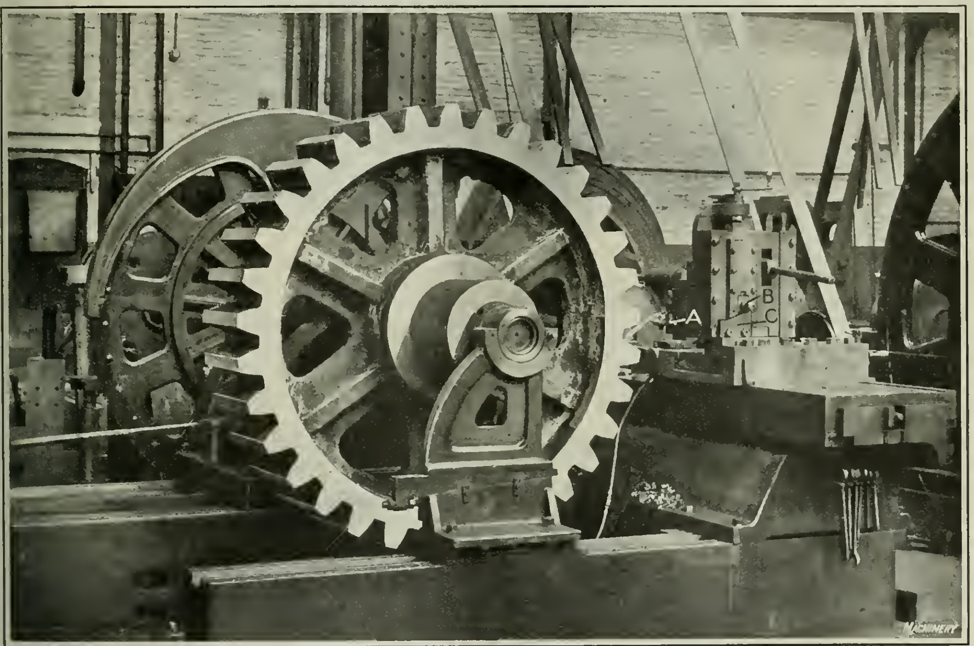


Fig. 1. Gear Planer of the Templet or Form-copying Type with Finished Spur Gear in Position

Operating Features of Templet Type Gear Planers

One of the Gleason planers of the type designed exclusively for cutting external and internal spur gears is shown in Fig. 1. The tool *A* is held by a slide which can move vertically. This slide is connected with another slide that is given a horizontal feeding movement after each cutting stroke of the tool. A roller *B* attached to the vertical slide, rests upon a templet *C*, which is stationary. When the horizontal slide feeds inward for taking a finishing cut, the tool planes one side of the tooth to the required curvature, because the path it follows is controlled by the shape of templet *C*. Sets of these templets are supplied with a gear planer, one templet of each pair being for the upper sides and the other for the lower sides of the teeth. Each pair of templets in the set covers a certain range of diameters and can be used for planing any pitch from the smallest up to the pitch stamped on the templet, which requires the full length of curve of that templet. The entire tool is mounted upon a large main slide that is traversed by a crank type of drive on the particular machine shown in Fig. 1.

The indexing mechanism may be seen in Fig. 3 which shows another machine of the same general type set up for cutting a larger gear. The large dividing wheel D is engaged by a worm connecting with a mechanism for controlling the indexing movement. After one side of a tooth is planed, the index mechanism is tripped by the operator, and then the gear is automatically rotated an amount equal to the circular pitch of the gear being planed. The power for this indexing movement is supplied by a small auxiliary motor M forming part of the indexing mechanism. The tool-slide of the machine shown in Fig. 3 is also motor-driven.

The thrust of the cut on these gear planers is taken by a rim support mounted on brace E. This support, which bears directly against the rim while the planing tool is at work, must be withdrawn slightly to permit the gear to swing freely while indexing. This is done by hand, by means of handle F. Gears of different diameter are accommodated by shifting along the main bed, the head carrying the work-spindle and also the bearing (see Fig. 1) for the outer end of the work-arbor.

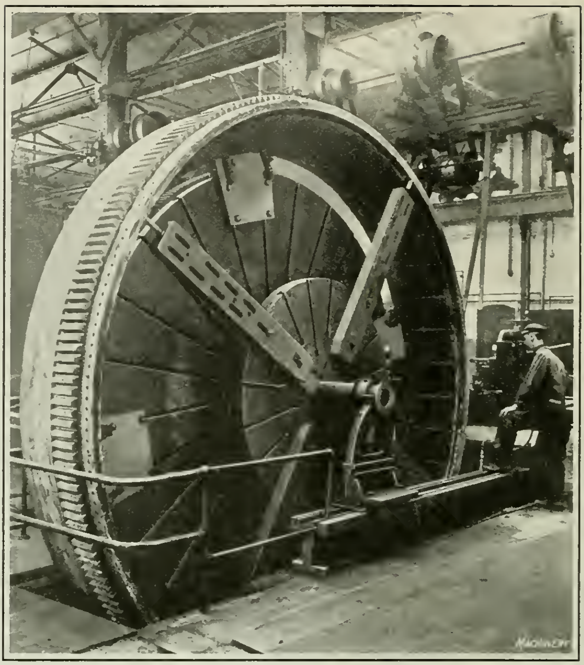


Fig. 2. Gear Planer provided with a Pit for swinging Large Gears

As a general rule, gears having a circular pitch of two inches and smaller are planed with tools which are used for both the sides of the teeth and the fillets at the bottom, but for coarser pitches, different tools are used for the sides and the fillets. A line representing the root circle is marked on one side of the gear blank, preferably by using a sharp-pointed tool at the time the blank is turned. When these gear planers are used for cutting internal gears, a special attachment is employed, which will be described in a subsequent article in connection with the cutting of internal gears.

Examples of Large Spur Gear Planing

When gear planers are used for gears having a larger radius than the distance from the center of the work-spindle to the floor, a pit is provided in order to increase the capacity of the machine. Figs. 2 and 4 show front and rear views of a planer at the Gleason Works, Rochester, N. Y., cutting a large gear which enters a pit beneath the floor. This machine is similar to the type just described. The gear teeth are on a large ring-shaped casting. In order to hold this casting, a large auxiliary faceplate was mounted on the work-spindle. The regular faceplate is located in front of the auxiliary faceplate. Four supporting arms are bolted to each of these faceplates for holding the ring-gear in position. As Fig. 4 shows there are gear teeth on the rim of the auxiliary faceplate to permit revolving it by a direct drive when it is necessary to turn the rim of a large gear which is beyond the capacity of machines generally used for turning operations. These planers for large gears are equipped with

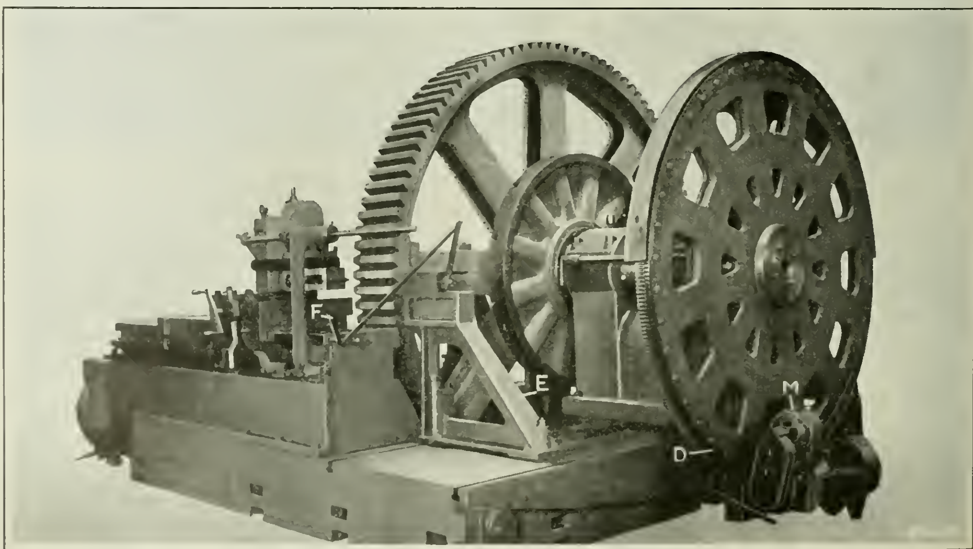


Fig. 3. View of a Spur Gear Planer showing the Indexing Mechanism and Large Dividing Wheel

dividing wheels of large diameter (see the illustration Fig. 4) to minimize indexing errors.

Another example of large spur gear planing is shown in Fig. 5. This illustration was obtained from the plant of the Farrell Foundry & Machine Co., Ansonia, Conn. An idea of the size of this gear may be obtained by comparison with the operator. The pitch diameter of the gear is 16 feet 10½ inches, the circular pitch 6 inches, and the face width 18 inches. This is another operation illustrating the use of a pit to provide room for swinging a large gear. It will be seen that this planer is of the same design as that illustrated in Fig. 1.

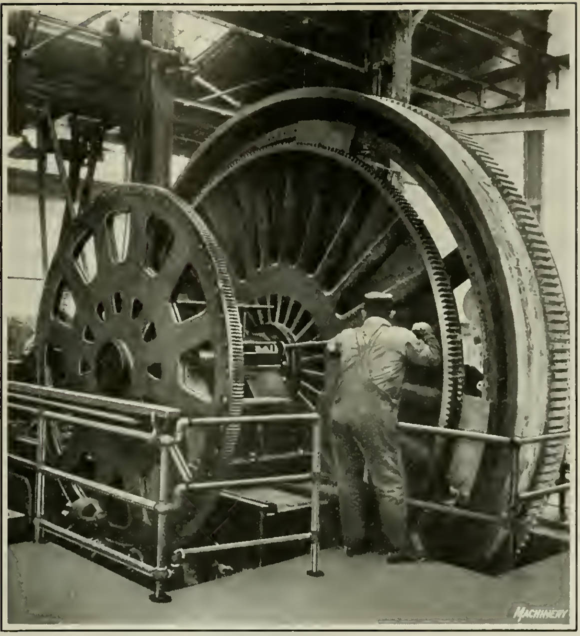


Fig. 4. Rear View of the Planer shown in Fig. 2. Note Large Dividing Wheel at Left-hand End of Work-spindle

Combination Gear Planers

Planers designed for cutting either spur or bevel gears differ from the type used for spur gears only, especially in regard to the arrangement of the main slide upon which the head is traversed. One end of this slide is provided with both vertical and horizontal bearings. The vertical bearing permits it to swing horizontally, and the horizontal bearing provides for a vertical movement. A feeding mechanism controls the horizontal motion, whereas the vertical movement is controlled by a former engaged by a roller attached to the outer end of the main slide. These combined horizontal and vertical movements cause the tool to follow the converging form of a bevel gear tooth. The toolholder used for bevel gears does not have a cross-feed relative to the main slide, but when planing spur gears another tool-head having this lateral feeding movement is used and then the main slide is held stationary in a position parallel to the axis of the gear. On planers of the combination type, the head which carries the gear blank has not only a side adjustment to care for different diameters, but also an adjustment that makes it possible to set bevel gears of different angles so that the apex of the pitch cone of the gear will coincide with the "center of the machine."

Gear Teeth Cast to Approximate Shape

Rough or unplaned blanks for large gears, such as are cut on the templet type of gear planer, ordinarily have rough-cast teeth, which are left thick enough to allow for planing. When the teeth are cast, it is not necessary to remove so much metal when machining them, although these cast teeth have a hard scale which offsets, more or less, the advantage men-

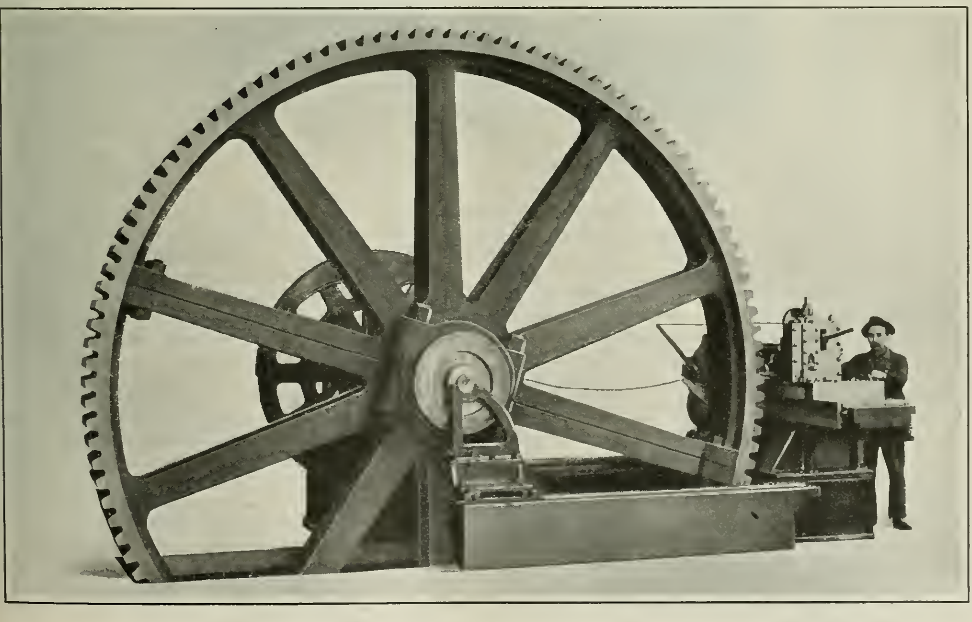


Fig. 6. Planing a Spur Gear having a Pitch Diameter of 16 Feet 10½ Inches and a Circular Pitch of 6 Inches

tioned. Because of this fact it is easier to cut the teeth "from the solid" in some cases; however, there is a good reason for casting the teeth to the approximate shape required. When the teeth of large gears are cast, this tends to insure soundness in the rim of the casting and tooth surfaces free from defects. On the contrary, if coarse teeth are cut from a solid rim, blow-holes or other interior defects might be encountered, especially in those rim sections adjoining the spokes or arms. According to one authority, there is no advantage in casting the teeth if they are smaller than one diametral pitch.

Cutting Large Gears on Templet Planer of Vertical Design

Another design of gear planer adapted for machining large spur gears is illustrated in Fig. 6 which shows a machine built by the Newton Machine Tool Works, Inc., Philadelphia, Pa. The tool-slide has a vertical reciprocating movement when the machine is at work. This traversing motion is derived from a rack and spiral pinion drive, the latter being rotated in opposite directions by open and cross belts similar to the arrangement of a planer drive. The vertical column may be adjusted along the horizontal bed to suit the diameter of the gear, and this machine will plane gears up to 40 feet in diameter.

The templets controlling the path followed by the tool as the latter feeds inward are attached on each side of the tool-slide. One templet controls the tool movement when planing one side of the teeth, and the templet on the other side of the tool-slide is used when planing the opposite sides of the teeth. When the planing tool is at the top of its stroke, it feeds inward for taking the next cut and at the same time the tool-slide is given a lateral movement under control of whichever templet is in use. This lateral movement is obtained from a "star feed" in conjunction with a friction device, that allows for whatever slipping may occur after proper contact with the templet has been obtained. The indexing movement is derived from a motor which transmits motion through change-gears and worm-gearing to the work-table. This indexing mechanism is controlled by simply releasing a hand-operated plunger which allows the motor to rotate the work-table and gear an amount equivalent to the circular pitch.

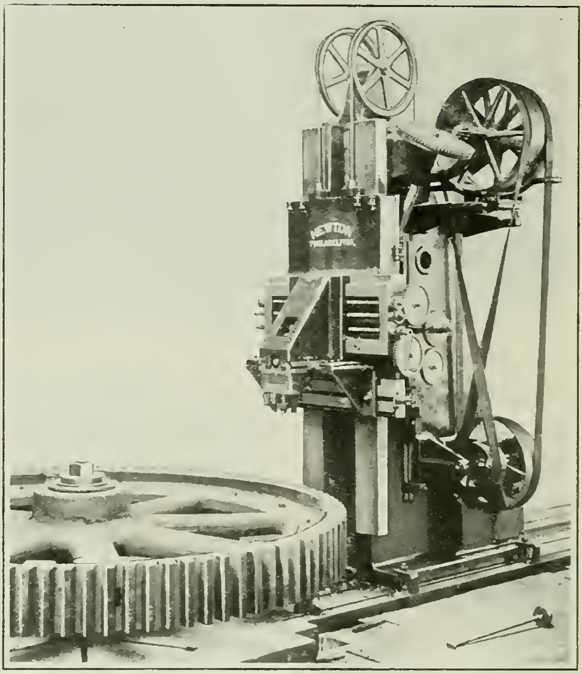


Fig. 6. Spur Gear Planer of Vertical Design

* * *

France is now the leader among European nations in tonnage of iron ore reserves, having 35 per cent of the total tonnage for the Continent; the United Kingdom follows with 18 per cent, Sweden with 12.5 per cent, and Germany with 11 per cent. Central and southern Russia, Spain, and Norway are the only others possessing more than 2 per cent of the total, according to a recent report (Bulletin 706) issued by the Geological Survey.

NUMBERING TOOL DRAWINGS

By JOHN E. COLLINS

Having twice been called upon to devise and install a drawing number system, and believing that the simplest way of doing anything is always the best, the writer developed the following method of numbering tool and pattern drawings. No cross-index systems are required to find the tool drawing for any part, or to determine from a tool drawing what parts are to be machined with the tool shown on that drawing.

The part number the tool is designed for is used in all cases as the base for the tool number. Thus if the part number is 4500, the tool number will also contain the number 4500. This ties the tool number up with the part it is to be used on. To take care of tools of different sizes, it is necessary to have the drawings on sheets of various sizes. This makes it desirable to include some method of noting the size of the sheet on which the drawing is made, as a separate file is preferable for each size drawing regularly used.

The tool numbers for the various operations on any one part are distinguished from one another by simply using the operation number of the part. On the tool drawing sheet a space is provided at one side of the general title for the model and part number. If at any time a new model is released for manufacture and the tool can be used on this model also, this information is noted on the tool drawing. It should be remembered that the details must be drawn on sheets which are the same size as those used for their tool lay-out drawings.

For example, let the tool number 4-4500-6 be selected. The first number 4 identifies the sheet size. In the plant under consideration there are four sizes. The number 4 indicates that the sheet is 24 by 36 inches. The number 3 would indicate a sheet 18 by 24 inches, number 2 a sheet 12 by 18 inches, and number 1 a sheet 9 by 12 inches. Therefore, if we have the tool number we also have the sheet size, which in turn indicates what cabinet and drawer it is filed in.

The next number is the part number 4500, which identifies the tool with the part. By knowing the part number it is an easy matter to find the tool number, or vice versa. The last number 6 identifies the operation number on the part 4500 and at the same time serves to distinguish between tools used on the same part. If more than one tool is used for one operation letters A, B, C, etc., are used to identify them.

Tool pattern numbers are the same as tool drawing numbers. If more than one pattern is required for any one tool, the pattern numbers have a prefix attached, thus: A, B, C, etc. The operation-sheet forms are typed on very thin paper with carbon paper backing up the letters on the rear side This allows any number of duplicate blueprints to be made from the original operation sheets.

Operating a Factory with a Reduced Force

By JOHN C. LEASE, General Superintendent, Houston, Stanwood & Gamble Co., Covington, Ky.

THE organization and methods for operating a factory economically when run at full capacity are not always applicable when the factory is running at only 25 or 30 per cent of capacity. Many manufacturers have become keenly aware of this fact during the past year. At the Houston, Stanwood & Gamble plant the problem arose of operating the factory profitably at 30 per cent capacity. By adopting a unique method of control and enlisting the interest and co-operation of the employes, it has been possible to accomplish noteworthy results in this direction, and the factory has been run on a paying basis in spite of the reduced business.

Chart Showing Productive and Non-productive Labor

In any scheme of management the secret of success is to reduce the non-productive labor hours to a minimum, while maintaining the productive labor hours at a maximum. The first thing to be done in running a factory on a reduced scale is to investigate the proportion between productive and non-productive labor hours. The term "productive labor hours" means time spent in directly producing such products of the company as are sold to customers. The expression "non-productive labor hours" designates time spent on maintenance and equipment, experimental work, store-rooms, supervision, shipping, watchmen, etc. If an investigation is made in the average shop during the period of depression when the shop is engaged at but a small percentage of capacity, it will be found that non-productive working hours run up to an unexpected figure, as compared with productive hours.

Fig. 1 shows what such an investigation revealed in the plant of the company referred to, when the system of control to be described was first put into operation. There were 1750 non-productive hours per week, as compared with 2450 productive hours. The first step was to reduce to a minimum the amount of non-productive labor being performed about the shop, and, as will be noted from the chart, in three weeks' time the non-productive time was reduced to 618 hours. Meanwhile the productive hours decreased also, due to a lack of orders, but the proportion between productive and non-productive hours was far more favorable at the end of the three weeks than at the time when the chart was begun. At the end of each week the total number of productive and non-productive hours is noted on the chart, and the entire scheme of holding down the non-productive work is explained to the employes, so that they take a remarkable interest in seeing the productive curve rise while the non-productive remains either stationary or falls. It has been explained to the employes that only by increasing the productive labor hours in proportion to the non-productive can the firm expect to do a business profitable enough to keep them permanently employed, and the interest taken in this matter by everybody in the entire factory is an indication of the possibilities of teamwork within an organization, when all the problems pertaining to the manufacturing program are explained and understood by the employes.

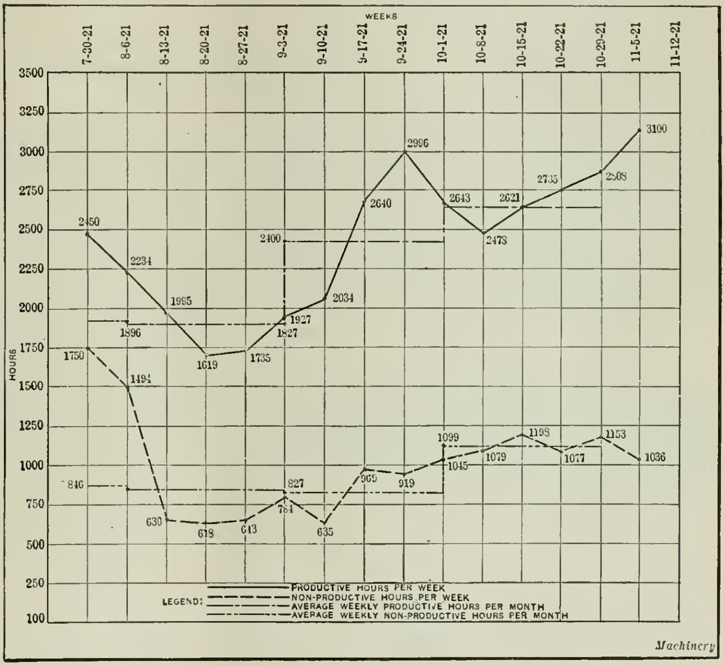


Fig. 1. Chart showing the Relation between Productive and Non-productive Hours, Weekly and Monthly

Operation of the System

Besides the general superintendent, two men are employed to keep the system running. One is the production supervisor, who makes every effort to increase the productive hours. The other is the employment manager and timekeeper, who acts as a clearing house for the hours spent both in productive and non-productive work, and who, in addition, is directly responsible for holding down the non-productive hours. The employment manager, of course, has a complete record of all men employed in the plant. If a foreman in a given department finds that he will be short of work for a certain number of men within a few days, he notifies the employment manager, who then transfers these men to some maintenance work that may have been held up for the time being but with which it may seem advisable to go ahead, employing the men temporarily idle. Should there be no non-productive work to be done, it will be necessary to reduce the force. However, one of the objects of the system of transferring men from productive to non-productive work is to keep the men permanently employed as long as possible, giving them a steady job in the shop, even though they have to do a variety of work in the course of their employment.

Reports on which the Chart is Based

Each day a shop labor report is prepared by the two men who have charge of the productive and non-productive labor, respectively, and this report is added to the records of the employment manager from which the chart shown in Fig. 1 is constructed. This shop labor report is arranged as shown in Fig. 2. It gives the number of hours spent on productive work, on standard machinery orders and special orders, and the number of non-productive hours spent on maintenance and equipment, experimental work, etc.

Shop Labor Report								
Description	Daily Time Entries							Total for Week
Sales Orders								
Special Orders								
Stock Lots								
Total Productive Hours								
Maintenance & Equipment								
Machine Shop								
Foundry								
Pattern Shop								
Experimental								
Stores and Traffic								
Watchman & Supervision								
Total Non-productive Hours								
Number of Men Employed								

Fig. 2. Daily Shop Labor Report of Productive and Non-productive Hours, used in laying out Chart shown in Fig. 1

Record of Productive and Non-productive Men in the Shop

A record of the number of productive and non-productive men in the shop is kept by the employment manager on a chart which shows the plan of the shop, as indicated in Fig. 3. Each circle indicates a productive man, and each black dot a non-productive man. A dot within a circle indicates a working foreman. The dots and circles are not put in with ink but with crayon, so that they can be easily removed and replaced, and in this way a graphic index of the number of productive and non-productive men in every department is always before the eyes of the general superintendent, the production supervisor, and the employment manager.

Transferring the Men from One Job to Another

The employment manager keeps a list of all the machines and occupations within the plant, which gives the names of the men capable of performing the work under each head. This list is known as a key sheet, a sample of which is shown in the accompanying table. From this sheet it can be quickly determined which men are capable of operating several machines, so that when work on one machine runs out, they can be transferred to a job that is waiting to be done on some other machine. In this way it is possible to run the shop efficiently with a greatly reduced force, and to retain men capable of operating a number of different machines so that all the required work can be handled without hiring a great number of men that are specialists on one machine only. The key sheet helps to solve the problem of operating a plant with a small force of men during a period of depression.

Every plant would have to devise some modifications in a system of this kind to suit its peculiar conditions, but it is believed that the outline given will suggest to the managers of machine shops in general how an effective control may be established to prevent the overhead due to unproductive labor from becoming too large during times of depression. The key sheet also indicates how, by employing not more than, say, twenty-five men, it is possible to fill the jobs for which eighty-five men would normally be required. It is evident that such a key sheet is very valuable in determining which men should be laid off in case there is not enough work to be done. The men who have the best all-around experience would naturally be kept, and those that could not be transferred readily from one machine or job to another would have to be dispensed with first. The details of the system can be readily worked out for each shop according to the local conditions. No attempt has been made to explain anything but general principles. At this time, when so many plants are operating on a reduced schedule, an idea such as outlined should prove especially valuable. It is not a mere theory, but has proved its applicability.

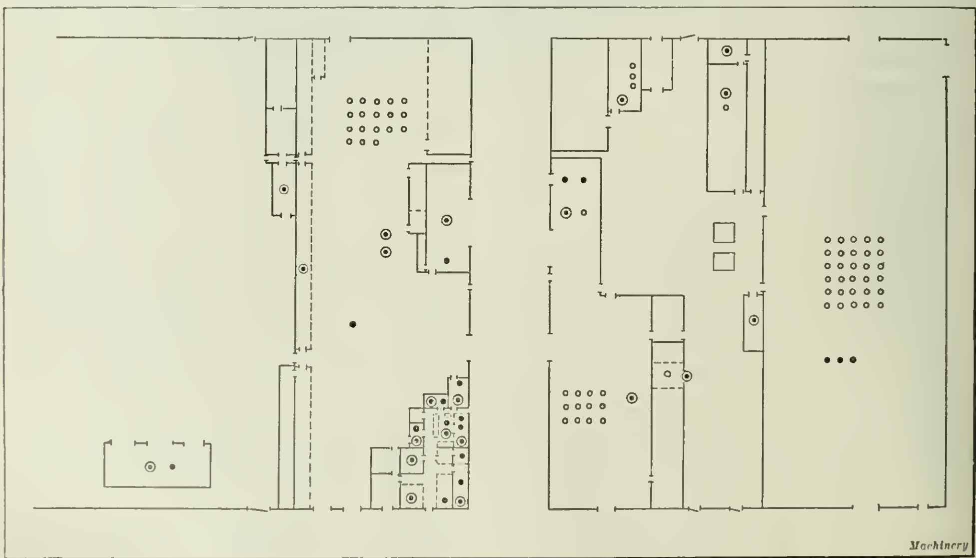


Fig. 3. Lay-out showing the Disposal of Productive and Non-productive Labor about the Plant

KEY SHEET SHOWING DIFFERENT JOBS WHICH THE VARIOUS EMPLOYES CAN HANDLE

Vertical Boring Mills	**Toolmakers**	**Bench Vises**	**Horizontal Boring Mills**	**Oilers**
Brown	MacIntosh	Cooper	Green	Hogan
Johnson	Wilcox	Wilcox	Jones	Cohen
R. Williams	Cooper	Thurston	**Drilling Machines**	**Electricians**
Keyseaters	**Turret Lathes**	MacIntosh	Johnson	Hewitt
Smith	Hoover	**Assemblers**	R. Williams	Lynch
Olsen	R. Williams	Jones	Brown	**Painters**
Martin	**Grinding Machines**	Johnson	**Sweeper**	Dixon
Small Lathes	Wilson	Cooper	Cohen	Klein
Thurston	Cooper	Smith	**Casting Cleaners**	**Firemen**
Wilson	Thurston	Connor	Jones	Bradley
MacIntosh	MacIntosh	Booth	Riley	Riley
Wilcox	**Hydraulic Presses**	J. Williams	**Repair Workmen**	Hogan
Hoover	Connor	Hoover	Booth	Cohen
Large Lathes	Booth	**Planers**	Connor	**Engineers**
R. Williams	**Milling Machines**	Olsen	Bradley	Lynch
Brown	Wilcox	Martin	Smith	Hewitt
Roughing Lathes	Green	J. Williams	**Work Distributors**	**Packers**
Martin	Jones	Johnson	Hogan	Klein
Johnson	Wilson	Smith	Riley	Dixon
Brown	**Gear-cutters**	**Shapers**	Bradley	....
	Green	J. Williams	**Carpenters**	....
	Jones	Olsen	Klein	
	Cooper	Smith	Dixon	

COUNTERBORING ATTACHMENT

By D. A. NEVIN

Seventy-five thousand brass parts like the one shown at *A* in the illustration were required to have the 0.437-inch hole counterbored or burred to a square bottom and sized concentric with the outside diameter. This could not be done economically on the automatic screw machine employed for the preceding operations, because of the loss of time resulting from the slow feed for which the automatic machine was set, and the necessity for frequent sharpening of the counterbore. Rechucking in the hand screw machine was undesirable, as it would tie up a high production machine on a comparatively simple job which required the use of but one tool. Also the amount of unnecessary floor space which would thus be devoted to this operation, and the inaccuracy which would probably result from the use of a counterbore held in the turret without a pilot were also factors to be considered.

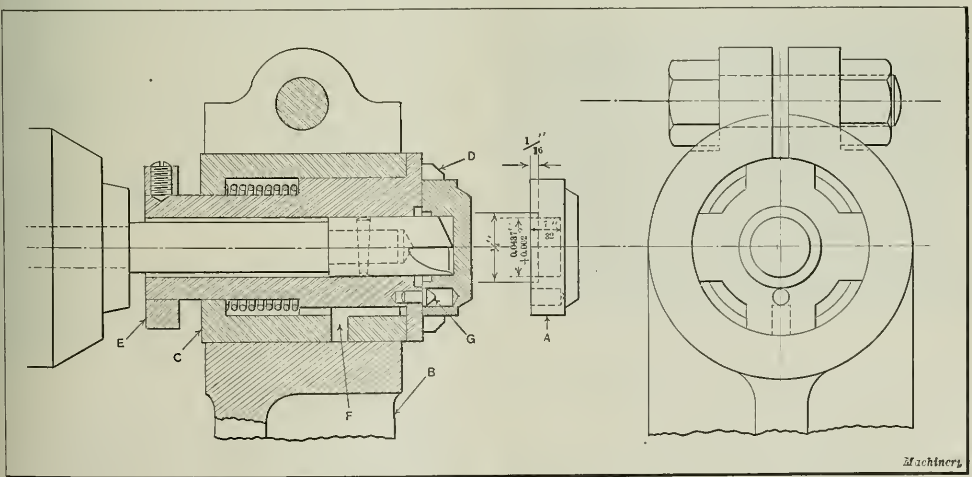
There were several small lathe heads in the store-room which had been used a number of times for tapping and burring. One of these heads was mounted on the bench with the chuck facing the operator and the counterboring attachment added as shown. The bracket *B* is attached to the lathe head and carries the bearing *C*. The spring-operated work-holder *D* is retained in bearing *C* by the collar *E*. Part *D* is keyed to bearing *C* by the key *F*, and the work is driven by the pin *G*.

This and other similar jobs were performed very rapidly by the use of the attachment, as the work is simply placed in the pocket and pushed against the cutter with the thumb. In the sectional view the work is shown in position with the counterbore or cutter at the bottom of the cut. There is probably a considerable amount of hand screw machine work in various factories that could be performed with this device. For general use, it would be necessary to employ interchangeable work-holders, and provide longitudinal adjustment for stop-collar *E*.

* * *

FOUNDRYMEN'S CONVENTION

Announcement has been made that the annual convention and exhibit of the American Foundrymen's Association which was scheduled to be held during the week of April 24 in Cleveland is to be held instead in Rochester, N. Y., from June 5 to 9. All activities of the association will be centered at Exposition Park, which is located a mile and a half from the center of the city.



Counterboring Attachment for Lathe Head

Price and the Machine Tool Salesman

By a Machine Tool Sales Manager

EVEN in the best of times most salesmen are somewhat reticent when they must talk price. They will talk about their product ardently and demonstrate it enthusiastically, until they create an interest and the prospective customer begins to view the article with an eye to its possession. When he wishes to learn the consideration necessary to possess it, the tone of the salesman often changes from one of aggression to one of hesitation. This change frequently makes the prospective customer feel that while the salesman has confidence in the product, he has no confidence in its price.

This lack of confidence is sometimes expressed as well as implied. Recently a buyer needed a collet for a machine previously purchased. When he asked the salesman the price of the collet, he replied: "I am almost ashamed to tell you; it is $11." The collet was not purchased—not at that time.

The salesman's reason for his attitude on price may be that he wishes his customer to notice that he is looking out for the customer's interest. If machine tool prices are or were at any time exorbitant, this would be a commendable attitude on the part of the salesman, but machine tool prices are not high—a fact that may easily be proved by comparative figures—and for the salesman to intimate this in any way borders on misrepresentation. It also creates a misconception in the mind of the buyer that sooner or later must be corrected.

The Salesman's Attitude toward Price

The price of every article is always a factor in its sale, but at no time should this be the sole factor. It is not good salesmanship to dwell too much on the price or even to quote it before explaining the value of the machine itself. On the other hand, there is no reason why the salesman should fear to talk price. Price is a feature of the product. It is so related to the quality of the product that any salesman should feel free to speak of it in bold-face type instead of whispering it in parentheses.

Some machine tool salesmen avoid quoting a price at the time of an interview and state that they will make a formal quotation. This puts too small a value on the importance of price and postpones a decision on the part of the buyer. It is human nature to procrastinate in the spending of money (at least for useful purposes). The salesman generally is not present when the formal proposal is studied, and he has no opportunity to answer questions relative to price. Simply stated, the salesman puts up a fight for the mechanical features of the machine and runs away to let the price shift for itself.

The Relation of Price to Output

In most products there has been a sad lack of stability of price that has caused buyers to be reluctant in placing orders. In the machine tool industry there is uo just basis for hesitancy. It is one of the salesman's problems, however, to bring this phase before the buyer in its true light, and to explain the conditions to the customer. Back of every machine tool there is usually some definite proof that may be presented to show the buyer that the price is a reasonable one—not to say a favorable one.

The builder of a production machine tool recently decided to talk to his prospects in terms of output only. Instead of merely stating that the price of the equipment is so much, he also quotes the cost of the operation per piece. The cost of the equipment—the "cost of ownership"—was figured at 6 per cent interest on the original outlay, with depreciation at the rate of 10 per cent per year. Two thousand production hours in a year were assumed. The interest and depreciation divided by 2000 represents the cost of the machine per production hour. Then there are the items of overhead, aside from the interest on the investment and depreciation —such items as rent, light, heat, power, and upkeep. These miscellaneous items were assumed and added to the "cost of ownership." This particular concern allows 30 cents per hour for the miscellaneous items per machine. A $3000 machine on this basis would equal cost, in total, 54 cents per hour. To this cost is added the operator's rate, and this sum, divided by the production per hour, gives the cost per piece.

The whole problem may be expressed by the formula:

$$x = \frac{(A + B) \div C + D + E}{F}$$

in which

x = cost of production per piece, in dollars;
A = interest on investment (6 per cent of cost of equipment);
B = depreciation (10 per cent of cost of equipment);
C = production hours per year (assume 2000);
D = cost of overhead per production hour, in dollars;
E = operator's rate per hour, in dollars; and
F = number of pieces produced per hour.

This method of arriving at the cost per piece may seem somewhat roundabout, but it is more effective than merely assuming a fixed rate per hour, because it shows what items the salesman has taken into consideration in arriving at the cost per piece. Also, the methods of computing shop costs vary widely and are understood often only by the auditor or the cost department, and these departments ordinarily are not consulted in the selection of new equipment.

Another way of justifying the price of machine tools is by the use of comparative figures. Take the composite price of 327 commodities as published by the United States Department of Labor, and compare this with the price of machine tools, in 1914 and in 1922. This comparison will show that machine tools have closely followed the general price curve, and the salesman can prove that any delay in the purchase of a machine tool is unwarranted. Besides, there have been improvements in design and workmanship in most machine tools, and the price will never be as low as before such improvements were made.

Another comparison that is worth while is the relative prices of machine tools and pig iron. Beginning with 1915, and assuming that pig iron and machine tools then had a definite relation in price, it can be shown by a chart that during the years 1917, 1918, and 1920 pig iron rose to a much higher level than machine tools, while in 1919 the two followed closely together, and in 1921 both showed the same downward trend. Pig iron, on account of the conditions, fell somewhat more rapidly, but recovered, while machine tools show a steady decline commensurate with the reductions in raw materials and wages.

Improvement in Quality and its Relation to Price

An example of the effect of improvements on price recently came to the writer's attention. A machine tool manufacturer who formerly used cast iron and soft steel gears is now using heat-treated steel gears that cost five times as much to produce. Such great changes should be pointed out to the buyers of machine tools in order to explain to them thoroughly the reason why improved quality must demand a higher price.

It is doubtful if any machine tool salesman who studies the problem of manufacturing costs can come to any other conclusion than that machine tool prices today are low in proportion to prices of most other manufactured products. When he has thoroughly studied the subject and come to this conclusion, he is prepared to speak authoritatively on the price question. He may even come to share the opinion of many manufacturers in the machine tool field that some prices of machine tools are now too low and that renewed activity will bring about increases. At this point his real work today begins—to prove and to transmit to the buyers of machine tools the information that he has gathered as to machine tool prices. Armed with the actual facts in the case, he need have no hesitancy on the question of price when making a sale.

* * *

STRAIGHT PIPE THREADS

By J. R. SHEPPARD

Referring to the article on straight pipe threads, appearing on page 492 of February MACHINERY, the writer offers the following additional information:

When hydraulic pressures of 2500 pounds per square inch and over are used, the best practice demands the use of straight threads. In this case a double extra heavy pipe is used, and the gasket placed between the ends of the pipes. The flanges then act simply as connections to hold the ends of the pipes together, the pipe protruding through one flange, while the other flange is counterbored to form a pocket that confines the gasket. With this arrangement, there is only one joint; whereas, if taper threads were used, there would be three joints for each flange connection. The same is also true for plugs for these high pressures, straight pipe threads being used and the joint made with a gasket at the bottom of the plug.

* * *

THE FOREIGN MARKETS FOR MACHINERY

The Industrial Machinery Division of the Bureau of Foreign and Domestic Commerce has issued a review on the expanding markets for machinery, pointing out that while the flow toward Europe represents a smaller percentage than formerly, the demand in certain other sections is rapidly rising. While Asia absorbed only 7.4 per cent of the American machinery exports in 1910, this market absorbed about 25 per cent in 1921. The statistics indicate that the markets that have shown the greatest activity in 1921, compared with pre-war years, are to be found in British India, Dutch East Indies, Japan, China, Mexico, Argentina, Brazil, and Cuba. Considering the machinery field as a whole, it appears that there is reason to be optimistic regarding the machinery markets in these countries as well as in Australia and South Africa. In certain lines of machinery, these markets have absorbed much of the exports that normally would have gone to Europe.

* * *

A joint meeting of the Virginia sections of the American Society of Mechanical Engineers, the American Society of Civil Engineers, and the American Institute of Electrical Engineers was held at the Virginia Polytechnic Institute at Blacksburg, Va., February 17 and 18. The subjects dealt with pertained particularly to the distribution and production of coal, and papers were read on the transportation of coal, the electrification of railroads, and coal combustion. A visit was made to the power station at Bluestone Junction, where experiments are now being made with pulverized coal fuel equipment, and a trip was also made to Pocahontas, Va., to see the coal mining operations in this well-known mining region.

CHAMFERING RING BEVEL GEARS

The chamfering of the outer edges of bevel gear teeth is sometimes an advantage, but in doing this work, it is often difficult to produce a neat-looking job. As the result of some experimenting, the Illinois Tool Works of Chicago, Ill., have made successful application of the hobbing process for this purpose. A special hob has been developed, as illustrated in Fig. 1, where a No. 18 Gould & Eberhardt hobbing machine is shown engaged in beveling the teeth of a spiral bevel ring gear. A section of this gear with a number of teeth is

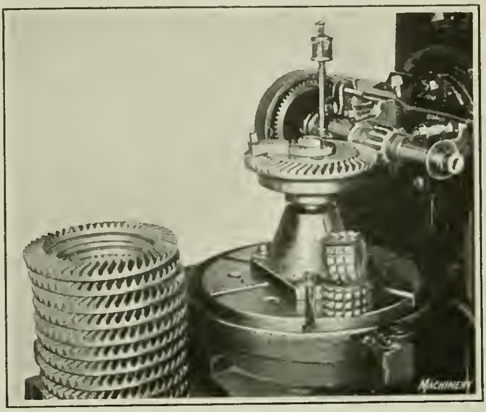


Fig. 1. Chamfering Gear Teeth on the Hobbing Machine by the Use of a Special Hob

shown in Fig. 2, from which it will be noticed that the work presents a neat appearance and that all teeth are uniform.

Owing to the continuous generating action of the hobbing process, and to the fact that very little stock is removed in the operation, the work may be performed with considerable speed. For example, in a recent trial, ring bevel gears having fifty-five teeth were chamfered in forty-five seconds each, floor to floor. It is believed that this performance can be duplicated by using these special hobs with any suitable hobbing machine. It is necessary to provide a work-holder having a quick-releasing feature, by means of which the ring gears may be located accurately and held securely, and this is the only extra equipment required for handling work of this kind. The hobs, except in the very coarse pitches, are

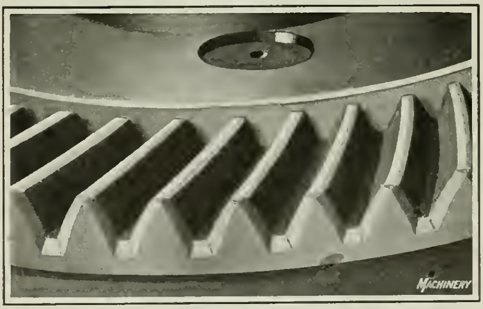


Fig. 2. Section of a Ring Bevel Gear showing Teeth which have been chamfered

of standard dimensions, that is, 3½ inches in diameter and 3 inches long, as this size is best suited for the purpose. Hobs of this length allow for shifting into several positions to make use of all the teeth before they need to be removed for regrinding. The life of a hob used for this work will extend over a long period of time, because it is only necessary to sharpen the hobs at intervals of several days.

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BALL BEARINGS FOR LINESHAFTS

It has long been claimed by manufacturers of ball and roller bearings that considerable saving in power would result from the use of such bearings for lineshafts, and recent experiments made by one of the well-known ball bearing manufacturers have demonstrated the justice of these claims. The experiments referred to were made in textile mills, where it was found that when the lineshafts were running idle the power saving due to the use of ball bearings amounted to from 9 to 25 per cent. When the spinning machines were running, the load on the lineshaft being fully thrown on, the saving amounted to from 6 to 7 per cent of the total load.

The saving of so comparatively small a percentage is not a small item in dollars and cents. One of the installations, where the experiments were conducted, paid for itself within a year on account of the saving in power, and another paid for itself in six and one-half months. With coal selling at high figures these power savings are well worth while; and, generally speaking, after the first year the saving is all "velvet."

The economy resulting from the use of ball and roller bearings for lineshafts is applicable to small installations as well as large ones. In a small factory where the power cost averaged between $36 and $40 a month, and $200 was spent on installing ball bearings, the power cost was reduced to from $23 to $26 a month. In other words, the saving in a single month was sufficient to pay a large annual interest on the first cost of the bearings, or, figured in another way, the entire cost of the installation was repaid in about eight months.

* * *

TRAINING FUTURE EXECUTIVES

The president of a large locomotive company recently said that quite a number of executive positions in his organization remain vacant because of the difficulty of finding men capable of filling them satisfactorily. Had young men of the requisite ability and energy been trained in time to fill the higher positions as the opportunities arose, capable men would have been ready. But the management is by no means entirely responsible for this condition, for usually the heads of large businesses are constantly searching for and trying out men who apparently have the making of future executives. Those they try out line up from mediocre to fairly good. Seldom is a star executive developed. In one concern more than a hundred outside young men were looked over in a careful but vain effort to find an office executive. The head of one of our largest concerns recently said that he never expected to find one hundred per cent men. He felt lucky if he found eighty-five per centers, and this is true generally, especially among shop men, who are less likely than office men to have the advantage of education in their youth.

It is usually difficult to obtain from the outside a thoroughly trained and satisfactory executive. Such men lack the necessary familiarity with essential details of the business, and they must be engaged for a long period at high salaries, which they are not always worth. The ideal method is to train men taken from the organization, because those who have worked for a concern for a period of years usually possess a more thorough knowledge of its product, policies, methods and needs than an outsider.

A large manufacturer in the Middle West is at present endeavoring to develop executives by means of a series of meetings and studies which bring the plant superintendent and a number of the other executive heads of the company in close contact with the foremen and others in minor executive positions. During these conferences such subjects as principles of inspection, production management, time and motion study, wage payment systems, duties of foremen and other minor executives, and methods of handling men efficiently, are brought up. In this way the management is afforded an opportunity to form a sufficient estimate of the judgment and ability of some of the subordinates to warrant trying them out further.

* * *

MECHANICAL AND MARKETING PROBLEMS

The head of a large machine tool plant, when recently asked what in his opinion were the most important questions for machine tool builders to consider during present conditions said that they should devote their time principally to three distinct problems:

First, they should develop the design of their machines to the highest point of productive efficiency, profiting by their experience during the high productive period since 1915. If they do not feel warranted in spending money on actual development and experimental work, they should at least give all the thought possible to working out designs carefully on paper, so that the resulting improvements can be quickly turned into concrete form when the market warrants.

Second, machine tool builders should study the methods used in their own plants with an eye to reducing manufacturing costs and to improving the accuracy of their product. Machine tool builders could often profit, this manufacturer said, by applying in their own plants methods of interchangeable manufacturing which some of them have developed for their customers. By applying the unit system of design and construction to a line of machine tools, it would frequently be possible to produce many parts of the machine in greater quantities and at a reduced cost.

Third, they should not lose sight of the possibilities of foreign trade in non-European countries. It is not likely that Europe will buy many machine tools for several years; but there is a constantly increasing market in other parts of the world. Japan, China and India, for example, imported, in value, more metal-working machinery in 1918 than England and France combined imported in 1910, and almost as large an amount as England, France, and Germany combined imported from the United States in 1909. In 1919 and 1920 the imports of metal-working machinery into Asia were greater than in 1918, and it is expected from present figures that in 1921 the entire value of our metal-working machinery going to Asia will be nearly $6,000,000—three times the value of the metal-working machinery sold to England and France in 1910. Australia also offers a growing market, and the same is true of South America. These markets may offset the important pre-war European markets, now dormant, and competition with England and Germany will undoubtedly be keen in all of them. For that very reason our machine tool manufacturers should study them carefully and prepare themselves to meet the competition there.

The Supply of Used Machine Tools

DURING the war period, machine tools were built in much larger quantities than would have been required for the normal needs of the country in peace time. For much of this machinery there appears to be no immediate use; hence it is generally believed that large quantities of such machinery are for sale—a quantity vastly greater than was normally on the market in pre-war years. Manufacturers as well as users of machine tools share this belief, which is a logical inference from past and present conditions. Nevertheless, there were many indications that the supply of used machinery was not materially greater than in pre-war years, and MACHINERY undertook to get the facts from the War and Navy Departments and from dealers in used machinery, and others, throughout the country. The results we are now able to place before the machine-building industry and the users of machine tools in other fields.

It is generally believed by manufacturers as well as buyers of machine tools that there are very large stocks of used metal-working machinery which will seriously affect the market for new machine tools. MACHINERY has investigated the situation, and the results are given in the present article. There is no substantial foundation for the belief that large stocks of used machinery are available. Neither the War and Navy Departments nor the dealers in used machinery have any abnormally large stocks of such machinery.

The Effect of the War

While enormous quantities of machine tools were built during the war, thousands of machine tools were used up during that period. Machines of older types considered adequate up to that time were found useless for the hard service required by war conditions, so that while there was a tremendous increase in the number of machine tools built, there was also a great increase in the number of machine tools scrapped; and at the end of the war, many of the machines bought specifically for the manufacture of munitions and other war supplies had been used so severely that they were not marketable as used machinery. An instance may be cited: One of the largest plants in the country advertised for sale early in 1919 a large quantity of machine tools used in its munitions plants, but the prospective buyers found them so far below par that most of them had to go to the scrap heap.

Furthermore, much of the machinery built at that time was special in nature, and while it added to the curve that showed an increase in machine tool production, it did not add to the available supply of machine tools for general purposes. We have seen several hundred shell turning lathes in the yards of a large plant ready to be broken up for scrap, there being no further use for them; and recently the Government offered for sale some fifty lathes of a well-known make built for a special purpose, having neither lead-screws nor carriages. It is easy to imagine how much sale there will be for lathes of this kind in the used machinery market.

Present Government Stocks

The War and Navy Departments have nothing like the big stocks of machine tools on hand with which they are generally credited. Most of the machinery to be disposed of by these departments, where the machines are of general applicability, has been sold. Machines built for special purposes, and obsolete machines for which there is no market, are still available, although many have been scrapped, especially by the Navy Department.

In addition to the machine tools sold by the War Department in this country since the war, large quantities were sold abroad, and a considerable percentage was acquired by the schools and colleges under the provisions of the Caldwell Act. To be sure, there are still War Department machine tools on the market, and additional ones will doubtless be offered for sale, but the quantity is not such as to warrant any apprehension on the part of the machine tool industry.

The Navy Department's records do not show any considerable quantity of machine tools for the market. Such machines as turning and boring lathes, and special single-purpose tools, which were required during the war period, have been absorbed by the various naval shops, or otherwise disposed of. A considerable quantity has been scrapped because there was nothing else to do with them. It is stated by the Navy Department that machine tool manufacturers need not be apprehensive about any large offerings of machine tools by the Navy.

Stocks of Dealers in Used Machine Tools

A canvass of the used-machine tool trade shows that most of the leading dealers in used machinery have no larger stocks (by volume) of such machine tools at present than they considered normal in pre-war days. A few have a smaller stock by volume—if not by value—than they carried before the war, and a small percentage have larger stocks—two or three considerably larger stocks. There are some exceptions, of course, but the fact is that the dealers, generally, have not stocked up to an extent appreciably exceeding their pre-war supply.

As compared with a year ago, about one-half of the dealers report that they are keeping their stocks at about the same level. Most of the remainder report smaller stocks, and only a few report larger stocks than a year ago. It is also found that the dealers have difficulty at the present time in obtaining good first-class used machinery to add to their stock. What is offered are mainly obsolete machines or those for which there is not a ready sale.

Machine Tools Available in the Used Machine Tool Market

Referring specifically to different classes of machine tools, it may be stated that while there is a fair quantity of production lathes in the used machinery market, there is a scarcity of good precision lathes. Some dealers state that it is almost impossible to buy lathes of certain well-known makes known for their quality. Only in the centers where there were an unusually large number of tool and contract shops, some of which have gone out of business, are used machines of this type available. There are but few heavy lathes available except those having unusual bed dimensions, in which case some are for sale, with no buyers, because the machines were designed for special purposes, such as for boring gun tubes. There is a fair quantity of turret lathes on the market, but few machines of the best known makes. The same is true of the smaller sizes of automatic screw machines—in fact there is a great scarcity of the best makes; but of larger sizes of automatics there is a fair quantity available.

In the milling machine field, there is a scarcity of universal machines, a fair quantity of plain machines, and a considerable number of Lincoln and semi-automatic milling machines. The supply of planers is practically normal. There are always used planers for sale, but the number today is not excessive.

In the drilling machine field, the greatest supply is in the multiple-spindle type. There is a fair number of radials offered, but comparatively few single-spindle upright machines. The supply of shapers is small. In the grinding machine field, there is a scarcity of universal and surface grinders, with a fair quantity of plain grinding machines being offered.

The best makes of vertical boring mills are scarce—in fact, it would probably be impossible to obtain certain sizes of some specific makes. This is also true of horizontal boring machines—few machines of the well-known makes are available. The supply of gear-cutting machines is not above normal, and buyers have found it difficult to obtain specific makes in the local markets. Some machines may be available elsewhere, but it is not easy to bring the buyer and seller together.

In the press field, there is a large quantity of presses built especially for war work—for the drawing of cartridge cases, for example. But there is no surplus of small presses and comparatively few toggle presses are available.

Briefly summarized, there are few machines in the used machinery market of the best grade of small and medium sized types. Much of the machinery in the hands of the dealers is special, and some is obsolete; and sooner or later some of this will be scrapped as there is no market for it.

Opinions of Dealers in the Used Machinery Field

The opinions of a number of the leading dealers in the used machinery field will prove of interest. A well-known dealer in the Middle West makes the following statement: "We find a scarcity of good tools that can be purchased at reasonable prices and feel certain that some of our competitors who are sacrificing their stock to do business will find it very difficult to replace it later on. The average buyer today desires to purchase machine tools and other equipment at a lower price than the average dealer can buy them for, and the owners of good tools that are for sale are holding them at higher prices than the dealer is willing to pay. This condition will lead to a scarcity of good tools in the hands of the dealers and means higher prices later on."

Another dealer in the same territory says: "We have looked at a great deal of machinery that is for sale around the country, but naturally are buying only the desirable machines and only those that we can buy at a price which will enable us to carry such machines for from three to five years and face a further decline in machine tool prices."

It is only from the cities that were exceptionally active in war work that we hear of more than normal quantities of machine tools being available in the used machinery market. A dealer in one of the New England cities, well known for its war activities, says: "The opportunities for securing used machinery are greater than they have been for a number of years, and in our opinion there is more used machinery on the market today than at any time since 1914." This view is the exception, and is explained by local conditions. A similar opinion is given by a dealer in one of the large Middle-Western tool and contract shop centers where many of the tool shops have gone out of business.

A New England dealer believes that there is going to be a fine market in 1922 for good up-to-date, overhauled second-hand machine tools; but he states that at the present time "there are very few good second-hand machines on the market for resale at the proper prices."

In Philadelphia it is found that sales of both new and used machinery are from 15 to 20 per cent better than for last October, and the present outlook is better than it was during the past year.

In Pittsburg the stock of used machinery is no larger, comparatively, than would be considered normal in pre-war years—that is, speaking of volume alone—and the stocks in general are smaller than those of a year ago.

INDUSTRIAL CONDITIONS IN FRANCE

Business conditions in France are not quite so good at present as they have been during the last two or three months, due in part to the recent political changes. Our correspondent writes, however, that the outlook is encouraging, especially in financial circles. One indication of this is the confidence shown on the stock exchanges. If the financial condition improves, there is no doubt that general business conditions will also be favorably affected. It was generally thought that the industrial situation would be greatly affected by troubles due to proposed reductions in wages of miners in the northern part of France, but after several conferences, a satisfactory agreement was reached between the workmen and their employers with the result that the danger is past.

An order for 800 freight cars has recently been placed by the Nord Railroad Co. In addition, the same company has asked for quotations on from 2000 to 2500 passenger cars. An order has also been obtained from Roumania for 50 trolley cars and 50 trailers. Several orders have been placed with manufacturers of nuts and bolts. One order for expansion bolts was accepted at 110 francs per 100 kilograms (about $4.40 per 100 pounds, present exchange). Another order for bolts weighing 85 kilograms (about 190 pounds) per 100, was accepted by a factory in the Ardenne district at 77 francs per 100 kilograms (about $3.10 per 100 pounds). These prices include delivery to a railroad station in the vicinity of Paris. An order for galvanized-steel coopers' tools has been accepted by a company in the Lorraine district at 94 francs per 100 kilograms (about $3.75 per 100 pounds).

Conditions in the bicycle industry continue to be very good, French dealers now being able to compete successfully in France with British manufacturers. However, they are unable to market their product abroad because of the German competition made possible by the low rate of exchange. The competition among foundries is very keen. Simple steel castings averaging 30 kilograms (about 65 pounds) are quoted at 130 francs per 100 kilograms (about $5.20 per 100 pounds).

* * *

SAFETY CENSUS

The National Safety Council is taking a census of the men and women engaged professionally in safety and industrial health activities in all the industries of the United States as well as in public safety work. The council frequently receives requests from firms, municipalities, colleges, and other organizations for help in finding speakers or writers on safety subjects, and the census records will greatly increase the facilities of the council for filling such requests. To assist in obtaining the names of persons engaged in preventing accidents and promoting good health in the machine-building industry, readers of MACHINERY employed in this class of work are requested to communicate with the National Safety Council, 168 N. Michigan Ave., Chicago, Ill., who will supply them with forms to fill out, giving the necessary data.

* * *

The general depression in Scandinavian financial and industrial life still prevails, and financial experts say that the crisis will be of long duration, according to a communication from Commercial Attaché W. L. Anderson at Copenhagen, Denmark. Scandinavian industries continue to struggle with high production costs, and are operating at a minimum profit. Employers claim that wages must be reduced further before the industries can be put on a competitive basis. Unemployment continues to be a serious problem, and the number of unemployed has increased slightly of late. The Swedish iron and steel production has been reduced to a minimum, the high costs of production resulting in inability to compete with foreign iron and steel products.

USE OF PREHEATING TORCH FOR REPAIR WORK

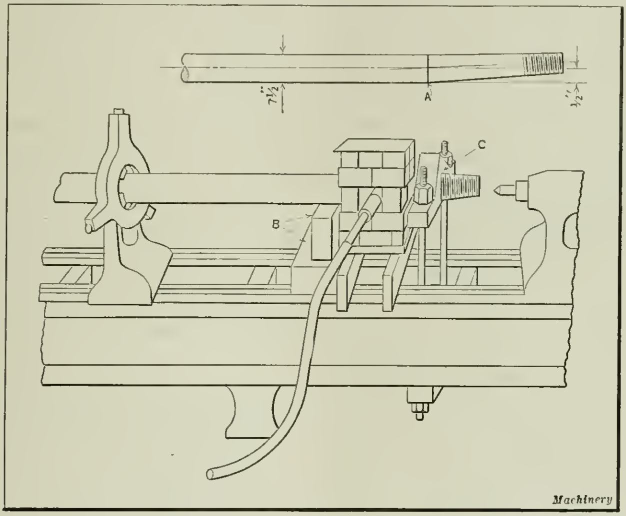
By J. HARRY CLEMMENCY, Superintendent Repair Shops, Bureau of Water, Philadelphia, Pa.

A great deal has been written on the subject of thermit welding and its usefulness in repair work. Little attention, however, has been given to the use of the preheating torch of the thermit welding outfit as a means of facilitating repair shop work. While the preheating torch is considered as auxiliary equipment, designed primarily to produce conditions favorable to a perfect thermit weld, it has nevertheless proved well adapted for a great variety of work encountered in the repair shops of the Philadelphia Bureau of Water. The following examples of work done in these shops with the aid of the preheating torch will suggest ways in which it can be employed in the average machine shop.

The preheater itself is so simple in construction and so compact that it may readily be moved about to any place where heat is to be applied. In machine shops, especially those engaged in miscellaneous repair work, it is frequently necessary to provide means of applying intense heat to definite points, and the preheater will be found admirably adapted for work of this nature.

Straightening Piston-rod

An unusual task that illustrates the usefulness of the preheater was the straightening of a 7½-inch steel piston-rod that had received a short bend as a result of meeting with an obstruction in the cylinder of a pumping engine. The bend was at the shoulder point of the tapered end as shown at *A* in the accompanying illustration. The end of the rod was thrown out about ½ inch from the center line as indicated by the somewhat exaggerated view. A careful examination at the point of the bend revealed no trace of a crack or flaw. It was therefore decided to straighten the rod and put it back in service.



Straightening Bent Piston-rod with the Aid of a Preheating Torch

Ordinarily there is nothing difficult about straightening a bar of steel 7 or 8 inches in diameter, but when the operation is complicated by the fact that the rod to be straightened is finished and no hammer or sledge blows are permitted, and that it is required to be true when finished, it will be readily apparent that the work presents some difficulties. The success with which the straightening was accomplished was in a large measure due to the use of the preheating torch of the thermit welding outfit. In performing the straightening operation, the rod was held in a heavy 36-inch lathe. One end was placed in the chuck and the other end supported firmly on steel blocks *B* built up from the ways of the lathe at a point just back of the bend. The lathe steadyrest was used to centralize and steady the rod, being placed a foot or two back of the blocking as shown.

A piece of sheet iron was placed under the point of the bend, and upon this was built an improvised furnace of old discarded firebricks. The top of the furnace was covered with a piece of sheet iron. An opening was left in the front of the furnace just below the center of the rod into which the burner of the preheater was introduced. The heavy V-shaped clamp *C* was placed over the end of the rod, and two stud bolts passed through the ends of the clamp and down between the shears of the lathe through a heavy cross-clamp placed under the lathe bed. When the torch was lit, the flame, being confined by the firebricks, swept around the rod at the proper point and thus speedily heated it to the required temperature. Wrenches were applied simultaneously to the two nuts on the clamp stud bolts. The bent end was thus gradually pulled back to its original position, the center of the tailstock serving as a guide to determine when the work was properly centralized. When the blocking and clamps were removed, it was only necessary to take a very light cut over the tapered portion of the rod in order to insure a perfect fit and alignment. The ease with which this piece of work was handled was due to the fact that the flame of the preheating torch was confined to the right portions of the work.

Use of Preheater in Assembly Room

It would be difficult to describe all the uses to which the preheating torch may be adapted in the assembly department. The possibilities are practically unlimited, and each shop can develop its service in line with its own particular requirements. In the general work of assembling miscellaneous machine parts, the application of heat is often desirable and sometimes necessary. For work of this kind where tight and shrink fits are required the hot clean flame of the preheater will be appreciated when its advantages are fully realized. The flame of the preheater can also be used to advantage as a means of loosening parts that have become cemented together by corrosion. In dismantling old machinery, many cases of this kind are encountered.

Melting Babbitt and Heating Rivets

The preheater is also useful in babbitting work. It has been found that babbitt can be removed from old bearings more rapidly and conveniently with the preheating torch than by any of the methods usually employed. A number of bearing shells are placed in a line over a metal receiver and the flame of the preheater passed from one to the other, thus melting the babbitt linings in a few minutes. When cracks develop in cast-iron cylinders that are to be welded with the acetylene torch, the preheating essential to a good weld can be conveniently done with the preheater.

In one instance where a large number of rivets were to be driven at a considerable distance from a forge, the work was facilitated by arranging a few firebricks on a piece of sheet iron which served as an oil-burning furnace to heat the rivets. By introducing the flame of the preheater into the open side of this furnace sufficient heat was quickly generated to bring the rivets to the required temperature for driving. Kerosene is used for all heating operations done with the preheater, except preheating for thermit welds, in which case gasoline is invariably employed.

Duralumin and Its Use as a Gear Material*

By ROBERT W. DANIELS, Baush Machine Tool Co., Springfield, Mass.

DURALUMIN is an aluminum alloy produced after years of search for a metal combining the lightness of aluminum with the strength and toughness associated with ferrous metals. This condition has been met to a remarkable degree, and the resulting physical characteristics make duralumin a most desirable material for certain kinds of gearing. The commercial manufacture of the metal in this country dates back little more than two years, although it was first made in Germany and developed by A. Wilm and associates, during the years intervening between 1903-1914.

The principal and unusual feature of duralumin is that after it has been hot-, or hot- and cold-worked, it may be further strengthened and toughened from 40 to 50 per cent by heat-treatment. This heat-treatment is somewhat analogous to the heat-treating of alloy steels and consists of quenching at temperatures below the melting point, followed by an aging process. The increased physical properties are not all produced immediately on quenching, but increase during the subsequent aging. In addition to being made in Germany, the manufacture of duralumin was taken up in England by Vickers, Ltd., prior to the war. Its use for structural purposes in connection with aviation brought the material to the attention of the engineering world, and today duralumin is recognized as occupying the same relative position to ordinary aluminum sheets or bars that heat-treated alloy steel does to ordinary carbon steel.

Physical Properties of Duralumin

The strength and toughness of duralumin are comparable with mild steel, and are obtained with a specific gravity of 2.81 as against 7.8 for steel. The melting point is approximately 1210 degrees F., the recalescence point, 970 degrees F., the annealing temperature approximately 680 degrees F., and the coefficient of expansion 0.00001798 per F. degree of temperature. The chemical composition of the alloy varies within the following limits, copper 3 to 5 per cent, magnesium 0.3 to 0.6 per cent, manganese 0.4 to 1 per cent, the remainder being aluminum plus impurities. Small quantities of other metals are sometimes added for certain reasons; for instance, chromium may be added to increase the burnishing qualities of the metal.

In the annealed form duralumin can be drawn, spun, stamped, and formed into a great variety of shapes, similar to brass and mild steel. The physical properties in this state average: Ultimate tensile strength, 25,000 to 35,000 pounds per square inch; yield point, 22,000 to 24,000 pounds per square inch; elongation in 2 inches, 12 to 15 per cent; Brinell hardness, 57; and scleroscope hardness, 11.

Duralumin in its heat-treated form may be slightly shaped or formed and may be bent cold to 180 degrees over a mandrel having a diameter of four times the thickness of the sheet. Its remarkable tensile strength is here combined with its maximum elongation as follows: Ultimate tensile strength, 55,000 to 62,000 pounds per square inch; yield pound, 30,000 to 36,000 pounds per square inch; elongation in 2 inches, 18 to 25 per cent; Brinell hardness, 93 to 100; and scleroscope hardness, 23 to 27. Heat-treated duralumin forgings have similar physical properties. When the sections of forgings are heavy, it is advisable to lower the minimum tensile requirements to 50,000 pounds per square inch. This will cause a proportional increase in elongation.

*Abstract of a paper read before the American Gear Manufacturers Association

Heat-treated and hard-rolled duralumin is used where no bending or forming is required. It is a hard, strong, springy metal in this state, and machines and polishes well. Its physical properties in this form average: Ultimate tensile strength, 67,000 to 72,000 pounds per square inch; yield point, 58,000 to 65,000 pounds per square inch; elongation in 2 inches, 3 to 8 per cent; Brinell hardness, 130 to 140; and scleroscope hardness, 39 to 42.

General Characteristics

Duralumin is unaffected by mercury, is non-magnetic, withstands atmospheric influences, and offers unusual resistance to sea and fresh waters. It is only slightly affected by numerous chemicals which readily corrode other metals and alloys and does not tarnish in the presence of sulphurated hydrogen. It takes a polish equal to that of nickel-plated articles and remains bright without cleaning longer than plated or silvered articles. It is an ideal substitute for aluminum, German silver, brass, copper, and steel when lightness combined with strength is required. Although duralumin is only one-third the weight of steel, heat-treated duralumin forgings approximate mild steel forgings in strength, so that wherever weight is a deciding factor, duralumin is satisfactory for most shapes made by hot-working or forging. Duralumin forgings are especially desirable for reciprocating or moving parts where the inertia due to their own weight, forms a large part of the total stress. Duralumin machines easily and, as it does not corrode, is suitable for use in many places where weight is not the prime essential.

Process of Manufacture

The manufacture of duralumin is somewhat analogous to that of steel and is carried on in the following sequence:

1. Manufacture of the alloy from its aluminum base.
2. Casting the ingot.
3. Hot-rolling or cogging in blooms, billets, or slabs.
4. Hot- or cold-working to the final shape.
5. Heat-treating.

The ingots are poured at as low a temperature as practicable, that is, just enough above the melting point to fill the mold and prevent cold shuts. They are then either hot-rolled or cogged into slabs, blooms or billets, similar to the manner of working steel. This hot working is done at a temperature of from 840 to 900 degrees F. Such low temperatures cannot be judged by color, and it is therefore necessary to use pyrometers in heating the metal previous to working it.

The final rolling or forging may be done hot or cold according to the character of the work being handled or the shape it is desired to produce. The hot- or cold-worked metal in its final shape shows greatly improved physical properties over the cast ingot, but the full development of its qualities is obtained only by a specific heat-treatment. To obtain this heat-treatment, the metal is heated to a temperature of from 930 to 970 degrees F. for a period of time depending upon the section of the piece, and then immediately quenched. The heating and quenching improve the physical qualities of the metal, but the maximum results are obtained only by a subsequent aging. During the aging period, which takes from one to five days, the tensile strength, hardness, and elongation of the alloy increase markedly. Aging is sometimes accelerated by placing the metal in a hot water bath of a temperature up to 212 degrees F. or in a hot room. The heat-treatment develops properties which have not been obtained in a like degree in any other aluminum alloy. The cast ingot has a tensile strength of from 28,000 to 32,000 pounds per square inch, and an elongation of from 1 to 3 per cent.

When it is required to put a considerable amount of work upon duralumin in its finished state, it is often found necessary to anneal the sheets between operations in precisely the same manner as with other metals. This annealing should be done at about 660 degrees F. If several drawing operations are to be performed, it may be necessary to anneal the metal between such operations. Annealed duralumin can be heat-treated and the maximum physical properties obtained, no matter what shape or form the metal may be reduced to. Conversely, heat-treated duralumin may be annealed. Duralumin may be cold-worked after heat-treatment and aging. This operation produces a hard smooth finish, and materially increases the tensile strength of the metal at the expense of elongation.

Use as a Gear Material

For a given section, the weight of duralumin is about one-third that of bronze, and for parts produced in large quantities, duralumin is the cheaper of the two metals. Therefore duralumin is an ideal material for worm-wheels, and especially those used in automobile constructions, provided the wearing qualities are satisfactory. The tensile strength and relatively high elastic limit insure a superior tooth strength, while the homogeneous structure and uniform hardness of heat-treated duralumin forgings insure entire freedom from hard spots, porosity and spongy areas so common in bronze castings, which entail not only a machine loss but uneven tooth wear in service. The data from various laboratory tests on bronze and duralumin worm-wheels may be summarized by saying that tests destructive to duralumin worm-wheels were also destructive to those made of bronze.

When duralumin and hardened steel are run together the results are always good. An example of this application was shown by having duralumin connecting-rods running direct on the wrist-pins. A better life was obtained at this point than with conventional bronze-bushed rods of equal bearing area. Comparative tests of bearings made from duralumin and bearings made from babbitt show that for shaft speeds exceeding 700 revolutions per minute and loads over 200 pounds per square inch, duralumin bearings developed less friction, remained cooler and showed practically no loss in weight under most severe conditions. For lower bearing pressure and slower speeds, babbitt metal was superior.

An important condition was revealed in tests with worm-wheels made of duralumin, by examining the lubricant used. After long tests with bronze wheels where the oil has not been changed, the oil is found to contain particles of bronze in suspension. This condition is sometimes very marked and is of importance not only as indicating tooth wear but as showing the deterioration of the lubricating value of the oil. Oil heavily charged with metallic particles acts more like an abrasive and less like a lubricant, and therefore is an important factor in the wear of automobile gearing, where the oil is infrequently renewed. When duralumin wheels were used, the charging of the oil with metallic particles was practically negligible.

The different tests point to excellent life for duralumin worm-wheels, unless the wheels are roughened by lack of lubrication or too high a tooth pressure which will injure or destroy any worm-gearing.

The same qualities that make duralumin a desirable material for worm-wheels also make this material valuable for other types of gears. It is suitable for this class of work when the pressures are sufficiently within its elastic limit of 30,000 pounds. Where this condition is met, and weight and quietness are desirable, duralumin will satisfactorily replace iron, steel, brass, fiber, fabrics, etc. Where duralumin can be run with steel rather than against itself the best results are obtained. An example of this application is found in the timing gear trains of automobile motors where both long life and quietness are essential. Helical duralumin gears alternated with steel gears have been very successful in service. That duralumin gears when meshed with steel gears are quiet may seem somewhat paradoxical since, when struck, all duralumin forgings are resonant. However, this condition obtains and is undoubtedly due to the difference in pitch of the sound vibrations of steel and duralumin.

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PRICES OF MACHINE TOOLS

It is apparent that there has been some hesitancy in the buying of machine tools due to lack of confidence in the stability of machine tool prices. While it is true that a large number of shops are not in operation to a sufficient degree to require new machinery, there are many that should buy to replace inefficient equipment and reduce their production costs so that they can successfully enter into competition with other plants having more modern machine tool equipment especially suited to their needs.

One of the well-known firms in the turret lathe field has carefully analyzed future labor and raw material costs, and has announced that its prices have been brought down to such a basis that there can be no further reductions. In order to indicate the reductions that have taken place, this company has published in its advertising the peak prices and the present-day prices for its turret lathes. This comparison indicates that machines costing, at peak prices, $3900 have been reduced to $2450; those costing $2690, to $1695; and the smallest size, costing $590, are now being priced at $370. The reductions on other machines in the line are in similar proportions, and it is not necessary to quote them all in detail.

The machine tool builders at present are divided into two groups—often through force of circumstance. One group comprises those who are liquidating their inventories at prices either yielding no profit at all or a loss, and who are taking orders for equipment at less than either present or expected future costs would justify. The other group includes those who are anticipating future costs in such a manner as to reduce their prices immediately to a final level to which they will adhere. The company whose announcement relating to final price reductions is appearing at present in the trade journals belongs in the latter class.

There is no reason why machine tool builders should sell their equipment below cost, virtually giving away part of it to the users. The user should be and is willing to pay for value received, provided he really needs the equipment and the industry as a whole maintains a consistent attitude of obtaining a reasonable price for its product. After all, the buyer of equipment is not pursuing the wisest course if he buys machinery merely because it is cheap. His main purpose should be to obtain productive efficiency. Taking the machine tool industry as a whole, there are no additional sales made because prices are at or below cost. Some one concern may obtain an order in preference to another company because it is selling at a very low figure, but the industry as a whole suffers if it does not receive a fair return for its products. And ultimately the machine tool buyer suffers also, because there will be less advance in the development of production machinery.

The machine tool builders should do all in their power to increase the confidence of the buyer in their product, both as to its quality, its capacity for production work, and the stability of its price. The best service that could be rendered the entire industry would be for machine tool builders in general to analyze their costs in the manner indicated, and definitely announce that they are quoting bed-rock prices. A stable market is always the best market, not only for the buyer but also for the seller.

The British Machine Tool Industry

From MACHINERY'S Special Correspondent

London, February 11

CONDITIONS in all branches of trade show a slight improvement, with the possible exception of the shipbuilding industry. In the latter case the idle time is being utilized in investigating the merits of new engine design and the suitability of the application for marine propulsion purposes, especially in connection with internal combustion engines of the Diesel type.

Conditions in the Automobile Industry

Under present conditions the most hopeful field for the machine tool maker is the automobile industry, particularly that branch which is engaged in the manufacture of light cars, and some new equipment is being bought by manufacturers in this line. It will be interesting to note the effect on the automobile industry of the increased value of the pound sterling in the United States, as at present American automobiles are being imported into this country on a smaller scale than for many years. Already certain American cars are being offered at very low prices, and any continued appreciation in the pound value will tend to reduce these prices still further. British makers can hope to improve the home and overseas trade only by building more of the most popular types of cars.

The demand for tractors also appears to be improving, which should, in turn, stimulate the market for machine tools and the necessary manufacturing equipment. The Ford Co. in Cork is reported to have been in the market for such equipment, and since it is located in that part of Ireland where tractors should find a big opening, business prospects are likely to be good as soon as conditions in Ireland become settled. Meantime, a gratifying increase in orders is reported among steel firms who supply the automobile trade.

General Industrial Conditions

In industry generally, buying is still confined to straggling orders sufficient only to meet the needs of the moment. Foundries are becoming busier, but here again the automobile trade is the main cause. One foundry firm has secured an order for 5000 engine crankshafts, and this represents, perhaps, the largest order of this kind that has been placed in this country. There is some improvement in the engineering trades in the Birmingham district, where government orders for bicycles and important inquiries from France for motorcycles are outstanding developments.

Much greater attention is being paid to special tooling equipment, and although this is most noticeable in the automobile industry, other branches of engineering are becoming more alive to the advantages of well planned manufacturing equipment. There are now several firms in the Midlands who specialize on tool production, and these, almost without exception, have orders in hand for complete tool, jig, and fixture equipment. and are running double shifts. In small tools a fair trade is being maintained, but this is understandable, as even with a small proportion of the total capacity of shops occupied, there is a continuous, though meager, consumption of small tools.

In Sheffield, much satisfaction is felt as prominent firms have secured a large amount of work in connection with the electrification of South African Railways for which the Metropolitan-Vickers Co., Manchester, has secured contracts for seventy electric locomotives to the value of £1,000,000. Considerable developments in connection with the electrification of many of the local systems of British Railways are being considered, and the Great Eastern Railway is having an electric locomotive built for passenger service and designed to draw a 450-ton train at 65 miles per hour. It is also capable of attaining a maximum safety speed of ninety miles per hour.

Apart, however, from the few instances noted there is little cause for optimism, and the hopes for a steady increase in business in the new year have proved unfounded. Very little new business is being done. That there exists, however, a big potential demand is shown in the case of a well-known machine tool concern in Yorkshire which, while working short time with a minimum force, finds it necessary to work over-time in the estimating department.

Overseas Trade

During the whole of last year the exports of machine tools showed a fairly steady decline from month to month. As against 2800 tons having a value of £400,000 exported in January 1921, only 760 tons having a value of £112,000 were exported in December. After a rapid fall to a little over 200 tons in March, the imports of machine tools remained somewhere around this figure for the rest of the year. During December the value per ton of imports fell below that of exports, the figures being £125 and £148, respectively. This very unusual condition was, to some extent, due to the increased value of the pound sterling in America. In passing, it is interesting to note that the total exports for the United Kingdom, based on 1913 prices, were in 1920 about one-third less than those of 1913, whereas in 1921 the exports amounted to less than half those of 1913.

Materials and Prices

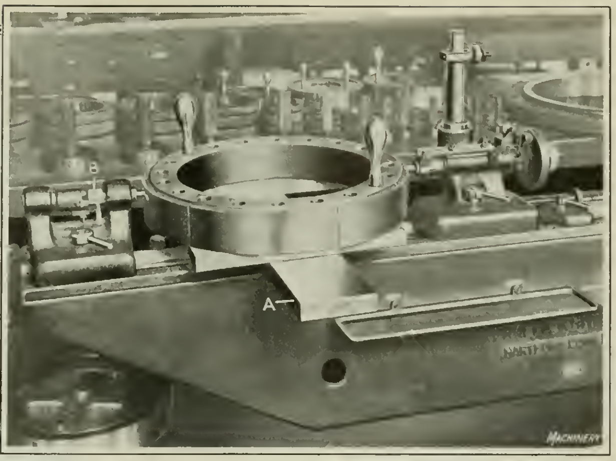
British makers in the iron and steel industry are beginning the year in an extremely favorable position as compared with a year ago, and although at present they are working in many cases below cost in order to provide employment, the outlook is regarded as more promising than for the last two years. Costs are being stabilized and there is some evidence that new orders are to be placed. The industry appears to be passing to a more active condition.

Any increased business seems to be generally at the expense of Continental and American makers. Because of the pig iron, freight and railway charges Continental firms find it almost impossible to compete with British manufacturers in the home market. The price of pig iron has fallen between 5s and 10s per ton during January, and now stands at £4 to £4 10s, according to the grade. Finished steels remain constant at a price between £9 and £11 15s for bars and plates.

As regards the prices of machine tools, there has been a movement in favor of drastic reduction, as a means of stimulating trade, but the majority of makers are convinced that no concession which it would be possible for them to make would have any material effect. Generally speaking, in the Midlands machine tool prices are about 20 per cent below those prevailing at the end of 1920. Although the price of raw materials and wages has dropped in some cases by considerably more than this amount, very few works are running at full capacity, and the heavy overhead in relation to the reduced output has materially increased the cost. The only way out appears to be by the usual route of increased demand, and until that arises prices cannot reach a stable level.

Measuring Thread Plug Gages

By J. M. HENRY
Pratt & Whitney Co., Hartford, Conn.



ACCURATE and convenient measurements of thread plug gages are made in the mechanical laboratories of the Pratt & Whitney Co., Hartford, Conn., through the use of the measuring machine manufactured by this concern. In the heading illustration is shown the usual method of mounting large casing gages for checking their taper threads by the three-wire system of measurement. Block *A* is mounted directly on the vee and flat way of the machine and held in place by means of a bolt and nut engaging the T-slot of the bed. The top surface of block *A* is machined at an angle relative to the bottom surface, this angle corresponding to the taper per foot of the gage thread to be measured. In the case illustrated, the taper is 3/8 inch per foot and the gage is about 15 1/2 inches outside diameter.

Block *A* is placed on the bed in such a manner that when the gage is mounted on parallels to bring it to the required height relative to the measuring anvils, the side toward the dividing head of the machine is at right angles to the anvil face of the dividing head. The opposite side is at an angle with the tailstock anvil corresponding to twice the taper per foot of the gage threads. The reading is obtained over the three wires by using the machine in the regular manner. At the time the photograph was taken the measuring point had been reached, as is indicated by the drop plug *B*, the handle of which has dropped from a horizontal to a vertical position. The exact pitch diameter of the gage is accurately computed from the reading obtained, by allowing for the angle of the side with the tailstock anvil.

Small plug gages are set up in a somewhat similar manner to that described, although the apparatus used is smaller. As shown in Fig. 1, a cast-iron block *A* is usually mounted over the ways. This block resembles those used for supporting end measures, but it is machined flat on the top instead of having a vee extension. Parallels are placed on top of block *A* to bring the portion of the thread to be gaged between the measuring anvils. The ideal condition is reached when the two wires on the tailstock side are equidistant from the center of the anvil, although measurements can be taken so long as both wires bear against any point on the anvil face. Taper blocks are used for small taper gages in the manner previously described for the large casing gage.

A device for measuring thread plug gages when held between centers is illustrated in Fig. 2. A baseplate *A* is secured to the ways of the machine, and on top of this plate is carried a second plate *B*, which has a T-slot at each end for securing the stationary center *C* and the movable center *D* to it. Plate *B* is mounted on three balls to allow freedom of movement when taking a measurement. At the back end of the lower plate *A*, a ball rests in a V-groove, and directly above it, there is a hardened steel button in the top plate,

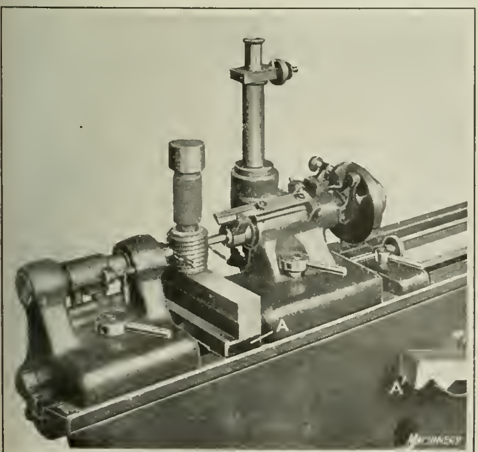


Fig. 1. Method of mounting Small Thread Plug Gage for measuring by the Three-wire System

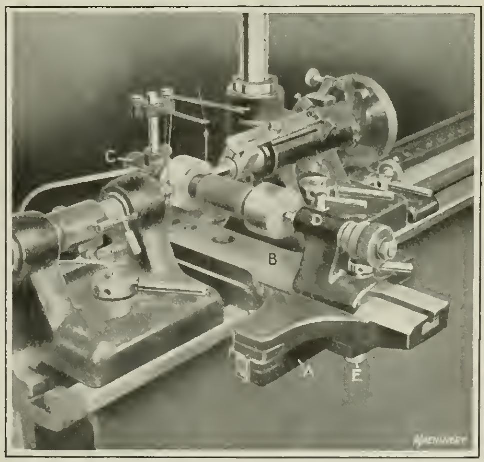


Fig. 2. Attachment developed to facilitate the measuring of Thread Plug Gages held between Centers

which rests on the ball. At the front end of the attachment two balls are used to provide ample support, one being placed at each end of the extensions of the plates. These balls are held between V-grooves in the upper and lower plates, and stops prevent them from falling out.

By this method of mounting, a gage may be brought between the anvil faces without the difficulties experienced with a solid mounting, because the floating movement of the upper plate, which rolls on an axis parallel to that of the anvils, insures that the measuring pressure of the anvils will not be affected. To prevent the plate from rolling too easily and endangering the anvil setting by causing the drop plug to fall out, a spring friction device fastened to the lower plate bears against the upper one. The friction is applied by operating knob *E*. The stationary center *C* is provided with an adjustable rod carrying a bracket from which fingers extend to permit the suspension of the three measuring wires over the gage. The movable center is adjusted by a knurled screw-knob. Both centers can be clamped and adjusted to suit the length of the plug gages.

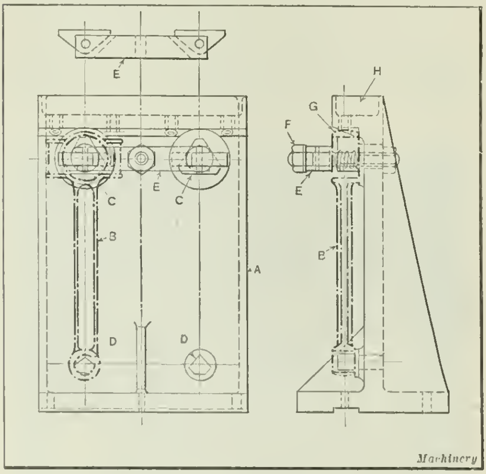
* * *

JIG FOR DRILLING CONNECTING-RODS

By WILLIAM OWEN

The jig illustrated was designed for use on a Moline "Hole Hog," and is so proportioned that two or three jigs can be lined up and bolted to the machine table if desired. The body *A* is of cast iron and is well ribbed. It is slotted on the bottom to provide a means of accurately locating the base on the machine table. One connecting-rod is shown in place by dot-and-dash lines at *B*. The connecting-rod is located at the top by the plug *C* and at the bottom by the plug *D*. These plugs have three bearing surfaces, a feature which eliminates much of the annoyance that would otherwise result from chips clinging to the plugs, and it also allows the rod to be slipped on easily.

The rods are held in place by an equalizing clamp *E*, actuated by the stud and nut *F*. One turn of the nut permits the clamp to be turned to a perpendicular position and the connecting-rods to be taken off or put on. This clamp will not twist the connecting-rod no matter how tight it is.

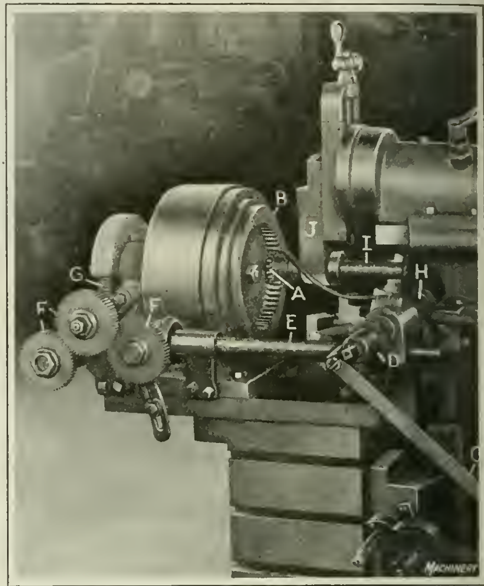


Drill Jig used in drilling Bolt Holes in Connecting-rods

The front edge of the arm in which the bushings are mounted is cut back at *G* so that the chips can work out, thus preventing drill breakage from this source. The cutting compound is fed to the drills by means of the trough *H*. This jig has proved accurate, is self-cleaning, and is adapted to high production rates.

CUTTING TEETH OF INTERNAL GEARS ON A SHAPER

The accompanying illustration shows a 14-inch crank shaper equipped with an auxiliary mechanism for cutting the teeth of an internal gear. Three functions are required of this mechanism, namely, the rotation and reciprocation of a formed gear-tooth shaping tool *A* over the face of the work *B*, and the indexing of the work, it being obvious that



Shaper equipped with a Special Attachment for cutting the Teeth of an Internal Gear

these movements must be synchronous. The way in which the desired movements are produced is described in the following paragraphs:

The link *C* extending up from the feed works actuates a pawl engaging the teeth of ratchet wheel *D*, it being possible to adjust the mechanism so that various numbers of ratchet teeth may be skipped by the pawl at each stroke to obtain the desired operating conditions. From the ratchet wheel, power is transmitted through a pair of spiral gears and a horizontal shaft *E* to a set of change-gears *F*, and by substituting different wheels provision may be made for obtaining the correct timing for cutting the teeth of gears with various numbers of teeth. The work-spindle is driven from gears *F* through the medium of a worm and worm-wheel as shown at *G*.

A horizontal shaft *H* transmits power through a pair of spiral gears to a spindle *I*, at the forward end of which the gear-shaping tool *A* is carried. Spindle *I* is splined into its driving gear and held by a special block *J* on the tool-head of the shaper, so that the spindle is free to rotate in this block but cannot move transversely through it. As a result of this connection of the spindle to both the reciprocating shaper ram and the rotating mechanism deriving power from ratchet wheel *D*, a combined rotary and reciprocating movement is imparted to the gear-shaping tool *A*. The stroke of the shaper is adjusted so that the tool just passes over the face of the gear blank in which the teeth are to be cut, and reverses in a clearance space provided at the back of the teeth for that purpose. On the job shown the gear to be cut has fifty-five teeth of 7 pitch, with a face width of 1 7/32 inches, and the time required for taking the roughing and finishing cuts in a gear of this size made of drop-forged steel is 1½ hours.

Cards and Records Used in Planning and Dispatching Work

By GEORGE H. SHEPARD, Professor of Industrial Engineering and Management, Purdue University

THE duties of the various units and members of a planning organization in a large contract or jobbing plant were discussed in December MACHINERY. The present article illustrates the different forms used in the functioning of a planning department of a large machine shop and describes their purpose. There are sixteen of these forms as follows: Job and shop order slip; shop memorandum slip; foundry credit memorandum; incoming plant delivery tag stub; outgoing plant delivery tag; material list; shop store stub; stub requisition; inter-shop order; progress card; instruction card; route tag; inspection tags; damage report; sample tag; and drawing index card.

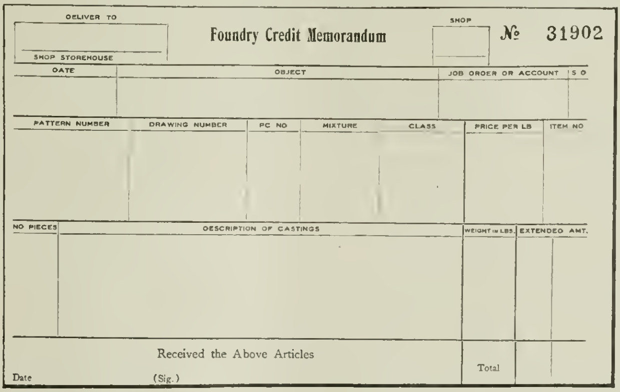
Files in Planning Office

Five files are used in keeping the records of the planning office. In one file are kept the progress cards, which are divided into two sections—active and inactive. The cards filed in the active section are those for orders that have been started in the shop, while the cards placed in the inactive section are for orders not yet given to the shop. On each card is indicated the actual progress of work in the shop for the corresponding order. In another file are kept jackets or containers for various data pertaining to a job, these jackets being filed under the name of the customer in the correct sequence of job order numbers.

A file for instruction cards is placed at the desks of the shop foremen, and this file is divided into pending and available sections. In the pending section are filed instruction cards covering work for which the material has not been delivered to the section or for which something requisite to the performance of the operation is lacking. In the available section are kept the instruction cards of the work for which the material has been delivered and which is ready to be performed. The fourth file consists of a perpetual inventory of shop stores. The latter consists of the bulk of the material frequently called for, and the inventory is kept in the customary manner. The fifth file is an ordinary tickler file for following up the delivery to the machine shop of material from other shops.

Job and Shop Order, Foundry Memorandum, and Delivery Tags

The job or shop order slip is issued by the central planning office and, as its name indicates, contains the job and shop order for work to be performed. The slip is sent from the central planning office to the departmental chief planner for his observation. It is next sent to the method man to be noted by him, and then to a clerk who fills in the data on a progress card as shown in Fig. 8, and on the jacket. The slip, together with the progress card and jacket is next sent to the inter-shop man who studies the shops that will handle the work and records this information in the proper place on the progress card. He then places the progress card in the inactive section of the file previously mentioned, and sends the job order slip and the jacket to the schedule man. The latter notes the job order, where blueprints will be needed, advises the blueprint man to secure the necessary prints of the parts, and then sends the order slip with the jacket to the jacket file. The job order is now represented



DELIVER TO | SHOP STOREHOUSE | Foundry Credit Memorandum | SHOP | № 31902

DATE	OBJECT	JOB ORDER OR ACCOUNT	S O

PATTERN NUMBER	DRAWING NUMBER	PC NO	MIXTURE	CLASS	PRICE PER LB	ITEM NO

NO PIECES	DESCRIPTION OF CASTINGS	WEIGHT IN LBS.	EXTENDED AMT.

Received the Above Articles | Total

Date (Sig.)

Fig. 1. Memorandum Slip on which is placed Information Relative to Castings delivered by the Foundry to the Receiving Clerk of the Machine Shop

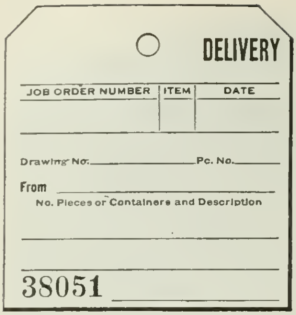


Fig. 2. Incoming Plant Delivery Tag Stub

by the progress card in the inactive section of the progress card file, which is continually reviewed by the schedule man.

Information and instructions from other shops regarding the job are written on a memorandum slip and never are accepted orally. This memorandum slip is received from outside shops by the receiving clerk and sent to the progress section which indicates the urgent items, from which it is sent to the chief planner for observation, after which it goes to the method man to be noted and assigned to a planner who plans the progress of the job through the shop. It finally goes to the jacket file.

Information relative to castings delivered by the foundry to the machine shop is given on the memorandum slip illustrated in Fig. 1, which is filled out by a clerk in the foundry office and delivered with the castings to the receiving clerk of the machine shop. The latter sends the memorandum to the progress section, where urgent items are suitably marked, after which the slip is sent to the chief planner to be noted by him. The chief planner next sends the memorandum to the method man who assigns it to a planner. The latter makes out the instruction card shown in Fig. 9 and the route tag shown in Fig. 11. The memorandum is then returned to the receiving clerk with a route tag; he places the route tag on the work and returns the memorandum to the progress section. The progress clerk notes on the progress card the receipt of the castings and sends the memorandum to the foundry. The foundry progress clerk notes receipt by the machine shop on his progress card and files the memorandum in his jacket file.

The incoming plant delivery tag stub shown in Fig. 2 is attached to material delivered to the receiving clerk of the machine shop, who tears off all but the narrow strip above the words "Job Order Number" etc., on which he marks for identification, the serial number of the stub, which in this case is 38051. The receiving clerk sends this stub to the progress section to have urgent items marked, and it is then sent to the chief planner to be noted. As in the case of the foundry memorandum, a planner also fills out an instruction card and a route tag and sends the stub with the route tag to the receiving clerk. The latter returns the stub to the progress section for noting on the progress card, it being later sent to the shipping clerk.

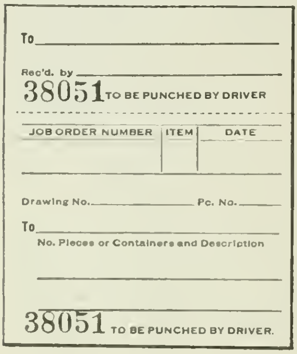


Fig. 3. Outgoing Plant Delivery Tag

The plant delivery tag for outgoing material illustrated in Fig. 3 is torn from the tag in Fig. 2, which originally has three sections, each of which is filled out by the shipping clerk. Of the three sections, the first (Fig. 2) goes with the material to its destination, the second (Fig. 3) goes to the files of the transportation department, and the third (Fig. 3) is stamped with the date and sent to the progress section of the shop that makes the shipment, to be recorded on the progress card. This portion of the tag is then placed in the jacket file.

Material List, Shop Store Stub, Stub Requisition and Inter-shop Order

The material list shown in Fig. 4 is made out in duplicate by the planner for each job, care being taken to give the number of pieces and the size to which stock is to be cut. The route tag number is also given for identification purposes. The planner sends the duplicate copy to the progress section so that it can be recorded on the progress card, after which it is sent to the jacket file. The original copy is sent with the route tag to the material man who fills out the shop store stub, Fig. 5, and the stub requisition, Fig. 6.

The shop store stub is a requisition on stores already issued to and kept in the shop. Each item on the stub must have the route tag number or numbers for the items on the job order for which the material is intended. The material section makes three copies of the shop store stub, one of which is clipped to the material list and sent to the jacket file. The other two copies and the route tag are given to the move man, who gives one of the stubs to the shop storekeeper to keep as a record. The route tag is attached to the work, which is then trucked to the desired section of the shop. The second copy of the shop store stub given to the move man is then signed by the supervisor receiving the material, and sent to the progress section, after which it is placed in the jacket file. The copy of the stub attached to the original material list and this list are then destroyed.

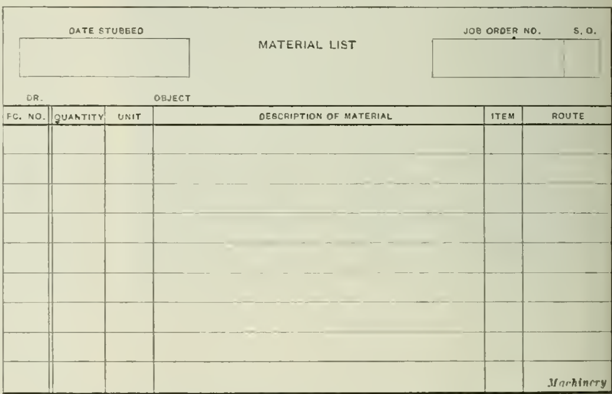


Fig. 4. Material List which gives the Number of Pieces and Sizes to which Stock is to be cut

The stub requisition, Fig. 6, is a demand made directly on the general storekeeper of the plant for material. Each item on this requisition must show the route tag number or numbers for the items on the job order for which the material is intended. As previously stated, the stub requisition is filled out in the material section from the material list and route tag received from the planner, four copies being made. One copy is clipped to the route tag and material list, and retained by the material man as a tickler. The other three copies are sent by mail or by an emergency trucker to the storehouse, from which the material and two copies of the requisition are taken by the transportation department to the shop store-room. Here one copy is signed by the shop storekeeper and sent back to the storehouse, while the other (the third) copy is sent to the material man. The latter copy with the route tag is then given to the move man and the other copy held by the material man is placed in the jacket file. After the move man delivers the material to the proper section of the shop, the third copy is signed by the supervisor receiving the material and sent to the progress section to be noted on the progress card; it is then sent to the jacket file, after which the copy previously placed in the jacket file is destroyed.

The inter-shop order is illustrated in Fig. 7; this is made out in triplicate by the planner. On orders of this kind for the foundry, the route tag number of the item is included so that the foundry clerk may write this number on the foundry slip for future identification of the items. After an inter-shop order has been filled out, the planner sends one copy to the method man for approval, who forwards it to the chief planner of the central planning office for his information and approval; if he disapproves of it he vetoes it. The other two copies are sent to the progress section to be noted on the progress card, after which one of these copies is sent to the shop where the work is to be done, and the duplicate is placed in the jacket file. The inter-shop order is a means of securing the flexibility and promptness of procedure necessary in a contract or jobbing shop. By using it as directed, the planning office of any shop can order necessary work directly from another shop without the intervention of the central planning office unless the chief planner of the latter sees fit to exercise his veto power.

DEPT. OR STORE	DELIVER TO	BUILDING	STUB REQUISITION	SHOP OR OFFICE	NUMBER
					86150

DATE	OBJECT	JOB ORDER OR ACCOUNT	S. O.

CHECKED BY	SERIAL No.	REQN. No.	CALL No	PRICED BY

STOCK NUMBER	QUANTITY	UNIT	ITEM AND DESCRIPTION	ITEM NO	UNIT PRICE	EXTENDED AMOUNT

RECEIVED (DATE) (SIG.)	APPROVED	DELIVER AND CHARGE AS INDICATED (SIG.)	TOTAL

Fig. 6. Stub Requisition for Material held by the General Storekeeper of the Plant

JOB ORDER NUMBER	SHOP No	SHOP STORE STUB	STUB No.	DATE

Tag No.	Item and Description	Unit	Quan.	Unit Price	Extension	St.Cd
Received	. Deliver	Extended by		Total		

THIS COPY TO ACCOMPANY MATERIAL WHEN ISSUED

Fig. 5. Shop Store Stub used to requisition Stores already issued and kept in the Shop

The Progress Card

The progress card which has been referred to a number of times in the foregoing is illustrated in Fig. 8 partially filled out. On this card the different symbols represent the following machines and departments: B1, milling machines, shapers, and gear-cutters; C, engine lathes up to 36-inch swing; S, machined parts store-room; YC, assembly section; and YCA, disassembly space. The numbers in the column headed "Source and Receipt" represent other shops.

In making out the progress card, a typist fills in the job order number, object, any essential information as a "brief" of the job, the issue date of the order, and the number of the shop receiving the original order. The card is then sent to the inter-shop man, who, if the job order has a completion date, determines the dates on which all items and the order as a whole should be completed in the machine shop. Information or instructions necessary for other shops, and the delivery that other shops must make to the machine shop, are also indicated on the progress card by the inter-shop man.

The progress card is then sent to the planner who fills out each item, giving a description of the item, the number of pieces desired, the kind of material, the pattern number, his signature, and drawing, piece, and route tag numbers. When the material list is issued, the planner puts a diagonal line in the "Material Ordered" column, and when the inter-shop order is issued he puts the date under the diagonal line. When instruction cards are sent to the method man, the planner inserts a date in the "Instruction Cards Issued" column. He also places a date under "Material" in the "Source and Receipt" column, upon the receipt of a foundry slip or incoming plant delivery tag stub, showing that the material has been received in the machine shop.

The progress card is then sent to the progress clerk, who checks entries made by the planner upon receipt of the material list, the inter-shop order, the triplicate instruction cards, the foundry memorandum slip, and the incoming plant delivery tag stub; inserts a date in the "Material Ordered" column, over the diagonal line placed by the planner, upon the receipt of the requisition for the material on its way to the stores; places a diagonal line under the letter in the "Routing" column for the section from which a white inspection tag of the type shown in Fig. 12 is received; inserts the date of receiving an instruction card marked complete, under the letter in the "Routing" column for the section

FROM	TO	INTER-SHOP ORDER	JOB ORDER NO.	S. O.

OR.	OBJECT	DATE ISSUED

FC. NO.	QUANTITY	DESCRIPTION OF WORK	ITEM	DATE REQUIRED	DATE PROMISED

Machinery

Fig. 7. Inter-shop Order used by Planning Office of a Shop to order Work from Another Shop without Permission from Chief Planner of Central Planning Office

JOB ORDER NO. | S. O. | CARD | OBJECT | BRIEF | INFORMATION: Back of A-11 | PREPARATION | SHOPS INVOLVED AND SCHEDULE DATES | DATE ISSUED | DATE COMPLETED

PCS.	ITEM	MAT'L	PATT	SIG.	OR. NO.	PC. NO	TAG NO	BLUEPRINTS, SKETCHES OR SAMPLES ISSUED	INSTRUCTION CARDS ISSUED	TOOLS REQUISITIONED	INTERFERENCES COVERED	MATERIAL ORDERED	MATERIAL SOURCE AND RECEIPT	ROUTING, COMPLETION, INSPECTION	ITEMS SCHED. FROM	ITEMS SCHED. BY	REMARKS
4	Sets wrist pin brasses			Csts	Instruction		10,011		12/30				YCA	B1 S			
2	" crank " "			"	"		10,012		12/30				YCA	B1 S			
	Crosshead Group			"	"		Grp T 10,013		12/30				5	YC S			
1	Eccentric Strap			Misc	"		10,014		12/30				YCA	B1 S			
1	Knuckle			"	"		10,015		12/30				YCA	YC C S			
1	Piston valve			"	Instruction + sample		10,016		12/30			12/30	94	C S			
1	" " yoke			"	Instruction		10,017		12/30				YCA	YC C S			
1	" " stem + 2 nuts			"	Instruction + sample		10,018		12/30			12/30	31	C S			
1	" " stem guide			"	"		10,019		12/30			12/30	94	C S			
1	set metallic packing			"	"		10,020		12/30			12/30	94	C S			
1	Gland			"	Instruction		10,021		12/30				YCA	C S			
	231																

Fig. 8. Progress Card upon which a Record is kept of the Progress of Work through the Shop

from which the card was received; inserts the date of receiving a plant delivery tag stub showing the shipment of material, under the number of the shop to which the material should be sent as shown by the routing schedule; and inserts the date of receiving the signed requisition triplicate under "Material" in the "Source and Receipt" column.

Instruction Card and Route and Inspection Tags

The instruction card, Fig. 9, forms a basis for the progress records and should be filled out accurately. In the "Item" space is given a description of the job and the kind of material to be used. In the "Description" column, instructions are given to the shop concerning the method in which the job is to be performed. Such a clear and detailed description of work to be done should be given that the man who is to do the work will readily understand what is wanted. Free-hand sketches are of practical value in this respect. The instruction card is furnished in four colors—white, yellow, blue, and pink. The white card is for customers' orders and tool orders; the yellow card for special manufacturing orders; the blue card for stock orders; and the pink card for rush jobs.

The planner makes three copies of the instruction card, one copy being sent to the progress section so that the necessary entries may be made on the progress card, and then to the jacket file. The other two copies are sent to the method man for approval and then to the foreman of the shop concerned. Upon the completion of the work, the foreman retains one copy for his private file and forwards the other to the progress section to be noted on the progress file, after which it is placed in the jacket file. The instruction cards filed in the jackets are the basic records from which can be summarized, as desired, the quantities of various parts made and of the materials used. All carrying of stock and determining of maximum and minimum limits should be based on these records. They also are valuable in deciding whether it will pay to specialize or standardize the making of any product, that is, to change its production from a jobbing to a manufacturing basis.

The route tag issued by a planner for a job is shown in Fig. 11. On the back of this tag is a list of the shops and departments through which the work must pass, the shops and departments being numbered serially to indicate the intended route. Group and master tags are made out in red ink, while tags for individual items are made out in black. The planning office uses a white tag for partial deliveries of work, while shop supervisors use a green one, thus denoting the partial lots originating in the shop. If a planner

INSTRUCTION CARD

Date Issued	Object	J. O.
Progress Sheet	Stowage	Operator
Sec.	Planner	Move to
Item		Drg.

Drawing	Pc. Mark	No. pcs.	Tag No.	Description

Fig. 9. Instruction Card giving Information to the Shop as to the Manner in which a Job is to be performed

DAMAGE REPORT

CHECK NUMBER .... DATE ....

Name .... Trade .... Rate ....

Item ....

....

J. O. .... Plan .... Piece ....

Material .... Pattern .... Tag ....

Replaced on J. O. ....

Remarks: ....

....

....

Fig. 10. Report made out by the Foreman of a Department in which Work has been damaged

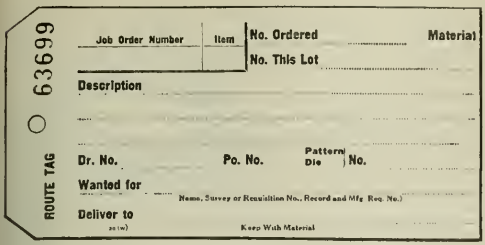


Fig. 11. Route Tag, which gives a List of the Successive Shops and Departments through which the Work must pass

attaches the route tag to a material list, both are sent to the material man, and if the tag is attached to a foundry slip, it is sent with the latter memorandum to the receiving clerk. When material on hand is to be used, the route tag is attached to the original instruction card and follows the same route as this card. The route card remains with the work until the latter is completed, and is then destroyed by the shipping clerk.

The inspection tags used on a job are shown in Fig. 12, the "Passed" tag being white in color, and the "Rejected" tag, red. Both of these tags are made out by the inspector. The "passed" tag is attached to the work and goes with it to the next section, where it is signed by the assistant foreman of the section. It is then sent to the progress section to be noted on the progress card, and finally placed in the jacket file. The "Rejected" tag is sent to the shipping clerk with defective material, and then to the progress section to have the proper notations made on the progress card, after which it is also placed in the jacket file. When an article is repaired, or errors are otherwise corrected, the shipping clerk destroys the red tag.

Damage Report and Sample Tag

When work is damaged in a shop, a report is made out by the foreman of the department on the form shown in Fig. 10. This report is then sent with the defective material to the shipping clerk, who forwards it to the progress section to be noted, on the progress card. It is then sent to the departmental chief planner for his observation, after which it goes to the material man. The latter makes out a credit and debit transfer stub in five copies—two pink, two green, and one white. The damage report and transfer stub

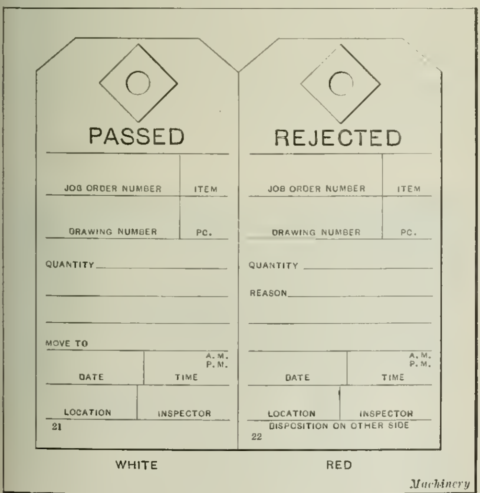


Fig. 12. White and Red Inspection Tags used for passing or rejecting Work

are then sent to the departmental chief planner for his approval and signature, after which the damage report is sent to the general foreman for action. The transfer stub is sent to the progress section to be noted on the progress card, after which the white copy is placed in the jacket file. One pink and one green copy of the transfer stub are sent to the shipping clerk, and the other pink and green copies are sent with the material to its destination.

The sample tag shown in Fig. 13 is attached to a sample which is to be sent to another shop. This tag is filled out by a planner who tears off the stub and sends it to the progress section to be noted on the progress card. The planner attaches the body of the tag to the sample and sends both to the receiving clerk, who forwards them to the shop designated by the tag. This shop later returns the sample and tag to the receiving clerk, who sends them to the section of the shop that is designated by the route tag. At the time the sample is returned with material to the shipping clerk, the sample tag is destroyed. When a request is made to a customer for a sample, the same tag is used, the stub being detached and sent to the jacket file. The body of the tag is sent with the request to the customer, the latter being asked to attach the tag to the sample when forwarding it.

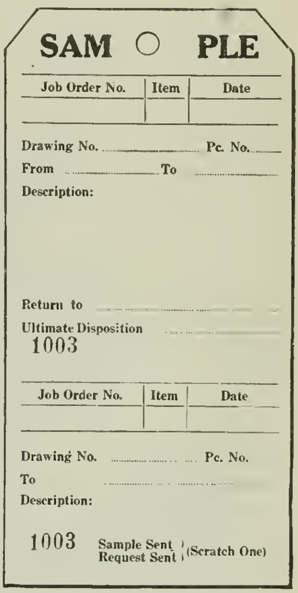


Fig. 13. Tag attached to Samples of Work sent to Other Shops or received from a Customer

The drawing index card is a record of the blueprints in the possession of the shop. These cards show the supply of every print on hand and to whom prints have been issued. They are kept by a clerk located in the shop planning office, and are filed in card index form by the symbol designation of the prints.

* * *

PLANING METHODS

By H. K. GRIGGS

Referring to the article "Planing Stock Reel Supports for Automatic Screw Machines" on page 205 of November, 1921, MACHINERY, the writer wishes to call attention to a mistake that is commonly made in setting up planer work, namely that of placing the angle-plate wrong side out. This mistake is particularly noticeable in planing such work as the flange faces of large pipe elbows. When the angle-plate is used as shown in the illustrations of the article referred to, there is a tendency for the pressure of the cut to lift the angle-plate from the planer bed, thus causing the tool to dig into the work. The lifting force is sometimes great enough to raise the table sufficiently to bring the pinion out of mesh with the rack and thus cause serious damage to the machine. By turning the angle-plate around, the pressure of the cut will spring the work downward and thus eliminate danger of the tool digging in. In the case of the work referred to, it is the writer's opinion that the castings could be more easily put on the planer if the angle-plate were turned around, and heavier cuts could be taken without causing chatter.

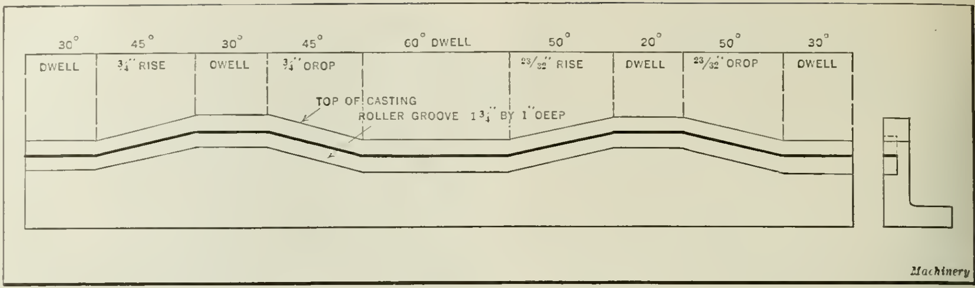


Fig. 1. Lay-out for Large Cam, which was cut on a 48-inch Boring Mill

SPRING MEETING OF THE A. S. M. E.

The tentative program of the spring meeting of the American Society of Mechanical Engineers, to be held in Atlanta, Ga., May 8 to 11, includes a strong technical program, covering machine shop and textile sessions, and papers relating to management, power, fuels, and the handling of materials. The power division's program will relate specifically to hydro-electro power developments in the Southeast. A paper giving the results of recent tests on a 60,000 kilowatt turbine at the Interborough Rapid Transit Co. of New York will also be presented. "Material Handling Equipment in the Steel Industry" will be the subject of one of the papers read; this paper will treat of the entire industry in a comprehensive manner, and will show how the handling of materials hinges on the adequate design of mechanical handling equipment. In connection with the meeting an excursion will be made to Birmingham, Ala., to inspect plants engaged in the manufacture of iron and steel. The programs of the management, textile, and machine shop divisions will all be devoted to problems arising in the textile industry, the machine shop division dealing particularly with textile machinery maintenance. After the sessions in Atlanta, those interested in seeing textile plants in operation will visit Greenville, S. C.

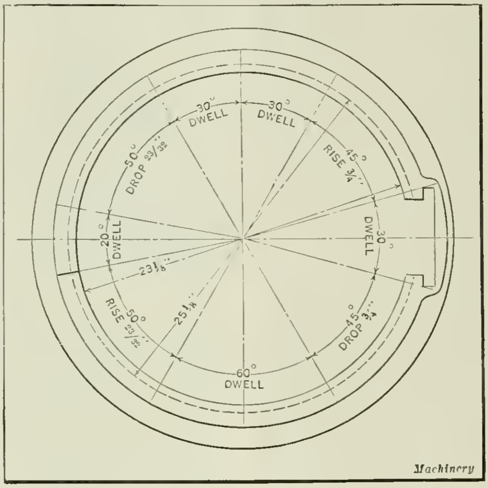


Fig. 2. Plan View of Finished Cam

CAM CUTTING ON A BORING MILL

By ARTHUR MUMPER

Having a cam to cut which was too large to be handled on any of the machines ordinarily used for cam cutting, the writer suggested doing the work on a Cincinnati 48-inch vertical boring mill as described in the following. The cam, which is shown in Fig. 4, was to be used in the construction of a special machine, and was required to be cut accurately. The lay-out for the job is shown diagrammatically in Fig. 1 and a plan view of the finished cam may be seen in Fig. 2.

The first thing to do was to get the ram of the machine to slide up and down with the least possible friction. An attempt was made to remove the pinion from the short feed-shaft which runs from the front to the rear of the ram on the boring mill. This proved impossible without removing the saddle from the cross-rail, and as time was an important consideration in this case, it was decided simply to remove the rack from the ram and fasten a bar of cold-rolled steel in its place, making this bar just enough smaller to allow the front pinion to clear it. This served the purpose, but it was found necessary to fasten a heavy counterweight on the ram, in order to make the tool follow the drop of the master cam, and reproduce the correct shape on the work.

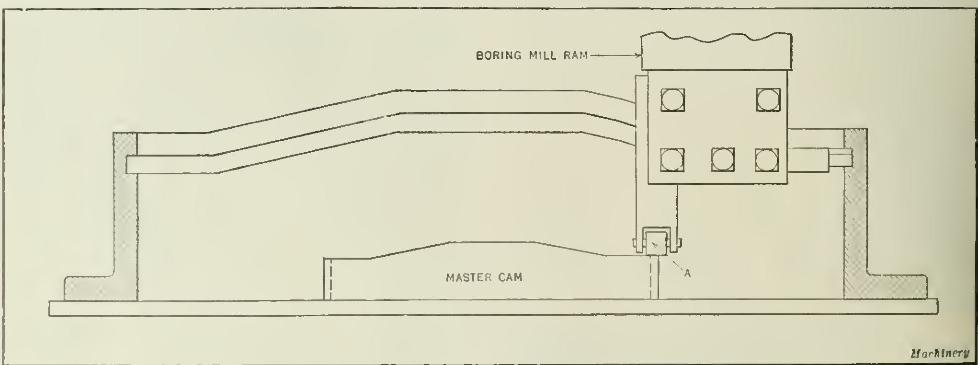


Fig. 3. Boring Mill Set-up for cutting Groove in Cam shown in Fig. 2

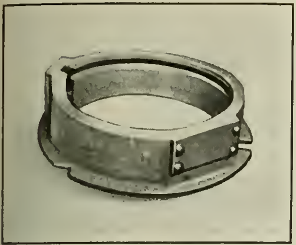


Fig. 4. Finished Cam

From the illustrations it will be apparent that the casting was so designed that it could be easily bolted to a bedplate. Hence a bedplate was cast for this purpose which was held in the chuck of the machine. The master cam was laid out on a bar of cold-rolled steel. ½ by 1¾ inches in size, which was then bent around a shaft 12 inches in diameter, the ends being clamped together. The master cam was 12 inches in diameter, while the diameter of the inside of the cam to be cut was 23⅛ inches. The master cam was clamped on the bedplate and in the true center of the job. Next a roller *A*, Fig. 3, was made and clamped to the inner side of the box-tool holder of the machine. This roller carried the weight of the ram, and as it rode on the master cam it imparted vertical movements to the box-tool holder, which resulted in cutting the cam groove to the required contour. The tool used in cutting the groove was a common straight parting tool about ⅝ inch wide on the cutting edge. As specified in the layout. Fig. 1, the cam groove was cut 1 inch deep by 1¾ inches wide. In Fig. 5 the cam is shown clamped to the boring machine table in position to be bored, previous to cutting the cam groove.

* * *

SCREW THREAD PRACTICE IN EUROPE

The U. S. standard screw thread appears to be little used in Europe. The form in most general use is the Whitworth thread, and consequently the metric countries, particularly Austria, Germany, Holland, Sweden, and Switzerland, are anxious to agree on tolerances for this form of thread. They believe that the Anglo-Saxon countries should take the lead in this work, but are anxious to have an agreement reached as soon as possible. It is reported that Austria, France, Germany, Holland, Italy, Sweden, and Switzerland either have adopted or will adopt three systems of screw threads, namely, the International System (metric), the Metric Fine Thread, and the Whitworth Thread.

The Germans have decided to discard several less used metric systems so as to have not over three in use. They are much interested in the number of threads per inch for the very large Whitworth screws. The German shipbuilding industry wants to continue the use of pitches coarser than four threads per inch on account of their use on British ships, but the other German industries want to limit the number of threads per inch to four, as recommended by the National Screw Thread Commission of the United States.

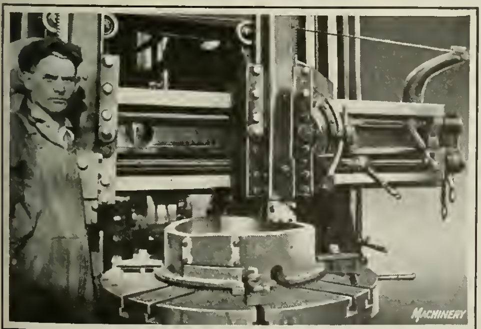


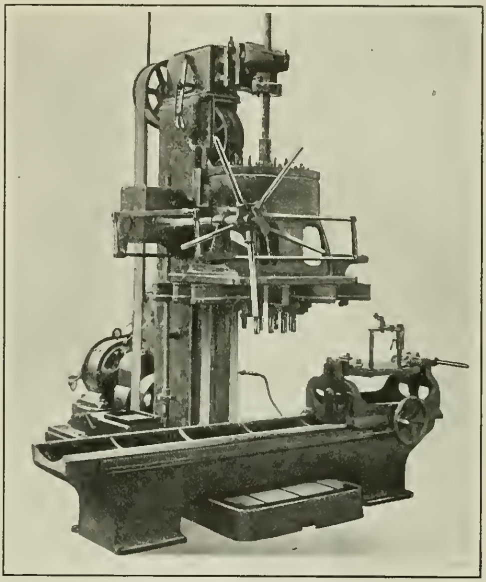
Fig. 5. Boring Operation on Cam

Germany, Holland, Sweden, and Switzerland take the nut as the fundamental basis, according to Secretary Agnew of the American Engineering Standards Committee. The Swiss have done extensive work in establishing screw thread tolerances for metric and Whitworth threads, but the results have not been published. The Dutch standards for bolts are now being revised. The British have organized an association of Bright Nut and Bolt Manufacturers, and this has greatly stimulated work on the general question of screw threads and on the details of nuts and bolts. It is believed that the Society of Automotive Engineers' thread is being extensively used in England, and the British association is undertaking to determine the extent of its use.

* * *

UNIQUE SLIDE FOR TRUNNION JIG

The accompanying illustration shows a unique means of traversing a trunnion jig beneath the spindle head of a No. 14 "Natco" multiple-spindle drilling machine. The photograph was taken in a machine shop in France. It will be seen that the bed of a dismantled lathe has been placed on the floor with the gap between the legs extending over the base of the drilling machine, the ways of the lathe bed being utilized as sliding surfaces for the jig. The latter is fed across the bed by revolving a handwheel on the jig, which rotates a pinion engaging the teeth of the rack on the front of the bed. The bed belongs to a worn-out lathe, and if an enterprising mechanic had not thought of its present application it would no doubt have been scrapped.



Old Lathe Bed utilized as a Slide for traversing a Jig under a "Natco" Multiple-spindle Drilling Machine

* * *

The waste from accidents is one that should be given greater attention than any other industrial waste. In a paper presented before the Industrial Waste Session at the Pennsylvania Industrial Relations Conference, it was pointed out that the rate of accidental death in the United States for each million of population is 860, as compared with 452 in England and 477 in France. Statistics were also presented giving the direct and indirect cost of fatal and non-fatal accidents as $1,500,000,000 annually. This is only the dollars and cents waste. Other elements of loss are not reducible to such a basis and are not replaceable.

Graphic Representation of Absorption of Impact by Springs

By LESLIE H. MANN, Engineer with Perin & Marshall, Consulting Engineers, New York City

THE determination of the energy absorbed by a spring under load as treated herein is based upon the assumption that the body producing the deflection of the spring is moving with its center of gravity in line with the axis of the spring, or in line with the point that will cause the spring to act most efficiently. It is further assumed that the deflection of the spring is proportional to the applied load, and the inertia of the spring is considered to be a negligible factor.

In the formulas,

W = weight of moving body;

V = velocity of moving body in feet per second at instant of striking the spring;

g = acceleration due to gravity (32.16 feet per second);

P = maximum applied force in pounds, or slowly applied load which would deflect the spring as much as will the moving body;

F = deflection of spring in feet;

E = energy in foot-pounds absorbed by the spring during deflection.

From the hypothesis and the laws of mechanics,

$$\frac{PF}{2} = E, \qquad \text{or} \qquad P = \frac{2E}{F}$$

$$\frac{WV^2}{2g} = \text{energy of body at instant of striking spring}$$

If the load deflects the spring vertically downward, additional energy WF is developed so that

$$E = \frac{WV^2}{2g} + WF \qquad (1)$$

If the load is directed toward the spring obliquely downward at an angle Z with the vertical, additional energy, $WF \cos Z$, is developed, or

$$E = \frac{WV^2}{2g} + WF \cos Z \qquad (2)$$

The general formula for the energy absorbed by a spring during deflection may be written:

$$E = \frac{WV^2}{2g} \pm WF \cos Z \qquad (3)$$

The last term in this formula takes the *positive* sign when the motion toward the spring is *downward*, and the *negative* sign when the motion toward the spring is *upward*. When the motion is *horizontal*, angle Z will, of course, be 90 degrees, and since the cosine of 90 degrees is zero, the last term will in this case disappear entirely and the formula becomes

$$E = \frac{WV^2}{2g} \qquad (4)$$

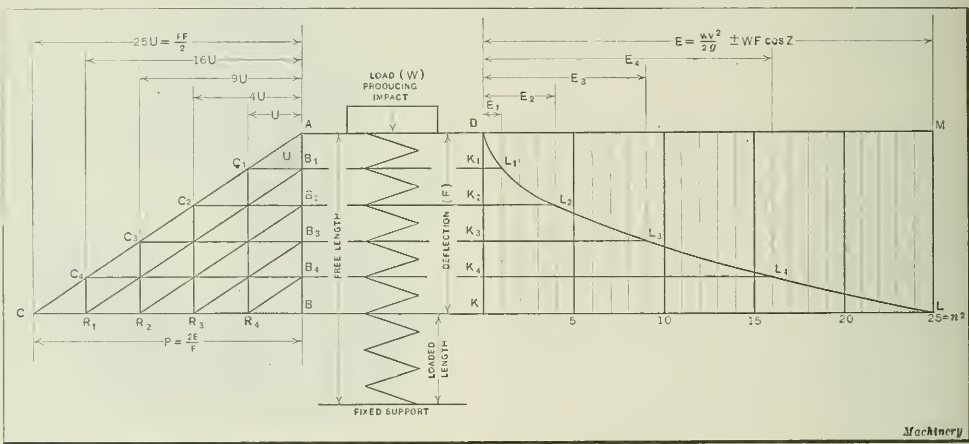


Fig. 1. Diagram for analyzing the Formulas for Absorption of Energy by Springs under Deflection

The formulas given in the preceding are placed in tabular form for convenience as follows:

Direction of Motion	Formula
Vertically downward	$E = \frac{WV^2}{2g} + WF$
Obliquely downward	$E = \frac{WV^2}{2g} + WF \cos Z$
Horizontal	$E = \frac{WV^2}{2g}$
Obliquely upward	$E = \frac{WV^2}{2g} - WF \cos Z$
Vertically upward	$E = \frac{WV^2}{2g} - WF$

The diagram Fig. 1 represents a load W striking against a helical spring which has a fixed support. The graphic depicting of the formulas is applicable to springs made from wire of any sectional shape, and, in general, to springs of any type. Draw two parallel lines AM and CL, the perpendicular distance between them representing the deflection F.

Draw AB and DK perpendicular to the horizontal lines and parallel to the line of deflection F, and divide these two lines into any desired number of equal parts n, as, for example, five. These divisions are represented by spaces AB_1, B_1B_2, DK_1, etc. Through corresponding division points on AB and DK draw the horizontal lines C_1K_1, C_2K_2, etc. By selecting the proper formula from the above tabulation, which will agree with the condition under which the spring is located, the computation for E may be made, and this value may then be graphically represented by making DM equal to E, using any convenient scale.

After calculating the value of P from the formula $P = \frac{2E}{F}$, lay off BC equal to this value, using any other convenient scale. Divide BC into the same number of equal parts as AB was divided into (in this case five), and designate the division points as shown. Complete the triangle by connecting points A and C and then draw similar inclined lines through the remaining division points; also draw the vertical lines C_4R_1, C_3R_2, etc.

The formula for energy absorbed by the spring has been shown to be $E = \frac{PF}{2}$, and since the sides AB and BC of the triangle equal, respectively, F and P, it follows that the area of triangle ABC which is $\frac{PF}{2}$, represents graphically the amount of energy E absorbed by the spring in its deflection from A to B. Likewise, the area of the small triangle AB_1C_1 represents the amount of energy absorbed by the spring during its deflection from A to B_1; also the area of the triangle AB_2C_2 represents the amount of energy absorbed through the deflection from A to B_2; and further, the area of each triangle shows graphically the energy absorbed in deflecting the spring a distance equal to the altitude of that triangle. It is evident that the area of the large triangle ABC is equivalent to twenty-five small triangles AB_1C_1, this unit area being designated on the diagram by letter U. Next, divide DM into the same number of parts as there are small triangles in the large one, that is, twenty-five, and from the division points on DK draw K_1L_1, K_2L_2, etc., equal to the same number of these subdivisions as there are units U in the corresponding triangles AB_1C_1, AB_2C_2, etc. A curve, which is parabolic, is then drawn through the termination of these horizontal lines, as shown in the diagram.

ABSORPTION OF IMPACT BY SPRINGS

Deflection	Area Representing Impact	Number of Units U or Parts of DM	Energy Absorbed
D to K_1	AB_1C_1	$1 = 1^2$	$K_1L_1 = E_1 = \frac{E}{25}$
D to K_2	AB_2C_2	$4 = 2^2$	$K_2L_2 = E_2 = \frac{4E}{25}$
D to K_3	AB_3C_3	$9 = 3^2$	$K_3L_2 = E_3 = \frac{9E}{25}$
D to K_4	AB_4C_4	$16 = 4^2$	$K_4L_4 = E_4 = \frac{16E}{25}$
D to K	ABC	$25 = 5^2 = n^2$	$KL = E = \frac{25E}{25}$
K_1 to K_2	$B_1B_2C_2C_1$	$3 = 4 - 1$	$E_2 - E_1 = \frac{3E}{25}$
K_2 to K_3	$B_2B_3C_3C_2$	$5 = 9 - 4$	$E_3 - E_2 = \frac{5E}{25}$
K_3 to K_4	$B_3B_4C_4C_3$	$7 = 16 - 9$	$E_4 - E_3 = \frac{7E}{25}$
K_4 to K	B_4BCC_4	$9 = 25 - 16$	$E - E_4 = \frac{9E}{25}$

Machinery

In the accompanying table, the data contained is deduced from the diagram, and shows the amount of energy absorbed during deflection of the spring from its free length to any point of equal division of F, and also the amount of energy absorbed during each successive portion of the deflection. It will be noted that the energy absorbed during the last part K_4K of the deflection is nine times that absorbed through the first part DK_1 of the deflection.

A diagram which may be used to determine graphically the energy and the load values for a given deflection is shown in Fig. 2. The rectangle $ABCD$ has its parallel sides divided into ten spaces each. Draw the diagonal AC and the parabola AKC. Prolong CD through E and F and prolong CB to G. From B lay off the oblique line BM, terminating in the line EF, which will show to any convenient scale the total energy absorbed. In a similar manner, from A lay off AL terminating in line EF, and line AT terminating in line CG, to represent the maximum load in pounds and the deflection in feet, respectively.

From any point of deflection, as T_1, draw T_1C_1 parallel to GC, intersecting the parabola at K and the diagonal at C_1. Drop a perpendicular KM_1 to BM. Where this perpendicular intersects BC, the fraction of the total energy is indicated. Erect a perpendicular from point C_1 intersecting AL; where this perpendicular intersects AD the fractional part of the maximum force or load is indicated. By properly graduating lines AT, BM, and AL, representing assigned total values, corresponding intermediate values of deflection, energy, and load may be quickly determined. It is evident that at 0.5 of the total deflection, the energy already absorbed is only 0.25 of the total energy E; also the corresponding force or load P on the spring is 0.5 of the maximum load. In the present case, where the deflection is 0.15 foot, the energy absorbed is 0.25 of the total energy or 525 foot-pounds; and the load on the spring is 0.5 of 14,000 pounds, or 7000 pounds.

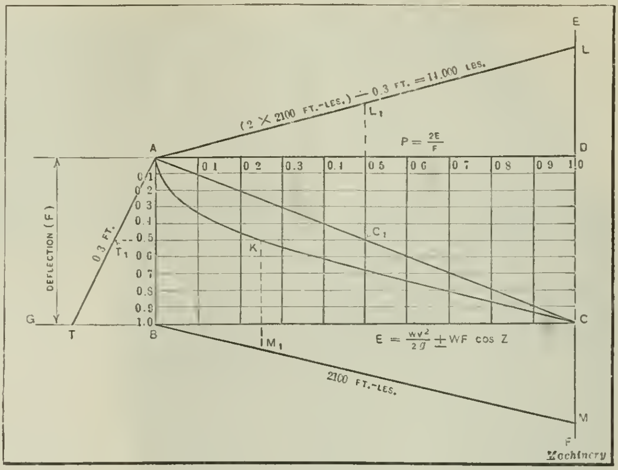
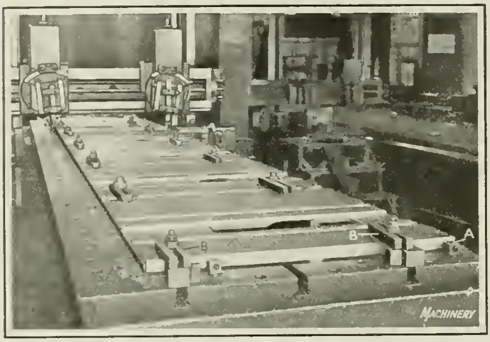


Fig. 2. Graphic Method of determining Values of Spring Deflection, Energy Absorption, and Load

PLANING SAW BENCH TABLES

The accompanying illustration shows a Niles-Bement-Pond planer equipped for planing the ends of saw bench tables in the plant of the Pratt & Whitney Co., Hartford, Conn. Six castings are set up in a string, so that they can be operated upon at one continuous cut. The work is rather unusual because of its great length and width, as compared with the



Planing the Ends of Wood-cutting Saw Bench Tables

thickness. Two end-stops *A* receive the thrust of the cutting tools and also locate the finished edges of the work at right angles to the line of travel of the planer table. The work is held down by two straps *B* located between each pair of castings. The two cutting tools are of simple design, one operating on each end of the castings. The material is cast iron, and the depth of cut on this job is ½ inch, the feed ⅛ inch per table stroke, and the cutting speed 30 feet per minute. The top surface of these castings was planed at a previous setting on the same machine, and this job is of interest because of the large area that is finished. On this operation the depth of cut was 1/16 inch, and the tools were fed at a rate of ⅞ inch per table stroke, with a cutting speed of 30 feet per minute.

* * *

SNAP GAGE DESIGN

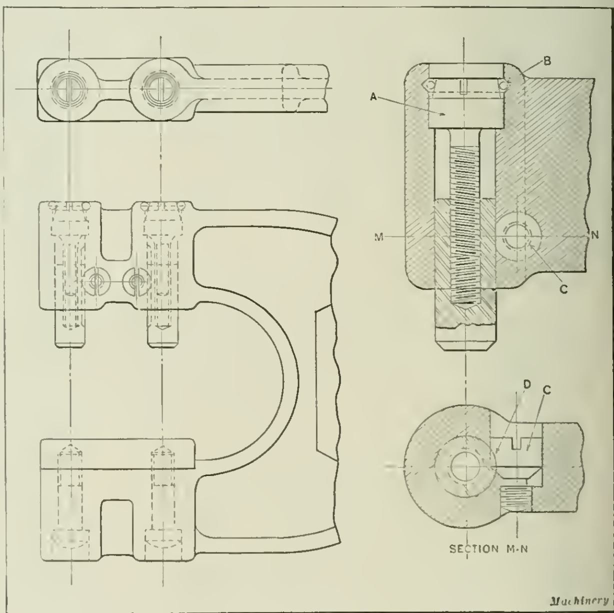
By J. B. CONWAY

A table prepared by the writer, which appeared in August, 1920, MACHINERY on page 1123, gave dimensions for snap gage frames in sizes ranging from ¼ to 17 inches. The adjusting and locking devices shown in the accompanying illustration were designed by the writer, and have been used successfully on frames of the type described in the article referred to, as well as on gage frames of similar design. In designing snap gages, there are several points that must be carefully considered if satisfactory results are to be obtained. A frame of substantial design, preferably of material that will break before distorting, is of first importance. An adjustable feature to provide for readily adjusting to different sizes, and to compensate for wear, and a locking device or mechanism which provides for independent adjustment of the different parts are practically indispensable.

The design of frames described in the article mentioned will be found rugged and durable. Selection of the material from which they are to be made, either cast iron or other material, is left to the judgment of the designer. Whether four anvils or blocks are employed is also a matter of opinion, and depends somewhat on the conditions under which they are to be used. Referring to the accompanying illustration, it will be seen that means of adjusting the gage plugs and of securing them in position after they are set to the desired points are incorporated in the design. Aside from the frame and anvil this design consists of an adjustable plug, an adjusting screw, a retaining ring, and a locking screw.

The plug is adjusted in or out by means of the adjusting screw *A*, which has a left-hand thread. When the adjusting screw is turned in a clockwise direction, the distance between the gaging points is decreased. To increase the size of the gage the screw is given a reverse movement. The adjusting screw is retained in position by ring *B* which fits in a V-shaped annular groove as shown. This ring is made of spring brass or steel, and is split to allow for closing it a sufficient amount when placing it in position. A groove cut in the plug at *D* is made to conform to the shape of the head of the locking screw *C*. The action of screw *C* when it is forced against the plug is to grip the side in contact with the head, and as further pressure is exerted it binds on the parallel side of the head. This affords a positive lock, and insures setting the plug in its original position with respect to its face whenever it is changed for adjustment or after relapping.

Besides the usual care required in maintaining accuracy in gages of this kind, attention must also be given to the accuracy of the seat on the head of the locking screw and to the angle of the groove in the plug. The proximity of the locking screw to the plug can be such that the distance will just permit the passage of the body of the screw without actual contact between the screw and the plug. This design of locking device can be employed on gages of other types such as large "sweep" or "windmill" gages, inside gages, and various types requiring adjustability of the gaging points or surfaces.

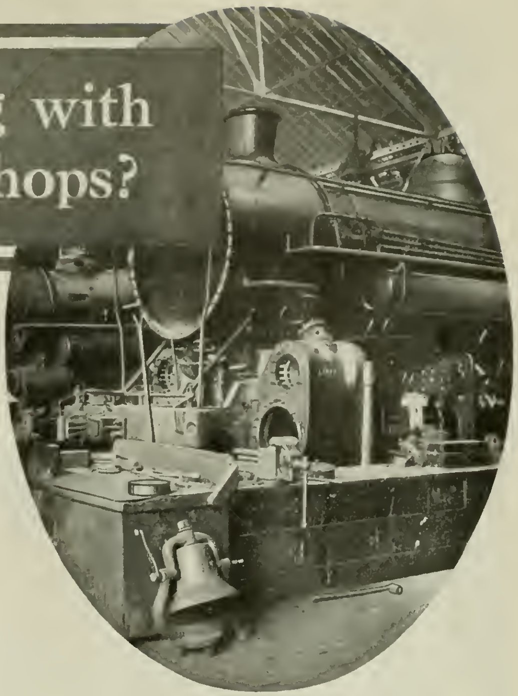


Snap Gage equipped with Adjusting and Locking Devices

* * *

National standardization bodies now exist in fourteen countries as follows: Austria, Belgium, Canada, Czecho-Slovakia, France, Germany, Great Britain, Holland, Italy, Japan, Norway, Sweden, Switzerland, and the United States.

What is Wrong with the Railroad Shops?



An Investigation into the Relative Costs of Performing Machining Operations in Seven Representative Railroad Shops

By EDWARD K. HAMMOND

THOSE who are capable of passing reliable judgment are of the opinion that the average efficiency in American railroad shops is far beneath that of industrial plants engaged on similar lines of work. The trouble is largely due to unsuitable equipment and inefficiency of railroad shop labor. The methods employed are usually satisfactory, but there is room for improvement both as regards the mechanical equipment of the railroad shops and the efficiency of the men employed in them. The railroad's finances have often made shop superintendents hesitate to requisition mechanical equipment which their better judgment told them was imperative.

Labor has been the other drawback. Prior to the period of government control, many of the shops were operated under some piece-work or bonus system that created an incentive to do efficient work, but after the government took control, the so-called National Agreement on Working Conditions abolished all such systems of remuneration and put all the workers on an hourly or monthly pay basis. A falling off in efficiency was inevitable, and this was most pronounced in those shops where bonus or piece-work methods were formerly in use. These piece-work or bonus systems were not only a means of enabling the railroads to get out their work at what was more nearly a minimum production cost, but they also afforded all shop employes an opportunity for greater earnings.

Recently, the United States Railroad Labor Board handed down a decision providing for the re-establishing of various piece-work or bonus systems, and permitting the railroads to deal individually with their shop men; it is expected that if the necessary readjustments can be made in line with these rulings, a higher standard of efficiency will result.

Importance of Constant Supervision

It is undeniable that the efficiency of any productive organization deteriorates rapidly without constant supervision; but during the period in which the National Agreement was in full force, adequate supervision of labor was impossible. Today this obstacle has been largely removed, and in starting to increase railroad shop efficiency, one important step would be to send out men to make thorough studies of conditions in each of the shops, with a view to establishing the normal cost of every operation and ascertaining the cause of failure to attain this degree of efficiency. In most cases it would probably be found that both mechanical equipment and labor are partially responsible for low efficiency.

A man who has had an unusual opportunity to observe conditions in railroad shops suggests that better results can be obtained from shop workers by creating a financial incentive, such as a properly applied piece-work or bonus plan of payment, which would be of benefit to both the men and the management; and he believes this idea could be carried still further by placing the shop foremen on a bonus system as well as the men.

A Plan for Increasing the Efficiency of Labor

In working out such a plan for rewarding the efficiency of the foremen, it would be necessary to determine what working force would normally be required in each department for handling the average amount of work coming into the shop. Then if this normal force could be reduced by increasing the rate of output per man, the foreman would be paid a percentage of the saving in labor costs of his department. The foreman would urge the men to obtain the maximum production by pointing out the increase in their earnings made possible by the bonus system. Such a plan would be far-reaching in its effect, because it would overcome the jealousy that is sometimes felt by foremen because of the high earning capacity of men who are working on a piece-work basis.

Efficiency in the management of any manufacturing enterprise requires the successful adjustment of three fundamental factors—methods, mechanical equipment, and men. Conditions in a railroad shop are not radically different from those in industrial plants handling similar classes of work; in both cases, to make it possible to machine parts at a minimum cost, it is imperative (1) to develop methods for performing each operation rapidly; (2) to make sure that a machine of the proper type and one that is in good mechanical condition is available for handling every job; and (3) to have the machine operated by a mechanic with the necessary experience and ability, who makes an effort to produce the high rate of output possible with the machine and methods used. The present article is an investigation into the extent to which railroad shops meet these requirements of efficient management.

TIME FOR PERFORMING MACHINING OPERATIONS ON LOCOMOTIVE PARTS

No. of Operation	Part to be Machined	Operation	Railroad No. 1 Santa Fe Type Engine		Railroad No. 2 Santa Fe Type Engine		Railroad No. 3 Mikado Type Engine		Railroad No. 4 Santa Fe Type Engine		Railroad No. 5 Heavy Mikado Type Engine		Railroad No. 6 Santa Fe Type Engine		Railroad No. 7 Santa Fe Type Engine	
			Type of Machine Used	Time, Hours	Type of Machine Used	Time, Hours	Type of Machine Used	Time, Hours	Type of Machine Used	Time, Hours	Type of Machine Used	Time, Hours	Type of Machine Used	Time, Hours	Type of Machine Used	Time, Hours
1	Cylinder casting	Bore cylinder	Horizontal boring mill....	11.53	Horizontal boring mill....	7.50	Special mch. }	12.00	Special horizontal boring mill (bore and face cylinder)	25.00	Horizontal boring mill....	9.00	....	....	Horizontal boring mill....	30.00
2	Cylinder casting	Bore valve chamber	Horizontal boring mill....	6.63	Horizontal boring mill....	5.00	Special mch. }				Horizontal boring mill....	5.00	....	....	Horizontal boring mill....	20.00
3	Piston-head	Face ends, turn outside diameter, cut two grooves and bore rod fit	Vertical turret lathe	2.60	....	....	Lathe	3.50	Boring mill....	3.50	Vertical boring mill	8.00	Vertical turret lathe	5.50	Vertical turret lathe	4.00
4	Piston-ring	Turn and bore sleeve, and cut off rings	Vertical turret lathe	0.27	....	....	Vertical turret lathe	0.20	....	0.33	Vertical boring mill	0.28	Vertical turret lathe	0.48	....	0.33
5	Main-rod	Machine sides at each end	Planer type milling machine	1.76	....	....	Planer	3.00	Planer (Includes Operation 8)	6.00	Planer	11.00	Planer	4.00	Planer type milling mch...	8.00
6	Main-rod	Machine four sides of body, channel two sides	Planer type milling machine	9.53	....	....	Planer	12.00	Planer	12.00	Horizontal milling machine	12.00	Planer	16.00	Planer	16.00
7	Main-rod	Mill radius at small end	Vertical milling machine ..	3.13	....	....	Slotter	0.50	Vertical milling machine	1.00	Vertical milling machine...	2.00	....	....	Slotter	3.00
8	Main-rod	Mill strap fit at large end	Vertical milling machine ..	6.97	....	....	Slotter	2.00	Included in Operation 5......	....	Planer	1.00	Slotter	9.00	Draw cut shaper	3.00
9	Main-rod strap	Finish edges	Planer type milling machine	1.04	Planer	0.70	Planer	2.00	Planer	2.00	Planer	8.00	....	....	Planer	2.00
10	Main-rod strap	Mill or slot inside and out	Vertical milling machine ..	6.87	Slotter	3.80	Slotter	6.00	Slotter	6.00	Slotter	15.00	Slotter	8.50	Slotter	5.00
11	Main-rod brass	Face joints	Engine lathe..	0.44	Shaper	0.50	Shaper	0.17	Planer type milling machine	0.50	Shaper	0.50	Engine lathe..	0.50	Shaper	0.50
12	Main-rod brass	Sweat together	....	0.23	....	....	....	0.17	....	0.33	Coke furnace..	0.25	....	0.50	....	0.50
13	Main-rod brass	Face both ends.....	Engine lathe..	0.11	....	....	Shaper	0.17	....	0.33	Vertical boring mill	0.50	Engine lathe..	0.50	Boring mill....	0.50
14	Main-rod brass	Machine strap fit...	Crank planer..	1.11	Miller	1.50	....	1.67	Slotter	4.00	Shaper	3.00	Shaper	1.50	Shaper	2.00
15	Main-rod brass	Bore hole	Vertical boring mill	1.11	Vertical boring mill	0.90	Vertical boring mill	0.67	(Bore and face one side)......	1.50	Vertical boring mill	1.00	Engine lathe..	1.25	Vertical boring mill	1.50
16	Driving wheel center	Turn outside diameter	Vertical boring mill	7.38	Wheel lathe...	4.00	Vertical boring mill	3.00	(Turn, bore axle fit, face sides)	14.00	Wheel lathe...	2.50	....	....	Wheel lathe...	4.00
17	Driving wheel center	Press on axle.......	Hydraulic press	0.30	Hydraulic press	2.00	600-ton press..	0.67	....	1.50	Hydraulic press	1.00	Hydraulic press	1.00	Hydraulic press	1.00
18	Wheel center ..	Quarter	Quartering mch.	0.94	Quartering mch.	3.50	Quartering mch.	1.50	....	4.00	Quartering mch.	3.50	....	....	Quartering mch.	2.00
19	Driving wheel tire	Bore inside diameter	Vertical boring mill	3.20	Vertical boring mill	1.00	Vertical boring mill	0.67	....	1.00	Vertical boring mill	0.67	....	....	Vertical boring mill	1.25
20	Driving wheel tire	Shrink on center....	Special heating furnace	0.70	Special heating furnace	1.20	Unit heater....	0.33	Kerosene oil burner	0.67	Oil heating device	0.50	Special heating furnace....	1.25	Special heating furnace	0.50
21	Driving wheel tire	Turn tread and flange	Wheel lathe...	0.63	Wheel lathe...	1.12	Wheel lathe...	0.50	Tire turning machine	0.83	Wheel lathe...	1.50	Wheel lathe...	2.50	Wheel lathe...	2.67
22	Main crankpin..	Turn all over........	Engine lathe..	4.17	Engine lathe..	4.00	Engine lathe..	4.47	....	6.00	Engine lathe..	15.00	Engine lathe..	6.50	Engine lathe..	7.00
23	Main crankpin..	Press into wheel....	Hydraulic press	0.22	Hydraulic press	1.50	600-ton press..	0.17	....	0.50	Wheel press...	0.50	Hydraulic press	0.50	Hydraulic press	0.25
24	Driving-box	Face hub face and opposite end	Horizontal milling machine...	0.96	Vertical boring mill	1.50	Vertical milling machine	2.00	Vertical boring mill	3.50	Planer	1.50	Planer	2.00	....	....
25	Driving-box	Slot brass fit........	Slotting mch..	1.57	Slotting mch..	3.30	Slotter	2.50	Slotter ..... }	4.50*	Vertical slotter	3.00	Slotting mch..	2.25	Slotting mch...	3.00
26	Driving-box	Slot cellar fit........	Slotting mch..	0.77	Slotting mch..	1.20	Slotter	1.00	Slotter ..... }		Vertical slotter	1.60	Slotting mch..	1.50	Slotting mch...	1.00
27	Driving-box	Machine shoe and wedge fits	Horizontal milling machine...	2.28	Planer	5.00	Planer	5.00	Planer	4.00	Planer	3.00	Planer	3.50	....	....

*Operations 25 and 26 performed at one setting on the slotter.

Machinery

TIME FOR PERFORMING MACHINING OPERATIONS ON LOCOMOTIVE PARTS—(CONTINUED)

No. of Operation	Part to be Machined	Operation	Railroad No. 1 Santa Fe Type Engine		Railroad No. 2 Santa Fe Type Engine		Railroad No. 3 Mikado Type Engine		Railroad No. 4 Santa Fe Type Engine		Railroad No. 5 Heavy Mikado Type Engine		Railroad No. 6 Santa Fe Type Engine		Railroad No. 7 Santa Fe Type Engine	
			Type of Machine Used	Time, Hours	Type of Machine Used	Time, Hours	Type of Machine Used	Time, Hours	Type of Machine Used	Time, Hours	Type of Machine Used	Time, Hours	Type of Machine Used	Time, Hours	Type of Machine Used	Time, Hours
28	Driving-box	Plane dovetailed groove in shoe and wedge faces	Draw-cut shaper	1.03	Planer	1.50	Planer	1.00	(Dovetails cast in box)	....	....	....	Shaper	1.50	Draw-cut shaper	1.00
29	Leading driving-box	Recess hub for lateral bearing brass..	Vertical boring mill	2.36	Vertical boring mill	0.70	Vertical boring mill	0.50	....	....	Vertical boring mill	1.50	Vertical boring mill	3.25	Vertical boring mill	1.50
30	Trailing driving-box	Recess hub for lateral bearing brass..	Vertical boring mill	0.86	Vertical boring mill	0.60	Vertical boring mill	0.50	....	....	Vertical boring mill	1.50	....	....	Vertical boring mill	3.00
31	Main driving-box	Cast brass liners on shoe and wedge faces and hub.......	Special fixture	1.69	Special fixture	0.50	Special fixtures	1.00	....	1.00	....	....	....	....	(Liners riveted in place)	3.00
32	Other driving-boxes	Cast brass liners on shoe and wedge faces and hub.......	Special fixture	1.24	Special fixture	0.50	Special fixtures	1.00	....	0.75	....	....	....	....	(Liners riveted in place)	3.00
33	Main driving-box	Plane shoe and wedge faces	Crank planer..	3.32	Planer	1.80	Planer	1.00	Bed planer....	3.00	Planer	1.00	Planer	3.25	Planer	2.00
34	Other driving-boxes	Plane shoe and wedge faces	Crank planer..	1.16	Planer	1.80	Planer	0.33	Bed planer ...	1.50	Planer	0.67	Planer	1.50	Planer	2.00
35	Main driving-box	Bore axle fit and face hub bearing....	Vertical boring mill	2.82	Vertical boring mill	1.40	Vertical boring mill	0.50	....	3.50	Boring mill....	1.00	Vertical boring mill	2.50	Vertical boring mill	2.50
36	Other driving-boxes	Bore axle fit and face hub bearing.. .	Vertical boring mill	1.23	Vertical boring mill	1.40	Vertical boring mill	0.50	Car-wheel boring mill	1.00	Boring mill....	0.67	Vertical boring mill	1.25	Vertical boring mill	2.00
37	Driving-box	Drill dowel, and cellar pin-hole and oil-hole	Vertical drilling machine...	1.81	Vertical drilling machine...	1.20	Radial drilling machine	0.58	Radial drilling machine	0.33	Drilling machine	1.00	....	....	Vertical drilling machine ..	1.50
38	Main driving-box	Assemble	....	3.51	....	1.70	....	....	....	2.50	Pneumatic press	1.00	....	4.50	....	3.00
39	Other driving-boxes	Assemble	....	1.48	....	1.70	....	....	....	1.75	Pneumatic press	1.00	....	1.50	....	3.00
40	Main driving-box	Fit and apply to wheels	....	2.56	....	1.90	....	0.50	....	0.83	....	1.50	....	3.25	....	2.00
41	Other driving-boxes	Fit and apply to wheels	....	0.53	....	1.60	....	0.50	....	0.50	....	1.50	....	1.25	....	1.50
42	Driving-box brass	Turn box fit.........	Engine lathe..	0.56	Engine lathe..	1.00	Engine lathe...	0.50	....	0.42	Vertical boring mill	1.00	Engine lathe..	0.50	Boring mill....	0.50
43	Driving-box brass	Shape box fit........	Shaper with rotary attachment	0.23	Shaper with rotary attachment	0.70	Shaper	0.50	....	0.33	Shaper	0.33	Planer	1.00	Shaper	0.25
44	Shoe	Machine all over....	Horizontal milling machine	0.53	Planer	2.10	Planer	1.50	Bed planer.....	0.75	Planer	0.50	Shaper	1.00	Planer	1.50
45	Wedge	Machine all over....	Horizontal milling machine	0.53	Planer	2.00	Planer	1.50	Bed planer.....	0.75	Planer	0.50	Shaper	1.00	Planer	1.50

Machinery

To successfully apply such a system, the investigators who establish what constitutes a normal working force for each department must keep constantly in mind the fact that it is not the purpose to impose an unnecessary or unjustifiable amount of work upon any employe, but merely to have all the men in every department kept constantly employed during working hours. Frequently a machinist sets up a job and starts his machine on an operation which takes a considerable time to complete, and on which the machine works automatically until the job is finished. Under such conditions the mechanic is idle until it is time for him to remove a finished piece from the machine and set up another.

All such causes of lost efficiency should be overcome by providing other work for the man to do, such as operating a second machine engaged on the same work, or performing some other operation on the pieces that he is machining. This would afford an opportunity for the workman to earn more money, it would effect a saving for the railroad by reducing the number of men employed in the shop, and with a bonus system of the kind mentioned, it would allow the foreman of the department to earn a bonus.

Comparative Data on Railroad Shop Costs

With a view to emphasizing the importance of investigating the costs of handling railroad shop work and of correcting the causes of low efficiency, an investigation has been conducted by MACHINERY to ascertain the time required for performing a number of machining operations regularly handled in practically all such shops throughout the country. As might have been expected, these figures show a wide divergence, and their lack of uniformity shows that many of the shops are paying out large sums of money for labor, which could be saved if better mechanical equipment were used and the efficiency of machinists were greater. Those railroad shop managers who are dissatisfied with the results they are securing would do well to investigate immediately all conditions that exist in their plants. This would probably uncover many unsuspected sources of loss in even the best managed shops; and even where substantial expenditures were required for the necessary equipment, the new machines would earn a satisfactory return, because of their greater output and the reduced amount of labor required.

A typical instance will prove this statement. In machining the edges of main driving-rod straps, one shop handles this job on a planer and takes eight hours to finish one piece, while another shop handles the job on a planer type milling machine and finishes a piece in 1.04 hours. This means a loss to the first shop of 6.96 hours per piece, and allowing 77 cents per hour for labor, the equivalent in money is $5.36 per piece. Any shop that has a large number of main driving-rod straps to mill would find an investment in a milling machine to be well worth while; such a machine could also be used for other operations besides the one mentioned.

In collecting the figures in the accompanying table, an effort was made to include shops where the conditions are regarded as good, fair, and poor. This gives a representative survey of the conditions existing in railroad shops. Six of the shops are located in the United States and one in Canada. These data were collected for MACHINERY through personal investigations in the various shops made by a man who was for a number of years the superintendent in charge of a well-known American railroad shop.

Causes of Failure to Obtain Normal Efficiency

In collecting these figures, an effort was made to ascertain the cause of trouble in cases where the time required to handle a job was much above what is believed to be a normal average. Although there were exceptions to the general rule, in the majority of cases it was found that the method of tooling up each machine for its work had been modernized as far as possible, so that the fault was usually either with the type or condition of the machine that was used or with the efficiency of the man assigned to the job. These two causes of inefficiency were about equally balanced.

Another interesting point developed during the course of this investigation was that in some shops where the average of conditions was very bad, certain operations were performed with an unusual degree of efficiency. A case in point is the machining of piston-heads where it is required to face the ends, turn the outside diameter, cut two ring grooves and bore the rod fit. In one shop where the general condition of the machinery is very poor and where the efficiency of the working force is equally unsatisfactory, this particular job is completed in a very reasonable time. This fact is the more noteworthy when it is borne in mind that the working force in this shop has been very hard to handle. The reason that the present job is so successful is not hard to find. A modern type of vertical turret lathe was bought for this machining operation, and it was carefully tooled up to enable the various steps in the complete operation to be handled in such a way that several tools are often working at the same time. The investment in this equipment is earning a very satisfactory return.

Wide Variations in Results Obtained by Different Shops

In looking over the comparative figures for various railroad shop operations, it will be seen that in many cases there is a wide variation in time, even though the type of machine on which the work is done is practically the same. In many such instances the explanation lies in the method of handling the work while setting up and removing it from the machine, or in some advantage secured through the provision of efficient auxiliary equipment. Another point which in some cases is responsible for the difference in results is that one shop adopts the modern manufacturing practice of setting up a number of pieces to be machined in a single operation, while another shop adheres to the old plan of handling one piece at a time. In order to bring its costs down to a normal average, the railroad shop must give the same care that the progressive industrial plant does to the perfection of every detail of manufacture.

Independent Contract Shops for Repair Work

In making repairs on locomotives and cars, each railroad shop bears somewhat the same relationship to the corporation which it serves that an entirely independent concern would, which had an absolute monopoly on the class of service the railroad desired to purchase. In other words, there is no competition, and consequently no stimulus toward higher efficiency and lower costs.

With a view to avoiding the limitations of efficiency set up by the terms of the National Agreement, eight railroads in the United States have, up to the present time, placed one or more of their car repair shops under the control of contractors who handle the work along strictly commercial lines. This plan has a number of advantages. In the first place, the contractor always realizes that his methods must be kept up to date and that he must take advantage of all possibilities of reducing production costs in order to hold the work against bids of competing organizations. Also, the independent contractor would not be hampered by many of the burdensome regulations that are still imposed by the United States Railroad Board.

In some quarters it is the belief that this constitutes the real solution of the railroad shop problem, and those who hold to this belief are inclined to advocate the idea of applying the same principle in handling locomotive repair work. The solution of the railroad shop problem is of the greatest importance, because the railroads exert a general and important effect upon the business and prosperity of the country.

There is no question about the urgent need of rehabilitating means for maintaining railroad equipment in an efficient operating condition. The problem is to decide which method is the more satisfactory—to continue operating the shops as a department of the railroads or to place them under independent control. If the former expedient is adopted, each railroad must conduct a thorough housecleaning; and if the shops are placed on an independent commercial basis, the same course of action would follow as a matter of course, because no experienced manufacturer would expect to be able to get results with the inefficient labor and obsolete equipment that are found in many railroad shops at the present time.

* * *

REDUCING THE COST OF JAPANNING

By HUGO A. BIESEN

In order to reduce production costs, the Cutler-Hammer Mfg. Co., Milwaukee, Wis., has adopted a new practice in connection with the japanning of machine parts. In the past this operation was performed after the castings had been machined. They were then sent to the japanning department where a hand painting or spraying operation was performed. This resulted in the japan partly covering the machined surfaces, and it was practically impossible to keep the japan from clogging tapped or reamed holes. When these castings arrived in the assembly departments it was invariably necessary to again tap and ream the holes clogged by japan. With the idea of eliminating this duplication of operations, the feasibility of performing the painting operation before machining was carefully considered. As a result a change in the sequence of operations was made, and at present all castings are sent to the japanning department before being machined.

This reversal of operations entirely eliminates the necessity of reaming or tapping holes twice, and leaves all machined surfaces clean and free from japan. The greater amount of care required in handling and machining castings already japanned does not offset the saving which results from elimination of the operations required to remove the japan from machined holes and surfaces.

The cost of japanning castings has also been reduced by an appreciable percentage in consequence of this change in procedure, since it is now possible to apply the japan by the dipping method, whereas it was formerly necessary to apply it by means of a hand brush or spray.

PROFILING FIXTURE

When profiling operations are of such a nature as to require more than one former for guiding the cutter, as when milling different curved surfaces at one setting of the work, several methods may be used in designing the profiling fixture to permit locating two or more former plates successively in the working position. One method is to use pivoted formers, which are swung around to the working position, one after the other, for controlling the path followed by the guide pin when taking separate cuts that cannot be controlled by one former. This plan has often been adopted when two former plates of different curvature are required, the second former being swung into the working position, as determined by a stop, after completing the cut controlled by the first former.

Another method is to use a single pivoted former which has two or more slots cut in it, or possibly plates attached to it, instead of using independent plates. The different slots or outlines formed on the single pivoted plate are successively brought to the working position opposite the guide pin as the former plate is indexed from one position to the next. With this arrangement a locating plunger or pawl may be used in conjunction with suitably located notches for governing the positions of the former plate.

The fixture shown by the assembly drawing Fig. 1, and on the profiler in Fig. 2, has an indexing former slide for locating the different formers in the working position, but in this design the slide has a lengthwise movement. The slide *A* is mounted in dovetailed ways extending across one side of the fixture. Beneath the slide there is a locating strip *B* containing as many notches *C* as there are former plates. These notches are engaged by plunger *D*, which is withdrawn for indexing the slide by means of handle *E*.

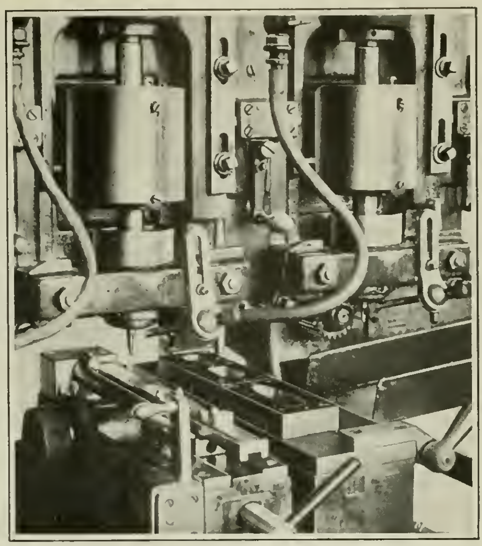


Fig. 2. Profiling Fixture equipped with Indexing Slide for locating Three Different Formers in the Operating Position

Handle *E* is connected to the end of shaft *F*, which has a groove extending throughout its length. This groove is engaged by a tooth on part *G*, which is connected with plunger *D*; hence slide *A* can be moved to any position and the locating plunger is always under the control of handle *E*. The groove in shaft *F* is formed by using a regular 6-pitch No. 8 gear-cutter, and the tooth on part *G* is milled by using a 6-pitch rack-cutter. Whatever former plates are required are attached to the top of the indexing slide, as shown in Fig. 2, which represents a profiling operation on the receiver of a rifle. The work-holding part of the fixture (see Fig. 1) consists of a quick-acting vise operated by a cam-lever *H*. The vise jaws are modified, of course, to suit the work. This design of fixture is frequently employed by the Pratt & Whitney Company whenever it is required to use more than one former.

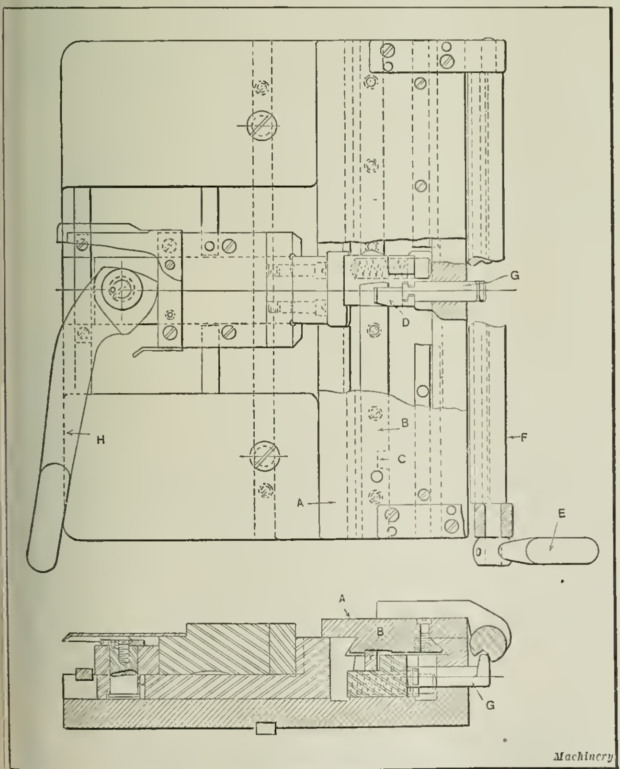


Fig. 1. Sectional and Plan Views of Profiling Fixture shown in Fig. 2

* * *

The advantages of standardization are summarized by the Chamber of Commerce of the United States as follows:

Easier financing and less capital tied up in raw, semi-finished, and finished materials, unnecessary equipment and extra storage floor space.

More economical manufacture on account of longer production runs with fewer changes; increased individual production; less idle equipment; reduced expenditure for clerical work and cost accounting.

More efficient labor, through greater stability and permanence of employment, because of the increase in skill due to repetitive processes in longer runs, and consequently increased earnings.

Better quality of product; prompter deliveries and increased efficiency in packing for shipment.

More efficient selling forces.

Increased rate of turnover.

Charts for Determining Belt Widths

By THOMAS J. COOK

MORE often than otherwise the success of an undertaking depends upon the careful study and working out of details which at first do not seem worthy of much consideration. This is especially true of belt transmission installations. Too often when installing a new belt, the width is selected without regard to the various factors that must be considered if the most efficient operating conditions are to be obtained. Sometimes a certain width is used simply because it can be carried on the face of the smaller pulley. A belt thus selected is frequently accepted as satisfactory simply on the grounds that it transmits the required horsepower.

For at least two reasons it is as great a disadvantage to employ a belt that is too wide or too thick as it is to employ one that lacks either width or thickness sufficient to supply the power demanded of it. If the size of the belt is in excess of what is actually required, the cost will be unnecessarily high. Another unnecessary expense of possibly more vital importance than the first is the extra driving power required. Although the extra power consumed in driving one belt may be very slight, it will perhaps, when multiplied by the number of belts installed in the plant, amount to an unnecessary overload for the power house that will be reflected in an equally unnecessary overhead expense.

Centrifugal force is a factor that must be taken into consideration in installing belting, especially in those cases in which the conditions demand a high speed. Up to a belt speed of 2000 feet per minute, this force need not be taken into consideration, but when the belt exceeds this speed it becomes a vital factor. If a belt is used that is either too wide or too thick, the centrifugal force becomes excessive, and the belt will have an increased tendency to continue in a straight line tangent to the face of the pulley instead of continuing in its true path about the circumference. As the centrifugal force increases the belt becomes looser on the pulley, which results in a marked decrease in the friction driving force. The lessening of the frictional driving force or the tendency of the belt to slip must therefore be overcome by increasing the tension of the belt. An increase in the tension is of course objectionable, as it materially reduces the life of the belt.

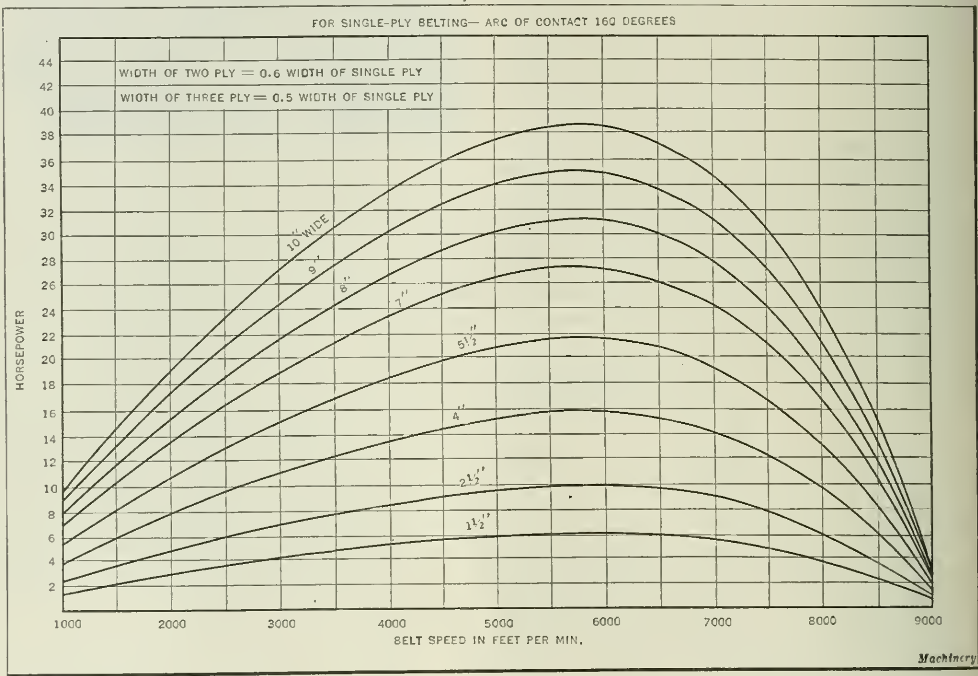


Fig. 1. Chart for determining Belt Widths when Pulleys are of Unequal Size

While there are many formulas that may be used to calculate the correct belt size for any condition, they all involve more or less tedious mathematical operations. Tables have been evolved which eliminate the necessity of making calculations to determine the proper size of belt to use under certain conditions, and many of these can be used with excellent results. To relieve those who are frequently called upon to determine the correct widths for belts, of the difficulties which may arise in making the required calculations, and to provide an even simpler medium than tables, the writer has devised the accompanying charts, which should enable anyone to ascertain at a glance the most efficient size of belt to be used for any condition which may arise.

The arc of contact of the belt on the smaller pulley must always be taken into consideration in determining the horsepower that a belt can transmit. The chart shown in Fig. 1

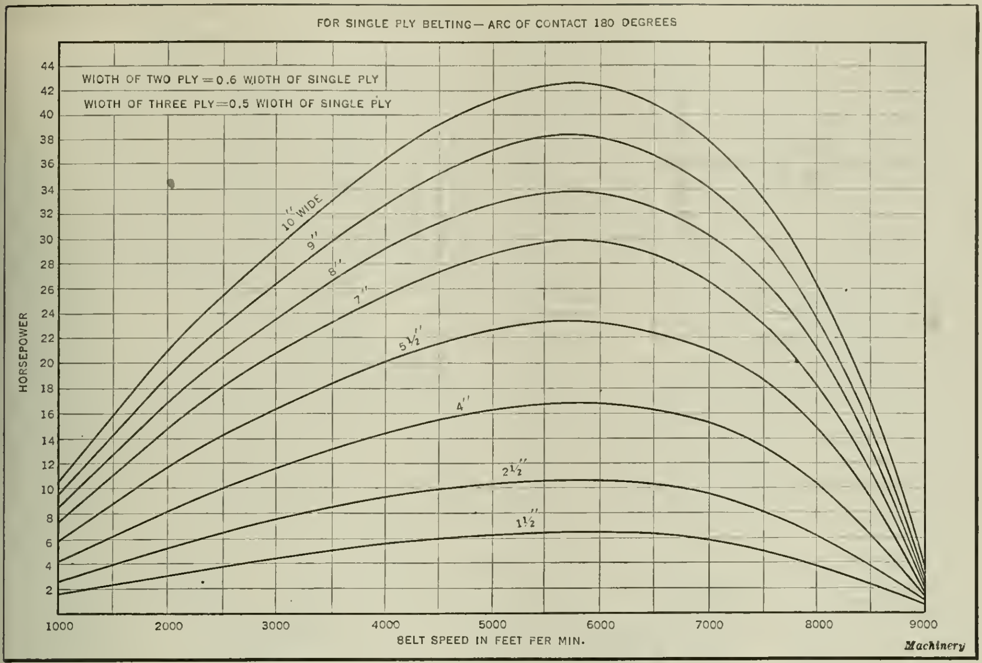


Fig. 2. Chart for determining Belt Widths when Pulleys are of Same Size

is for use when the arc of contact of the belt on the pulley is approximately 160 degrees. This chart is therefore suitable for use in the case of open belts where one pulley is smaller than the other. The chart shown in Fig. 2 is intended for use in the case of open belts where both pulleys are of the same size, that is, when the arc of contact is 180 degrees. The chart shown in Fig. 3 may be used in the case of cross belts, although such an installation is to be

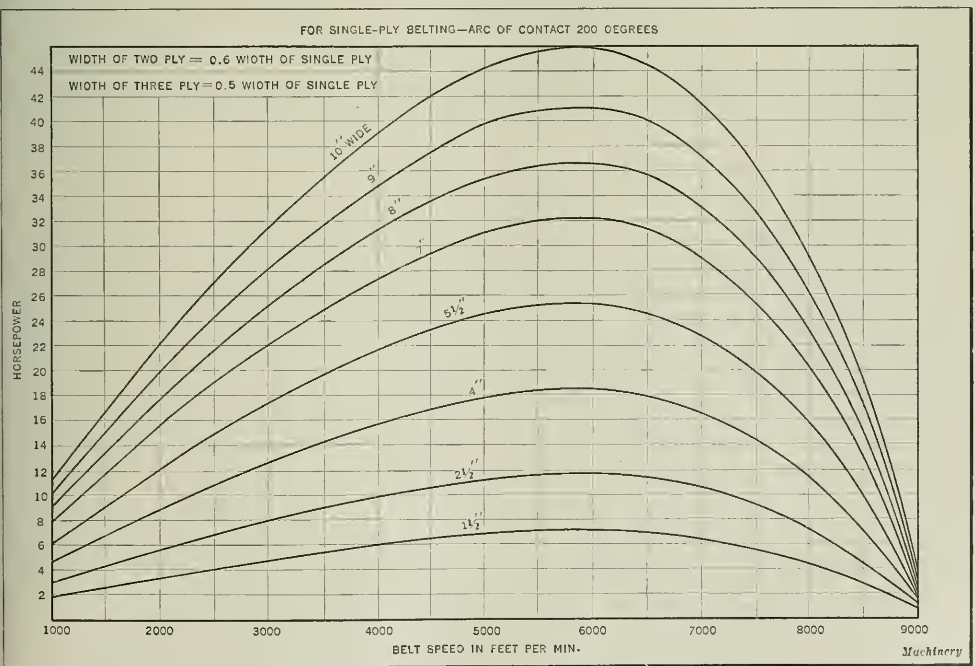


Fig. 3. Chart for determining Belt Widths when Cross Belts are used

avoided if possible on account of the increased wear, which shortens the life of the belt.

To illustrate the use of the charts, let it be required to find the size of a belt which is to transmit 42 horsepower running at a surface speed of 5500 feet per minute over pulleys of equal diameter having 8-inch faces. First locate on the 180-degree chart, Fig. 2, the point of intersection of the vertical line representing a surface speed of 5500 feet per minute, and the horizontal line representing a driving force of 42 horsepower. This point of intersection occurs about on the 10-inch curve or the curve representing a belt width of 10 inches. Thus, a 10-inch single-ply belt would transmit 42 horsepower. However, the pulleys have 8-inch faces so that a 10-inch belt could not be used. According to the note in the upper left-hand corner of the chart, the width of a two-ply belt of the same capacity as a single-ply belt is obtained by multiplying the width of the single-ply belt by 0.6. As 0.6 × 10 = 6, a 6-inch double-ply belt will therefore be the proper installation.

An 8-inch face pulley required to transmit 42 horsepower is an extreme case, but the example serves to show the application of the chart. The width of a belt can often be read direct from the curves. Every point on each curve shown on the chart was calculated separately, use being made of a well-known belting formula in which allowance is made for the effect of centrifugal force.

An inspection of the charts will disclose some interesting and important facts relative to the proper installation of belts. It will be noted that the curves continue in a straight line until they reach the vertical line representing a speed of 2000 feet per minute. This bears out the statement that centrifugal force does not have any noticeable effect until the belt runs in excess of 2000 feet per minute. At this point the curves begin to diverge from a straight line, gradually at first, and more rapidly as the speed increases, but always in an upward path, until the peak of the curves is reached between 5500 and 6000 feet per minute. This, therefore, may be said to be the efficient belt speed, but in actual practice a somewhat slower speed should be used.

Beyond a speed of 6000 feet per minute the centrifugal force becomes so great that the curves on the chart fall rapidly, indicating that the pulley is subject to more or less slippage with a consequent loss of power. This emphasizes the fact that no belt should be allowed to run over 6000 feet per minute. At the line representing a speed of 9000 revolutions per minute, the curves so nearly run out at the zero power line that it is evident that at this speed the belt will continually slip on the pulley and practically no power will be transmitted. Belt widths of 1½, 2½, 4, 5½, 7, 8, 9, and 10 inches have been selected in making up the charts, because by multiplying or factoring these widths it is possible to obtain a greater range of widths. For example, to find the horsepower that can be transmitted by a 3-inch single-ply belt running at 4000 feet per minute over pulleys of equal size, it is only necessary to use the 1½-inch curve of the chart shown in Fig. 2 and multiply the value given by 2. From this chart it will be found that a 1½-inch belt running under the given conditions will transmit 5.6 horsepower. Therefore a 3-inch belt will transmit 2 × 5.6 horsepower or 11.2 horsepower.

GENERAL-PURPOSE MILLING FIXTURES

By A. J. CAYOUETTE

Standardizing certain types of milling fixtures is a practical and economical practice, and has proved especially so in the manufacture of firearms. Milling fixtures of standard design are suitable for use in a wide variety of manufacturing. Designing milling fixtures which are simple in construction, strong, quick-acting, and which can be adapted for holding a large range of work will greatly reduce the costs and the time required for doing tool work. The designs of milling fixtures described in this article have been standardized to such an extent that many of the parts were made up and are kept in stock so that fixtures may be built up in a short time and at a lower cost than would be involved if a special holding fixture were required for each new piece of work.

The fixture shown in Fig. 1 has proved practical to standardize, and is an efficient tool for handling a variety of work. The range of the fixture can be extended by providing jaws to suit the contour of the part to be machined. The work is held between the stationary jaw *E* and the movable jaw *F*, the stationary jaw being fixed to the base of the fixture by dowel-pins and screws and located by a tongue and groove, while the movable jaw swivels on stud *G* which is carried in slide *D*. This slide is operated in a slot in the base of the fixture, as shown in the sectional view.

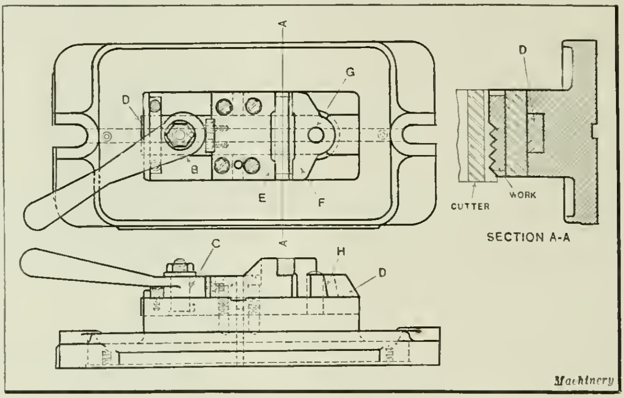


Fig. 1. Milling Fixture which will accommodate a Variety of Work

The work is securely clamped to the stationary jaw by operating the eccentric lever *B*, which is free to pivot about the fixed stud *C*, carried in the opposite end of slide *D*. Tool-steel plates, one attached to the base of the fixture and the other to the jaw *E*, provide bearing surfaces against which the eccentric lever operates, thus reducing wear and increasing the length of service of the fixture.

By making the movable jaw *F* so that it can swivel, the clamping pressure is equalized on the work. Surface *H* of this jaw is angular, and fits a corresponding surface at the rear of slide *D*, which prevents the jaw from lifting when the clamping pressure is exerted. The base of this fixture, as well as of the other fixtures illustrated in this article, is made of cast iron, and is molded to form a reservoir for lubricants and coolants employed in the milling operation. The reservoir is provided with a drain hole so that the liquid may flow back to the supply tank.

The fixture illustrated in Fig. 2 is designed to hold two pieces of work at a time, one set of jaws being stationary with regard to the plane in which they operate, while the other half of the fixture contains a clamping unit, the jaws of which may be raised or lowered to compensate for differences in the diameter of the two cutters that might result from wear. This fixture has all the advantages of that shown in Fig. 1 as regards rigidity and simplicity of operation, and the stationary half of the fixture is identical in construction with the one just described. The feature that permits vertical adjustment of the clamping jaws also enables this tool to be used (with the employment of properly designed jaws) on work which is slightly different in design but on which similar milling operations are to be performed.

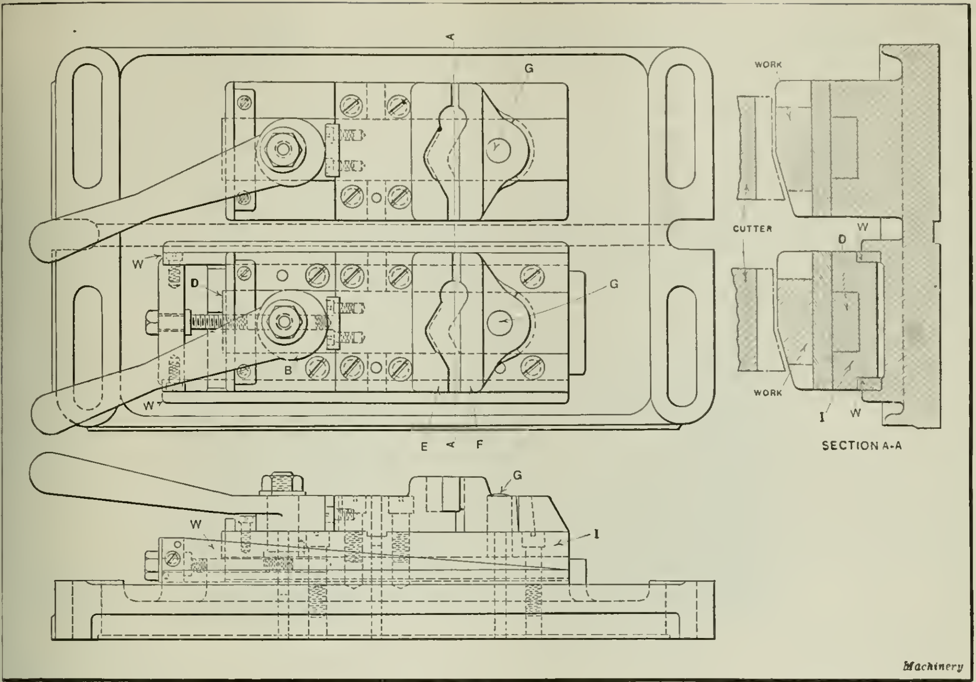


Fig. 2. Duplex Milling Fixture with Provision for adjusting the Vertical Position of One Holding Unit

The construction of the adjustable side of the fixture is, of necessity, a little different from the stationary side. The fixed jaw *E* is attached to a steel block *I* by a suitable tongue and by the use of dowel-pins and machine screws, after the general manner of attaching the fixed jaw to the base in Fig. 1. Slide *D*, therefore, operates in a suitable groove in this block, instead of in the base of the fixture itself. This steel block rides on two hardened steel wedges *W* which are fitted into the base on each side and provide the angular bearing surfaces by means of which the clamping part of the fixture is elevated.

After the proper vertical adjustment is obtained, the block *I* is fastened to the base of the fixture by screws and dowel-pins, as shown. The wedges extend beyond the travel of block *I*, and their ends are joined by a piece in which are carried the adjusting screw and lock-nut used in obtaining the adjustment. This raising or lowering of the block *I* carrying the clamping jaws can be readily effected by the

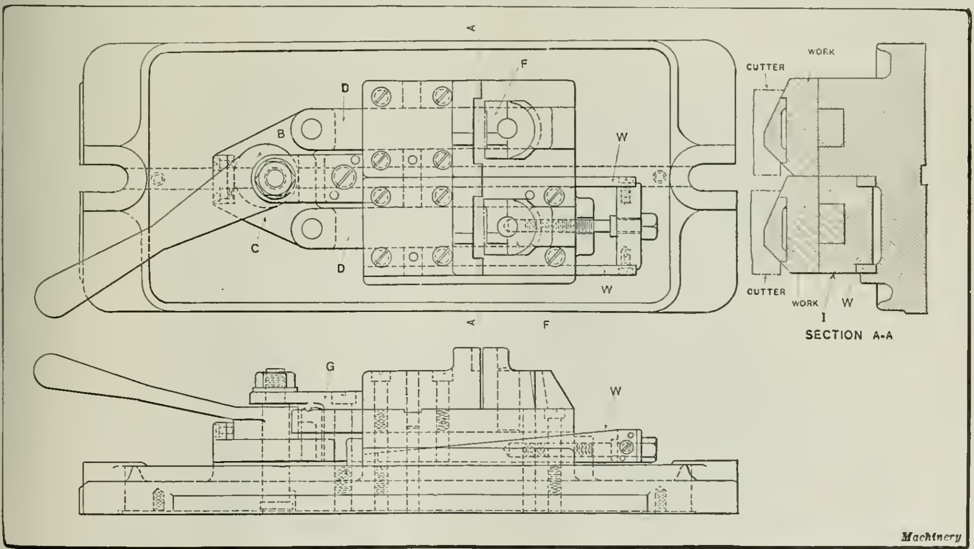


Fig. 3. Fixture Similar to that shown in Fig. 2, but with only One Cam for clamping the Work

simple means provided. The mounting of the jaw *F* is similar to that shown in Fig. 1, except that block *I*, instead of the base of the fixture, carries the stud *G* about which the jaw swivels. The eccentric lever *B* swivels on a stud attached to the base of the fixture and bears against steel pieces, similar to the construction employed in the fixture shown in Fig. 1 and in the stationary part of this fixture.

A somewhat lighter type of duplex milling fixture than that shown in Fig. 2 is illustrated in Fig. 3. The two sets of jaws are operated by a single eccentric lever, which enables a quicker clamping action to be obtained. This fixture also has one side designed to be independently adjusted in a vertical direction; the other side is stationary and designed according to the standards already outlined. In the design of this fixture the wedges *W* extend at the opposite ends of the steel block *I*, but are connected, similar to the construction employed in the fixture shown in Fig. 2, by a steel connecting piece in which the adjusting screw is carried. The two slides *D* are linked together by an equalizer *C*, which is free to swivel on the stud carrying the eccentric lever *B*, the latter being fixed in the base of the fixture. This equalizer is a yoke casting which, being free to swivel, enables the movable jaws *F* in each clamping unit to adjust themselves to any variation in the width of the work. The stud about which the eccentric lever swivels in clamping and releasing the work is reinforced at the top by a strap *G*, against the thrust exerted in operation. The other features of the fixture are the same as described in connection with the other two fixtures.

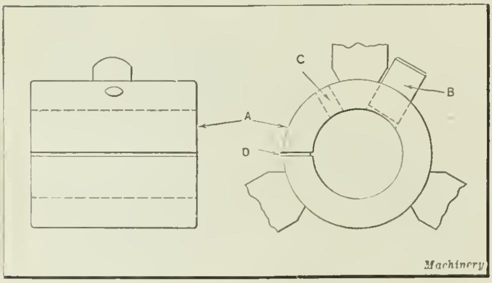
* * *

BRONZE BUSHING FOR STEADYREST

By H. H. PARKER

A bronze bushing *A* which can be clamped in the jaws of a lathe steadyrest, as indicated in the accompanying illustration, will prevent scratching or otherwise injuring the finished surfaces of spindles or shafts while facing their ends. When a large number of spindles of the same diameter are to be end-faced, this device is particularly useful, as it eliminates the necessity of placing pieces of flat leather or other material around the work to prevent the regular jaws of the steadyrest from scratching or marring the finished surfaces.

The bushing should be of bearing bronze, and reamed to fit the spindles or work to be faced. To prevent the bushing from rotating in the steadyrest jaws, a hole is drilled in the side and a brass stop-pin *B* driven tightly into this hole. The pin is brought up against the side of the top jaw and thus prevents rotation of the bushing. On the other side of the bushing, near the top, is located an oil-hole *C*. An oil-groove is also chipped out inside the bushing. When the bushing becomes worn it can be split, pressed together slightly, a bronze shim *D* fitted in the slot, and the hole again reamed to fit the work. After this treatment the steadyrest jaws will prevent the bushing from spreading, and it will be a good running fit on the work.



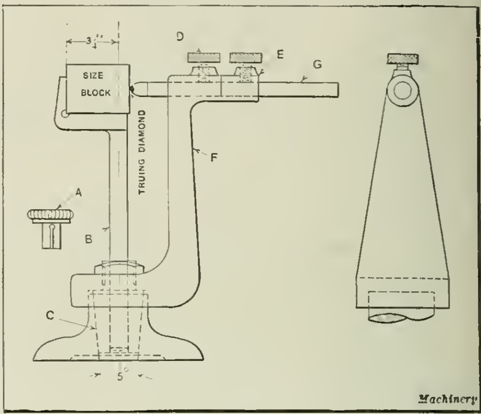
Bronze Bushing for Lathe Steadyrest

RADIUS WHEEL TRUING DEVICE

By WILLIAM C. BETZ

The device shown herewith is designed for truing the grinding wheels used in grinding beads or grooves on punches, dies, gages, and similar work. The fixture is made of tool steel, the swivel stud and base being hardened, and the tapered hole and stud ground and lapped. As the tapered stud has a 5-degree included angle it will not wedge, but will always work freely and smoothly with just the proper amount of friction.

The fixture may be used for grinding wheels having either concave or convex faces by moving the diamond point either side of the center of the stud. The diamond point is moved back for truing a wheel having a convex face, and forward for a wheel having a concave face. To set the diamond to a given radius, the dust-cap *A* is removed and the gage-bar *B* inserted in the hole in stud *C*. A size block of the dimension of the given radius plus 3/4 inch is used in the case of a convex wheel face, and a block 3/4 inch in length minus the given radius for a concave wheel face. The proper size block is placed on bar *B* as indicated. It will be noted that gage-bar *B* is made with the face of the stop 3/4 inch from the center of the stud hole.



Device for truing Radius Grinding Wheels

In setting the device for a convex wheel face, screw *D* is tightened, thus binding the diamond-carrying rod in place. For a concave face, screw *D* is first tightened, after which collar *E* is held against the diamond rod holder *F* and fastened. Screw *D* is then loosened and the rod *G*, with the collar in place is drawn back to permit the removal of the gage-bar *B*. Dust-cap *A* is then replaced in the stud *C* and the diamond-carrying rod slid in to its original position with the collar against the holder *F*. Screw *D* is again tightened and the dresser is ready for service. It will be noted that the base of the device is designed for use on a grinder equipped with a magnetic chuck, but a base may be made to adapt it to any grinder using thin disk wheels.

* * *

A comparative summary of manufacturing conditions in the United States for the years 1919 and 1914, shows that there were 288,376 establishments in operation in 1919, as against 275,791 in 1914. The value of the products of these companies is placed at $61,588,905,000 in 1919 as against $24,246,435,000 in 1914. The value of automobiles increased from $503,230,000 in 1914 to $2,387,833,000 in 1919; cotton goods from $676,569,000 in 1914 to $1,877,919,000 in 1919; foundry and machine shop products from $866,545,000 in 1914 to $2,321,129,000 in 1919; iron and steel rolling mills from $918,665,000 in 1914 to $2,818,775,000 in 1919; woolen goods from $379,584,000 in 1914 to $1,053,875,000 in 1919.

Automobile Crankshaft Repair Work

Last of a Series of Three Articles on Automobile Repair Work

THE regrinding of crankshaft bearings is one of the most common jobs in crankshaft repair work. In the repair shop of Saucke Bros., Rochester, N. Y., the No. 4 Landis machine illustrated in Fig. 1 is employed for this kind of work. The illustration shows the regrinding of a Continental motor four-throw crankshaft, taken from a Republic truck. This machine carries two offset heads as a part of its regular equipment, which are provided with a graduated nut for roughly setting the chucks which the heads carry to agree with the throw of the crankshaft to be ground; a micrometer adjustment is used for obtaining the final settings. It will be noticed that the heads are counterweighted and also that the crankpin bearings being ground are supported by steadyrests from the front and bottom. The steadyrests carry maple bearings in contact with the surfaces to be ground so that there is no possibility of abrasion due to the revolving crankshaft.

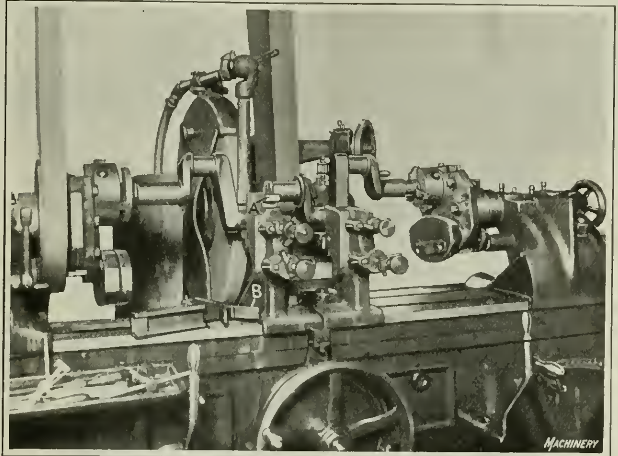


Fig. 1. Crankshaft Regrinding Machine set up for refinishing Crankpin Bearings on a Four-throw Crankshaft

The crankshaft is placed in the chucks of the offset heads after the chucks have been approximately adjusted to suit the throw of the crankshaft, but the chucks are not tightened on the end bearings until the throws are aligned with the centers of the machine. For obtaining this alignment a centering gage which is part of the regular equipment furnished with this type of machine is employed. This gage is shown lying on the ways of the machine to the left of the steadyrest bracket, and is used in the following manner. The gage is made to slide on the top guide *A* of the foremost steadyrest bracket, and when in this position a post carrying a V-block *B* at its lower end is permitted to drop down and engage the bearing of the crankshaft that is to be ground. Then by the use of a feeler 0.001 inch thick the amount of adjustment required to obtain perfect alignment is determined. When the centers of the throws are in alignment with the machine spindles, the chuck jaws are tightened and the wooden steadyrest bearings brought into contact with the crankpin bearing.

In this particular case the throw is 5¼ inches, and it was found that the greatest depth of score was 0.012 inch. In machining the rough surfaces of the bearing, 0.019 inch more stock was removed than was required to clean them up; in other words, 0.031 inch of metal was removed.

It is good practice on crankshaft work first to test the alignment on a lathe, using an indicator, and then if necessary straighten on an arbor press. The shaft should be within 0.007 inch of alignment before grinding. The crankpin bearings must not only be ground to uniform diameter, but they also must not vary more than 0.0025 inch between ends, that is, they must not be tapered. If this condition is found to exist it can be readily remedied by simply turning the entire table to compensate for any slight taper. The table pivots on a central pin, and the proper adjustment can be obtained by means of a graduated scale at the foot end of the machine. The wheel used in this shop for crankshaft regrinding is a 24-inch wheel of proper face width to agree with the length of bearings being ground. This wheel is the regular Landis 246 shape, grade K, and is made by the Abrasive Co., Philadelphia, Pa. The time required for the job illustrated is as follows: Setting up, about 1½ hours; grinding the four crankpin bearings, about 2¼ hours; and grinding the three main bearings, about 1¾ hours.

It is sometimes necessary to repair the end bearing of a crankshaft which has been broken or twisted off, and Fig. 2 shows a job of this kind being performed in the Frostholm Bros. plant at Syracuse, N. Y.

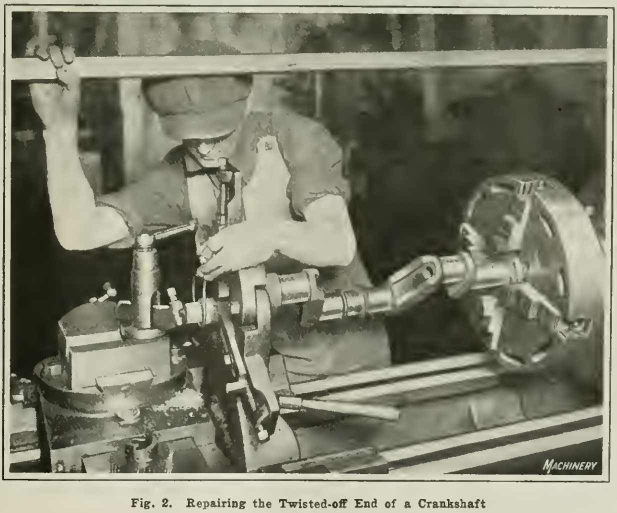


Fig. 2. Repairing the Twisted-off End of a Crankshaft

The machine used is a Whitcomb-Blaisdell engine lathe in which the shaft is chucked by the flywheel flange and supported at the overhanging end by a steadyrest. This is a Duesenberg motor four-throw crankshaft, which has previously been built up on the end by acetylene gas welding. The work illustrated is simply that of turning the welded end to the proper diameter.

* * *

METHOD OF FILING REFERENCE PRINTS

By T. H. MORIARTY

In a certain plant the practice of using tracings for reference resulted in many valuable tracings being damaged. In order to overcome this trouble Van Dyke or brown prints of all tracings in common use for reference were made up and folded twice. Each print was placed in a commercial mailing envelope, 13 by 19 inches in size, and the number of the print was blue-penciled in large figures near the top center of each envelope. The envelopes were then filed numerically in a wooden box, which was made for the purpose.

A draftsman, instead of referring to the tracing, would then use the print. Before removing the print, he would write his name on the envelope, and on the return of the print the name would be crossed off. This method is so simple that no filing clerk is necessary, and little difficulty is experienced through draftsmen forgetting to sign their names when removing prints from the file. When the tracings are revised, new prints are automatically supplied to replace the old ones. This system has been in use for over a year and has resulted in a great saving, as no original tracings are worn out through excessive handling. A saving in time is also effected, as there is no waiting for tracings to be returned from the blueprint room.

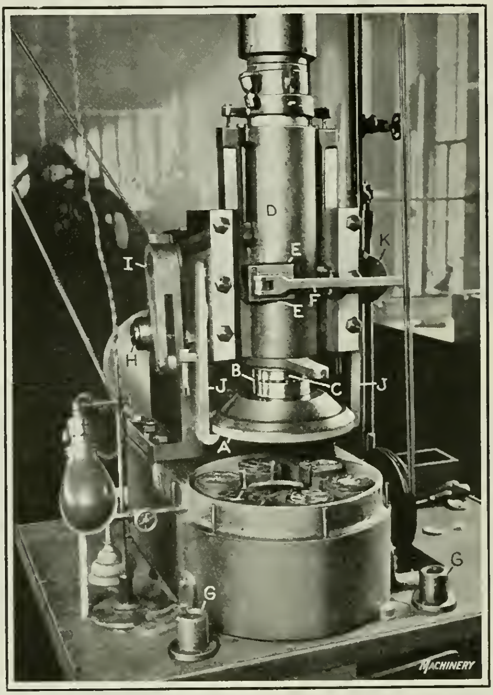
* * *

EXPORTS OF MACHINERY DURING 1921

The Industrial Machinery Division of the Department of Commerce, in a special review of the machinery export situation, points out that during the first eleven months of 1921 the United States exported machinery of all kinds to a value of $238,000,000 as against $92,300,000 for the entire year of 1913. While official figures for the entire calendar year of 1921 are not yet available, it is believed that $250,000,000 is a conservative estimate of the total value for the year. The foreign trade in metal-working machinery for the year ended June 30, 1913 was $16,097,315, and for the year ended June 30, 1914, $14,011,359. For the first eleven months of 1921 the total exports of metal-working machinery amounted to $18,766,962 of which $8,468,440 represented machine tools. In comparing the exports for 1921 with the pre-war exports, it should be remembered that the prices in 1921 were nearly double the prices in 1914, so that the relative volume is not in direct proportion to the figures given.

WATCH PLATE STONING MACHINE

A rotary grinding or stoning machine used to finish the surfaces of watch plates in the plant of the Waltham Watch Co., Waltham, Mass., is shown in the accompanying illustration. This machine was developed by A. G. Cassidy, master mechanic of the Waltham Watch Co. The stoning operation is performed with a ring lap *A*, and this lap is carried on a spindle which has a shoulder at *B*, the top surface of which forms the lower raceway for a ball bearing. The upper raceway of the bearing is the lower end of a sleeve *C* through which the main part of the shaft extends. This shaft projects up beyond the beams to which the countershaft is hung, and at the upper end is connected by a clutch to the bevel gear shaft from which it is driven.



Watch Plate Stoning Machine

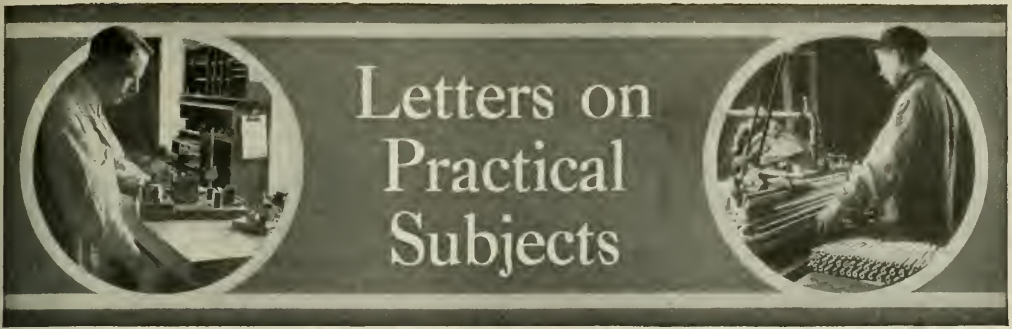
The vertical feed of the spindle is actuated by air pressure, the air cylinder being located above the countershaft beam. The sleeve through which the spindle operates is contained in the cast-iron bearing *D*. This bearing has an opening at *E* through which a clamping lever *F* passes, by means of which the vertical position of the sleeve and the shaft which carries the lap can be adjusted following each operation to compensate for wear on the face of the lap.

The chucks, of which there are six, rotate slowly during the grinding operation. The machine is operated by air, as previously stated, it being necessary to use both hands on the valves *G* when starting the machine, thus safeguarding against danger to the operator's hand. As soon as the air valve governing the feed movement has operated, shaft *H* which carries the feed-cam is revolved and the arm *I* feeds the entire spindle-bearing unit downward; after the work has been ground to the desired thickness, the lap and the spindle are raised. When the unit has reached its uppermost position and the air valve which controls the feed movement has been closed, the plunger in air cylinder *K* releases lever *F* and allows the sleeve to slip downward and be relocated by the fingers *J* which hang on opposite sides of the spindle slide. These fingers are operated by an air plunger at the top end immediately preceding the release of the spindle sleeve.

As soon as this vertical adjustment has been made, the plunger in air cylinder *K* again advances and holds the sleeve firmly in its new position in bearing *D;* then fingers *J* swing out from under the lap. The release of the clamping section of bearing *D* is by springs interposed in back of the section between the opening for the clamping lever. The various movements just described are all governed by cam-operated air valves in the base of the machine.

* * *

A bulletin on the manufacture, properties, and uses of aluminum alloys is being prepared for publication by the Pittsburg Experiment Station of the United States Bureau of Mines.



COLD RIVETS FOR ELECTRICAL APPARATUS

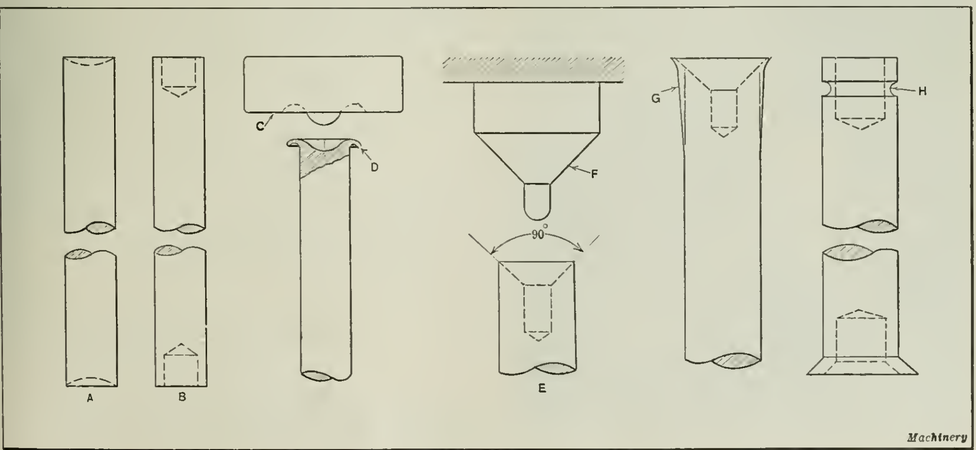
The type of cold rivet usually employed in the manufacture of laminated iron pole-pieces for electrical apparatus is shown at *A* in the accompanying illustration. These rivets are made slightly concave at each end so that they may be readily headed by a pneumatic hammer. Five or six rivets are needed, as a rule, for each pole-piece, and from 100 to 200 blows of the pneumatic hammer are required to head each rivet properly, the number of blows depending on the size of the rivet. This is a very slow process, and the cost of replacing worn and broken parts of the pneumatic hammer is considerable. At *B* is shown a rivet with a drilled hole at each end. The holes are drilled about 1/4 inch deep and of such diameter as to leave a wall from 1/16 to 5/32 inch thick, depending on the size of the rivet. Rivets of this design can readily be upset on both ends at one operation in a hydraulic press by equipping the upper and lower dies with hardened steel buttons like that shown at *C*. The shape of the head after compressing is shown at *D*.

A 1/2-inch rivet, such as shown at *B*, having a wall thickness of 5/64 inch requires an upsetting pressure of three tons. Using five rivets to a unit, the pressure required for the upsetting operation would be fifteen tons. Allowing a pressure of six tons for compressing the laminations, the total pressure for the whole operation would be only twenty-one tons. It will be evident that this method of assembling will effect a considerable saving.

Cold rivets for other purposes are often machined as shown at *E*. The upsetting of these rivets is also accomplished by means of hydraulic pressure. This type of rivet is used in nearly all small motors having laminated iron fields and malleable iron frames. A 3/4-inch rivet of this design requires a 27-ton pressure for upsetting at its ends. This high pressure is necessary because of the 90-degree taper *F* on the punches. As the pressure is applied these rivets have a tendency to expand in the field frame before the heads are formed. This incorrect design of rivet as shown expanded at *G* prevents the two frames from closing in tightly on the laminations. It also causes a great loss in hydraulic power. With this process a pressure of about 250 tons is required to compress one unit of four rivets.

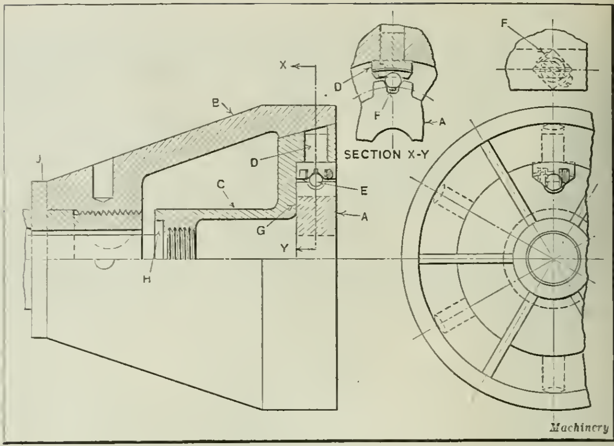
Using the method illustrated at *D* and calculating the pressure required to head the four rivets as $4 \times 27 = 108$ tons, allowing an additional pressure of 12 tons for compressing the field laminations, the total pressure would be 120 tons. The process illustrated at *D* is therefore shown to be more economical, as it requires 130 tons less pressure than when using rivets like that shown at *E*. A 3/4-inch rivet like the one shown in the diagram at *B* could be upset with a pressure of 9 tons. Four rivets would consequently require a pressure of 36 tons. By allowing an additional pressure of 12 tons for compressing the field laminations, a total pressure of 48 to 50 tons would be required instead of 130 tons. Rivets of the type shown at *H*, with grooves cut at the bending points, are preferable for castings with frail frames, although not absolutely necessary. The grooves prevent the rivet from expanding below the head as is the case with the rivet shown at *G*. It will be seen from the foregoing that it is often possible to employ a lighter weight casting by selecting the type of rivet best adapted for the work at hand, and at the same time to effect a reduction in the cost of manufacture and in the expense for tool equipment.

East Orange, N. J. JOHN E. UNGER



Various Designs of Cold Rivets used for Electrical Apparatus

CHUCK FOR SPIRAL GEARS



Chuck designed for locating and holding Spiral Gears

The special chuck illustrated is designed for locating and holding a spiral gear that is required to have the shaft hole ground concentric with the pitch circle. The spiral gear (a section of which is shown at *A*) has a pitch diameter of approximately 4 inches, a 45-degree left-hand spiral, and teeth of 6 diametral pitch. The chuck may be referred to as a "ball-control" type, because steel balls, brought into contact with the teeth at points near the pitch circle, serve to locate the gear and hold it tightly in place. As this chuck has proved capable of accurate work, and can be adapted to nearly all internal grinding machines, it may be of interest to those who have work of a similar nature. The chuck consists essentially of a heavy cast-iron body *B*, which is screwed on the spindle of the machine, and a spring collet *C*, which is split to suit the number of teeth in the gear. The collet carries the ball-holders *D*, which are located between the slots in such a position that the balls *E* come in contact with the gear teeth as indicated.

The ball-holders are made of square stock and have round shanks machined at one end as shown. These holders also have a V-slot cut across the corners in their squared heads, which serves to locate the balls and transmits the required inward clamping movement when the chuck is tightened. The balls are held in holders *D* by small steel straps *F* in such a manner that they are permitted to roll a limited distance in the V-slots in holders *D*.

A rolling or rotary motion is imparted to the gear when inserting it in the chuck. The gear is held against face *G* by the grinding wheel spindle until the collet is drawn up by means of the draw-bar *H*, which is actuated by a handwheel at the end of the machine spindle *J*.

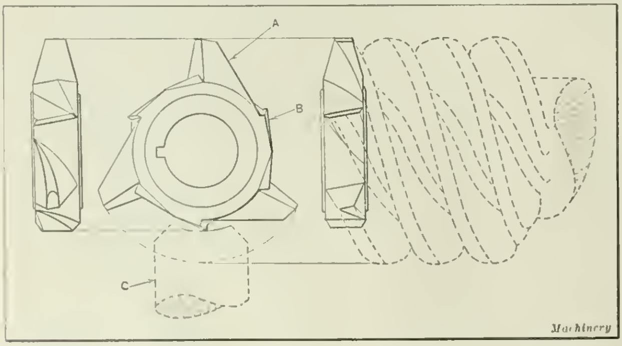
Pittsburg, Pa. WILLIAM OWEN

CUTTING WORM-WHEELS WITH A SPECIAL INVOLUTE CUTTER

It is customary, in shop practice, to use a fly cutter in cutting sample worm-wheels. In using this method to cut worm-wheels having multiple threads, considerable care is required to insure accuracy in the lead and pitch of the threads. In the accompanying diagram is illustrated a unique method which was used successfully in cutting a triple-thread worm-gear. Instead of the usual fly cutter, a regular No. 1 four-pitch involute gear-cutter was used, being ground in such a manner as to leave six teeth, three of which were ground like the one shown at *A* to fit a No. 1 worm pitch gage, and the remaining three, as shown at *B*, like a milling cutter used for milling flat work.

A 3-inch diameter, 1-pitch, left-hand triple-thread worm, with a lead of 3 inches is shown in dotted lines at the side of the milling cutter to make clear the action of the cutter. The three teeth *A* are equally spaced, and there is one tooth for each of the triple threads. As one tooth of the cutter takes a cut and leaves the tooth space of the worm-wheel, the next cutter tooth enters the succeeding tooth space of the worm-wheel being cut. The three teeth which are ground down as shown at *B* are for the purpose of cutting the proper clearance radius at the top of the worm-gear teeth. A section of the worm-wheel which is to be cut is shown by the dotted lines at *C*. The three equally spaced teeth *A* are ground circularly to the same diameter as the worm to be used with the worm-wheel, plus an amount equal to 0.1 times the linear pitch of the worm, in order to provide the necessary clearance. A regular cutter grinder was employed to grind the sides of the teeth *A* to fit the 29-degree worm thread gage. Care was taken to obtain the correct lead and the proper helical and radial angles, and to insure the correct clearance for a 1-inch pitch, 3-inch lead hobbing cutter, as well as to grind the three teeth *B* to the proper size for cutting the worm-gearing to the correct throat depth. It required a little less than ten hours to grind the cutter.

The cutter was mounted on the spindle of a regular hobbing machine, care being taken to have the center of the cutter teeth on a radial line passing through the center of the worm-gear. As the cutter had a tooth for each thread, it was unnecessary to reset the cutter for each lead. The worm-wheels had thirty-three teeth in this case and as three tool settings would have been required had a fly cutter been employed, it can be clearly seen that it would have been difficult to obtain great accuracy with the fly cutter method. It was found that the same feeds as used with a regular hob could be employed when using the reground involute cutter.

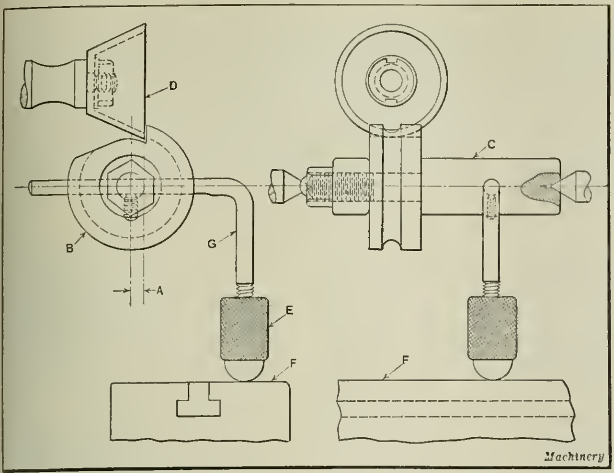


Use of a Specially Ground Involute Cutter for cutting Worm-wheels

Cleveland, Ohio J. E. BAKER

MANDREL FOR GRINDING CIRCULAR FORMING TOOLS

The mandrel shown at *C* in the accompanying illustration is intended primarily for holding circular forming and cutting-off tools while grinding their cutting edges on a toolroom grinder. Ordinarily the cutting edge or



Use of Mandrel for holding Circular Forming Tools while grinding

face of a circular forming tool is milled back from the center line of the cutter a predetermined distance *A*, in order to obtain a better cutting action. A circular cutter of the type shown at *B* is held on the mandrel by means of a collar and hexagonal nut. When performing the grinding operation, mandrel *C* is held between the centers of the grinding machine.

The grinding machine saddle is adjusted until the face of the grinding wheel *D* extends beyond the vertical center line of arbor *C*, the required distance *A*. The knurled adjusting nut *E* is then allowed to come in contact with the top surface *F* of the machine table. Nut *E* is tapped to fit on the threaded end of the bent rod *G* and prevent it from working loose after adjustment. The forming cutter can be revolved toward the working face of the grinding wheel after each cut, by adjusting knurled nut *E*. This method of feeding the work to the grinding wheel serves to keep the distance *A* practically constant. Very slight variations due to the wearing down of the grinding wheel face, however, may occur, but these can easily be compensated for by resetting the grinding wheel.

Conneaut, Ohio F. A. Gross

ASSIGNING DRAWING NUMBERS

In a certain drafting-room each new drawing was assigned a new number in rotation, and as there were a large variety of machines and tools, it was finally decided to make the numbers of all drawings for each job run consecutively. Accordingly it became the practice for each draftsman working on a separate design, to reserve a group of numbers for that particular job, marking the reservation in pencil upon the record book, and being sure to reserve enough numbers to more than cover the number of drawings needed.

This practice led to confusion in some cases, as there was sometimes a blank space of numbers left that were never used, and there was also a tendency to use the same number twice, if anyone failed to mark down a number taken for a small job. To avoid this confusion, it was decided to let the filing clerk keep the drawing record, and make him responsible for the assignment of all drawing numbers. At the same time each draftsman was to be allowed to take as large a group of numbers as he believed would be required for his job.

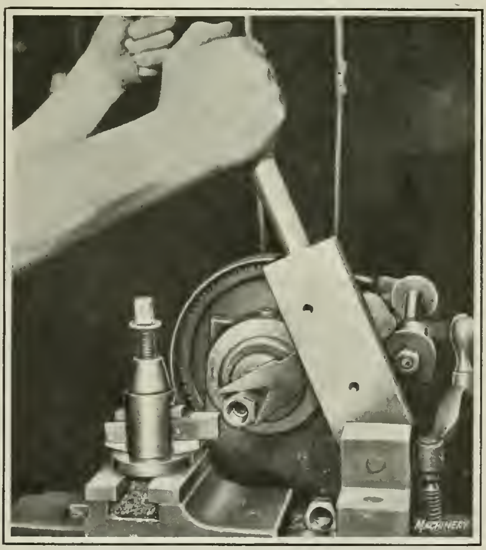
The clerk, instead of directly marking down the name of every drawing for which he assigned a number, took a bunch of old cards from which he made tickets, keeping a hundred or more in reserve. On each of these tickets he marked one of the numbers that followed in rotation, and then looking back over the record, found all the blank numbers that had not been assigned, and made tickets to correspond with them. Whenever a draftsman desired to reserve a group of numbers, he would receive as many tickets as there were numbers wanted, always seeing that the numbers handed out for one job were in consecutive order. The draftsman receiving these numbers would hold the tickets until the job was complete, marking down the title and subtitle of each drawing, with such other information as was to be recorded, on the ticket. When the work was finished, and no more drawings were to be made for that job, the whole group of tickets was returned to the clerk, who entered them on the permanent record, leaving all the blank numbers so returned, to be reissued at the first opportunity.

If a small job came in, the smallest group of consecutive numbers that could be used was issued, and if a very large job was begun, the group was issued from entirely new numbers. The tickets were so kept that it was easy to find a group of numbers that would just about suit the size of the job to be provided for. This was done by keeping the tickets in a box with spacing cards between the groups.

North Judson, Ind. William H. Kellogg

FACING NUTS SQUARE WITH THREAD

It is not always a simple matter to devise a satisfactory and economical method of facing nuts so that their finished faces will be square with the threads, or in other words, so that the face of each nut will be at right angles to the axis of its thread. If a plain threaded arbor is inserted in the lathe spindle and the nut screwed on this arbor and tightened up against a shoulder while being faced, the work will vary considerably in accuracy. If the back face of the nut is at right angles to the thread, the front face will usually be finished true; but if the back face is not square with the thread, the front face will also be out of square when finished. In order to eliminate this trouble and obtain



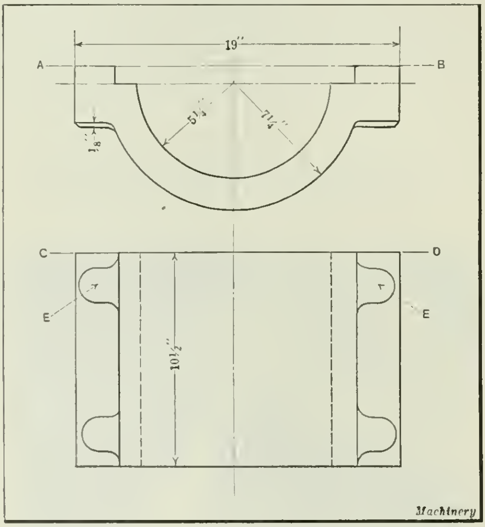
Device for removing Nuts from Threaded Arbor more accurate results, an arbor was made with the threads at the low limit pitch diameter for a length equal to three-fourths of the thickness of the nut, and from this point tapered 0.020 inch per inch for a distance of from four to six threads. The nut can be assembled on this arbor while the machine is in motion. When it reaches the tapered part of the thread on the arbor it locks tight enough to permit a light cut to be taken on the face. The nuts faced while held on this arbor were found to be true within 0.002 inch, when tested with an indicator. However, it was a difficult matter to remove the finished nut from this arbor by means of a hand wrench.

The accompanying illustration shows clearly the method adopted for removing the nuts, which enables the work to be done rapidly and without danger to the operator. With this device the operator reverses the machine with one hand while he operates the nut remover with the other. It will be seen that the device consists simply of an elongated wrench attached to a lever in such a manner that it can be quickly brought forward to grip the work.

Clio, Mich. CHARLES E. HENDRICKS

MOLDING A LARGE BEARING CAP

The breaking of a cast-iron bearing cap of the dimensions shown necessitated supplying a new casting at once. Accordingly, a pattern was made and sent to the foundry with an order to deliver two castings as soon as possible. The molder knew that it would take time to provide sand bars or gaggers that would properly support the body of hanging sand in the cope flask if the mold was made in the customary manner with *AB* as the parting line between the cope and the drag. Consequently, he removed the four bosses *E* from the pattern, leaving it plain and straight so that it could be molded on end in a plain drag and flat cope, with the cope parting on line *CD*.



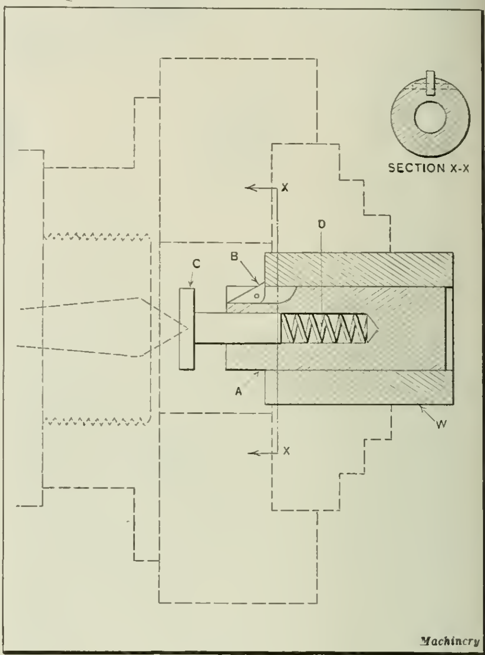
Bearing Cap molded in Upright Position

Kenosha, Wis. M. E. DUGGAN

LENGTH GAGE

The machining of the work or bushing shown at *W* in the accompanying illustration was greatly facilitated by the use of the special gage shown. The work was to be left rough on the outside, but was required to be bored, reamed, and faced on both ends at one chucking. The final facing operation was required to finish the work to a predetermined length. A 14-inch three-jaw chuck, indicated by dotted lines, was employed to hold the work, which was about 4 inches long and 3 inches in diameter.

The gage consists of a cylindrical member *A*, which is made a good sliding fit for the reamed hole in the work; a triangular shaped stop *B* pivoted in a slot cut in part *A*; a plunger *C*; and a compression spring *D*. In chucking the work, care is taken to see that the inner end projects beyond the inner surfaces of the chuck jaws a sufficient distance to permit the use of a back-facing tool.



Gage employed in facing Bushing to Length

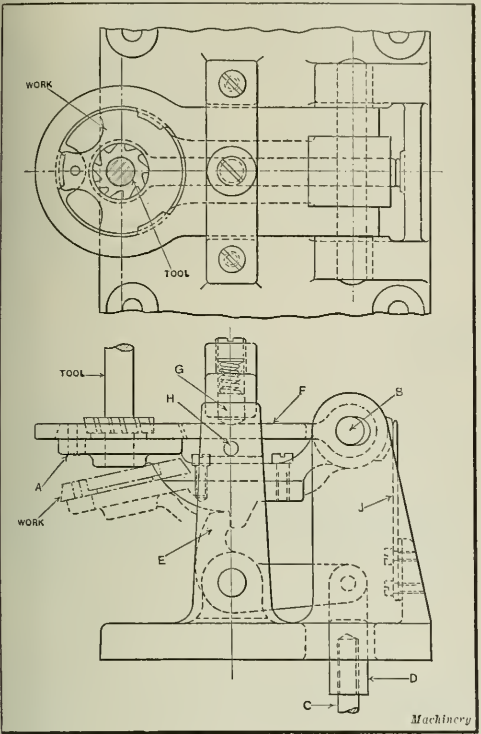
After boring and reaming the work to the required size, the inner end is faced off with the back-facing tool. The gage is then slipped into the reamed hole and pressed inward against the action of spring *D* until the pivoted triangular stop *B* passes the faced end of the work and assumes the position shown in the illustration. It is evident that the stop, when in this position, will prevent any outward movement of the gage, and that spring *D* will hold it in place while the outer end of the work is being faced. The distance from the perpendicular face of stop *B* to the outer end of part *A* corresponds to the length of the finished work. Therefore, a facing tool can be easily set for the final finishing cut by bringing it up until it just makes contact with the end of part *A*.

Rosemount, Montreal, Canada HARRY MOORE

PEDAL-OPERATED DRILL JIG

A drill jig or fixture which permits a high rate of production, and which may be adapted for drilling, tapping, and counterboring, is shown in the accompanying illustration. The locating nest or plug *A* is dropped to the position shown by the dotted lines to facilitate loading and unloading. Part *A* pivots on the pin *B*, and is operated by a foot-pedal through the connecting-rod *C*, yoke *D*, and operating cam *E* which is shown in the raised position. The cam *E* is released by a spring under the bench, allowing the locating nest to drop when pressure is removed from the foot-pedal.

The work is clamped by the upper plate F which is acted upon by spring plunger G. A stop-pin H limits the upward travel of part A. The flat spring J absorbs the slight shock resulting from returning the work-table to the operating position, and thus prevents undue wear of the elongated pivot hole. This type of drilling fixture can be designed with interchangeable locating nests and bushing plates, and



Drill Jig operated by Foot-pedal

when so equipped will be found convenient for a large variety of drilling machine work. A special counterboring tool is shown in the operating position in the illustration.

Waynesboro, Pa. D. A. Nevin

JIG FOR DRILLING COMPANION FLANGES

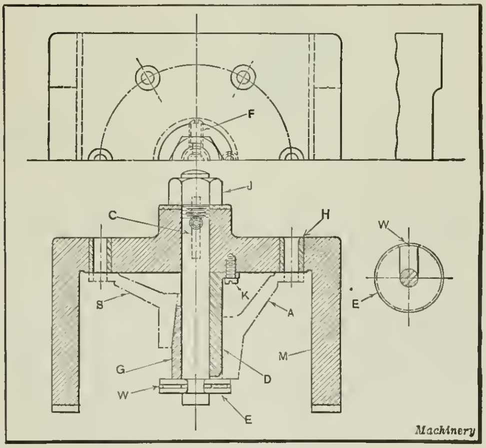
The jig shown herewith was designed for use in drilling six holes in each of two companion flanges. A half section of one flange is shown by heavy dot-and-dash lines at A, and a half section of the other at B. The two finished flanges are bolted together when in use. The holes in each flange must therefore be spaced the same and be of the same size. Being so nearly alike, it was found advisable to design a drill jig that could be used for both pieces. The jig body was made of a channel-shaped casting M in the top of which were pressed six drill bushings like that shown at H. The under side of the top section is finished to provide a locating pad for the flanged face of the work. In the center of the top is a boss of sufficient length to give the required bearing surface for the draw-bolt C, which is a sliding fit in the casting. The bottom of the jig body is finished and relieved, as illustrated, to give a four-point bearing on the drilling machine table.

Let us consider first the drilling of flange A. The hub of this flange has a straight reamed hole in it. The plug D is therefore used when drilling this piece. Plug D is a sliding fit on draw-bolt C, and the outside diameter is a slip fit in flange A. After loosening the nut J on the top of the draw-bolt, the work is placed on the plug and washer E slipped into place in the groove on the draw-bolt. The bolt is then drawn up by tightening the nut J, thus pulling the slip washer against the hub end and clamping the face of the flange firmly against the finished under side of the casting.

In draw-bolt C there is a slot into which enters the pivot end of set-screw F. This set-screw is a sliding fit in the slot and keeps the bolt from turning when the nut is tightened. As it requires but a fraction of a turn to release the bolt enough to permit the slip washer to be easily withdrawn, the slot need not be very long to allow the required adjustment. A small fillister-head screw K passing through the flange of plug D and screwed into the casting keeps the plug from turning while the work is being put in place, and also keeps the plug from being pulled off the draw-bolt when the work is withdrawn from the jig.

Flange B has a tapered hole in the hub. To adapt the jig to this piece, a tapered plug G having a slip fit over the draw-bolt and tapered on the outside to fit the hole in the hub of the flange is used. The length of this plug is such that when it is drawn into the hub, its lower end will be approximately the same distance from the locating surface of the casting as the end of the hub of flange A. In this case the slip washer is pulled up against the plug itself, which is drawn into the tapered hole when the nut J is tightened, thus centering the flange and drawing the face firmly against the locating surface.

As there was no six-spindle drill head available when this jig was first used, the drilling of each flange was done with a three-spindle drill head, which necessitated two operations. The three drills in the head were equally spaced and of the same length, so that they entered the work at the same time, thus bringing all the thrust on the draw-bolt nut. The plugs and the draw-bolt are of hardened steel. To avoid confusion, each plug is stamped to show the work for which



Jig for drilling Companion Flanges

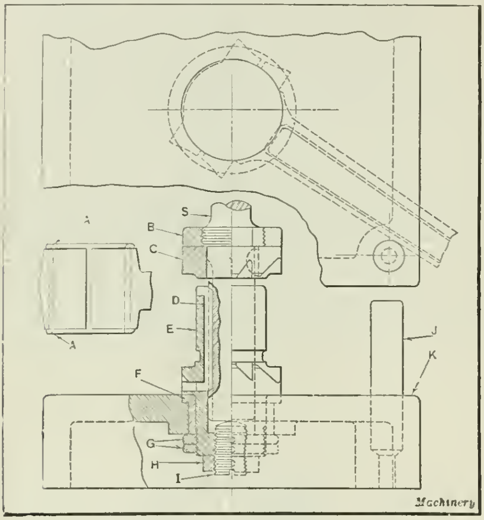
it is intended. When the jig is withdrawn from the tool-crib, the plug required for one piece only is given out. The other plug is left in the crib in the space provided for the jig itself.

To prevent loose parts from becoming lost while the jig is in the tool-crib, the plug D is left attached to the jig, but swung aside, using the screw K as a pivot so that plug G can be placed on the draw-bolt. Slip washer E has a groove turned on the outside into which is snapped a spring wire ring W. When the jig is in use, the wire is slid around until the opening between the ends is on the same center line as the opening in the washer, as shown in the assembly view. When the jig is in the tool-crib, this wire is slid around after the plug *G* is put in place so as to close up the opening in the washer as shown in the detail at the right. When the plugs *G* and *D* and the slip washer are put in place as described, there is little possibility of any parts becoming lost, as they are all assembled in one unit.

Pittsburg, Pa. CLARENCE M. SCHLEH

TOOL FOR FACING CONNECTING-ROD BUSHINGS

The facing tool shown herewith is used to finish-face both sides of a connecting-rod bushing and round the ends to the radii indicated at *A*. Referring to the illustration, *S* is a hardened and ground tool-steel member provided with a tapered shank. A right-hand, formed facing cutter *C* is pressed on part *S* and keyed to it with a Woodruff key as shown. The threaded collar *B* allows the cutter *C* to be removed in case of breakage, or for regrinding. The lower



Facing Tool for Connecting-rod Bushings

end of part *S*, which has a keyway cut in it, acts as a pilot for cutter *C* and as a driver for the lower left-hand cutter *E*. The upper part of cutter *E* is made a slip fit for the bore in the connecting-rod bearing.

A key *D*, pressed into a keyway in cutter *E* is made a slip fit in the keyway cut in *S*. The lower cutter *E* revolves in bushing *F* and is held in place by the lock-collars *G*. The adjustable stop *I*, locked by nut *H*, is set according to the width of the connecting-rod bearing. In operation, the tool body *S* with cutter *C* is withdrawn from the lower cutter *E* and the connecting-rod is placed in position on *E*. The tool body *S* is then lowered, and its pilot introduced for a short distance into *E*. The machine is next started and the upper cutter *C* is fed down until the bottom of the pilot on *S* strikes the stop *I*, thus completing the operation. A stop-plug *J*, pressed into the cast-iron base *K*, prevents the connecting-rod from revolving when the tool is in operation.

When both the cutters *C* and *E* are ground with the same clearance, they will remove the same amount of metal from the top and bottom of the bearing and will not chatter. As the bushings faced by this tool are of babbitt and brass, the cutters can be used a considerable time before requiring regrinding. This tool will hold the bearing width to within 0.0005 inch of the specified dimension.

Chicago, Ill. HAROLD A. PETERS

DETERMINING HEIGHT OF ARC WHEN MILLING KEYWAYS

Formulas for determining the height of arc *A*, Fig. 1, were given in December, 1920, MACHINERY on page 377, and in June 1921 on page 975. A formula similar to the ones given, but which the writer believes to be more convenient to apply is the following:

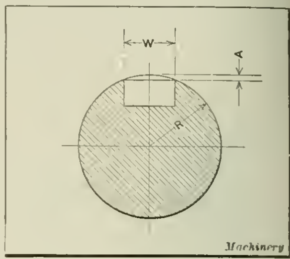


Fig. 1. Diagram used in finding Height of Arc

$$A = \frac{W}{2} \times \tan\frac{a}{2}$$

This formula is derived as follows: Referring to the accompanying illustrations,

$$\frac{\frac{1}{2}W}{R} = \frac{W}{2R} = \sin a;$$

$$b = 90 \text{ degrees} - \frac{a}{2}$$

$$\frac{A}{\frac{1}{2}W} = \cot b; \qquad A = \frac{W}{2}\cot\left(90 \text{ degrees} - \frac{a}{2}\right)$$

But as

$$\text{Cot}\left(90 \text{ degrees} - \frac{a}{2}\right) = \tan\frac{a}{2}, \text{ it follows that}$$

$$A = \frac{W}{2}\tan\frac{a}{2}$$

To use this formula, first find the sine of angle *a* by dividing the width of the keyway by the diameter of the shaft or hole. By consulting a table of trigonometric functions, the magnitude of this angle is found; then the tangent of one-half this angle is multiplied by one-half the width of the keyway. As an example let it be required to find *A*

when $W = \frac{7}{32}$ inch and $R = \frac{7}{16}$ inch.

According to the formula $A = \frac{7}{64}\tan\frac{a}{2}$

Then,

$$\text{Sin } a = \frac{W}{2R} = 0.25, \text{ and } a = 14 \text{ deg. } 29 \text{ min.}$$

Hence

$$\frac{a}{2} = 7 \text{ deg. } 14.5 \text{ min. and } \tan 7 \text{ deg. } 14.5 \text{ min.} = 0.12707$$

Therefore

$$A = 0.10938 \times 0.12707 = 0.01389$$

Hamilton, Mich. LEO LAUBMEYER

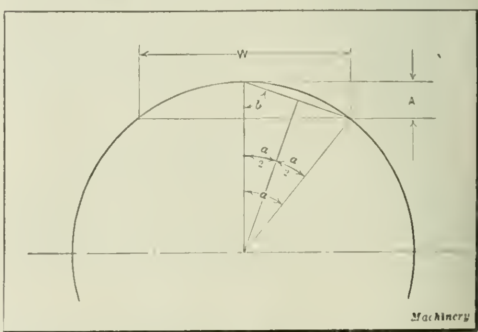
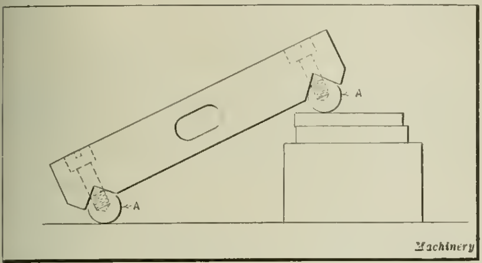


Fig 2. Diagram used in deriving Formula for Height of Arc

SHOP AND DRAFTING-ROOM KINKS

CONVENIENT SINE BAR

The accompanying diagram illustrates a sine bar which may be accurately and quickly set up by the use of gage-blocks. Two plugs *A* are held in the vees of the sine bar



Convenient Sine Bar

by means of fillister-head machine screws. These plugs project beyond one side of the sine bar a sufficient distance to permit the use of the latter in the same manner as one of the ordinary type. The construction is such that the sine bar can be readily made to the required accuracy, it being simply necessary to grind the vees after hardening in order to secure the desired distance between the two plugs.

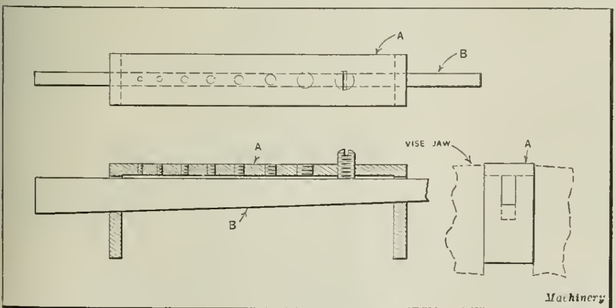
Rosemount, Montreal, Canada STANLEY ALMOND

HOLDER FOR SMALL SCREWS

Most mechanics find it difficult to hold small screws while slotting their heads, shortening them, rounding their heads, or performing any of the operations required to adapt them for various purposes. Holding them in the vise usually results in flattened threads and frequently the screw flies from between the vise jaws and is lost as soon as the file touches it.

A useful device for holding small screws can, however, be made as shown in the accompanying illustration. A device of this kind will well repay one for the time spent in making it. A piece of 1/8-inch steel is tapped for different sized screws along its center, and the ends bent down at right angles, forming the holder shown at *A*. Next a taper wedge *B* is made from the same stock. Two slots are then cut in holder *A* to accommodate this wedge. The piece *A* is held in the vise as indicated in the view at the lower right-hand corner of the illustration. A screw which is being operated upon is screwed into holder *A* until it projects on the under side. The wedge *B* is then lightly tapped into place, thus holding the screw securely.

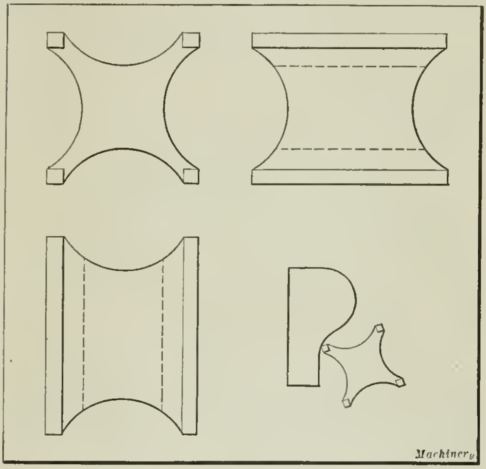
Rosemount, Montreal, Canada HARRY MOORE



Convenient Device for holding Small Screws

TEMPLET SCRAPER

In making templet and profile gages, it is often difficult to produce the working surface of the templet or gage with assurance that it will be exactly perpendicular to its parallel flat sides. This difficulty is caused mainly by the fact that much hand work is required in perfecting the profile of the tool. A scraping tool which will greatly assist in working down the contour surface of a templet or profile gage is shown in the accompanying illustration. This tool should be made of tool steel, and hardened and ground on all its working surfaces. It is used in the manner indicated in the lower right-hand corner of the illustration. The templet is laid on a surface plate, and the scraper, which will



Scraper for finishing Edges of Profile Gages and Templets, and Method of Use

always rest so as to bring the working edges absolutely perpendicular to the surface plate, used to scrape down all slight imperfections until the desired profile is obtained.

Ilion, N. Y. D. R. GALLAGHER

CUTTING KEYWAYS IN A BORING MILL

In the shop where the writer was employed, a 22-inch blower fan hub was to be rebored and resplined, and as there was no suitable keyseating machine for cutting the keyway, it was decided to perform the work on a 24-inch Bullard vertical turret lathe by making use of the vertical friction-driven head employed to raise and lower the turret slide. A standard boring-bar equipped with a high-speed steel tool bit, was used, and by taking light cuts the job was finished in a satisfactory manner.

New Britain, Conn. W. C. BETZ

HOW AND WHY

QUESTIONS ON PRACTICAL SUBJECTS OF GENERAL INTEREST

DETERMINING ALTITUDE OF AN ACUTE-ANGLED TRIANGLE

A. A. G.—Will you please show how to find the distances x and y from the dimensions given in the illustration?

ANSWERED BY LEO LAUBMEYER, HAMILTON, MICH.

The following method of solving the problem stated requires only an elementary knowledge of trigonometry and

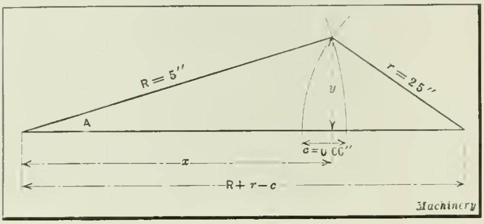


Diagram for calculating Distances x and y

the use of a table of trigonometrical functions. Referring to the illustration,

$$R + r - c = 5 + 2.5 - 0.66 = 6.84 \text{ inches}$$

According to trigonometry (see MACHINERY'S HANDBOOK, page 152)

$$\text{Cos } A = \frac{R^2 + (R + r - c)^2 - r^2}{2R\,(R + r - c)}$$

Substituting the known values and solving,

$$\text{Cos } A = \frac{5^2 + 6.84^2 - 2.5^2}{2 \times 5 \times 6.84} = \frac{25 + 46.7856 - 6.25}{2 \times 5 \times 6.84}$$

$\text{Cos } A = 0.9581228$ and $A = 16$ deg. 38 min. 24.8 seconds

$$\text{Sin } A = 0.28636$$

$$x = R \times \cos A = 5 \times 0.9581228 = 4.790614 \text{ inches}$$

$$y = R \times \sin A = 5 \times 0.28636 = 1.4318 \text{ inches}$$

[While this solution involves the use of trigonometrical functions, it requires less mathematical computations than the one given in September MACHINERY, page 61. A solution similar to the one here given was also submitted by George Warmington, Beverly, Mass.—EDITOR]

ANSWERED BY GEORGE H. SUESS, PHILADELPHIA, PA.

The writer believes that the following solution to the problem submitted by A. A. J. is simpler and involves less calculation than the one given in September MACHINERY on page 61. Referring to the illustration we have:

$$x + N = R + r - c = 5 + 2.5 - 0.66 = 6.84 \text{ inches}$$

Also the sum of the two shorter sides is:

$$R + r = 5 + 2.5 = 7.5 \text{ inches}$$

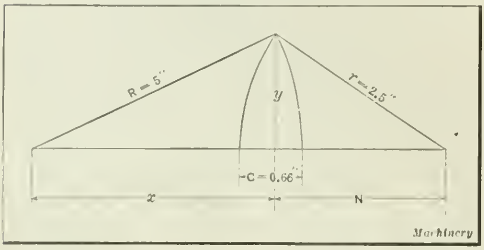


Diagram for determining Altitude y

and the difference between the two shorter sides is:

$$R - r = 5 - 2.5 = 2.5 \text{ inches}$$

Then

$$x + N : R + r :: R - r : x - N$$

or

$$6.84 : 7.5 :: 2.5 : x - N$$

Therefore

$$x - N = \frac{7.5 \times 2.5}{6.84} = 2.74123 \text{ inches}$$

According to arithmetic, if the sum of two numbers and their difference be given, the greater of the two numbers is equal to one-half the sum of their sum and difference.

$$x = \frac{(x + N) + (x - N)}{2} = \frac{6.84 + 2.74123}{2} = 4.79062 \text{ inches}$$

$$y = \sqrt{5^2 - 4.79062^2} = 1.43176, \text{ or } 1.4318 \text{ inches}$$

[Solutions similar to the one here given were also submitted by C. N. Pickworth, Manchester, England, and Herbert Bold, Ecorse, Mich.—EDITOR]

ANSWERED BY LEWIS D. CASTOR, ELIZABETHPORT, N. J.

This solution involves the application of a simple formula that is seldom given in handbooks, but which the writer has found useful in solving problems involving oblique triangles. Referring to the illustration, the formula is as follows:

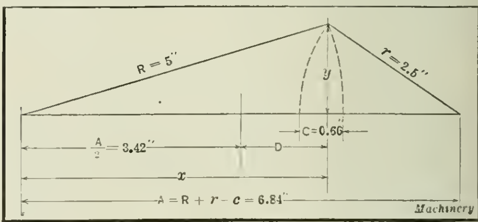


Diagram for determining Altitude of an Acute-angled Triangle

$$D = \frac{R^2 - r^2}{2A}$$

This formula is derived from the following equations:

$$\sqrt{R^2 - y^2} = \frac{A}{2} + D \qquad (1)$$

$$\sqrt{r^2 - y^2} = \frac{A}{2} - D \qquad (2)$$

Squaring both sides we have,

$$4R^2 - 4y^2 = A^2 + 4AD + 4D^2 \qquad (1)$$

$$4r^2 - 4y^2 = A^2 - 4AD + 4D^2 \qquad (2)$$

Subtracting (2) from (1) we have,

$$4R^2 - 4r^2 = 8AD \text{ or}$$

$$R^2 - r^2 = 2AD$$

$$D = \frac{R^2 - r^2}{2A}$$

Substituting the numerical values of the given problem.

$$D = \frac{25 - 6.25}{13.68} = 1.37061 \text{ inches}$$

$$x = 3.42 + 1.37061 = 4.79061 \text{ inches}$$

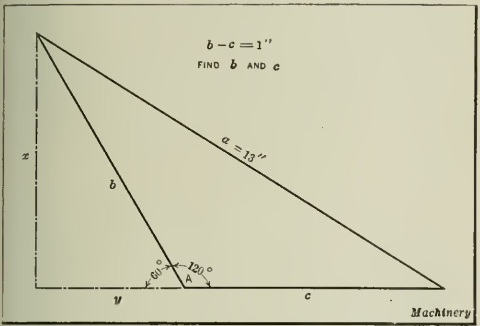
$$y = \sqrt{R^2 - x^2} = \sqrt{25 - 22.9441} = 1.4318 \text{ inches}$$

DETERMINING THE LENGTHS OF TWO SIDES OF AN OBLIQUE TRIANGLE

H. W. P.—The accompanying illustration shows an oblique triangle in which the difference between the lengths of sides b and c = 1 inch; the length of side a = 13 inches; and angle A = 120 degrees. How can the lengths of sides b and c be found?

ANSWERED BY J. W. JONES, CLEVELAND, OHIO

In the following are given two solutions, both of which the writer believes are simpler than that presented on page 238 of November MACHINERY. It will be noted that a well-known formula in trigonometry is employed in the first solution.



Oblique Triangle in which the Difference between Sides b and c, and Angle A are known

Solution by Trigonometry

Referring to the accompanying illustration:

$$a^2 = b^2 + c^2 - 2bc \cos A$$

Now as $\cos A = -\frac{1}{2}$, we have $a^2 = b^2 + c^2 + bc$

According to the conditions of the problem, $b = c + 1$. Therefore

$$a^2 = c^2 + 2c + 1 + c^2 + c^2 + c = 169$$

Then

$$c^2 + c = 56 \text{ and } (c + \tfrac{1}{2})^2 = 56\tfrac{1}{4} \text{ or } 225 \div 4$$

and

$$c + \tfrac{1}{2} = \frac{15}{2} = 7 \text{ inches and } b = 7 + 1 = 8 \text{ inches}$$

Solution by Geometry

Referring to the accompanying illustration, $x^2 + y^2 = b^2$; $y = \frac{1}{2}b$; and $b = c + 1$.

Further

$$a^2 = x^2 + (c + y)^2 = x^2 + c^2 + 2cy + y^2$$

and

$$a^2 = b^2 + c^2 + 2cy = c^2 + b^2 + cb$$

Then by substitution

$$a^2 = c^2 + c^2 + 2c + 1 + c^2 + c = 3c^2 + 3c + 1 = 169$$

Thus

$$c^2 + c = 56 \quad \text{and} \quad c^2 + c + \tfrac{1}{4} = 56\tfrac{1}{4} = 225 \div 4$$

and

$$c + \tfrac{1}{2} = \frac{15}{2} = 7 \text{ inches; } b = 7 + 1 = 8 \text{ inches}$$

FINISHING HANDWHEEL RIMS

B.—What method is employed in finishing the rims of machine handwheels?

A.—Ordinarily this operation is performed by turning on a lathe, followed by polishing, although the use of a rotary milling machine and a formed milling cutter is considered by some to be superior to turning. In one shop the polishing is done by spinning the handwheels on an arbor held by the hands, against a fabric wheel which is provided with a facing of abrasive. The surface speed of the rim is slackened to less than that of the buffing wheel by pressure against the workman's leather apron.

VOLUME SOLVED BY PAPPUS OR GULDINUS RULES

F. F.—Please show how to find the volume of the solid shown in the accompanying illustration, any cross-section of which, perpendicular to the axis, is circular. Length c = 18 feet, and the middle diameter d = 20 inches.

ANSWERED BY W. W. JOHNSON, CLEVELAND, OHIO

A.—Referring to the illustration, this solid is produced by the revolution of the segment of a circle XYZ about its chord XZ. The volume of any solid of revolution may be found by means of the Pappus or Guldinus rules given on page 144 in MACHINERY'S HANDBOOK.

Thus

$$V = 2\pi m A \qquad (1)$$

in which

V = volume of the figure;
A = area of segment XYZ; and
m = distance from the axis of revolution to the center of gravity of segment XYZ

The area of a segment of a circle is found by the formula

$$A = r^2(\alpha - \sin\alpha \times \cos\alpha) \qquad (2)$$

In this case,

$$r = \frac{c^2 + 4h^2}{8h} = \frac{46656 + 400}{80} = 588.2 \text{ inches}$$

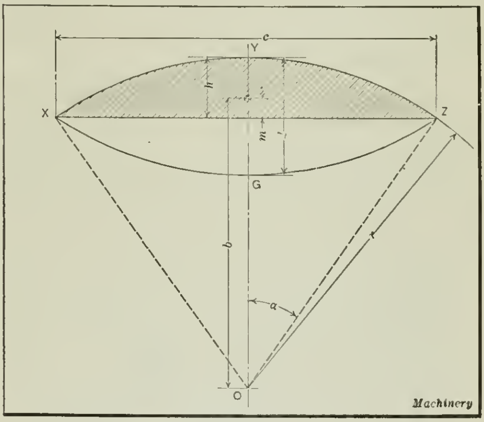


Diagram used to illustrate Method of calculating the Volume of a Solid of Revolution

$$\sin\alpha = \frac{c}{2r} = \frac{216}{1176.4} = 0.183611$$

$$\alpha = 10 \text{ degrees } 34 \text{ minutes } 49 \text{ seconds}$$

$$\alpha \text{ (in radians)} = 0.1846586$$

$$\cos\alpha = \frac{r - h}{r} = \frac{588.2 - 10}{588.2} = 0.982999$$

Inserting the numerical values in Formula (2), we get

$$A = 1442.46 \text{ square inches}$$

The distance from the center O to the center of gravity of the segment is obtainable by a formula given in MACHINERY'S HANDBOOK on page 267 which is as follows: $b = c^3 \div 12A$, from which we find b = 582.20539 inches.

Now

$$m = b - (r - h) = 4.00539 \text{ inches}$$

Inserting the numerical values for m and A in Formula (1), we find the volume of the solid to be 36,302 cubic inches or 21 cubic feet.

The Machine-building Industries

THERE are definite indications of a gradual resumption of activity in the machine-building industries and of a revival in buying of manufacturing equipment and tools. One of these indications is that some fair-sized orders have been placed for highly productive automatic and semi-automatic machinery, and another is that there is a steady increase in the volume of buying in the small tool field. It is generally recognized that the type of machine tool most likely to find a ready sale in the near future is one that it will be economical to buy, either because it gives greater production per dollar put into operating costs, or because it gives greater accuracy, or both. Much of the business done in this line of machinery during the present year will be replacement business—that is, the replacement of older types of machines by more efficient ones, in order to reduce manufacturing costs and improve the quality of the product.

The Effect of Improved Machinery

Examples of the effect of installing high-production machinery are growing more numerous every day. A case recently noticed was the production of a part used in great quantities, which is now being turned out at the rate of 1½ minutes, compared with 7 minutes by the older equipment. New equipment of this type was installed in one factory with the result that the manufacturer was enabled to undersell his competitors immediately, and now his competitors are negotiating for similar equipment, this being the only solution of their problem.

In another case an automatic machine which cost $7000 is producing parts in 40 seconds which used to require 3 minutes on a $12,000 machine. Still another interesting comparison will illustrate the point. By former methods an automobile manufacturer employed ten machines and eight men for the machining operations on one of the important parts of his engine. The total cost of the equipment was $25,000. This equipment has been replaced by modern automatic machinery at a cost of only $15,000, and two men and two machines are giving the same production as was formerly obtained. The quality of the product has not suffered.

These examples indicate better than general statements the lines along which there are possibilities for developing business in the machine tool field. The great need and the demand today is for the highly productive automatic or semi-automatic machine that will replace the less productive machinery of former days and relegate it to the scrap heap.

The Small Tool Industry

The increased buying in the small tool field constitutes one of the most cheerful signs at the beginning of 1922, although this industry is operating only at about 30 to 40 per cent of capacity. Most of the manufacturers of small tools continued to operate with full, or nearly full forces, for several months—in many cases for half a year—after the depression had started, and for that reason their stock-rooms are well filled. They are able to fill present orders chiefly from these stocks, so that the shops run mainly on special orders.

One of the plants manufacturing small tools reports 1921 sales equal to 45 per cent of the 1920 business; another reports 42 per cent; while the average of the majority of plants in this field is about 35 per cent. In most cases the lowest point in the small tool business was reached in June and July last year, and one of the important concerns in the field reports that December, 1921, and January, 1922, both showed increased sales over the corresponding months of a year ago. One concern equalled its 1916 business in 1921, and there are many reasons for the belief that 1922 will equal the 1917 business. There has been an improvement in exports too, especially to Australia. In the small tool field it is confidently expected that March will show up unusually well, compared with the last eighteen months. One of the plants has added 10 per cent to its force and increased the working hours about 30 per cent, compared with January 1.

In the grinding wheel field, similar conditions exist. There are numerous orders, although each is small, but the tendency now is toward bigger orders. For example, one well-known manufacturer who used to order about 250 wheels at a time two years ago but who cut down his orders to a dozen at a time, has recently increased them to 50 wheels per order, which is encouraging.

The Machine Tool Situation

In the machine tool field immediate prospects are not quite so promising, but they are very much brighter than at any time during the last eighteen months. Many new ideas are being worked out, new machines are being developed, and practically every machine tool builder has something new in mind. These new machines with their valuable new features will make it hard for manufacturers to keep on operating with old equipment. In the meantime, many machine tool builders are turning to other fields in order to utilize the excess capacity of their plants. Machines being built in machine tool works at the present time include printing machinery, laundry machinery, domestic washing machines, ice cream freezers, automatic refrigerators, motorcycles, and Diesel engines.

Stability in machine tool prices seems to have been reached in most instances, substantial reductions having been made from time to time during the past year. An investigation made by MACHINERY into the condition of the used machine tool market definitely shows that the fear that second-hand machine tools will seriously interfere with the sale of new equipment is not well founded. While there are many second-hand machines on the market, most of them are of old types, and as business improves many of them will be scrapped—they cannot compete with the later and far more efficient equipment available. A complete review of this situation will be found on page 539.

The Automobile Industry—The Railroad Situation

In this review, in February MACHINERY, it was stated that the total number of passenger cars and trucks built in 1921 was 1,680,000, a decrease of 24 per cent from the production in 1920. The factory prices of these cars and trucks aggregated $1,222,350,000, which was 45 per cent less than the factory prices of 1920. The average factory price of an automobile in 1921 was $702, compared with $897 for the previous year. The average factory price of motor trucks in 1921 was $968, as against $1273 in 1920. Automobile manufacturers are moving cautiously, and are not planning any material increase in production until there is greater evidence of a steady and increasing market. There has been a slight increase in exports of both passenger cars and motor trucks, but these exports are still far below the 1920 figure.

The greatly improved financial results during the last six months are encouraging; and as equipment and supplies in general have materially decreased in price, a considerable number of orders has been placed by the railroads in the last few months. Rolling stock can now be purchased at from 30 to 35 per cent less than peak prices, and the contracts for locomotives and cars placed during December and January are providing substantial employment for several of the shops in this field.

NEW MACHINERY AND TOOLS

THE COMPLETE MONTHLY RECORD OF NEW AMERICAN METAL-WORKING MACHINERY

Peerless Universal Shaping Saw

A UNIVERSAL shaping saw having the general characteristics of a hacksaw machine, but designed along lines that adapt it for many operations impossible to perform with the common type of hacksaw machine, is being introduced to the trade by the Peerless Machine Co., 1611 Racine St., Racine, Wis. From Figs. 1 and 2 it will be seen that this saw is built to machine tool standards, accuracy in construction being essential to fit the machine for the class of work for which it is intended. Samples of the work that is handled by this machine are illustrated in Fig. 3.

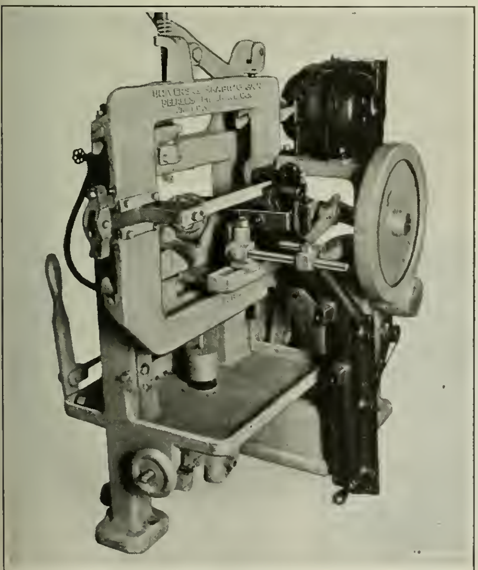


Fig. 1. Universal Shaping Saw manufactured by the Peerless Machine Co.

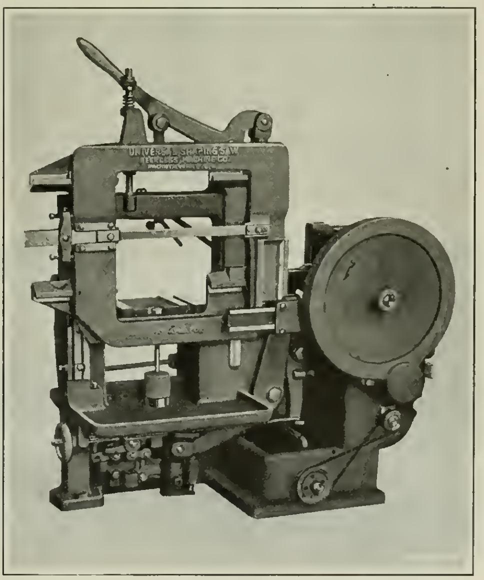


Fig. 2. Side View, showing Mechanism for feeding Saw and lifting it on Return Stroke

The saw blade is carried by a four-sided frame which permits the blade to be placed under ample tension without danger of distorting the bearings. The saw frame is supported on the horizontal bearings or ways of a vertical slide which, in turn, is mounted on vertical ways on the main frame of the machine. The saw frame is reciprocated through a crank and connecting-rod, and during the draw or cutting stroke of the blade the connecting-rod is always approximately parallel with the line of blade travel. This gives a direct pull on the blade and allows the cutting stroke to take place when the angle of the crank is such that the cutting speed is reduced to the minimum of the cycle period, although this speed is the maximum suitable for the work being handled. Then, during the return stroke, the change in the angularity of the crank causes the blade to be returned to the starting point at a high rate of speed. A speed-box having a cone of gears provides three changes of cutting speed to meet the requirements of different jobs.

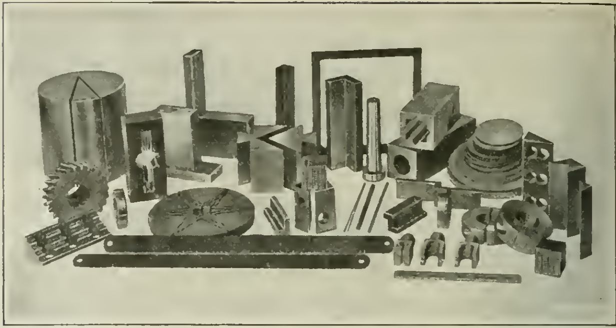


Fig. 3. Typical Examples of Work cut on the Peerless Universal Shaping Saw

Another important feature of this shaping saw is the positive power-feed mechanism with which it is provided. At the end of the draw or cutting stroke, a cam on the crankshaft actuates a lever, which raises the vertical slide on which the saw frame reciprocates and thus lifts the blade clear of the work while the saw is being returned to the starting position. After it has been returned, the saw is lowered to the cutting position by means of the same cam and lever. Simultaneously, a second cam on the crankshaft becomes operative, and through a link and lever mechanism and a ratchet and pawl, a worm meshing with a rack connected to the vertical slide on which the saw frame is mounted, is turned in such a way that it pulls the rack and saw frame down slightly. The repetition of this cycle of movements at the beginning of each cutting stroke provides for feeding the saw into the work at a predetermined rate. The rate of feed is adjusted by turning the small handwheel near the base at the front of the machine.

The feed is regulated automatically by a spring that compensates for the resistance of the material being cut. For instance, if a feed pressure of a certain number of pounds is required for cutting a given material at the rate of 1/32 inch per cut, each cut will be made to that depth as long as the composition of the material remains the same, but if a harder substance is encountered, the depth of cut is automatically decreased proportionately. When a cut has been completed, the feed worm is automatically tripped out of engagement with the rack, after which a spring lifts the saw frame to its upper position and stops the machine. This makes it unnecessary for an operator to watch the work.

For the performance of angle-cutting operations, a special fixture is furnished on which the work may be clamped to either a horizontal or a vertical face. A typical angle-cutting operation is illustrated in Fig. 4. Another useful fixture which adds to the range of the machine is a cross-feed mechanism secured to the table. A piece of work can be placed in this fixture and fed transversely under the reciprocating saw, the latter acting much like a shaper tool and producing a smooth finish on the surfaces machined. Fig. 5 shows a job accomplished by means of this mechanism, a screw-adjusted depth gage being employed for controlling the downward movement of the saw blade.

A reservoir in the base of the machine may be filled with a cooling solution for delivery in a copious amount by a pump and piping to the saw blade and work, after which it is returned to the reservoir. The machine has a capacity for work 6⅝ inches square, takes blades from 10 to 14 inches in length, and has a stroke of 5½ inches. The maximum number of strokes per minute is 132, and the minimum number 50. When equipped with a standard vise, the machine weighs approximately 750 pounds.

BOYE & EMMES CONELESS ENGINE LATHE

The 18-inch geared-head engine lathe shown in the accompanying illustration is being introduced to the trade by the Boyé & Emmes Machine Tool Co., Cincinnati, Ohio. All gears in the headstock are constantly in mesh, the various speeds being obtained through positive clutches operated by means of levers on the headstock. There are twelve selective spindle speeds, ranging from 9 to 350 revolutions per minute. The drive from the pulley shaft is through a friction clutch. The spindle is a heat-treated chrome-nickel steel hammered forging. The top cover of the headstock has a removable plug which affords a convenient means of filling the headstock with oil, a glass oil-tube showing the level of oil at any time in this unit. The number of threads which may be cut per inch ranges from 2 to 56.

The apron is of the double-plate type, which permits the shafts and studs to have a bearing on each end. All feeds are reversible in the apron, and the mechanism is so arranged that the longitudinal and cross feeds cannot be engaged while cutting threads. Attached to the right-hand end of the apron is a lever that slides along a rod, the operation of which controls the starting, stopping, and reversing of

Fig. 4. Cutting Angular External Surfaces

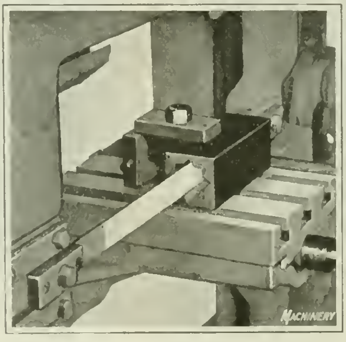
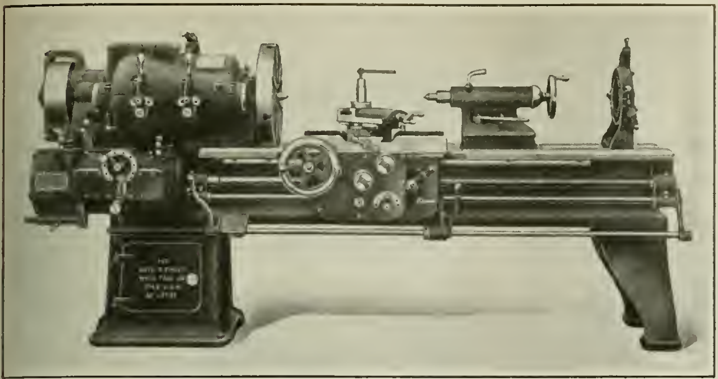


Fig. 5. Use of the Cross-feed Mechanism



Coneless Engine Lathe built by the Boye & Emmes Machine Tool Co.

the headstock spindle. A second lever is mounted on this controller rod at the left-hand end. The tailstock is of the cut-away type, so as to permit the compound rest to be swiveled parallel with the ways of the bed. Double plug clamps are employed to lock the tailstock spindle in position. This spindle is also made from chrome-nickel steel and accurately ground. The tailstock has a sidewise adjustment to provide for taper-turning operations.

The motor is attached to a baseplate mounted on two planed surfaces on the back of the cabinet leg. Constant-speed motors of from 3 to 5 horsepower, and of a speed not exceeding 1160 revolutions per minute are recommended for driving this machine. Its principal dimensions are as follows: Actual swing over bed, 19½ inches; swing over carriage, 13¼ inches; diameter of hole in headstock spindle, 1½ inches; distance between vees of carriage, 14 inches; and distance between centers on a lathe having an 8-foot bed, 4 feet 2 inches. This lathe, when furnished with an 8-foot bed, weighs about 4275 pounds.

LANDIS PIPE THREADING AND CUTTING MACHINE

A pipe threading and cutting machine recently added to the line of products manufactured by the Landis Machine Co., Waynesboro, Pa., is shown in the illustration. This machine may be equipped for threading oil-well casing and high-pressure pipe in addition to ordinary line pipe. It regularly accommodates from 4- to 12-inch pipe, but it may be equipped to thread and cut pipe as small as 2½-inch. Two die-heads of the stationary type are employed, a 6-inch die-head for pipe less than 6-inch, and a 12-inch die-head for pipe ranging from 6- to 12-inch. The entire range of each of these heads is covered by one set of Landis chasers. The chucks for gripping the pipe have three jaws; these jaws are geared, have universal adjustment, and are self-centering on the pipe. The rear chuck is equipped with grips to provide for fitting up flanges.

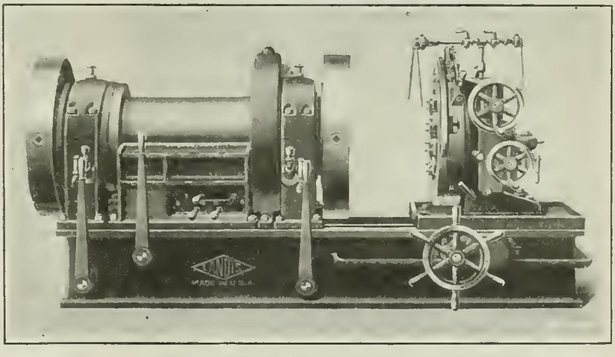
The carriage supports the die-head, cutting-off tool, and reaming tool, and may be moved either by power or hand. Both forward and backward power traverses are controlled by a lever located on the operating side of the carriage. In advancing the carriage toward the chuck, this lever is operated and held until the threading position for the die-head is reached. To reverse the movement of the carriage, the lever is moved in the opposite direction and held there. The carriage may be stopped at any point along its traverse by releasing the lever. Automatic stops prevent the die-head from coming in contact with the chuck in the forward movement and the carriage from running off the guides of the machine in the backward movement. The reaming tool is quickly set to the desired position and locked by means of a lever, and it is fed to the pipe by rotating the cutting-off feed handwheel in a counter-clockwise direction.

The machine has a single-pulley drive, eight speeds being obtainable through a gear-box under the main spindle, by shifting levers located on the side of the gear-box. The machine is started and stopped through a friction clutch operated by either one of two levers at the ends of the headstock. This arrangement enables the operator to stop or start the machine conveniently when threading or when fitting up flanges. The lever midway between the starting and stopping levers is manipulated to reverse the operation of the machine. A motor drive may be quickly arranged by substituting a sprocket for the pulley and fitting a plate to the side of the machine for mounting a motor, a silent chain being used to drive from the sprocket on the motor to the sprocket on the machine. The machine weighs 13,000 pounds.

STEVENSON DOWN-STROKE GEAR SHAPER

A gear shaper made by the Stevenson Gear Co., Indianapolis, Ind., on which all or a number of the teeth of a spur gear, sprocket, etc., are cut simultaneously by a tool-head having a series of radially disposed tools spaced about the circumference of the blank to be cut was described in August, 1921, MACHINERY. It will be recalled that in this machine the tools are fed radially after each reciprocation of the work-holding ram, at which time the work is also indexed a distance of one tooth space. The tool-head is placed above the ram so that the gear blanks are cut on the upward stroke. As the work-holding arbor is passed through the tool-head in putting work in place, the machine is suitable for cutting plain work only. To accomplish the rapid cutting of internal and cluster gears and splines, the same company has developed the machine shown on the following page.

This machine is known as Model 6-A, and is of a down-stroke type; that is, the tool-head is placed beneath the ram and the teeth are cut on the downward stroke instead of on the upward stroke as in the machine referred to. On the

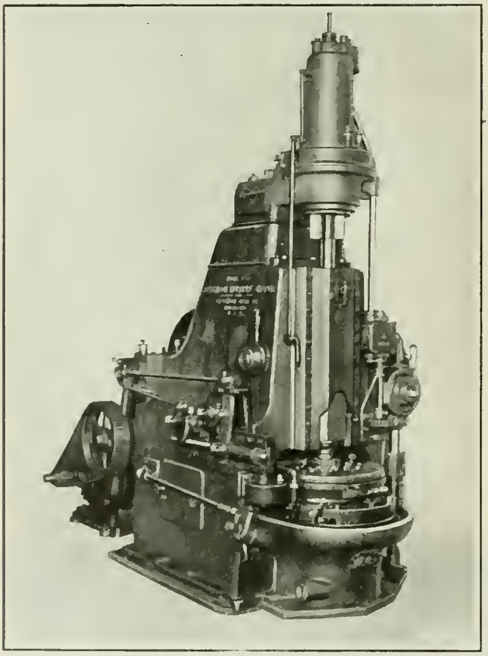


Twelve-inch Pipe Threading and Cutting Machine brought out by the Landis Machine Co.

new machine, the ram is elevated a sufficient distance to enable the arbor of completed gears to be removed and an arbor of blanks to be inserted in the spindle socket of the ram. After the taper shank of the arbor has been inserted in the socket, the operator, by means of a convenient lever, engages a power-driven clutch, which causes a draw-bolt passing through the center of the spindle to revolve and securely draw the arbor into the socket. This clutch is automatically disengaged the moment that the arbor has been tightened a predetermined amount.

After the ram has again been lowered by power to the operative position, at which point it stops automatically, the operator starts the machine by means of an electric push-button switch. As the entire machining operation is automatic, the operator has sufficient opportunity to place blanks on a second arbor while the machine is in operation. In this manner an arbor of cut gears may be replaced by an arbor of blanks with a minimum loss of time. At the completion of an operation the machine is stopped by means of a push-button switch that controls an electric brake. The operator then temporarily elevates the ram, reverses the draw-bolt lever previously mentioned, to eject the arbor, after which the procedure is the same as before.

The tool-head is almost identical with that used on the up-stroke machine, the tool bits and other important parts being interchangeable on the two machines. Two tool-heads are provided, so that while one is in use, the tools of the other may be resharpened and reset. The mechanism for

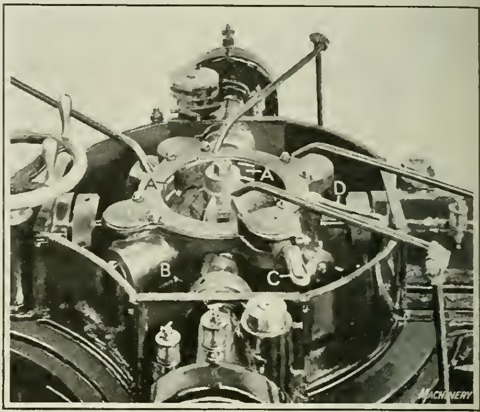


Model 6-A Down-stroke Multiple-tool Gear Shaper designed by the Stevenson Gear Co. for cutting Internal and Cluster Gears

driving the ram and elevating and lowering it consists of a crank which reciprocates a worm during the operation of the machine. This worm transmits its reciprocatory movements through a worm-wheel mounted on a rock shaft. However, when it is desired to elevate the ram, the worm is kept from reciprocating and given a rotary movement, causing the worm-wheel and rock shaft to revolve and elevate the ram. Power for this rotary movement is derived from a small motor which also furnishes power for actuating the draw-bolt mechanism. This machine will be built in a number of sizes.

REED-PRENTICE FOUR-WAY DRILLING MACHINE

In October, 1914, MACHINERY, was described a four-way drilling machine built by the Reed-Prentice Co., 677 Cambridge St., Worcester, Mass., for simultaneously drilling four holes in automobile universal-joint rings and for turning the four arms of differential spiders. This machine has now been built for drilling four bearing holes in the upper and lower sections of tractor rear-axle housings, a special work-holding fixture being provided, which has several novel features that permit rapid handling of the work. Four hardened steel strips *A* placed around the inside of this fixture locate the work centrally, while the bosses in which the bearing holes are to be drilled are properly located by means of guide pins in the lower part of the fixture which engage two holes previously machined in the flanges of the housing members.



Work-holding Fixture of Special Four-way Drilling Machine built by the Reed-Prentice Co.

The lower half of the housing is dropped into position first, after which four plungers in bearings spaced 90 degrees apart, as at *B*, are forced toward the center of the fixture by operating lever *C*. The second or upper half of the housing is then placed in the fixture and the work clamped tight on the plungers by means of a center bolt that passes through both housing members. This arrangement supports the work rigidly during the drilling operation. When this has been completed, the upper housing section is removed, and after withdrawing the four main plungers, the lower half is raised by operating lever *D* to actuate four vertical plungers which bring the lower half of the housing into a position from which it is easily lifted out of the fixture. Hardened steel bushings inserted in the main body of the fixture guide the drills properly and insure accuracy in drilling the bearing holes.

HANNIFIN ADJUSTABLE BORING-BARS

A complete line of boring-bars in which the cutters can be accurately adjusted by means of a scroll has been developed by the Hannifin Mfg. Co., 621-631 S. Kolmar Ave., Chicago, Ill., for rough- and finish-boring, reaming, and line-reaming operations. Various combinations of standard cutters may be included in one bar for boring to different diameters, counterboring, and facing in one operation. By using angle- and straight-type cutters, several sets can be spaced close together on a bar. This possibility will be apparent by reference to Fig. 1, which shows the front end of a bar equipped with sets of angular and straight cutters. A phantom detail view of the angle-type cutter is shown in Fig. 2, while Fig. 3 shows a similar view of the straight type.

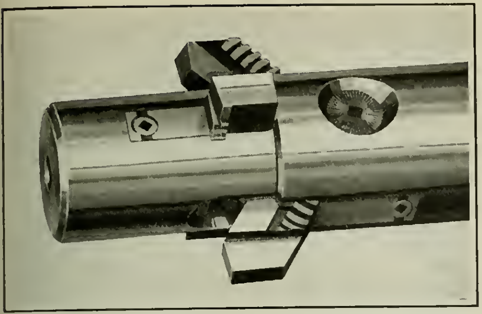


Fig. 1. End of an Adjustable-cutter Boring-bar made by the Hannifin Mfg. Co.

One side of the cutters is provided with curved teeth for engagement with the thread of a scroll, and as the latter is revolved by applying a wrench in the square hole at its center, the cutters are either advanced or drawn back. Graduations on the scroll enable accurate settings to be made, and two locking screws are utilized to keep the cutters in position. The inner ends of the cutters overlap each other, which permits greater expansion and rigidity. The cutters are backed metal to metal and cannot work loose.

The angle-type cutters are particularly adapted for facing and counterboring operations, because they are also adjusted forward as they are adjusted radially. Grinding the cutter faces after they have been set out, keeps them in the original position. This style of cutter is also especially suitable for boring to the bottom of blind holes. With a combination of the angle and straight types, the cutters can be adjusted to machine to a common diameter, thus making a four-point cutting tool. The cutters are quickly replaceable and adjustable to size without removing the bar from the machine.

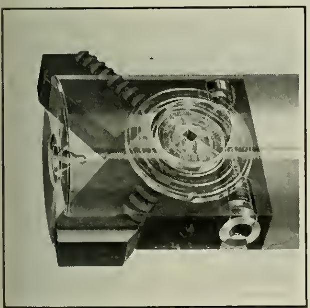


Fig. 2. Phantom View, showing Construction of the Angle-type Cutter

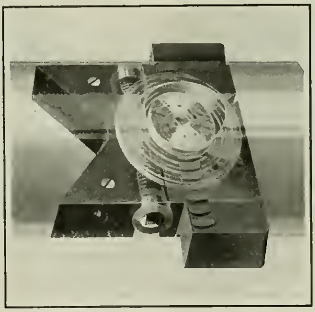
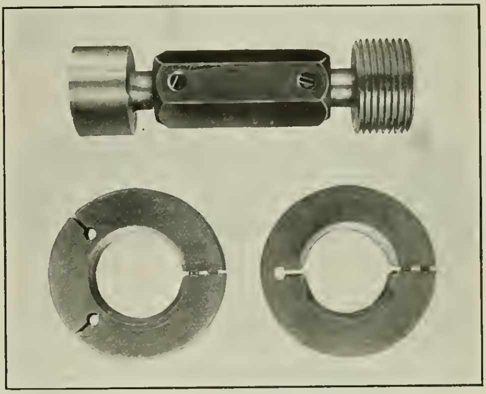


Fig. 3. Adjustable and Locking Details of the Straight-type Boring-bar Cutter

This company also manufactures boring-bars in which the blocks holding the scroll-adjusted cutters may be quickly removed from the bar to permit the substitution of another block having cutters for a different operation. By this arrangement rough-boring, finish-boring and reaming may be rapidly performed in succession without removing a bar from the machine. Bars with these removable blocks are particularly adapted for the line-boring and reaming of crank-cases and transmission cases, and the rough- and finish-boring of cylinders. Strip pilots can be furnished on any bar, and when worn they may be shimmed up and reground to fit the pilot bushing. Boring-bars can also be provided with hardened and ground pilots. In addition to line boring-bars, the company makes straight- and taper-shank boring-bars suitable for use on turret lathes, drilling machines and engine lathes. The angle-type, straight-type and removable block cutters are regularly made in different sizes for boring and reaming holes from 1 to 10½ inches in diameter.

PLUG AND TEMPLET THREAD GAGES

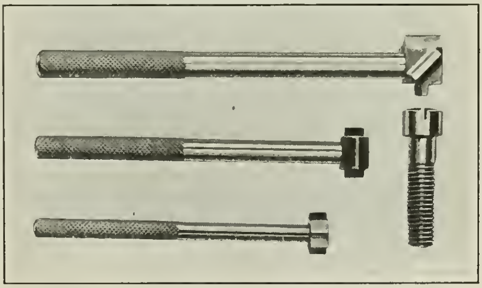
A line of plug and adjustable templet thread gages, several of which are shown in the accompanying illustration, is being placed on the market by the Superior Thread Gage Mfg. Co., Inc., 1985 Troy Ave., Brooklyn, N. Y. The templet gages are made in two styles, either with one half-way slot on the inside of the gage, or two half-way slots leading to the periphery. The latter style furnishes a fuller contact for the threads of the work, a feature of interest especially to the users of small-size gages. The plug gage is fitted at one end with a thread plug, and at the opposite end with a plain plug equal in diameter to the root of the thread that it is intended to gage. These plugs are readily replaceable as they become worn. The gages are regularly made for all sizes of standard threads, U. S. standard, Whitworth, S. A. E., etc., from 3/16 inch in diameter up. They can also be made for special threads.



Thread Gages manufactured by the Superior Thread Gage Mfg. Co., Inc.

PORTER OFFSET SCREW-DRIVER

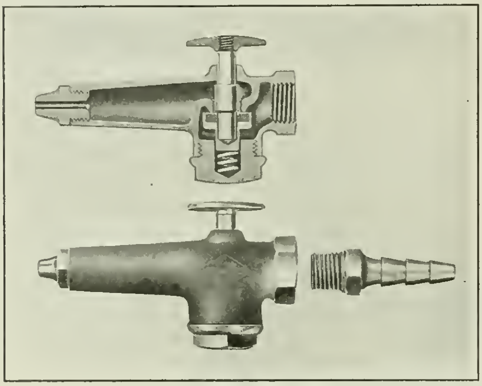
The assembly or disassembly of machine parts is often difficult due to the fact that the holding screws are located so close to walls or projections that an ordinary screwdriver cannot be readily engaged in the screw-head slot. To enable a machinist to reach such screws conveniently, the Porter Products Corporation, Keith Theater Bldg., Syracuse, N. Y., has brought out the offset screwdrivers shown in the illustration. Each screwdriver consists of a handle having a square forged end. On the four sides of this end are long, narrow projections with which the slots



Offset Screwdriver Set made by the Porter Products Corporation of screw-heads may be engaged. In use, the handle is held at right angles to the screw axis. The projection on any of the four sides is at an angle of 45 degrees to the projection on each of its adjacent sides. Therefore, if a screw is located in a cramped position, after turning the screw as far as space will permit, the screwdriver is given a quarter turn by the fingers and again applied. The screwdriver may be used in places so cramped that only an eighth turn of the screw is possible at a time. The design also has the advantage of enabling a considerable leverage to be applied to screws rusted in place. The manner of using this screwdriver will be understood by referring to the machine screw shown in the illustration.

JENKINS AIR GUN

A brass compressed air gun now being placed on the market by Jenkins Bros., 80 White St., New York City, finds application in machine shops for blowing chips and dirt from the tables of machines, and cleaning taps, dies, and other tools. To eliminate loss of air through leakage, the gun is designed with a disk that can be readily renewed as



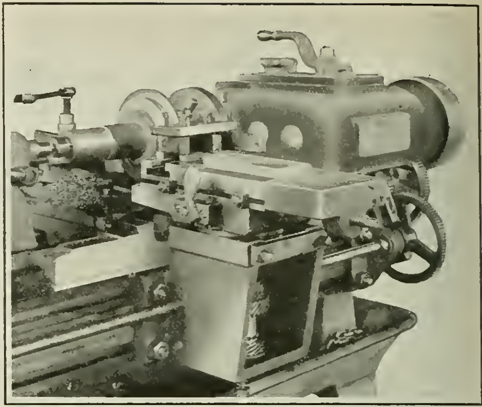
Compressed Air Gun for blowing Chips from Machines, etc., which is made by Jenkins Bros.

it becomes worn after removing the cap at the bottom of the gun. The sectional view in the illustration clearly shows the gun construction. Air is allowed to pass through the device when the user presses on the knob at the top, and the moment pressure is released from this knob, the coil spring at the bottom forces the disk previously referred to upward and against its seat, thus shutting off the passage of air. The gun may be used with 1/8-, 1/4-, 3/8-, and 1/2-inch hose by providing the proper size nipple. A nipple of the type used is shown to the right in the lower part of the illustration.

BACK-FACING ATTACHMENT FOR ADAMS "SHORT-CUT" LATHE

To accomplish the back-facing of work at any desired angle, the Seneca Falls Mfg. Co., Inc., 381 Fall St., Seneca Falls, N. Y., has recently brought out a universal power-operated back-facing attachment intended for use on the Adams "Short-cut" lathe. The attachment is especially suitable for turning bevel gears. It is a simple matter to set the device for machining the gear to the proper angle, the bevel surfaces being machined simultaneously with the turning of the gear hubs. Nine in-feeds are obtainable, ranging from 0.003 to 0.050 inch per spindle revolution. These feeds are secured through gearing connected to a splined shaft at the rear of the machine.

Reversal of the mechanism is accomplished by sliding positive clutches which engage with worm-gearing. There are

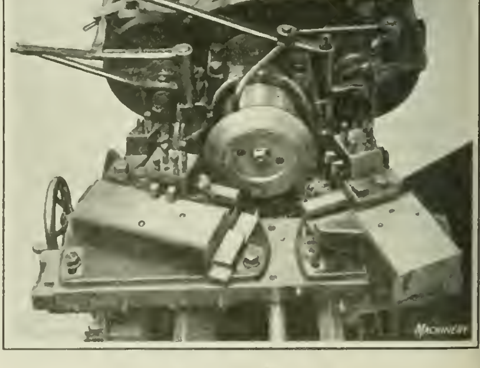


Back-facing Attachment made by the Seneca Falls Mfg. Co., Inc., for Use on the Adams "Short-cut" Lathe

twenty-seven automatic reverse feeds, ranging from three to fifteen times the forward feed that happens to be engaged. These feeds enable the operator to secure the proper timing necessary for back-facing, necking, under-cutting, and grooving work. The in-feed stop causes the mechanism to reverse automatically while the out-feed also stops automatically at the completion of a cycle. The back-facing tool is actuated by a screw and nut arrangement, which gives a smooth even motion. The relation of the back-facing feeds to the turning and facing feeds of the lathe permits innumerable combinations and puts the lathe into the semi-automatic class because, when equipped with this device, several machines may be run by one operator.

WARNER & SWASEY TURRET LATHE ATTACHMENT

The rapid machining of forged bevel gear blanks sometimes presents a troublesome problem to automobile manufacturers, because of the special metals from which the gears employed in automobiles are generally made. To facilitate such operations, the Warner & Swasey Co., Cleveland, Ohio, has brought out the attachment illustrated, which is adaptable to the No. 3-A universal hollow hexagon turret lathe manufactured by this concern. The attachment has two tool-slides and interchanges with the top slide of the regular carriage, so that the machine may be used either for bevel gears or for the other classes of work regularly handled on the turret lathe. The attachment is suitable for machining work up to 14 inches in diameter to all standard angles.

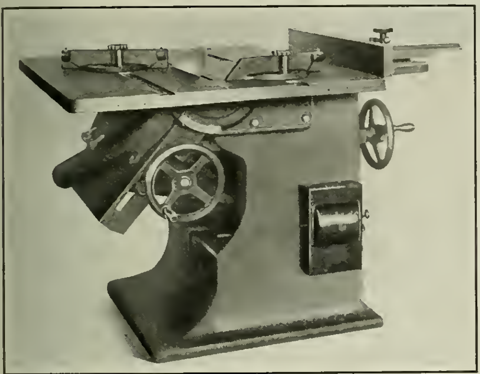


Attachment for machining Bevel Gear Blanks on a Turret Lathe built by the Warner & Swasey Co.

The two tool-slides are operated by the hexagon turret and saddle. A rack extending forward from the turret engages a double pinion on the attachment, and when the turret is advanced, this double pinion drives a second rack, transmitting a sliding motion to it, toward the rear of the machine, and causing it to rotate two other double pinions which drive racks fastened to the tool-slides. Thus, the two tools operate simultaneously.

TANNEWITZ TILTING-ARBOR SAW

A wood-cutting saw on which the saw arbor can be tilted to any angle up to 45 degrees, and which is therefore particularly adapted for service in pattern shops, is a recent product of the Tannewitz Works, Grand Rapids, Mich. The table of the machine is always in a horizontal plane. The tilting of the arbor is accomplished by operating the handwheel at the right, which is also used to lock the arbor in the positions to which it is adjusted. The handwheel at the left is employed to raise and lower the table, and lock it in place. The motor and saw are mounted on a sliding bracket



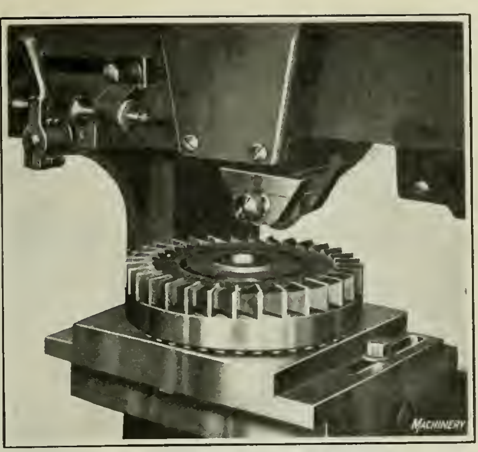
Saw developed by the Tannewitz Works for cutting Wood at Any Angle up to 45 Degrees

which is supported by a yoke, the latter being hinged on the housing. The motor has a speed of 3600 revolutions per minute, and is operated by an enclosed safety switch mounted on the outside of the housing. A complete set of graduated gages forms part of the equipment.

MARTIN HYDRAULIC MARKING MACHINE ATTACHMENT

A hydraulically operated machine built by the Martin Machine Co., Inc., Turners Falls, Mass., for the rapid marking of names, trademarks, etc., on metal products was described in detail in February, 1918, MACHINERY. Attachments recently developed for this machine enable marking to be done around a circle on the flat sides of cutters, rings, and similar parts, as shown in the illustration. The object to be marked is placed on a fixture mounted on the table of the machine, the top of this fixture being free to revolve on ball bearings. The fixture can be adjusted for marking to any radius, so that the marking will conform to the space provided on the work.

A plain roll die is used, and it is held in one position and revolved about its axis by means of a rack fastened to the slide of the machine. As the work is brought into contact with the revolving die, the top plate of the fixture is revolved. A plug set into the center of the revolving plate and fitting the bore of the work keeps the latter in the proper position. At the end of a marking stroke, the die is returned to its starting position by the return stroke of the slide.



Circular Marking Attachment for Machine manufactured by the Martin Machine Co.

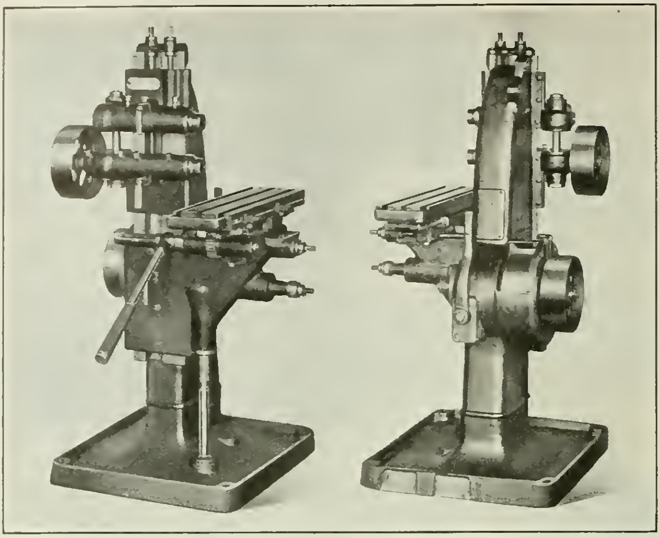
The hydraulic operation of the table results in satisfactory marking, regardless of variations in the thickness of the work.

REED INSIDE MICROMETER CALIPERS

An inside micrometer set having five rods that enable measurements to be made ranging from 3 to 8 inches, in increments of 0.001 inch, is now being introduced to the trade by the Reed Small Tool Works, Cherry and Vine Sts., Worcester, Mass. This set will be found useful not only in determining the internal diameters of cylinders and rings, but also in taking linear measurements, testing the parallelism of surfaces, comparing gages, etc. The barrel, spindle, and thimble are similar in construction and diameter to like members of the outside micrometer made by this company. A feature of this micrometer is the provision of a detachable handle, which may be instantly set to permit easy reading of the graduations, whether the work is right- or left-hand.

The extra rods allow quick changes to suit the length of the part to be measured, the substitution being made by simply unscrewing the rod on the threaded stud of the barrel and then screwing the proper rod in place. Each rod is ground square at the hardened end so as to seat in the proper relation to the barrel shoulder. The point of measurement is fitted with a hardened tool-steel anvil which is adjustable to lengthen the rod and to compensate for anvil wear. The faces of the anvils are ground to a small radius. Rods of lengths permitting measurements other than in the range specified can also be supplied.

Set of Inside Micrometer Calipers added to the Line of Measuring Instruments made by the Reed Small Tool Works



Front and Rear Views of a Double-spindle Hand Milling Machine brought out by the Superior Machine & Engineering Co.

fastened to the base of the machine. This milling machine weighs approximately 900 pounds.

DUPLEX HAND MILLING MACHINE

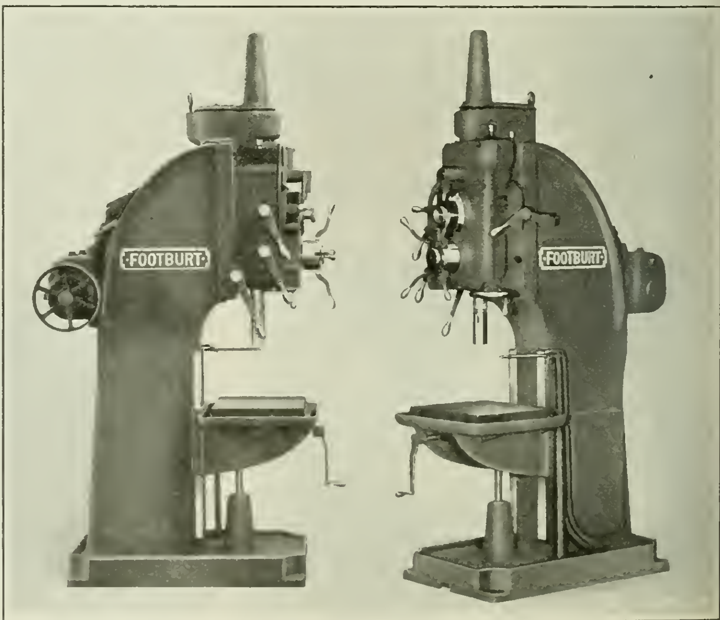
A machine for rapidly slitting automobile piston-rings of the step-cut type, splitting babbitt-lined bearings for automobile crankshafts, milling slots and keyways, and similar operations has been developed by the Superior Machine & Engineering Co., 451-457 E. Fort St., Detroit, Mich. The machine has a single-pulley drive, which is engaged and disengaged by operating the clutch lever. On the driving pulley shaft is mounted a change pulley, from which power is transmitted by belt to a pulley on the lower spindle and then through spiral gears to the upper spindle. The spiral gears are hardened and run in oil. The number of teeth on the two gears of a pair are prime to each other so as to insure a uniform distribution of wear. The spindles are made of high-carbon steel and run in oiled bronze bearings.

The two spindle heads are adjustable and can be clamped in any position on the column without disturbing the gibs. The vertical positioning of the work relative to the lower spindle is done by raising or lowering the knee. This member can be clamped in any position on the column. In making a set-up, the upper spindle head is adjusted relative to the lower one, after which both heads are clamped to the column. Graduated dials are provided on all adjusting screws for securing accurate settings. The saddle of the table can be adjusted toward and away from the column by means of a screw, while the table is traversed past the spindles by operating the hand-feed lever seen in the illustration. The machine can also be driven by a 1½-horsepower motor which may be mounted on a bracket fastened to the base of the machine. This milling machine weighs approximately 900 pounds.

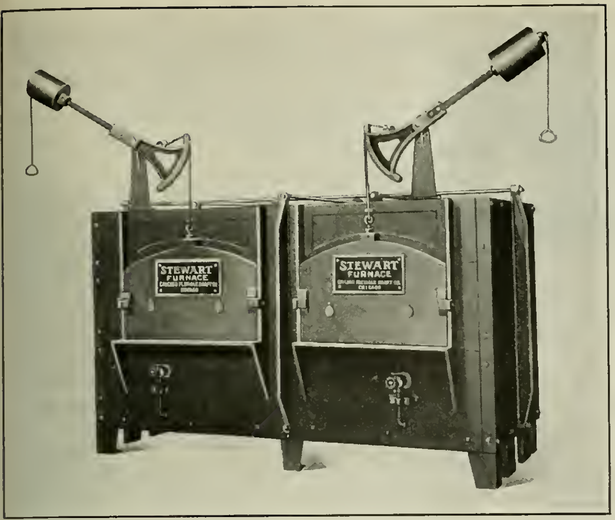
FOOTE-BURT HIGH-DUTY DRILLING MACHINE

Simplicity of construction and operation has been the aim of the Foote-Burt Co., Cleveland, Ohio, in redesigning the No. 23 high-duty drilling machine shown in the accompanying illustration. This machine has a capacity for drilling a hole 1½ inches in diameter through solid steel. Practically all operating members are contained in the head, which can be readily dismantled, should trouble of any nature be experienced, and carried by a crane to a convenient place for repairs. The head is bolted on the vertical face of the heavy box-section upright to bring the bolts into shear. The upright, base, and jack-screw support are cast integral to insure rigidity. Convenient control is provided, all operating levers being located at the front of the head. The single screw of the table permits a 12-inch vertical movement of this member without the necessity of providing a hole in the floor for the screw.

The machine is driven through a single pulley, from which power is transmitted to the driving members through a friction clutch. Nine spindle speeds, ranging from 75 to 610 revolutions per minute, and three feeds, of 0.006, 0.012, and 0.026 inch, respectively, are instantly available through sliding change-gears. Helical gears transmit power to the spindle which has a double-rack feed that eliminates side friction on the sleeve. Either Hyatt or taper roller bearings are supplied in all driving shaft bearings, and ball bearings take the thrust of the spindle. The speed change-gears run in an



No. 23 High-duty Drilling Machine redesigned by the Foote-Burt Co.



Double-chamber Semi-muffle Heat-treating Furnace recently brought out by the Chicago Flexible Shaft Co.

oil bath, while the feed gears are lubricated by a splash oiling system. The upper driving helical gears and their bearings are packed in grease and covered by a cap large enough to contain several months' supply of grease. Some of the principal specifications of the machine are as follows: Distance from center of spindle to face of column, 10 inches; maximum distance from nose of spindle to top of table, 28⅝ inches; length of power feed, 12 inches; taper of spindle socket, Morse No. 4; working surface of table, 20 by 16 inches; and approximate weight of machine, 2700 pounds.

WODACK PORTABLE ELECTRIC DRILL AND GRINDER

A portable electric drill on which two separate speeds may be obtained, which adapt the equipment for grinding operations in addition to drilling, has been brought out by the Wodack Electric Tool Corporation, 23-27 S. Jefferson St., Chicago, Ill. This equipment greatly resembles the drill illustrated in January, 1921, Machinery. It has a drilling capacity of from ⅛ to ⅝ inch in steel, and is supplied with a 6- by ¾-inch wheel for grinding operations. The slow speed is intended for use in drilling, and the high speed for grinding. The motor is of ½ horsepower and is of the universal type, operating on either alternating or direct current of the same voltage. It is controlled by a quick make-and-break switch in the handle. This combination drill and grinder weighs about 18 pounds.

STEWART HEAT-TREATING FURNACES AND OIL-PUMPING SYSTEM

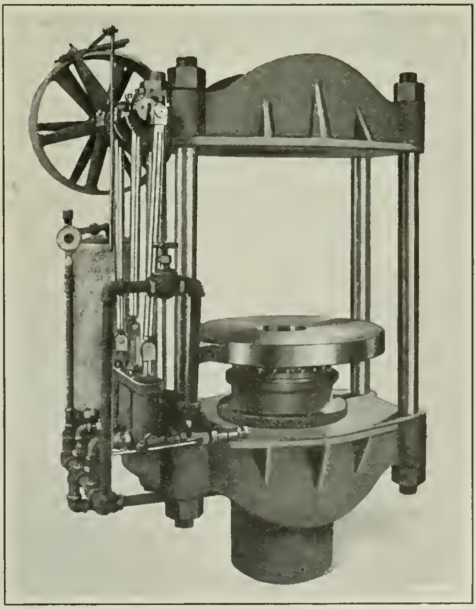
The Stewart double-chamber, semi-muffle heat-treating furnace here illustrated has been added to the line of heat-treating equipment lately developed by the Chicago Flexible Shaft Co., 1154 South Central Ave., Chicago, Ill. Both chambers of this furnace are individually controlled, enabling different operations to be carried on simultaneously. For instance, it is possible to carburize or anneal work in one chamber and at the same time reheat or preheat work in the second chamber. The furnace is underfired, combustion taking place under the floor and the products of combustion passing up along both walls to the arch and then down on the work. Either gas or oil may be used for fuel, or the furnace may be fitted up with combination gas and oil burners. A line of furnaces is also built in which the casing is made of sheet steel instead of cast iron.

Another recent development of this company is an oil-pumping system, which delivers fuel oil at a uniform pressure and free from foreign matter, the latter being removed from the oil by strainers. Spring-load relief valves prevent injury to the system in case the discharge should become closed. These valves also furnish variations in the operating pressure. A pressure dome dampens pulsations in the pump, and serves as a settling chamber in which the water and sediment settle before the oil is delivered to the burners. Gages provide easy readings of the pressure on the oil. This pumping system is regularly made with a capacity for delivering 100 gallons of oil per hour, but special sizes can also be built.

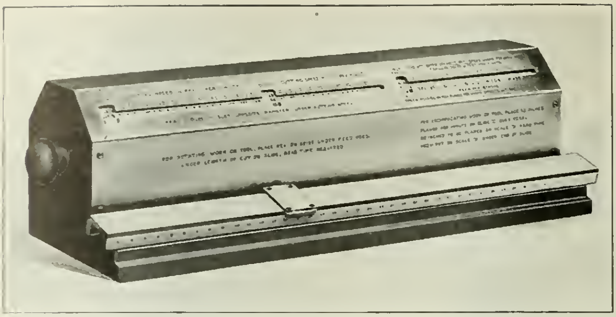
WEST HYDRAULIC PRESS

The 250-ton hydraulic press shown in the accompanying illustration is intended primarily for pressing solid rubber truck tires on or off wheels, but it is also adapted for a variety of other uses. This machine is a recent development of the West Tire Setter Co., Rochester, N. Y. The frame and top platen are steel castings. The ram area is sufficient to produce the required tonnage with the comparatively low initial pressure of 2000 pounds per square inch. The pump is of the three-plunger type with an automatic cut-out for the larger plunger. It is equipped with a 2-inch low-pressure plunger for filling the pipes and cylinder quickly.

When a pressure of approximately 200 pounds per square inch has been obtained, the larger plunger is automatically cut out by a special by-pass valve, leaving the two smaller plungers in operation for obtaining the higher pressure re-



Hydraulic Press developing a Pressure of 250 Tons, which is a Recent Product of the West Tire Setter Co.



Instrument for calculating Operation Time, which has been placed on the Market by the Simplex Calculator Co.

quired for the maximum tonnage. The pressure is applied or released by closing or opening, respectively, a globe valve located in the by-pass piping taken out of the main-pressure pipe. When this valve is opened, the oil or water used as the medium of pressure is returned to the supply tank instead of being delivered to the cylinder of the machine for applying pressure to the ram.

The tank is of the enclosed type, and when desired a compressed air line can be connected to the top of the tank to furnish means of forcing the oil or water quickly into the cylinder to move the ram up to the point where high pressure is required. In cases where air pressure is used for this purpose, the pump furnished has all high-pressure plungers instead of being of the type previously mentioned. A safety valve prevents overstraining of the press when it is run by a careless operator. The bottom platen is 42 inches in diameter, and the maximum distance between the top and bottom platens is 37 inches. The ram has a stroke of 33 inches.

SIMPLEX MACHINE TIME CALCULATOR

A calculator intended for use in computing the time required for operations performed with machine tools, and which is applicable to either rotating or reciprocating work or tools is shown in the accompanying illustration. This instrument is a recent product of the Simplex Calculator Co., Box 184, York, Pa. It consists of a cylinder enclosed by an aluminum case, and a slide-rule of special design attached to an extension of the base. For use in connection with rotating work or tools on such machines as lathes, boring mills, and drilling or milling machines, the cylinder has tables giving the number of revolutions per minute made by work or tools of diameters from 1/4 inch to 10 feet, at all ordinary cutting speeds. The range of speeds is shown above the slot at the left-hand end of the case.

The number of revolutions per minute made by a given piece of work is read in the slot opposite its diameter and directly under the cutting speed selected. This number is then transferred to the slide-rule which has four scales marked Feed, R.P.M., Length, and Time. The number found on the cylinder is located on the R.P.M. scale on the slide, the slide then being moved until the number of revolutions is brought directly under the number on the feed scale corresponding to the feed of the work in inches per minute. The runner is then moved along the length scale to the number representing the length of the cut. Directly under this number on the time scale is found the time in minutes required for the operation. All such problems require but one setting of the cylinder and one movement of the slide and runner.

In connection with planers, shapers, slotters, or other machines having reciprocating tools or work, the procedure is quite similar. The number of square inches planed per minute at various forward and return rates of speeds and different feeds are read on the cylinder through the slot at the right-hand end of the case. After determining the total number of square inches of surface to be planed, either mentally or by the use of the rule, it only remains to divide this number by the number of square inches planed per minute. With one setting of the slide on the rule, the time required for the operation may be read on the time scale under the end of the slide. This instrument was designed primarily for rate setters, estimators, and others whose duties require a study of machine operations. It is about 16 inches long and weighs approximately 3 pounds.

DAVENPORT SLOTTING ATTACHMENT

The slotting of screw heads may now be readily accomplished on the five-spindle automatic screw machine built by the Davenport Machine Tool Co., Inc., 167 Ames St., Rochester, N. Y., by the use of a recently designed attachment. Fig. 1 shows the head containing the saw by means of which the screws are slotted, this unit being mounted on the machine directly above its revolving head. The saw is driven by pulley *A* through the regular change-gears of the machine, thus providing for a number of different speeds. The saw head is covered by a guard, which has been removed in the illustration.

The unit shown in Fig. 2 is mounted on a bracket bolted to the machine. It receives each screw as it is cut off the stock, and carries it through the slotting operation. Turret *B* has three plungers *C* held in bosses spaced equidistantly around a circle struck from the center of the turret. These plungers are fitted at their front end with a bushing that fits the screw to be slotted, while the rear end is machined with a T-head. On support *D* are mounted three sliding spindles which are yoked together by spider *E*, the spindles thus being slid forward in unison by a motion imparted to the spider by a cam-lever. Two of the spindles have a head *F*

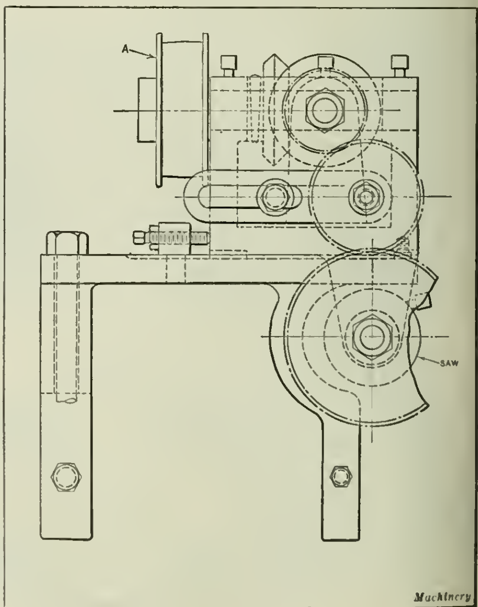


Fig. 1. Saw Head for Five-spindle Automatic Screw Machine built by the Davenport Machine Tool Co., Inc.

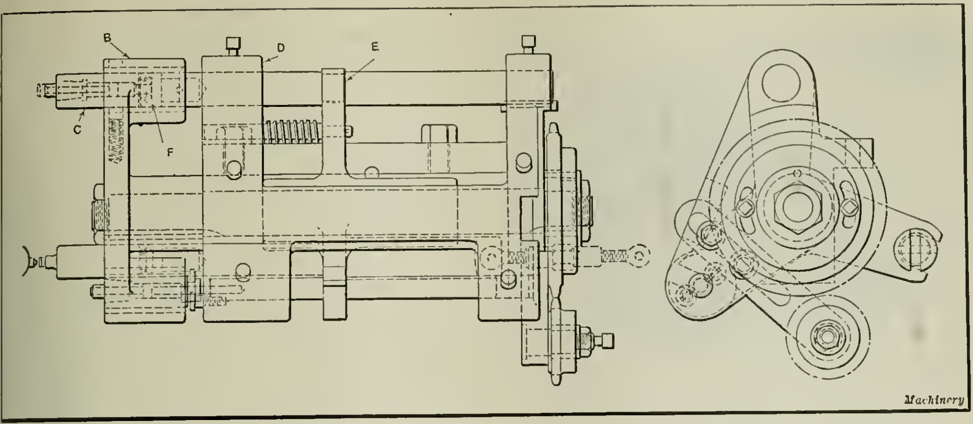


Fig. 2. Attachment employed in Connection with the Saw Head shown in Fig. 1 for slotting the Heads of Screws

provided with a T-slot that fits the rear end of the plungers, while the third spindle carries an ejector that is forced through the plungers as they are indexed to this position.

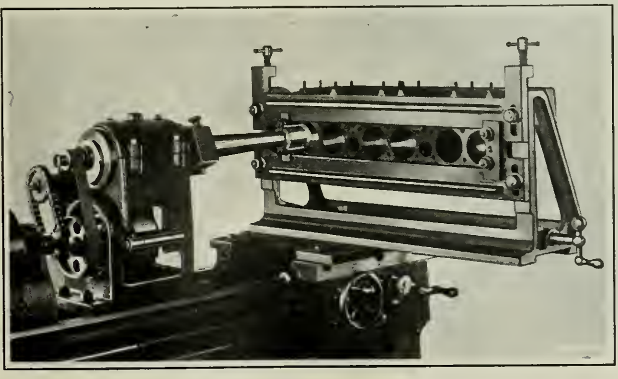
The turret is indexed one-third of a revolution for each revolution of the crankshaft of the machine. After each indexing, two of the plungers are forced forward by the sliding spindles, while the ejector slides through the other plunger, as previously mentioned, one of the plungers receiving a cut-off screw. After the two plungers have been drawn back by the spindles to a stop, the turret is again indexed one-third of a revolution. Then, as the plungers are advanced again, the screw previously received is brought into contact with the saw and slotted, while a second screw is received by the plunger bushing indexed into the loading position.

At the next forward movement of the spindles, which occurs after another indexing of the turret, the slotted screw is ejected, the second screw is slotted, and a third screw is received by the remaining plunger. This cycle is continuous. When the work does not require it, the attachment can be quickly dismantled after removing two bolts. By making slight modifications, the attachment can also be used for milling, cross-drilling and burring.

"ELTECO" LATHE CYLINDER-GRINDING ATTACHMENT

To enable small machine shops and garages to equip themselves at slight expense for regrinding automobile cylinders, the Liberty Tool Co., 1080 Springfield Ave., Irvington, N. J., has brought out the attachment illustrated, which is applicable to lathes of 14-inch and larger swing. The driving motor is mounted beneath the wheel-spindle in a housing placed on the bed close to the headstock. The motor is of ½ horsepower and is intended to be driven from an ordinary lamp socket. The cylinder block is held on an angle-plate mounted on the regular lathe carriage, and is fed to the grinding wheel by means of the carriage feed, the feed gearing being driven through sprockets and a silent chain by the motor of the attachment. This arrangement permits all the different feeds of the machine to be utilized. The wheel-spindle is driven at the rate of 5600 revolutions per minute.

The eccentric throw of the wheel from dead center is adjustable by a hand-screw graduated to 0.0005 inch. The holder will accommodate the largest-size six-cylinder block, having an inside length of 33 inches. Cross movements of the holder are obtained through a screw, and the holder may be raised or lowered by means of two vertical screws. The attachment weighs about 500 pounds.

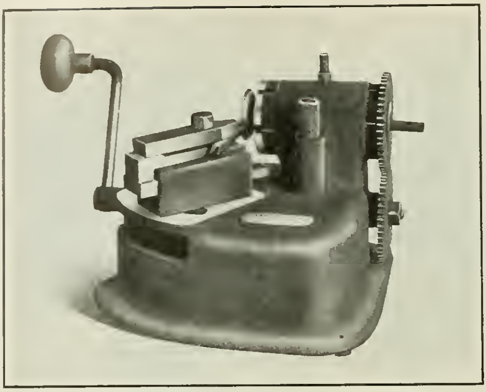


Lathe Attachment made by the Liberty Tool Co., for regrinding Automobile Cylinders

STEINER VALVE FACER

A hand-operated bench machine for accurately and quickly refacing valves of internal combustion engines has been placed on the market by Steiner Bros., Lima, Ohio. It is called by the manufacturers the "Peerless valve lathe." The mechanism for holding the valve consists of two collars having three cam surfaces on the inside which, when the collars are turned, operate three pins at each end of the hollow spindle through which the valve stem is inserted and cause these pins to advance toward the center of the spindle and bear on the stem. The latter is inserted from the left-hand end of the spindle, the hole of which is sufficiently large to accommodate the fillet, which is quite pronounced on some valves. The cams are then turned by applying a spanner wrench to the slots on their periphery. A nut provides for locking one cam, while the gear that rotates the spindle also serves as a locking device for the second cam. The spindle is driven through this gear by revolving the crank on the driving shaft.

A pin at the top of the machine functions both as an oil plug and a locking device for the spindle, the locking being accomplished by inserting the long end of the pin through holes in the body and the spindle. It is necessary to lock the spindle when manipulating the cams and locknut. The tool is fed

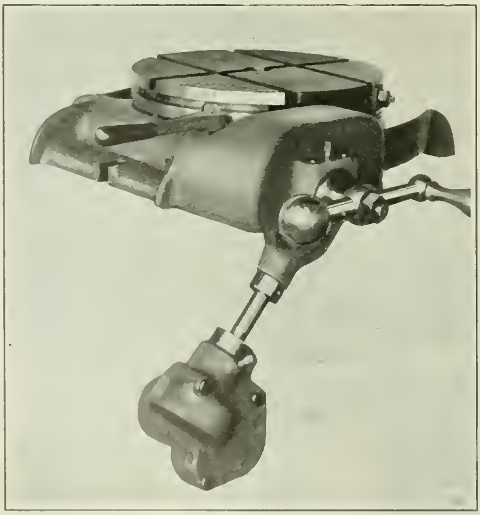


"Peerless" Valve Facing Machine made by Steiner Bros.

uniformly through a worm on the driving shaft which meshes with a worm-wheel on a vertical shaft. Near the lower end of this shaft and immediately above the worm-wheel a pinion engages a segment mounted on another vertical shaft, at the top of which is fastened a second segment that operates a rack attached to the tool carrier. When positioning the tool, the worm-wheel is disengaged from the driving shaft by depressing the knurled knob at the top of the machine. Provision is made for quickly returning the tool to the starting position when it is found that more than one cut is necessary on a valve face. The uniform rate of feeding the tool is said to produce a satisfactory face and reduce grinding-in to the minimum.

TAYLOR & FENN CIRCULAR MILLING ATTACHMENT

To adapt the high-speed vertical milling machine of its manufacture to circular milling operations, the Taylor & Fenn Co., Hartford, Conn., has designed the attachment shown in the accompanying illustration. This attachment is mounted on the regular table of the machine and driven from the telescopic shaft which furnishes the longitudinal table power-feed. By this means the thirty-three different feeds of the machine may be quickly obtained for the circular table, and in addition the circular feed may be varied by transposing two gears in the lower driving bracket. This provides a wide range of feeds which will be found especially useful in continuous milling operations. It is possible to drive both the longitudinal and circular tables simultaneously, this being of advantage on some classes of work. Some of the principal specifications of this attachment are as follows: Diameter of working surface, 10½ inches; maximum height from nose of machine spindle to table, 9 inches; ratio of table revolution to turning of handle, 40 to 1; and weight, about 110 pounds.



Circular Milling Attachment intended for Use on the Vertical Milling Machine built by the Taylor & Fenn Co.

HOFFMAN DRAWING TABLE

A line of drawing tables in which the supporting members are tubular, as shown in the accompanying illustration, has been developed by the Hoffman Drawing Stand Co., 189 N. Water St., Rochester, N. Y. This design provides a light construction without sacrificing strength or rigidity. The table can be quickly raised to any height from the floor up to 44 inches by revolving the handwheel on the vertical screw; and, in addition, the table can be tilted from the horizontal plane to almost a vertical position. Large corks inserted in the feet of the stand prevent the marring of polished floors or slipping of the stand. The drawer tray may be attached to either the left- or right-hand vertical supporting rod and held in any position on the rod.

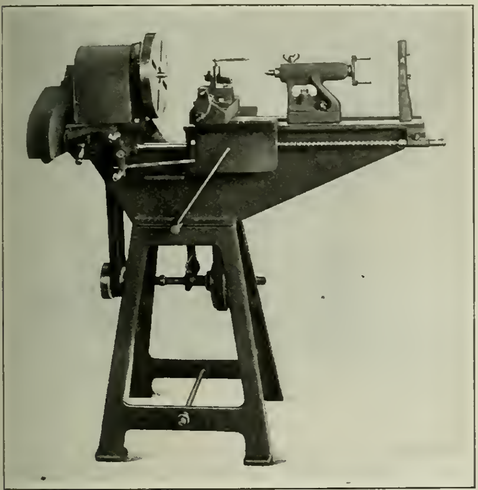
Drawing Table placed on the Market by the Hoffman Drawing Stand Co.

ARTISAN SMALL-SIZE GAP LATHE

An 11-inch gap lathe having a maximum distance of 24 inches between centers, which may be used as a portable equipment, has recently been brought out by the Artisan Mfg. Co., Cincinnati, Ohio. From the illustration it will be noted that a quick-change feed-box is furnished, the feed-box containing a clutch for engaging and disengaging the feed. This clutch is operated by the lever below the double crank-handle. The crank-handle is used for traversing the carriage by hand when working on short jobs with the carriage close to the faceplate. The shelf below the gap serves as a support for the carriage when it is run over the gap, an adjustable plug on the left end of the apron bearing upon the planed surface of the shelf to withstand the downward pressure.

When the carriage is required near the tailstock end of the bed the double crank-handle may be put on the right-hand end of the lead-screw where the screw extends from a bearing. The feed-box offers a wide range of feeds which enable all standard threads to be cut from 8 to 224 per inch, inclusive, and also 11½ pipe threads per inch. Reverse gears providing for the cutting of both right- and left-hand threads are contained within the swinging quadrant at the end of the headstock. This quadrant also contains compound gears for cone gears within the feed-box. A sliding tumbler lever engages any of the cone gears, while a direct-reading index-plate on top of the feed-box designates the proper position of this lever for a desired feed.

The cross-slide may be swiveled for angular turning, and when set for straight facing, taper dowel-pins serve to locate it in the correct position. The countershaft is mounted in self-aligning bronze bearings secured to the rear legs, and may be driven direct from a lineshaft through its friction pulley or by a motor mounted on the bed. The friction pulley is of the cone type having a spring that keeps it in engagement. A vertical rod at the rear of the machine has a fork which engages a flange of this friction clutch. This rod is



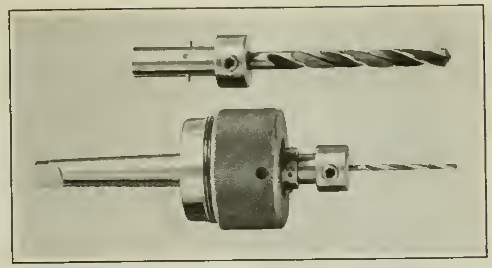
Eleven-inch Gap Lathe produced by the Artisan Mfg. Co.

operated by a shaft extending through the bed which has a lever at the front end. When this lever is pushed downward, the friction cone is withdrawn from the pulley and the fork that engages the flange of the disk serves as a brake to stop the countershaft instantly.

The drive from the countershaft to the headstock is through three-step cone pulleys. The cone pulley on the headstock is geared to the main spindle and in combination with a sliding back-gear gives six changes of speed in geometrical progression. A motor of ½ horsepower is recommended for driving this lathe, and the current may be supplied from an ordinary light socket. The swing of this machine at the gap is 16 inches, and over the carriage 8¾ inches.

"SAVE-ALL" SAFETY DRILL AND TAP CHUCK

A positive safety chuck for straight-shank drills, taps, reamers, counterbores, etc., which is intended for operations in which the feed is by hand, has just been placed on the market by the Save-All Tool Co., 59 River St., Waltham, Mass. It has been designed with the purpose in mind of eliminating the breakage of small tools. The safety device by means of which such breakages are prevented consists of two friction members and a soft steel driving pin, which is



Safety Chuck for Hand-fed Tools, made by the Save-All Tool Co.

sheared when the tool is overloaded. The tool is held in a hardened collet by means of a "Bristo" hollow safety set-screw which bears on a flat on the tool shank.

The soft steel driving pin is inserted through the collet and a hardened male friction member which is adjusted by the knurled nut on the outside of the chuck body. The female friction member is keyed to the body, the nut bearing on it and thus preventing it from tightening or loosening when the tool is run forward or backward. When the resistance to the tool becomes too great so that it sticks, the pin is sheared. There are three sizes of pin holes in the standard collet, the smaller ones being used with high-speed drills. The pin is held in place by a spring plunger.

MARQUETTE SPRING CUSHION FOR PUNCH PRESSES

With the view of eliminating wrinkles when drawing shells on punch presses and of reducing the pressure on the draw-ring, the Marquette Tool & Mfg. Co., 321 W. Ohio St., Chicago, Ill., has brought out an even-pressure spring cushion that differs somewhat in design from the spring cushion developed for the same purpose, which was described in October, 1921, MACHINERY. The new type is designed primarily for use on small and medium-size presses and under conditions requiring that a device of this kind be quickly attachable and detachable. Fig. 1 shows the cushion applied to a press. It is unnecessary to provide holes on the machine for attaching it, the cushion being simply held in place by screwing the upper threaded end of the suspension bolt, clearly seen in Fig. 2, into a tapped hole in the bottom of the die or bolster plate.

This suspension bolt extends through a sleeve having teeth cut on its outer surface near the upper end which are engaged on opposite sides by the teeth of two compensating cams. These cams swivel about their bearings when the draw-pins of the die are forced downward, the draw-pins

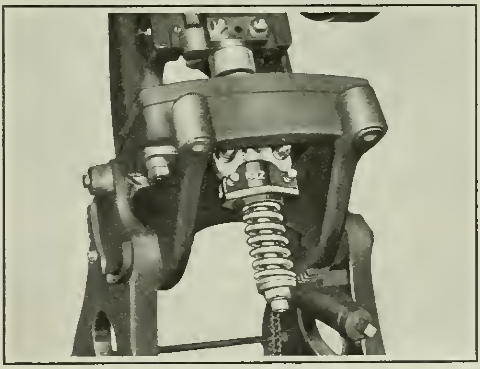


Fig. 1. Application of the Even-pressure Spring Cushion introduced to the Trade by the Marquette Tool & Mfg. Co.

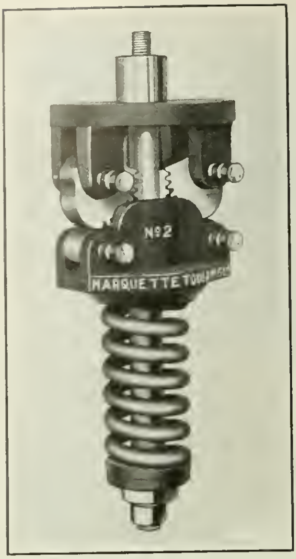


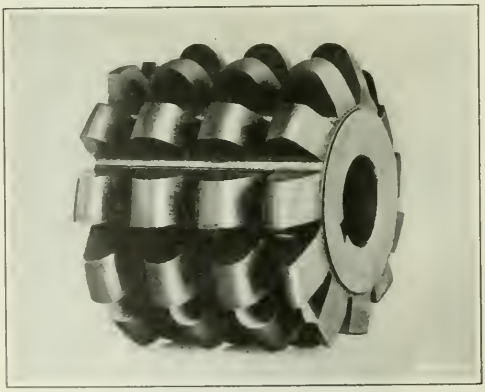
Fig. 2. Even-pressure Spring Cushion

resting on a plate and spacer block placed on top of the cam housing. Another housing directly below the cam housing has two rollers that contact with the cams. The swiveling of the cams on their bearings causes a vertical movement of the rollers and so controls the compression of the spring in an operation, this compression, of course, being less than if the spring was not provided with compensating members.

When pressure is released from the draw-ring, the friction between the rollers and cams caused by the spring forces the cams to return to their original positions. The initial pressure on the spring may be regulated by means of an adjustable nut placed on the lower end of the sleeve. Grease cups provide for adequate lubrication of the roller and cam bearings. It is said that presses equipped with this die cushion will produce in one operation work generally performed in two, and that the wear on the dies is less severe.

DIAMOND SPROCKET-TOOTH HOBS

The accompanying illustration shows a hob of a set manufactured by the Diamond Chain & Mfg. Co., Indianapolis, Ind., each of which is suitable for cutting any number of sprocket teeth of a given pitch and roller diameter. Thus each hob will do work that ordinarily requires from six to nine cutters. In addition, there is the advantage of em-



Hob manufactured by the Diamond Chain & Mfg. Co. for Cutting Sprocket Teeth

ploying a hobbing machine which permits high production rates and convenient and accurate indexing. These hobs are designed to cut sprocket teeth in conformity with the specifications for the "American Standard" sprocket-tooth form, which has been approved by manufacturers of roller transmission chains, the Society of Automotive Engineers, the American Society of Mechanical Engineers, and the American Gear Manufacturers' Association. This tooth form is particularly adapted for production by hobbing. Its space angle gradually decreases as the number of teeth increases, while its tooth angle, and hence its pressure angle, gradually increases. The generating action of a hob tends to produce these changes although not at the same rate. The pitch of each hob is greater than the circular pitch of the sprocket for all above a certain number of teeth, and less than the circular pitch for all under that number.

NIAGARA COMPOUND-SEAM CLOSER

Air-tight side seams can be made on such articles as drums for calcium carbide and cans for calcium chloride by employing the seam-closing machine developed by the Niagara Machine & Tool Works, 637-697 Northland Ave., Buffalo, N. Y., which is illustrated in Fig. 1. The seam produced may be filled with a sealing compound, although the seam as closed by the machine is practically air-tight. Offsets

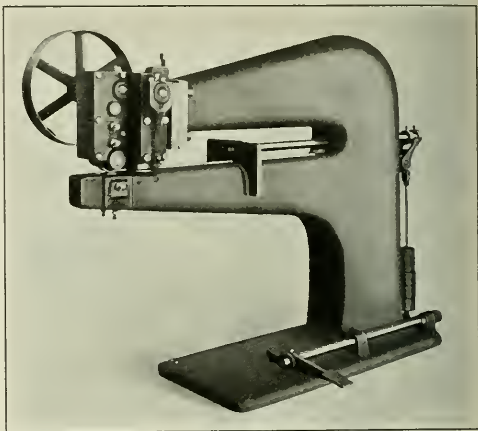


Fig. 1. Seam-closing Machine built by Niagara Machine & Tool Works

are first formed on the ends of the sheet to be joined, as shown at *A* and *B* in Fig. 2, after which the sheet is rolled to a cylindrical shape and placed over the horn of the machine with the offsets lying on the guide piece set into the top of the horn.

The machine runs continuously, and therefore does not require tight and loose pulleys or a clutch, the pulley being run at the speed of 100 revolutions per minute. The treadle at the front of the machine is connected to a sliding member, and by depressing the treadle the work is moved forward along the horn and fed between the first set of rolls which squeeze the seam together at the bottom. After these rolls take hold of the work, the latter is automatically fed through the machine, the second set of rolls flattening and thus closing in one operation the double-lock seam shown at *C*. The maximum length of work that can be handled is 42 inches, and the minimum diameter for this length is 13½ inches. The machine has a capacity for No. 22 gage soft steel, and weighs approximately 2700 pounds.

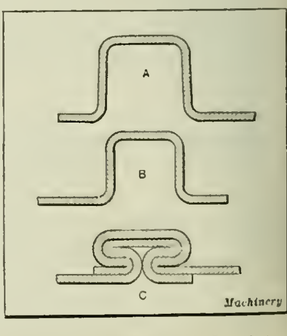
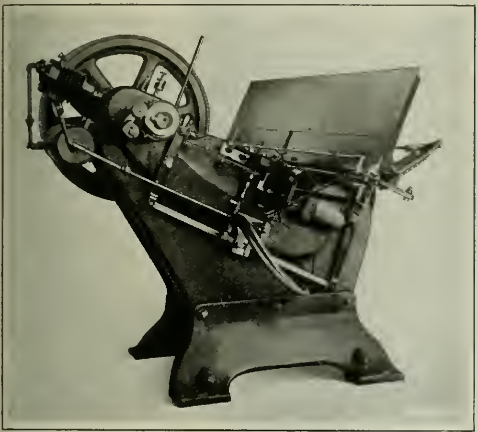


Fig. 2. Three Stages in the Seam-closing Operation

ADRIANCE STAGGER-FEED PRESS

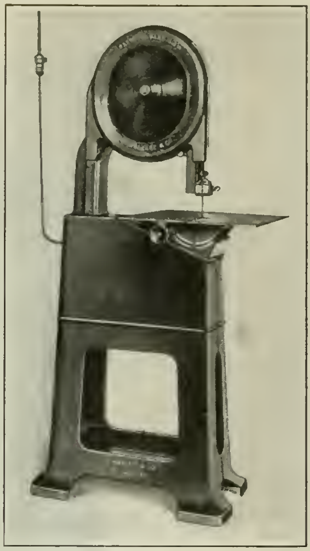
An automatic punch press on which the punch operates continuously and cuts blanks in a staggered relation to one another, leaving a mere thread of metal between the holes is shown in the accompanying illustration. This machine has been recently developed by the Adriance Machine Works, Inc., 78 Richards St., Brooklyn, N. Y., and is especially suitable for the production of such parts as can tops and bottoms and other small shells. The sheet stock is held in a carrier which travels in either direction past the reciprocating punch. It is not necessary for the carrier to be returned to the starting point after punching a row of blanks, because the moment the end of a row has been reached the action of the carrier is automatically reversed and the next row may be punched as the carrier returns to the starting point. After the last blank has been punched from a sheet the carrier stops automatically. It is thus possible for an operator to run several presses at one time. His safety is assured, because at no time do his fingers come near the die. The scrap stock is ejected automatically. The machine will cut blanks from 1 to 4 inches in diameter and has produced them at the rate of 100 per minute.



Automatic Stagger-feed Punch Press placed on the Market by the Adriance Machine Works, Inc.

WALLACE BENCH BAND SAW

A machine primarily of interest to patternmakers is the 16-inch portable band saw illustrated, which is a recent development of J. D. Wallace & Co., 1421 W. Jackson Blvd., Chicago, Ill. This saw is driven by an enclosed motor built into the machine and direct-connected to the lower saw wheel by a fabroil gear and a steel pinion, both of which run in oil. The motor is of ½ horsepower, and runs at a speed of 1750 revolutions per minute, operating on current obtained from a lighting circuit. The machine is equipped with steel disk wheels. The table is a ground plate mounted on a rocker bearing which is adjustable from 45 degrees in one direction to 5 degrees in the opposite direction. An indicator shows the angle at which the table is tilted. All adjustments are obtained by means of handwheels or thumb-screws. The saw blades are made from a special steel, and are operated at a speed of 3150 feet per minute. The table has a surface of 19 by 21 inches, and is located 42 inches above the floor. The height of the machine is about 6 feet.



Wallace Sixteen-inch Band Saw

MONITOR "THERMALOAD" MOTOR STARTER

A thermal-limit starter known as the "Thermaload," which is intended for controlling the operation of alternating-current, single-, two-, or three-phase motors of from ¼ to 10 horsepower, has been placed on the market by the Monitor Controller Co., Baltimore, Md. This starter (see Fig. 1) is peculiarly adapted to machine tool application in that a number of control stations, which are of the push-button type, may be mounted in several convenient locations on a machine so that the operator can instantly stop the machine when he desires. If the load on a cutting tool becomes too great, the appliance immediately stops the motor. It allows the motor to exert six or seven times its normal power for a limited period, but at the same

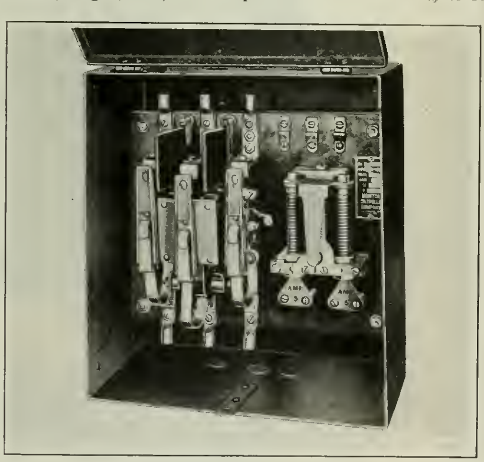


Fig. 1. "Thermaload" Starter for Induction Motors made by the Monitor Controller Co.

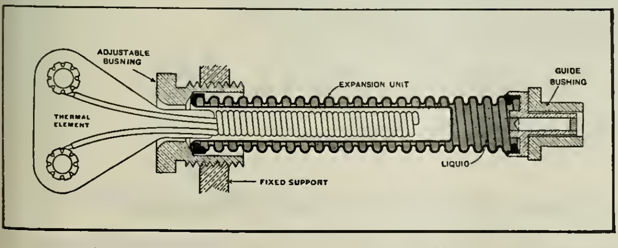


Fig. 2. Sectional View of the Thermal Unit in the Monitor Starter

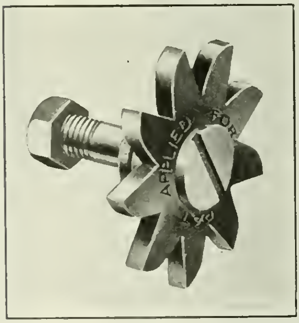
time will protect it from a prolonged overload as small as 25 per cent and from overheating sufficiently to cause injury to insulation. It prevents polyphase motors from running on single-phase current.

The starter consists of a three-pole magnetic contactor and a thermal-limit relay, mounted on a slate panel and enclosed in a metal cabinet which may be locked or sealed and placed in a remote location, as on the ceiling. The thermal-limit relay consists essentially of two units which expand between a fixed support and a hinged contact arm, the latter being arranged in such a way as to multiply the motion of the expansion units several times at the contact. The construction of an expansion unit is shown in Fig. 2. It will be seen that a unit consists of a double-walled tubular receptacle, the inner wall of which is smooth and closed at one end, while the outer wall is corrugated and closed at both ends.

The space enclosed between the two walls is filled with tetrachloride of carbon, a non-corrosive, non-freezing liquid used in fire extinguishers. The thermal element which operates the expansion unit consists of a coil of asbestos-insulated wire attached to a piece of insulating material by means of brass eyelets. These eyelets register with brass binding posts to which they are securely clamped by means of brass screws. The binding posts, in addition to serving as electrical connections to the element, also furnish its support. A relay can be changed from one rating to another by merely inserting the proper elements.

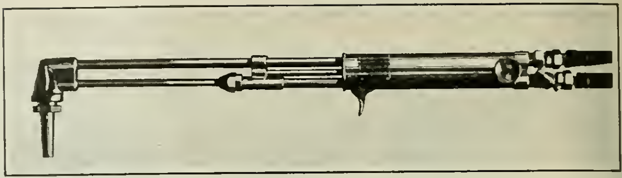
DISSTON SAW-CHIP REMOVING DEVICE

Breakage of the teeth of metal-cutting saws is frequently caused by the clogging action of the chips, which causes a heavy strain to be placed on the teeth. With a view to eliminating such trouble, Henry Disston & Sons, Inc., Tacony, Philadelphia, Pa., has brought out the special wheel illustrated, which has teeth spaced to suit the teeth of the saw with which it is intended to be used. This wheel is attached by means of the stud, to some member adjacent to the saw; it is placed at right angles to one side of the saw in such a position that the teeth of the wheel engage the tops of the saw teeth as the saw revolves and push the chips from these surfaces. As the saw teeth are kept free from chips when this device is used, the saw can be operated at faster speeds and heavier feeds.



Saw-chip Remover made by Henry Disston & Sons, Inc.

DAVIS-BOURNONVILLE CUTTING TORCH


New Type of Cutting Torch brought out by the Davis-Bournonville Co.

A cutting torch in which two tubes instead of three connect the head with the handle, and in which the preheating gases, which may be oxygen and acetylene or some other combustible gas, are mixed in a chamber between the handle and the head, is a new product of the Davis-Bournonville Co., Jersey City, N. J. This design requires a new style of tip, inasmuch as the mixture of the gases is accomplished before they reach the tip. The tubes are silver-soldered in the head, the latter being a copper forging, which, besides being free from pin holes and similar defects, will withstand higher temperatures than bronze or brass castings.

The ratio of the mixed gases is controlled by two needle valves, one of which has a cross-bar handle and the other a knurled disk handle. The cutting-oxygen valve is operated by a finger-lever connected to a linkage so designed as to hold the lever in either the closed or the open position. Thus the operator may cut work without holding his finger on the trigger after the operation has been started, and when he wishes to stop cutting, a reverse pressure on the trigger closes the valve. A spring holds the trigger in the closed position until the trigger is operated again. Provision is made for easily removing the back end of the torch in case it becomes necessary to clean the screen or to remove the oxygen-cutting valve seat.

The tips are made of copper and held in a taper seat by a bushing nut, this construction being identical with that of the Davis-Bournonville standard torch. The tips are made with the cutting-oxygen hole at the center and the preheating holes surrounding it. The number of preheating holes in a tip varies from two to six, depending on the combustible gas used, the manner in which the torch is applied, and the metal being cut. Bent tips are furnished for cutting off rivets. Gases of low calorific value such as butane, hydrogen, carbo-hydrogen and even illuminating gas, may be used, although acetylene is recommended when cost is not the prime consideration and smooth even cutting is required.

PANGBORN SAND BLAST

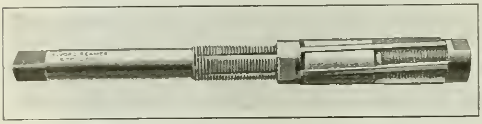
A small size sand blast, which can be easily conveyed from place to place about a plant, is a recent addition to the line of sand-blast equipment manufactured by the Pangborn Corporation, Hagerstown, Md. This sand blast has a suction type gun in which the blast action is controlled by a trigger in the handle. Compressed air passing through the air jet creates a vacuum by which the abrasive, either sand or metallic, is brought from the hopper to the gun body, which has a mixing chamber where the air and the abrasive are given a swirling action similar to the movement given a bullet by the rifling of a gun barrel.

Quickly interchangeable nozzles make the equipment suitable for use under a number of conditions. It may be operated at any pressure between 5 and 100 pounds per square inch. The small cabinet set over the hopper of the sand blast in the illustration provides an economical means of cleaning small parts. The sand blast, however, may be used without this cabinet.


Small Sand Blast and Cabinet manufactured by the Pangborn Corporation

ALVORD HELICAL INSERTED-BLADE REAMER

An adjustable inserted-blade reamer incorporating the unusual feature of having the blades set at an angle so as to produce a shearing cut is a recent product of the Alvord Reamer & Tool Co., Millersburg, Pa. This tool is sold under the trade name of "X-Cel." The purpose of the design is primarily to eliminate chatter in operation. Its construction is similar to the straight-fluted adjustable reamer manufactured by the same company. The body is made of a tough alloy steel and heat-treated on the shank end to withstand rough treatment. The threads that control the adjustment feature are accurately chased and finally checked



"X-Cel" Shear-cut Adjustable Blade Reamer made by the Alvord Reamer & Tool Co.

by a gage. The tapered slots that receive the blades are milled to close limits and at the proper angle to produce the desired shearing effect.

The blades are made of a special steel and accurately ground all over. Both ends of a set of blades are ground to the correct angle for contact with the nuts in one setting on a grinding machine, which also insures that all the blades will be produced to exactly the same length. Thus they are locked securely in their seats when the nuts are tightened. The nuts are made of crucible steel, and are also hardened and ground. This reamer is especially recommended for use with bearing metals, particularly bronze. It produces satisfactory results when employed with split bearings and holes provided with oil-grooves or keyways. The reamer is made in seventeen standard sizes to cover a range of diameters from 15/32 to 4 1/16 inches.

* * *

NEW MACHINERY AND TOOLS NOTES

Worm-gear Drive for Lineshafting: Cleveland Worm and Gear Co., Cleveland, Ohio. An enclosed worm-gear unit for driving lineshafting direct from a motor attached to the ceiling, the armature shaft of the motor being at right-angles to the lineshafting. This driving method permits the use of smaller, higher speed motors. Large ratios of reduction can be obtained.

Buffing and Grinding Machines: Valley Electric Co., 3157 South Kingshighway, St. Louis, Mo. A line of floor-type buffing and grinding machines on which the motor is totally enclosed and its shaft is extended and threaded at both ends for accommodating the buffing and grinding wheels. The motor is mounted on a cast-iron pedestal on the front of which is a safety switch. A pulley on the motor shaft provides for driving an air compressor.

Lathe Chucks: Cushman Chuck Co., Hartford, Conn. An improved line of lathe chucks made in all sizes from 10 to 30 inches. A special feature is the thrust bearings which are made in two parts and completely encircle the screws at a point about midway of their length. The stems of the thrust bearings are driven into round holes in the chuck body and are therefore self-aligning. The bearings hold the screws in place whether the jaws are assembled or not. All parts are finished to gages and are interchangeable.

Automatic Cutting Machine: General Welding & Equipment Co., 74 Brookline Ave., Boston, Mass. An automatic cutting machine intended for cutting such metal parts as dies, cams, crankshafts, and drop-forge tools directly from steel plates. The machine has two carriages, one of which is mounted on the other. The upper carriage has on one side an oxy-acetylene cutting torch, and on the opposite side it supports the driving and tracing system. Any movement on the pattern is transmitted directly to the torch. A motor on the top carriage transmits its power through a friction wheel.

PERSONALS

Charles B. Siner has been made treasurer and general manager of the T. C. Dill Machine Co., Philadelphia, Pa.

T. H. Hays has been appointed manager of the Indianapolis office of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa.

J. J. Wittenburg has been placed in charge of the St. Louis office of the Chicago Flexible Shaft Co., Chicago, Ill. The office is located in the Railway Exchange Building, as it has been heretofore.

L. E. Salom has been appointed district representative for the New York territory of the Cleveland Electric Tramrail Division of the Cleveland Crane & Engineering Co., Wickliffe, Ohio. He will make his headquarters at 50 Church St., New York City.

Kenneth MacNeal, formerly secretary-treasurer of the Jones, MacNeal & Camp Co., Warsaw, Ind., has become president of that concern, succeeding L. E. Jones. Arthur MacNeal has been elected vice-president and treasurer, and D. B. MacNeal assumes the duties of secretary and general sales manager.

H. L. Carpenter, Jr. has been appointed traveling representative in western Pennsylvania for the Ajax Metal Co., Philadelphia, Pa. He has been associated with this company for over twenty years, having had charge of the Pittsburg office and later being connected with the main office in Philadelphia.

L. A. Carter has been made president of the Lehmann Machine Co., St. Louis, Mo. He became connected with this company several years ago, starting as engineer and designer, and advancing to the position of general manager and now to the presidency. He is the designer of the lathes made by this company.

A. E. Hitchner, assistant to the manager of the industrial department, in general charge of the mining and electrochemical industries, of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., has been placed in charge of the sections formerly handled by W. H. Patterson, who recently resigned to become vice-president of the Kaestner & Hecht Co., Chicago, Ill., elevator manufacturer, who handles Westinghouse direct traction elevator equipment in the Middle West.

H. D. James, manager of the control engineering department of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., has been re-elected president of the Engineers' Society of Western Pennsylvania. The other officers elected at the annual meeting were Frederick Crabtree, vice-president, and J. C. Hobbs and C. D. Terry, directors. Mr. James had served as director of the society for three years, and has been president for the last two years. He is a graduate of the University of Pennsylvania and a member of the American Institute of Electrical Engineers.

William J. Cleary has been appointed assistant general sales manager of the Sharon Pressed Steel Co., Sharon, Pa., manufacturer of pressed-steel frames, axle housings, brake drums, and heavy pressed steel stampings for automobiles, railroads, mines, mills, and factories. Mr. Cleary has been connected with the automotive industry for the last fourteen years, having been associated with the Studebaker Corporation as assistant general purchasing agent for twelve years and with the Willys Corporation, Elizabeth, N. J., as general purchasing agent for the last two years. His headquarters will be 1214 Dime Bank Bldg., Detroit, Mich., and his duties will cover the automotive industry in general.

* * *

NEW BOOK ON FORGING

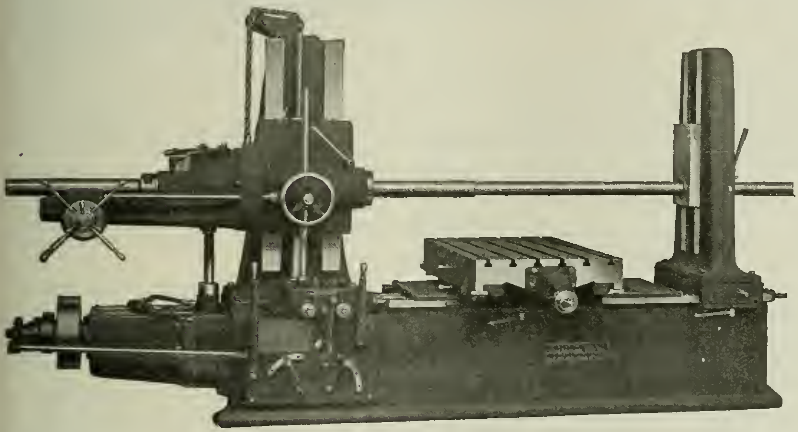
Machine Forging. By Douglas T. Hamilton. 106 pages, 6 by 9 inches; 85 illustrations. Published by The Industrial Press, 140-148 Lafayette St., New York City. Price, $1.

For many years inventors rarely crossed the threshold of the blacksmith shop. Hand-manipulated tools were used for many forging operations now performed in a fraction of the time entirely by mechanical means. A great deal has been accomplished during recent years in developing forging machines and various other classes of power-driven equipment for forge shops. The forging of bolts and rivets by machinery is an old method, but the use of machines for forging, welding and upsetting operations on machine parts of numerous shapes and sizes is a relatively modern development. The making of bolts, nuts, and rivets is an important and specialized branch of machine forging, and the construction and use of the machines and dies employed for this work are described in this treatise, as well as the application of machines designed for general forging operations. Dies designed for various typical operations are also described.

"Art stays the relentless hand of time"

The "PRECISION"

Boring, Drilling and MILLING MACHINE



Makes a good OLD Machine

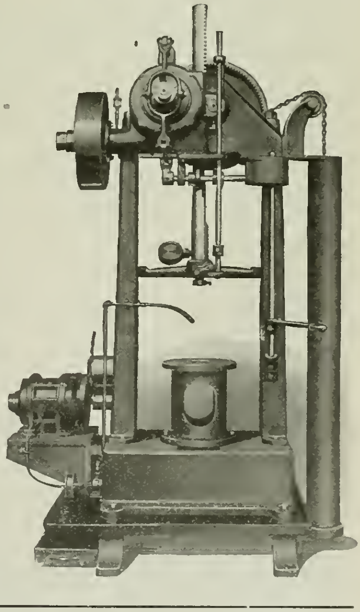
Almost like SLEIGHT OF HAND is the ease and quickness with which our new

Vertical Push-Broaching Machine

handles the broach.

"A SIMPLE TWIST OF THE WRIST" DOES THE TRICK

Less floor space—More production



LUCAS MACHINE TOOL CO. NOW AND ALWAYS OF **CLEVELAND, OHIO, U.S.A.**

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry. Societe Anonyme Belge, Alfred Herbert, Brussels. Aux Forges de Vulcain, Paris. Allied Machinery Co., Turin, Barcelona, Zurich. Benson Bros., Sydney, Melbourne. V. Lowener, Copenhagen, Christiania, Stockholm. R. S. Stokvis & Zonen, Rotterdam. Andrews & George Co., Tokyo, Japan.

OBITUARIES

John H. Streeter, secretary and treasurer of the Riverside Iron Works, Chicago, Ill., died January 26.

A. B. Hiler, for many years New York representative of the Jones & Lamson Machine Co., Springfield, Vt., died January 28, after a long period of suffering borne courageously and cheerfully. Mr. Hiler was born in Rockaway, N. J., in 1874, and received his early mechanical training at the Liberty Bicycle Works at Rockaway. Later he was employed in the screw machine department of the Thomas A. Edison Works in Orange, N. J., where he soon became foreman. About fifteen years ago he left the Edison plant and entered the employ of the Jones & Lamson Machine Co., remaining with this firm until the time of his death.

Howard V. Lewis, of the Fitchburg Machine Works, Fitchburg, Mass., died from meningitis on January 26 at the Burbank Hospital in Fitchburg. He was born in Cincinnati in October, 1878, and graduated from Harvard University in 1900. Upon leaving college he was employed for a number of years by the American Tool Works of Cincinnati, and later was connected with the Fairbanks Co. of New York. After severing his connection with the Fairbanks Co. he became a manufacturers' representative, with headquarters in New York City, and subsequently was associated with the Allied Machinery Co. of America for about a year, six months of which he spent in Paris. He went to the Fitchburg Machine Works in November, 1915, and during his residence there built up a wide acquaintance and was highly respected by his business associates and many friends. He held the position of vice-president, secretary, and sales manager at the time of his death. Mr. Lewis is survived by his widow and four children.

George William Peck of the Miner & Peck Mfg. Co., Derby, Conn., died at his home February 1, of kidney trouble. His father established the Miner & Peck Mfg. Co. in 1850 under the name of Milo Peck. At the death of his father in 1876, George W. Peck assumed active managership and continued as manager until his death. During his lifetime the concern was renamed, successively, Milo Peck & Co., Beecher & Peck, and the Miner & Peck Mfg. Co. In November, 1920, the company was purchased by the Birmingham Iron Foundry and removed to Derby. The firm name was retained, and Mr. Peck continued to serve as manager. In his years as manager he had continually developed the design of the Peck drop press and the Peck automatic lifter. He was well known and respected in the trade, and his passing will be regretted by a wide circle of friends. The Miner & Peck Mfg. Co. will continue its operation as before.

William C. Sargent, for twenty-two years secretary and also a director of the Chain Belt Co., Milwaukee, Wis., died suddenly on February 5 from heart failure. He was seventy-three years of age, and had been in ill health for several years. Mr. Sargent, prominent in industrial circles of Milwaukee and St. Paul, had a wide national acquaintanceship. He was born at Troy, N. Y., February 2, 1849. In 1871 he moved West, locating at St. Paul, where he organized the De Cou, Corliss & Sargent Co., manufacturer of sash and doors. He later became affiliated with the St. Paul Harvester Co., and it was while he was with this concern that he met C. W. Le Valley who subsequently founded the Chain Belt Co. of Milwaukee. This meeting was the beginning of a long business association, for in 1900 Mr. Sargent went to Milwaukee to become secretary and later a director of the Chain Belt Co. He was also a director of the Federal Malleable Co., West Allis, Wis. His father was one of the founders of the Terre Haute, Alton & St. Louis Railroad. Mr. Sargent established many of the early business connections of the Chain Belt Co., a large proportion of which are still among the company's jobbers.

COMING EVENTS

March 3—Sectional meeting of the American Society for Steel Treating in the Hotel McAlpin, 34th St. and Broadway, New York City. Secretary, W. H. Eisenman, 4600 Prospect Ave., Cleveland, Ohio.

March 15—Meeting of the Pittsburg section of the American Institute of Electrical Engineers in Pittsburg, Pa. Chairman, H. W. Smith, General Engineering Dept., Westinghouse Electric & Mfg. Co., East Pittsburg, Pa.

March 16-18—Mid-winter meeting of the Taylor Society at the City Club, Philadelphia, Pa. Address of secretary, 29 W. 39th St., New York City.

April 19-20—Annual meeting of the National Metal Trades Association in New York City; headquarters, Hotel Astor. Secretary, Homer D. Sayre, Peoples' Gas Bldg., Chicago, Ill.

April 20-22—Sixth annual convention of the American Gear Manufacturers' Association in Buffalo, N. Y.; headquarters, Lafayette Hotel. Secretary, F. D. Hamlin, 4401 Germantown Ave., Philadelphia, Pa.

April 22-May 2—Sixth annual Swiss sample fair at Basle, Switzerland, in the Great Exhibition Bldg. For further information apply to F. Dossenbach, Director of the Official Information Bureau of Switzerland, 241 Fifth Ave., New York City.

May 8-11—Spring meeting of the American Society of Mechanical Engineers in Atlanta, Ga. Assistant Secretary (Meetings), C. E. Davies, 29 W. 39th St., New York City.

May 10-12—Ninth National Foreign Trade Convention in Philadelphia, Pa. Secretary, O. K. Davis, 1 Hanover Square, New York City.

May 18-20—Annual conference of the National Association of Office Managers in Washington, D. C. Secretary, F. L. Rowland, Gilbert & Barker Mfg. Co., Springfield, Mass. Guests are invited to attend.

June 5-9—Annual convention and exhibit of the American Foundrymen's Association and allied societies in Rochester, N. Y. Secretary, C. E. Hoyt, Marquette Bldg., 140 S. Dearborn St., Chicago, Ill.

June 15-24—International exhibition of foundry equipment and materials in Birmingham, England, in connection with the annual convention of the Institution of British Foundrymen.

June 26-July 1—Twenty-fifth annual meeting of the American Society for Testing Materials in Atlantic City, N. J.; headquarters, Chalfonte-Haddon Hall Hotel. Secretary, C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

August 28-September 2—Annual Safety Congress of the National Safety Council in Detroit, Mich. Secretary, S. J. Williams, 168 N. Michigan Ave., Chicago, Ill.

SOCIETIES, SCHOOLS AND COLLEGES

California Polytechnic School, San Luis Obispo, Cal. Bulletin of information containing calendar and courses of study for 1921-1922.

American Welding Society, 33 W. 39th St., New York City, issued the first number of the proceedings of the society in January. It is the intention to issue the proceedings monthly, and they will include news items and reports of the society, local sections, the American Bureau of Welding, and the welding industry in general, as well as technical papers relating to the art of welding and its industrial application. Certain sections of the journal will be devoted to employment service, bibliography of current welding literature, names of new members, etc.

NEW BOOKS AND PAMPHLETS

Results of a Survey of Elevator Interlocks and an Analysis of Elevator Accident Statistics. 30 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Technologic Paper No. 202 of the Bureau of Standards. Price, 5 cents.

Friction and Carrying Capacity of Ball and Roller Bearings. By H. L. Whittemore and S. N. Petrenko. 34 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Technologic Paper No. 201 of the Bureau of Standards. Price, 10 cents.

State Laws Affecting Working Women. 49 pages, 6 by 9 inches. Published by the Women's Bureau of the United States Department of Labor as Bulletin No. 16.

This report covers the state laws affecting working women which were in effect in the United States July 1, 1921. The majority of the laws affecting working women have been charted, and five maps have been made of the charts to give a picture of conditions of the country as a whole. The laws covered are those regulating the length of the working day or week; laws providing for a day of rest, one shorter work day, time for meals, and rest periods; night work laws; laws regulating home work; minimum-wage laws; and mothers' pension laws.

The Modern Gas Tractor. By Victor W. Page. 590 pages, 5 by 7 inches. Published by the Norman W. Henley Publishing Co., 2 West 45th St., New York City. Price, $3.

This is the fourth edition, revised and enlarged, of a book which treats exclusively of the design and construction of farm tractors and tractor power plants, and gives instructions relative to their care, operation, and repair. It illustrates and describes the different types and sizes of gasoline, kerosene, and oil tractors. The chapter on engine repairing has been considerably enlarged, and instructions are now given for repairing well-known and widely used tractor power plants, many new forms of which are described. The book is not written as a technical treatise, an endeavor having been made to present the principles of design in such a manner that they may be readily understood by those without technical knowledge. It is intended to bridge the gap between the purely technical work and the manufacturer's instruction book dealing with one specific construction.

Involute Spur Gears. By Earle Buckingham. 91 pages, 6 by 9 inches. Published by the Niles-Bement-Pond Co., 111 Broadway, New York City.

In this treatise the author has aimed to present in concise form an analysis of the problems involved in designing, producing, and testing involute spur gears. The five chapters cover the involute curve and its properties; the design of involute gear tooth profiles; methods of production; methods of testing gears; and the strength of gears. Chapter I deals with the equation of the involute curve; the action of one involute against another; the action of an involute against a straight line; the duration of contact between meshing gears; sliding and rolling contact; undercutting of the involute, and teeth and bearing pressures. This chapter on the characteristics of the involute curve is followed by a study, in Chapter II, of the best method of utilizing these characteristics. The requirements are considered first, and then the interchangeability of involute gear tooth forms and representative standard tooth forms, including a comparison of the Brown & Sharpe, Fellows, and Maag standards. In Chapter III methods of production are summarized, and mathematical analyses of the hob and pinion-shaped cutter are given. Chapter IV is descriptive of several appliances for testing gears to check the size, accuracy of tooth form, or running qualities. The last chapter gives representative formulas for calculating the strength of gears, including empirical formulas for determining the increment load for gears running at high speeds under heavy loads. This book is a valuable addition to the literature of gearing, and the author is well known to the readers of Machinery, especially in connection with his series of articles on the general subject of interchangeable manufacturing.

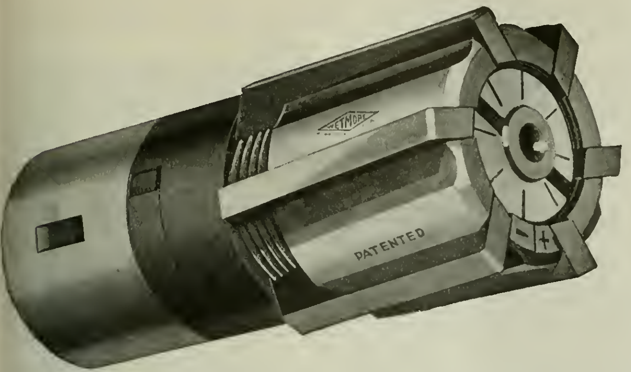
NEW CATALOGUES AND CIRCULARS

Porter Products Corporation, Keith Theater Bldg., Syracuse, N. Y. Leaflet illustrating and describing the Porter "Utility" offset screwdriver, for use in cramped quarters.

Hardinge Co., 120 Broadway, New York City. Bulletin 12, on Quigley fuel systems, describing the preparation, transportation, and burning of pulverized fuel.

Sprague Electric Works of General Electric Co., 527 W. 34th St., New York City. Bulletin 48716, descriptive of the Sprague electric dynamometer of the research type.

Cleveland Crane & Engineering Co., Wickliffe, Ohio. Circular showing applications of the Cleveland electric tramrail system for transporting material in garages, foundries, warehouses, factories, boiler rooms, etc.



Where extreme accuracy and a glass-like finish are required, this Wetmore Expanding 6-Blade Standard Reamer has no superior.

More Holes to a Grind

Wetmore Expanding Reamers

SUPERINTENDENTS, production men and mechanics in many of America's largest plants say that Wetmore Expanding Reamers are more durable—and hence more economical—than any other expanding reamers they know of.

Combined with this greater capacity for day-in, day-out hard service, every Wetmore Reamer—from the 6-Blade Standard Reamer shown above to the new Wetmore Expanding Small Machine Reamers which are now being made in sizes under one-inch—has a proved reputation for guaranteed accuracy and quality of reaming.

DISTINCTIVE WETMORE FEATURES

Among the advantages of Wetmore Expanding Reamers that are strongly appealing to users are the following:

Adjustments to the thousandth of an inch can be made in less than a minute. In fact, workmen say the Wetmore is the quickest and easiest adjusting reamer made. Cone expansion nut keeps blades always parallel with axis.

Solid, heat-treated alloy steel body—guaranteed against breakage.

Left Hand Angle Cutting Blades that prevent digging in, chattering, and scoring of the reamer while backing out.

No grinding arbor required for regrinding. Wetmore Reamers can be reground on their original centers.

AN INTERESTING JOB

Four hundred and fifty holes to a grind in 3½% chrome nickel steel! That is the performance of a Wetmore Standard Expanding Reamer (6-blade) in the shops of The Lodge & Shipley Machine Tool Co., Cincinnati, Ohio.

Such service, though remarkable, is not unusual for Wetmore Reamers. In fact, many of America's largest manufacturing plants have found that Wetmore Expanding Reamers have a longer life—a greater durability which enables them to stand up longer under constant punishment of peak production in small-tolerance machining.

If you are not using Wetmore Reamers, you should know more about them. Send us your name and we will mail you a valuable "hand-book" on expanding reamers, arbors and cylinder reaming sets—*free*. No obligation to you, of course.

WETMORE REAMER COMPANY

MILWAUKEE Box 21 **WISCONSIN**

(Manufacturers of Expanding Reamers and Cylinder Reaming Sets, Arbors and Thread Gauges)

WETMORE EXPANDING REAMERS

"THE BETTER REAMER"

Arva Stroud, 327 Broadway, New York City. Circular illustrating the application of R. V. 1-horsepower portable universal electric grinders for general work. The technical details are described, and instructions are given for upkeep and use.

New Departure Mfg. Co., Bristol, Conn. Loose-leaf sheets XV, XVI, and XVII containing dimensions and price lists for New Departure double- and single-row ball bearings, new "Radax" ball bearings, and magneto type ball bearings.

Monitor Controller Co., Baltimore, Md. Bulletin 101, discussing the starting of small alternating-current motors, and illustrating and describing Monitor "Thermaload" starters which are equipped with thermal-limit relays to protect against overload.

R & C Lap Co., Inc., Davenport, Iowa, has issued three new booklets covering the R & C line of laps for tool-room and production work, two of which have special reference to the lapping of automobile cylinders. Copies of the booklets will be sent upon request.

Cutter Co., Philadelphia, Pa. Circular illustrating and describing the "U-Re-Lite"—a circuit breaker for protecting electric motors and power and lighting circuits from overloading. The device is enclosed in a specially constructed steel case to insure safety of the operator.

Thwing Instrument Co., 3339 Lancaster Ave., Philadelphia, Pa. Bulletin 10, describing Thwing thermo-electric pyrometers of the indicating and multiple-recording types, as well as Thwing multiple-record high-resistance recorders, for use in connection with indicating instruments.

Bryant Chucking Grinder Co., Springfield, Vt. Circular containing specifications for the Bryant No. 2 semi-automatic double-head hole grinder. Illustrations are presented showing the method of grinding pistons on this machine, as well as plan views of typical work-holding fixtures.

Sundh Engineering & Machine Co., 1105 Frankford Ave., Philadelphia, Pa. Circular describing the Sundh cable draw-bench, which is an electrically operated automatically controlled machine for producing rods, tubes, moldings and bars of various shapes by drawing through a die.

Edison Lamp Works of General Electric Co., Harrison, N. J. Bulletin LD 130, containing an article on "The Eye as Affected by Illumination." Bulletin LD 134, discussing the lighting of metal-working plants and containing illustrations showing examples of adequate illumination in machine shops.

Mansfield Steel Corporation, 954 E. Milwaukee Ave., Detroit, Mich. Loose-leaf circulars illustrating a trailer hitch, or hook, designed to couple with the standard trailer eye recommended by the Society of Automotive Engineers, and Mansfield front bumpers and radiator guards for automobile trucks.

Olson Mfg. Co., Worcester, Mass. Circulars illustrating the Olson magazine screwdriver, which is made with a hollow handle for holding the different sizes of blades that can be used with this tool. The tool is regularly furnished with three blades and one awl, which adapts it for handling both large and small work.

L. S. Starrett Co., Athol, Mass. Supplement to catalogue No. 22, containing illustrations, specifications and price lists of several new Starrett tools, including metal case for micrometers, micrometer depth gage, inspector's micrometer caliper gage, standard end measuring rods, squares, vernier height gages, thickness gages, etc.

Shepard Electric Crane & Hoist Co., Montour Falls, N. Y. Circular announcing a new and smaller Shepard electric hoist, which is known as the "Liftabout" and which may be operated by one man. The hoist is made in ½- and 1-ton capacities, for operation on either alternating or direct current. A few of the many applications for which this hoist is adapted are shown.

Pawling & Harnischfeger Co., 38th and National Aves., Milwaukee, Wis. Bulletin HD501, describing P & H contractors' and builders' hoists and derricks. The illustrations show the single-, two-, and three-drum types of hoists, which are furnished for electric, gasoline or belt drive. The structural details of the P & H steel derrick are illustrated, and complete data in tabular form are included.

Cincinnati Grinder Co., Cincinnati, Ohio. Bulletin containing a description and illustrations of the Cincinnati automotive parts grinding machine, which has been especially developed for the repair shop, for use in grinding internal combustion engine parts. The machine is made in two styles, power feed and hand feed, and can be furnished for belt or motor drive. Copies will be sent to those interested upon request.

Mehl Machine Tool & Die Co., Roselle, N. J. Catalogue containing a prospectus of the tool service rendered by this company, which embraces the designing and manufacturing of jigs, fixtures, dies, gages, special machines, patterns and precision equipment. The book contains a large number of illustrations, showing examples of the work produced and interior views of the designing, pattern, manufacturing, and inspection departments.

Service Engineering Co., Inc., 25 Church St., New York City. Folder containing an outline of the activities and personnel of the company, which has been reorganized. The field covered is designing automatic machines; jigs and fixtures for economical manufacture; listing operations on parts; establishing tolerances or limits and gaging systems; planning lay-outs of machinery for increased production; and reorganization and appraisal.

Norton Co., Worcester, Mass. Form 907, containing information relative to alundum safety tile for stair treads, floors, and other uses where a slip-proof surface is desired. There are eleven pages of illustrations showing installations of alundum safety tile for different classes of service, and specifications for installing are included. A separate pamphlet is issued, which gives specifications for the proper installation of Norton alundum safety tile under various conditions.

Neidow-Cummings Co., 9 S. Clinton St., Chicago, Ill. Leaflet illustrating and describing "Airgrip" expanding mandrels, which can be loaded or unloaded without stopping the machine. The circular also illustrates the "Airgrip" piston manufacturing outfit, which includes an expanding piston arbor, a collet chuck, and an equalized drive arbor. This equipment may be used on any standard hand-operated, semi-automatic or full automatic machine, and will handle all sizes of pistons.

Mummert-Dixon Co., Hanover, Pa., is distributing a booklet to the trade entitled "Something Interesting about Stars," containing a study of some of the principal autumn and winter stars and constellations, besides a number of other subjects of general interest. The last pages of the book contain illustrations of the product of the company (which comprises oilstone grinders, radial grinders, oilstone wet tool grinders and facing heads) as well as a view of the pattern shop, which is equipped to handle all classes of pattern work.

Fellows Gear Shaper Co., Springfield, Vt. Booklet entitled "A New Development in Gear Cutting," describing a new type of gear shaper known as the No. 7, which has been developed for high production. The principle of operation and the mechanism of the machine are described in detail, as well as the method of operating, and other essential details. The construction is made clear by the liberal use of illustrations. The last chapter of the book shows examples of work, which indicate the possibilities of this type of machine for high production.

Cincinnati Milling Machine Co., Cincinnati, Ohio. Booklet entitled "Locomotive Repairs," containing data showing the adaptability of Cincinnati millers to the requirements of railway shops, and the reduction in costs that can be effected by milling this class of work. This book is of considerable interest, as the data is a record of actual performance in machining a large number of locomotive parts, and includes type of machine, speed, feed, material, stock removed, type and size of cutter, and time required for milling. The last few pages of the book are devoted to the use of Cincinnati universal millers in railroad tool-rooms.

Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. Circular Reprint No. 104, containing an article on "Babbitting Motor Bearings," by J. S. Dean of the railway motor engineering department of the company. The article is illustrated with a number of photographs showing equipment used in the manufacture of babbitt metals, and diagrams showing the results of various tests of samples of alloys. The cost of Westinghouse lead-base babbitt metal is discussed in Folder 4475. This publication also describes the properties and applications of the lead base babbitt metal known as Westinghouse alloy No. 25 and the babbitt known as Westinghouse alloy No. 14.

Joseph T. Ryerson & Son, Chicago, Ill., has published the second issue of its "Machinery Quarterly" which forms the machinery and tool section of the "Ryerson Steel Service Book." It is not intended that this book should be regarded as a complete machinery catalogue, the purpose being to place before machinery users condensed descriptive material covering the line of equipment furnished. Each issue shows a representative line of Ryerson equipment, including one or more machines or tools of each of the various classes with a brief description and specifications. This section shows lathes, planers, drilling machines, milling machines, grinders, power hammers, saws, bulldozers, punches and shears, bending rolls, riveters, threading and cutting-off machines, and many other types of metal-working machinery and equipment.

Torchweld Equipment Co., Fulton and Carpenter Sts., Chicago, Ill. Instruction book covering the assembly and use of oxy-acetylene welding, cutting, lead-burning, and carbon-burning equipment. The booklet presents the basic principles of oxy-acetylene welding and cutting, and is illustrated by views of "Torchweld" equipment. It is written in a style that can be easily comprehended by the shop man, and contains eighteen chapters dealing with the following subjects: Production of the Gases; Welding Materials and Supplies; Gas Pressure Regulators; "Torchweld" Welding Torches; the Welding Flame; Fundamentals of Welding; General Information for Welding; Welding Shop Suggestions; General Repair Work; Steel Welding; Production Work on Steel; Boiler Welding; Cast Iron, Copper, Brass and Aluminum Welding; "Torchweld" Cutting Torches; Metal Cutting; Lead Welding; and Carbon Burning.

TRADE NOTES

Cashman Tool Co., Waynesboro, Pa., has sold its property, building, and equipment to William H. Strauss, manager of the Wayne Tool Mfg. Co., Waynesboro.

Dale Machinery Co., 56 Lafayette St., New York City, dealer in machinery and tools, has moved its offices to 17 E. 42nd St. in the National City Bank Bldg., where larger quarters have been secured.

F. A. Calhoun Co., Lincoln Trust Bldg., Jersey City, N. J., has been appointed eastern representative in the New England and Middle Atlantic states for "Case-Hardo," a casehardening compound used for performing the same work as cyanide.

Surface Combustion Co., Inc., 366-368 Gerard Ave., Bronx, New York City, industrial furnace engineers and manufacturers, have secured the exclusive license for exploiting the Andrews rust-proofing process in the United States and foreign countries.

International Purchasing & Engineering Co., Inc., 506 McKerchey Bldg., Detroit, Mich., announces that it has made a reduction of approximately 15 per cent on the price of Van Dresser electric driven machines. No change has been made in the price of the hand or drill press types.

Sundh Engineering & Machine Co., Philadelphia, Pa., manufacturer of finishing machinery for brass, copper, and steel strip mills, has closed its branch office at 11th Ave. and 26th St., New York, and opened a downtown office in Philadelphia in the Otis Bldg., 16th and Sansom Sts.

Hauck Mfg. Co., 126 Tenth St., Brooklyn, N. Y., manufacturer of portable oil burners, torches, furnaces, etc., has moved its Philadelphia office to 1726 Sansom St., (Bell telephone, Spruce 5626). Herbert Vogelsang, who has been connected with the company for six years, will be in charge of the office.

Frank G. Payson Co., 9 S. Clinton St., Chicago, Ill., general sales agent for the Logan air-operated chucks, has discontinued business, and the general sales office of the **Logansport Machine Co.** has been moved to the factory at Logansport, Ind. Frank G. Payson will be located at Logansport as manager of sales.

Royersford Foundry & Machine Co., 54 N. 5th St., Philadelphia, Pa., manufacturer of Sells roller bearings, hangers, and other products, has made arrangements to have its full line of hangers handled in Chicago by the Clinton Supply Co., Inc., 110-112 S. Clinton St. This company will also act as distributor of Sells roller bearings.

Ingersoll-Rand Co., 11 Broadway, New York City, has been appointed general sales agent for the gas engines manufactured by the Rathbun Jones Engineering Co. of Toledo, Ohio. The Rathbun gas engines are of the vertical multi-cylinder type and are built to operate on natural, illuminating, producer, coke oven, oil still and other forms of gases that can be used in an internal combustion engine. The sizes range from 100 to 1450 brake horsepower.

Jones, MacNeal & Camp, Inc., formerly located at 522 S. Clinton St., Chicago, Ill., have moved to Warsaw, Ind., where they have acquired the factory previously occupied by the Blackhawk Tire & Rubber Co. This plant has 31,000 square feet of floor space, which will be devoted to the manufacture of a full line of "Power King" portable electric drills, having capacities for tools from 3/16 to 1 inch in diameter. A business office will be maintained in Chicago.

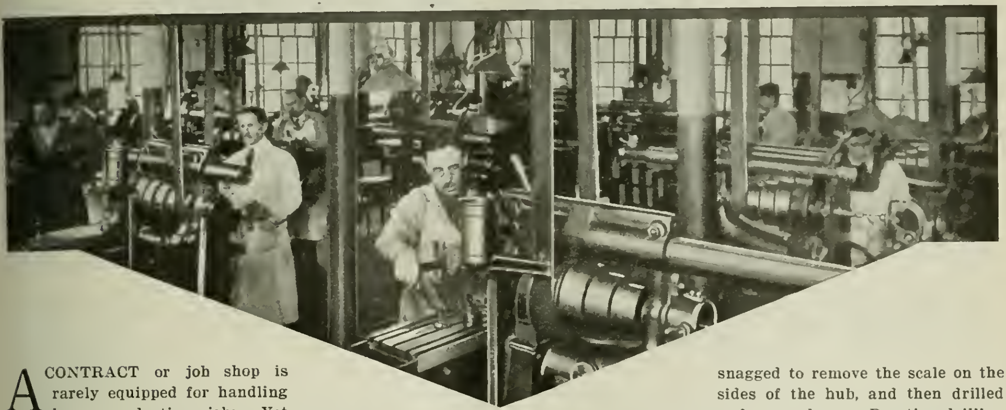
Quigley Furnace Specialties Co., Inc., 26 Cortlandt St., New York City, announces that its pulverized fuel department has been acquired by the Hardinge Co., 120 Broadway, New York City, which will continue the conduct of the business along the same lines as heretofore, the organization of the engineering department having been taken over practically intact. The rapid growth of the refractory specialties business of the Quigley company has made it advisable for the company to devote its entire attention to this branch of the work.

Oliver Machinery Co., Grand Rapids, Mich., manufacturer of woodworking machinery and machine tools, has established a new branch office at 716 Lincoln Bank Bldg., Minneapolis, Minn., in order to provide more efficient service for industrial plants, pattern shops, metal-workers, and woodworkers in the Northwest. George C. Ramer, who has had a wide experience in the sales department of the company, is manager of the office. The territory served by the new office consists of Minnesota, North and South Dakota, Nebraska, western Iowa, and western Wisconsin.

Cadillac Tool Co., Detroit, Mich., has been dissolved and is succeeded by a new concern which has been incorporated under the name of the Cadillac Machinery Co. The new company will retain the personnel of the Cadillac Tool Co., which was engaged in the sale of machine tools and which also did some manufacturing, but it will devote its entire efforts to selling machine tools. The president of the company is C. L. Campbell, and the other members of the organization are C. E. French, L. E. Bugbee, C. G. Valentine, and R. J. Borneman. The territory will be the same as that covered by the Cadillac Tool Co. The salesroom is located on the ground floor of the Boydell Bldg., East Lafayette and Beaubien Sts., Detroit.

APRIL MACHINERY 1922

Production Work in a Contract Shop



Manufacturing Methods Employed in the Plant of the Taft-Peirce Mfg. Co., Woonsocket, R. I., in Machining Automobile Parts—First of Two Articles

By FRED R. DANIELS

A CONTRACT or job shop is rarely equipped for handling large production jobs. Yet there are exceptions, and the present article deals with an instance where a contract shop has successfully solved the problems met with in quantity production. Many of the tools, jigs, and fixtures used in the manufacture of the Wills Sainte Claire eight-cylinder V-type automobile engine were made in the Taft-Peirce Mfg. Co.'s shop in Woonsocket, and in addition some thirty-five or more parts of this engine are being actually manufactured in this factory. Some of these parts include the valve follower assembly and shaft; camshaft drive pinion shaft bearing; fan assembly and shaft; distributor driven gear; intermediate shaft; piston-pin; and complete parts for the assembly of the camshaft drive shaft bearing retainer, oil-pump, oil relief valve, and connecting-rods. The present article deals with some of the more interesting operations employed in the manufacture of a number of the parts mentioned. Practically every finished dimension of these parts is held to close limits, which requires accurate manufacturing methods.

The parts of the valve follower assembly which involve the use of interesting equipment are the valve follower housing cover shown in Fig. 2, and the valve follower shown in the upper left corner of Fig. 3. These small forgings are assembled into the cover as shown at *A*, Fig. 5, four being used in the right-hand housing and four in the left. The forgings are first heat-treated, sand-blasted, and snagged to remove the scale on the sides of the hub, and then drilled and reamed on a Prentice drilling machine which carries a special multiple drill-head and an indexing fixture accommodating three pairs of forgings.

This machine is illustrated in Fig. 4, from which it will be seen that two followers *A* may be loaded at one station of the fixture while two other pairs are being drilled and reamed. It will be noted by referring to Fig. 3 that the reamed hole is held to a tolerance of 0.0005 inch. At every index movement of the fixture, two completely drilled and reamed forgings are removed. While the next two pairs of forgings are being machined, ample time is afforded the operator to reload and keep close watch on the condition of the holes by the frequent use of a plug gage.

The index device is released for revolving the turret of the fixture by the handle at the right of the loading station. This handle operates a rack and pinion, which withdraws the index-pin, and after it has been withdrawn it is snapped back ready to engage the next index-hole when the turret is revolved to the proper position. The work is located on the fixture by V-blocks that engage the hub of the work, and is secured in place by a wedge that is operated by a crank-handle.

The operation of rough- and finish-grinding cheek *A* of the forgings, Fig. 3, is performed on two Taft-Peirce cylindrical grinders, equipped with a special head and multiple grinding fixtures. One of these

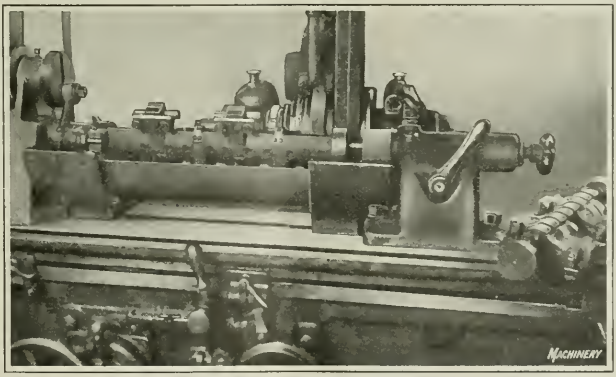


Fig. 1. Cylindrical Grinder with Special Equipment for grinding the Curved Surface of Valve Followers

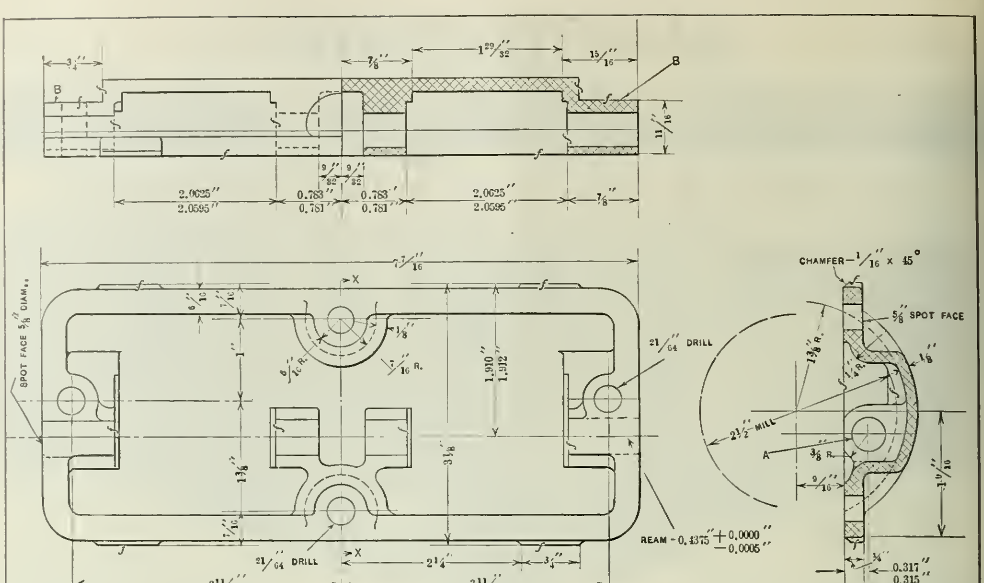


Fig. 2. Detailed Views of the Valve Follower Housing Cover

machines set up for the operation is shown in Fig. 1. The head transmits an oscillatory motion to the fixture and work; thus the machine practically performs the service of a radial grinder. The grinding fixture carries eight followers at a time in pairs, two machines and three fixtures being in use at once on this operation. A loaded fixture is shown on the table of the machine. As soon as one set of followers has been rough-ground, the fixture carrying the rough-ground work is transferred to the finish-grinding machine and replaced with another fixture. While the two machines are in operation the finished work is removed from the idle fixture and reloaded.

Fixture Used in Grinding Valve Follower

An assembled view of this special equipment is shown in Fig. 6, from which it will be seen that the spindle carries a

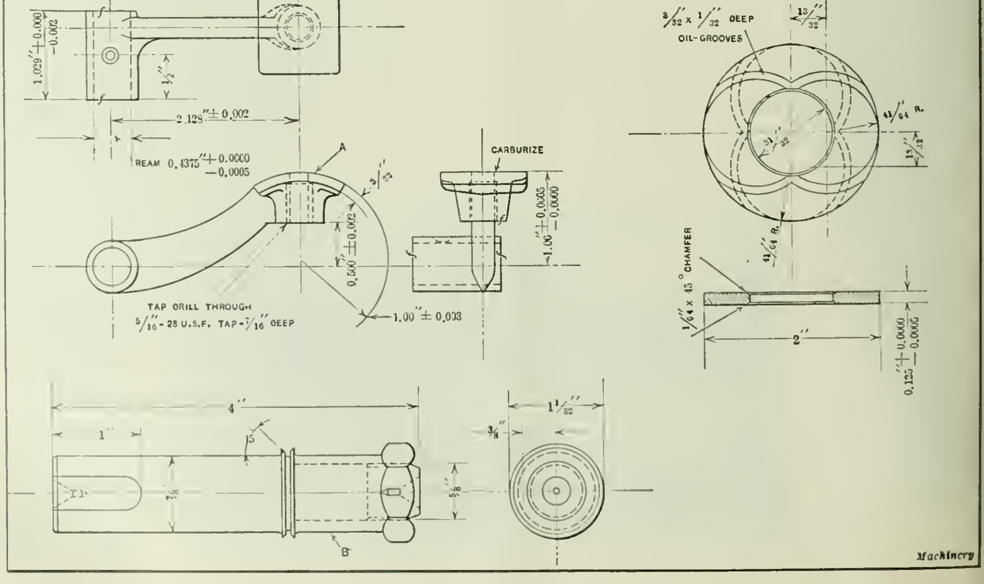


Fig. 3. (Upper Left View) Valve Follower; (Upper Right View) Bronze Washer; (Lower View) Special Arbor for straddle-facing Washers

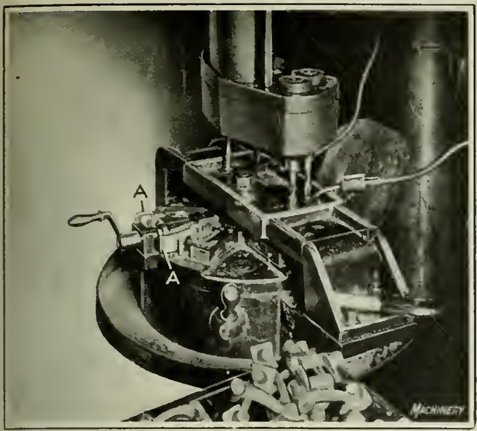


Fig. 4. Drilling Machine equipped with Multiple Head and Indexing Fixture for drilling and reaming Valve Followers

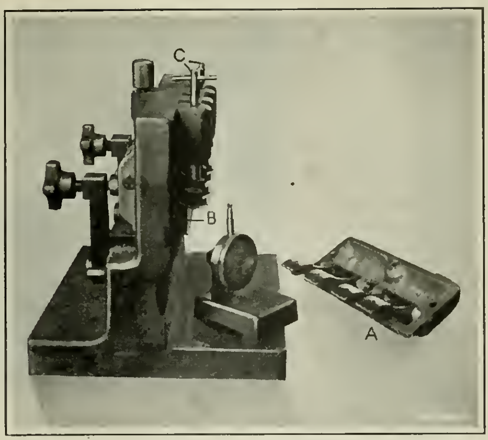


Fig. 5. Inspector's Gage and Test Blocks employed for gaging the Ground Cheek of Valve Followers

slotted driver A to which the crank-arm is attached in such a way that it can be adjusted to vary the arc of oscillation of the fixture. The body B has two projections on each side, in which a steel stud C is secured; the stud extends at both sides of the projection so that two followers may be carried on each stud. The end view shows the work W in broken outline in the position which the opposing followers occupy relative to the face of the grinding wheel when the loaded fixture is set up.

The head end of the fixture body has a cast ear D, so that when the fixture is placed between centers, a stud E will engage a slot in the ear to drive the fixture. Upon tightening a thumb-screw, the crank-arm transmits a rocking motion to the fixture. The work is seated against steel buttons carried in the body, and is held in this position by flat springs F which engage each pair of forgings close to the cheek. In loading the fixture, the operator simply snaps these springs over the work. The body of the fixture has steel female centers inserted at each end.

For the roughing operation a 36-L Norton wheel is used, and for finishing a 38-46 grade J wheel. A grinding wheel speed of 2500 revolutions per minute is employed which is equal to approximately 6000 feet surface speed per minute, and a feed of 0.0005 inch per oscillation. It may be mentioned incidentally that the same equipment is used for grinding the forgings to remove the copper-plating from the cheeks before the forgings are carburized on these surfaces.

Valve Follower Assembly

The camshaft housing valve follower cover in which the follower forgings are assembled is an aluminum casting. The central hole A, Fig. 2, which carries the stud for the followers must be accurately line-reamed and must have a uniform diameter in all four bearings within a tolerance of 0.0005 inch. This 7/16-inch hole is line-reamed on a Prentice lathe carrying a special long line-reamer with a universal-jointed driver which is held in the lathe chuck. The set-up of this job is illustrated in Fig. 7, which also shows the fixture used to hold the work while the holes are being reamed.

The work rests on four hardened steel buttons located so as to coincide with the centers of bosses cast on the inside of the aluminum covers. It is held back against two ground blocks at the rear of the fixture by means of a floating clamp A which seats evenly on the unfinished surface of the casting when the knob B is tightened. The cover of the fixture also has an equalizing clamp C carrying a hardened and ground button at each end, engaging the flat surfaces B (see Fig. 2), at each end of the casting. The fixture itself is clamped in

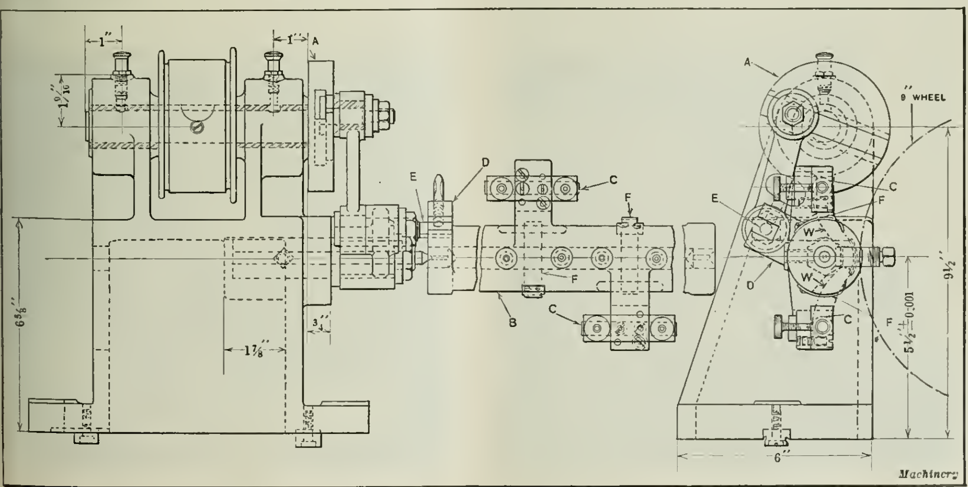


Fig. 6. Assembled View of the Special Head and Grinding Fixture employed on the Machine shown in Fig. 1

a milling vise which, in turn, is clamped to the bed of the lathe. The reamer operates at 180 revolutions per minute, and the feed is 0.005 inch per revolution of the spindle.

The gaging equipment for inspecting the ground cheeks of the assembled followers relative to the finished face of the aluminum cover, as well as the alignment, is illustrated in Fig. 5, which shows the assembled unit clamped to the upright part of the fixture on one side, with the followers extending through and resting on a hardened steel parallel *B*, which is set into the opposite side of the fixture. Four spring pins *C* hold the followers against the parallel, while a test block with a dial indicator is employed to gage the accuracy of the ground surfaces on the followers.

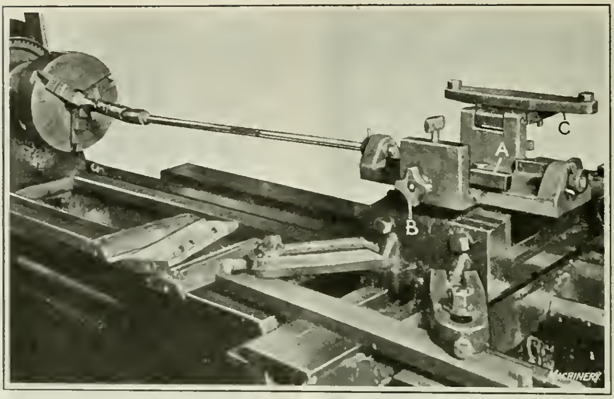


Fig. 7. Lathe set up for line-reaming Valve Follower Covers

Camshaft Drive Pinion Floating Washer

The camshaft drive pinion floating washer, shown at the right in Fig. 3, is machined from a cast bronze cylinder from which nineteen washers are made. The cutting apart of these bronze washers is illustrated in Fig. 8, which is a view of a Lodge & Shipley lathe looking toward the faceplate, and showing the multiple tooling set-up which is employed in this operation. The parting tools are set evenly in a special tool-block by means of a backing plate which is adjusted by the two screws shown at *A*. The casting is grooved to a depth which will bring the diameter within the grooves to 0.985 inch. This is slightly greater than the reamed diameter of the axial hole in the casting so that the washers can be readily broken apart. For grooving, a work speed of 50 feet per minute is used, with a hand feed.

It will be seen from Fig. 3 that there are circular oil-grooves 1/32 inch deep in both sides of this bronze washer. The machine and fixture used for cutting these grooves is illustrated in Fig. 9. The difficulty of holding these thin flat pieces so they would not become distorted made necessary the provision of special means for performing the oil-grooving operation. A heavy fixture is used for holding the washers during the milling of the grooves; to the base of this fixture is attached an upright bracket, which furnishes a rigid bearing for the cutter-arbor. This arbor has a driving lug which fits into a slot in the end of the hollow end-mill used to cut the grooves. One of these mills is shown on the table of the drilling machine. The mill can enter the arbor bearing when the machine spindle is raised, thus giving ready access to the work when loading and unloading the fixture.

The upper part of the fixture which carries the work may be slid transversely so as to bring the center of the spindle 13/32 inch either side of the center to agree with the location of the grooves in the work, as shown in Fig. 3. This movement of the fixture is effected by hand, the weight being sufficient to make the use of a locking device unnecessary. The cam-lever shown at the side of the fixture raises a center post to bind the work from underneath against flanges extending on each side, under which the work is located. This eliminates all possibility of distortion, and holds the washers perfectly flat during the grooving operation. A similar grooving operation is performed on both sides of the work using the same equipment. A Henry & Wright drilling machine is used for this work. It has been found advantageous, owing to the toughness of the material from which these washers are made, to heat them to between 650 and 700 degrees F. before any further machine work is performed. Formerly this was not done, and some difficulty was experienced in finish-facing the washers to within the required limits.

The washers are straddle-faced to a thickness of 0.128 or 0.129 inch, using diamond facing tools, and are then ground to the finished thickness indicated in Fig. 3, where it will be seen that a tolerance of 0.0005 inch is allowed. Considerable difficulty was experienced at first in holding the washers

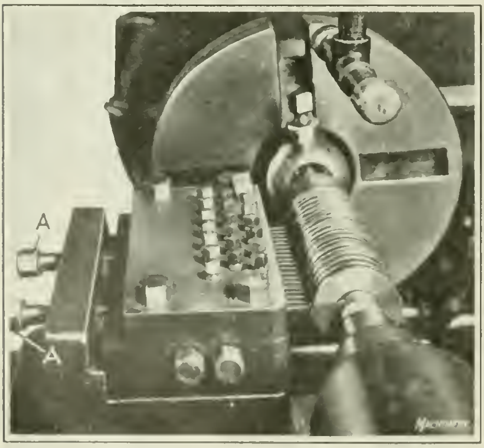


Fig. 8. Lathe with Multiple Tool-block, set up for cutting Bronze Washers from a Casting

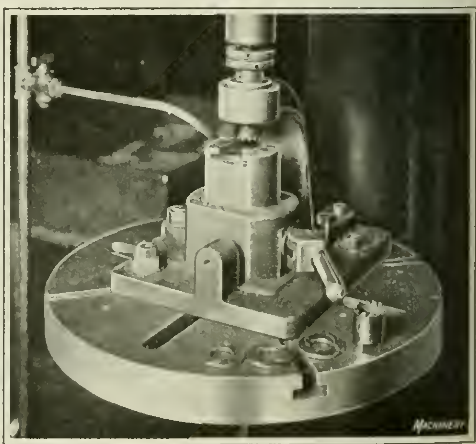


Fig. 9. Drilling Machine and Fixture used in cutting Oil-grooves in Bronze Washers

while straddle-facing them to thickness. For this reason, it was found desirable to chamfer both sides of the central hole, and to use a hardened tool-steel arbor, such as shown in the lower part of Fig. 3, to hold the work. This arbor has a 45-degree center and a sleeve *B* with a similar angular end, so that the washers can be mounted squarely between the shoulder on the arbor and the sleeve by means of the chamfered hole. A diamond tool is especially suitable for machining bronze, particularly where the work must be held within close limits. A hand-feed is employed and a work speed of 80 feet per minute.

The concluding installment of this article, which will appear in May MACHINERY, will describe operations on the camshaft drive shaft bearing retainer, the motor fan, and the intermediate and fan shafts.

* * *

SET-UP INSTRUCTIONS FOR BROWN & SHARPE AUTOMATICS

By SAMUEL R. GERBER
S. R. Gerber Co., Industrial Engineers, New York City

The importance of adhering strictly to detailed instructions for setting up automatic screw machines can readily be seen. If the set-up man does not see to it that he has all the necessary tools for the job before he starts setting up a machine, he may find himself well on the way before he discovers that a tool is missing. The set-up man can avoid this difficulty by adhering strictly to the rule of returning all tools to the tool-crib immediately after taking a job off the machine. If all tools, cams, and accessories are placed in a box and returned to the tool-crib where they are kept until they are needed again, there will be no need to search for tools the next time the job is started. It should be the duty of the man in the tool-crib to inspect the tools carefully before he puts them away. If he finds any tool that needs repairing, it should be attended to before the tools are put away on the shelves; if he finds any that are worn out or broken, he should immediately put in a requisition for replacements, so that they will be on hand when needed again.

It is also of vital importance that the set-up man set the machine to operate at the correct feeds and speeds. For this purpose he should be furnished with an instruction card which contains all the necessary information. Without such information the feeds and speeds and lay-out depend entirely on the memory of the set-up man. If the feeds, speeds, and job lay-out are noted on a card at the time when the machine is operating satisfactorily considerable trouble will be obviated on future set-ups.

List of Setting-up Operations

The following list of operations for setting up Brown & Sharpe automatic screw machines and the detailed explanation of these operations, if strictly adhered to, will, no doubt, greatly reduce the lost time in the department and consequently reduce costs, which, after all is the ultimate aim.

1. Obtain tools, instruction card, and drawing from tool-crib. Check all tools with tool list to make sure that none are missing. If any are missing, report to the man in charge of the crib and if he cannot furnish the required tool immediately, return all tools to him and start another job.

2. Tear down old job and return tools to crib. Remove gears, cams, and tools; clean and place in box. First remove and clean chuck. Then remove feed-finger from feed-tube and substitute new one. Finally, return tools to crib.

3. Put in chuck and feed-finger. Use pin-wrench for tightening up chuck-head.

4. Put on cams and gears and shift belts. Follow carefully the directions on set-up card and see that the belts are set to give proper speeds.

5. Grind tools. It is important to provide proper rake and clearance angles.

6. Place tools in turret and cross-slides and set them properly. Follow instructions furnished on set-up card, measuring the distance from the turret for all turret tools and setting cross-slide tools in proper relative positions.

7. Set trip-dogs. To set trip-dogs for turret tools, turn the handwheel until the cam-roll is on the high point of the cam lobe; then move the turret trip-dog in position under the trip-lever. Turn the handwheel until the cam-roll is on the high point of the next cam lobe and set the trip-dog as before. Continue this until all trip-dogs for the turret are set. To set the trip-dog for the chuck, turn the handwheel until the cam-roll just reaches the top of the stop-lobe on the cam; then move the trip-dog to position under the trip-lever. To set the trip-dog for the spindle, turn the handwheel until the cam-roll is on the high point of the cam lobe just preceding the cam lobe for threading; then move the trip-dog to position under the trip-lever. The second spindle trip-dog should be set where the cam-roll reaches the "dwell" of the cam lobe for threading. When both overhead and machine speeds are changed, avoid tripping simultaneously.

8. Put stock in chuck and adjust. The jaws should be adjusted so that the chuck can be locked with a snap by means of the hand-lever.

9. Make final adjustments. Adjust tools to bring part to fit gage. Set gage-stop first to obtain the proper length of piece. Feed stock to the stop, mark with the cut-off tool, measure the distance between the end of stock and the cut-off mark, checking this distance by means of the length gage. Finally adjust the feed length. The following precautions are necessary in making final adjustments: (A) Set the forming and cutting-off tools accurately before setting the turret tools; (B) test the thread body diameter before running on the threading die; (C) test length of piece before drilling or threading; and (D) test the diameter of holes before reaming.

10. Report to foreman. The foreman should always pass on the quality of the work before it proceeds further.

Importance of Following a Predetermined Sequence in Setting up the Machine

The order of operations in the list given is of the utmost importance for the successful setting up of the job in minimum time. For instance, the third step "Put in chuck and feed-finger" must be done before the sixth step "Place tools in turret and cross-slides, etc.," and the fifth step "Grind tools" must surely be done before the tools are set in place. Nevertheless, it is surprising how frequently these operations are done in the reverse order, which means repeating certain steps.

The seventh step "Set trip-dogs" must be done before the eighth step "Put stock in chuck and adjust." If the stock is put in the chuck before the trip-dogs are set, as is usually the case, it invariably follows that either a drill or the cut-off breaks. This means that the set-up man must remove the stock and proceed as he should have in the first place.

After the trip-dogs are set and the stock supplied, the set-up man may proceed to make the required piece, which can generally be done with few additional adjustments. It may require time and patience to train a set-up man to follow instructions in setting up an automatic screw machine, but any machine shop foreman will readily agree that it is worth while to train the set-up man, especially if he realizes that he can save time in the department by employing some such simple instruction methods.

* * *

Individual motor drive in the textile industry has been applied successfully for the first time to the revolving flat cotton card, an installation having been made at the plant of the Mason Tire & Rubber Co., of Kent, Ohio. Push-button control is employed, which provides for easy starting of the cylinders and spindles and permits adjusting the speed to suit conditions. The drive is equipped with a reversing motor switch.

Selling Machine Tools by Demonstration

By a Machine Tool Sales Manager

EXPERIENCED salesmen state that there are two classes of minds—those most easily impressed by what they see, and those most easily influenced by what they hear. Machine tool salesmen will probably agree that their customers respond more quickly to what they see than to what they hear; but still it is necessary both to explain and to demonstrate. The salesman has a fund of information about the machines he sells. This is his sales talk—his talking points for the ear of the prospect. In addition, he has something to show, to be conveyed through the eye. This is commonly called the demonstration.

The Use of Catalogues, Blueprints, and Photographs

In the simplest form of demonstration, the salesman uses catalogues, photographs, and blueprints. He seldom goes very far with his talking points without resorting to catalogues and other trade literature. He appeals simultaneously both to the ear and to the eye of the prospect.

It is the ambition of salesmen in some lines to become such fluent talkers that their prospects will listen to them spellbound, developing an eagerness to buy all that is offered for sale. It is doubtful if any machine tool salesman ever reached that goal, and if he did, it would not be of great value; for machine tool selling is an unemotional matter-of-fact business, and it is questionable if the most accomplished spellbinders from other fields of selling would have any great success with machine tools. Nevertheless, there is great value in being able to set forth selling arguments logically and forcefully; but an even greater appeal can be made through the eye, and more sales have been made by men who can clearly demonstrate the value of what they have to sell than by those who merely talk about the good features.

Some salesmen do not make the most of catalogues as a selling aid. Any machine tool manufacturer can tell of letter after letter received from possible customers, asking questions about points that are illustrated and explained in the catalogue, even though the salesman has called upon them recently. The salesman has overlooked some good demonstration material. Many salesmen also receive blueprints and photographs from the manufacturer, and submit them to their prospects without first becoming familiar with the recommendations made. They neglect to take advantage of the possibility of demonstrating to the prospect in terms of the prospect's problems.

The Importance of Complete Explanations of Methods

The neglect to fully explain lay-outs, drawings, and blueprints works an injustice not only to the manufacturer but also to the prospect. Recently an automobile manufacturer sent out blueprints to several machine tool builders. He received a number of proposals, and finally purchased a machine from Black & White. A bid had also been made on equipment by Smith Co. whose sales manager later happened to visit the automobile plant and saw Black & White's machine on the job. The production was much less than Smith had quoted. He asked why the other machine had been chosen. The buyer frankly told him that Smith's proposition had not been thoroughly studied. "It was really an oversight," he admitted, but added "Your salesman was also to blame. Your method of handling the job is somewhat unusual, and I did not understand at the time. The blueprints were left with me without explanation, and in the rush I did not study them thoroughly. Black & White's proposition, on the other hand, was presented to me so clearly that it seemed to me at the time to be the best we could hope to do. Now that we have this equipment, we cannot afford to take it out."

In this case the salesman lost out possibly because he did not himself fully understand the manufacturer's production plans, and left the blueprints for the buyer to study instead of using them as a means to demonstrate the superiority of his machine and method. No doubt he told the buyer repeatedly what the machine would do, but neglected to explain *how* it was done.

Demonstration of Machines

The use of catalogues and blueprints is not as effective as a demonstration of the machine itself. In some cases it is almost impossible to sell without an actual demonstration of a machine in operation. But there are great difficulties connected with demonstrations of machine tools.

An example of the physical demonstration of a difficult subject was recently met with in the practice of a bronze bearing manufacturer whose claims of superiority are based on the physical construction of his metal. This manufacturer had only a limited success when he depended upon printed or verbal statements. Then he supplied his salesmen with a microscope and fractures of his and other bearing bronzes. By thus demonstrating his metal in comparison with other materials, he not only increased his business but also received the benefit of publicity through his prospective customers telling their friends about the unique demonstration.

The practice of taking prospects to visit installations in nearby shops in order to demonstrate machine tools is very effective, but there are several objections to be noted. Frequently new machines are being introduced, and in that case other installations are not always available or conveniently reached. Sometimes a machine in use does not show up in as satisfactory a way as regards finish. The particular job on the machine at the time may not demonstrate it at its best, and it is always somewhat of an imposition on even a good friend to disturb his shop with visitors and temporarily hold up production; last, and most important, the salesman depends upon someone else to play what is usually the last card in his hand.

Demonstrations in Show-rooms

The show-room of a machinery house is seldom put to its maximum use. As a display place of machine tools it accomplishes only one of its possibilities. It augments the catalogue demonstration by showing the tool itself, so that the buyer can note its proportions and finish, and can move a lever or two or a handwheel here and there; but it would be still more effective if the machine were actually running. In European machine tool sales-rooms it is the usual practice to have one machine of every type under belt, and the salesmen are trained so that they can step up to the machines and operate them in a way that brings out the various features. This practice is worthy of thought on the part of those who would derive the maximum value from their show-room floor space.

Let us take a leaf from the book of the seller of phonographs. The chances of selling a phonograph by means of a catalogue are remote. The chances of selling by a mere display of the cabinet are small. But the playing of a record on the machine exhibits the service that the salesman really tries to sell. It is service that is sold in machine tools just as much as in phonographs.

In making a first-class demonstration of any article, it is highly important that the demonstration be in line with the normal use of the product. A salesman for the manufacturer of small tools used to carry with him a milling cutter as a sample of the firm's product. It is impossible to make a quick demonstration of the normal use of a milling cutter, but this salesman thought that he could demonstrate the abuse that his cutter would stand by throwing it on the floor. All went well with his demonstration until once when the cutter came in contact with a concrete floor. After he had exclaimed "Just see the abuse our cutters will stand," he sent the cutter to meet the hard concrete. The cutter broke into several pieces.

The writer has often heard machine tool salesmen argue that an exhibit that is not under belt at a convention is a waste of space; yet only a small percentage of the visitors at a convention are buyers, and under the excitement of the convention they are least susceptible to impressions. On the other hand, a running exhibit on a machinery dealers' floor is a perpetual exhibit to which only interested parties come, and they can concentrate upon the one item of the machine that they wish to buy.

The Introduction of New Machinery and Tools

There is every indication that many improvements in machinery and tools will be introduced by machine tool builders in the near future. Totally new and different tools will be brought out, but even in the mechanical field the buyers are notoriously slow in taking up new ideas. They are invariably skeptical, and equipment for machine shops is the object of more careful scrutiny than many other classes of products. The buyers of machine tools will not seek new equipment. The machine tool salesman must seek the buyer. There is still plenty of room for improvement in the demonstration and methods of selling machine tools. It is those that give most careful thought to effective demonstration who will enjoy the greatest success in selling.

* * *

FORM TOOL FOR GRIDLEY AUTOMATICS

By JOE V. ROMIG

In turning formed work on Gridley four-spindle automatics, it is customary to rough-turn with one tool and finish-form with another. A double-deck type of tool-holder such as the one shown at *A*, Fig. 1, is used on the rear or forming slide. The forming and sizing tool *F* and its holder *B*, shown mounted on the double-deck holder *A*, were devel-

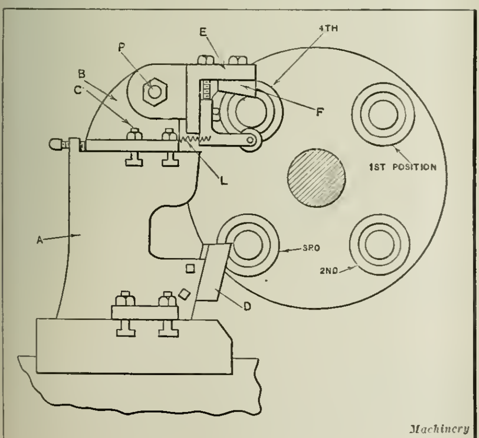


Fig. 1. Double-deck Tool-holder used on Gridley Automatics

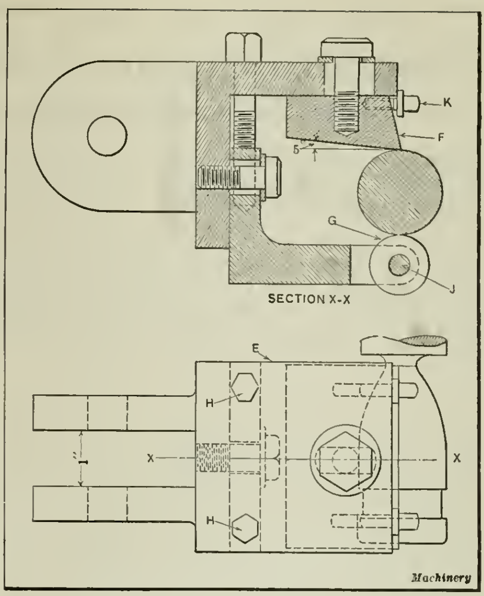


Fig. 2. Forming Tool used in Holder shown in Fig. 1

oped for use on work requiring a fine finish and a high degree of accuracy. The holder *B* is of inverted T-shape, and is clamped to the top face of holder *A* by bolts *C*. Slots are provided for these bolts which permit the tool to be adjusted so that it will be properly aligned with the lower tool *D*.

On the vertical section of holder *B* is pivoted the tool-carrying head *E*, which is also shown in Fig. 2. This tool-head is made of an accurately machined casting. The tools used in this holder are made with a bottom clearance of from 5 to 8 degrees and a lip angle which varies from 0 to 7 degrees according to the hardness of the material to be machined. It will be noted that the tool *F* shown in the illustration has a bottom clearance angle of 5 degrees. This tool passes over the top of the work, the latter being held to size by means of the roller *G*. This roller is mounted on an adjustable slide and is clamped to the inner face of the holder *E* as shown. Two elevating screws *H* are used to adjust and hold the roller square with the tool. On work having more than one diameter it is necessary that the roller be built up of two pieces of different diameters, each roller running loosely on the roller-pin *J*.

On tapered work also two rollers must be used, as any slippage on the work would mar the finished surface. By pivoting the whole head as shown, a self-adjustable feature is introduced, which works satisfactorily. The pivoted bolt *P*, Fig. 1, should be drawn up tight enough to hold the head erect by the friction of the clamping faces. The tool *F* is drilled and tapped on its front face for the two small screws *K*, which are used to adjust and hold the tool square with its holder as indicated in Fig. 2. A newly sharpened tool sometimes has a tendency to chatter, but this can be overcome by drawing a fine-grained oilstone across the edge.

Besides turning and forming the work accurately to size, the tool also has a burnishing action, which produces a very fine finish. The writer has found it advisable to insert a spring *L*, Fig. 1, between the base and the swinging head. This spring is made just strong enough to lift the head slightly. This will bring the roller into engagement with the work and permit the tool to be drawn downward as the slide feeds inward, thus resulting in a clean shearing cut. From 0.005 to 0.010 inch is sufficient allowance for a finishing cut. This tool operates equally well on straight, curved, or tapered work. It was first used in making one-pounder shells.

Standardization of Jig and Fixture Design

THE use of standardized parts in the design of jigs and fixtures is intended primarily to avoid unnecessary repetitions in the designing department and to reduce the cost of designing jigs and fixtures as well as the time required for making them. When certain features or details adapted to standardization have been found to be satisfactory, the advantage of using duplicate designs whenever practicable is evident, since such uniformity in the construction of details not only reduces the costs but also insures the continued use of parts that have been tested out in actual practice.

How Many Parts Should be Standardized?

The number or variety of parts which may be standardized to advantage in connection with jig and fixture design varies in different plants, and depends in a general way upon the uniformity of the work. Where there is great diversity in shapes and sizes of the parts requiring jigs or fixtures, standardization is largely confined to such details as handles, bushings, stop-pins, adjusting screws, clamping straps, latches, eyebolts, binder levers, and certain other small parts of a minor nature. If too many parts are standardized, especially large parts which necessarily control to some extent the design of a jig or fixture, there is sometimes a tendency to sacrifice the design or arrangement in order to utilize a standard part. In such cases, the standard is a detriment rather than an advantage.

In connection with the standardization of parts either for jigs, fixtures, or gaging devices, it is advisable to utilize as far as possible all universally adopted standards and commercial parts, such as machine screws, cap-screws, washers, taper pins, or other parts which may be much cheaper to buy than to make in relatively small lots.

Standardization of the Larger Parts

In determining whether or not it will pay to standardize the larger and more important details, such as plates, bases, indexing devices, clamping mechanisms, etc., the probable extent to which such parts or details can be utilized is naturally the factor to consider. In this connection past experience in whatever plant the jigs and fixtures are intended for serves as a reliable guide in determining to what extent certain parts are likely to be used, and also the advisability of having in stock parts made up in advance. These stock parts, which should be kept on hand in amounts depending upon the probable number required under ordinary conditions, frequently make it possible to design and construct jigs and fixtures in a relatively short time.

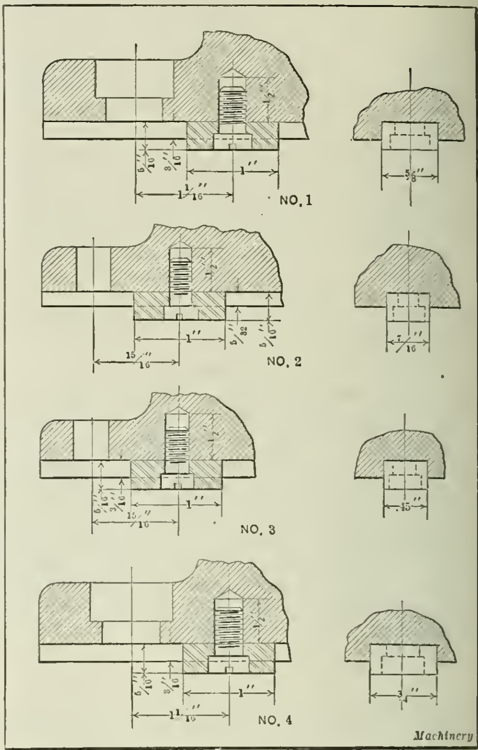


Fig. 2. Four Sizes of Standard Fixture Keys

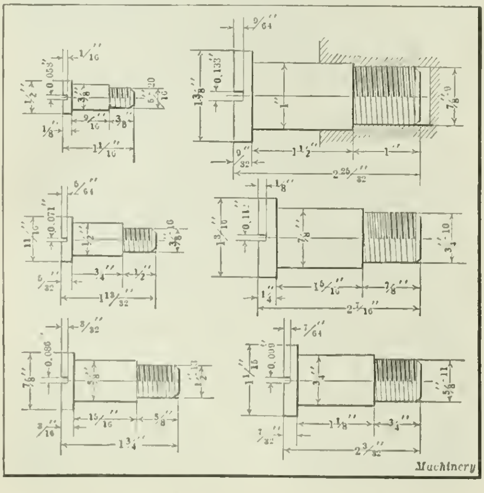


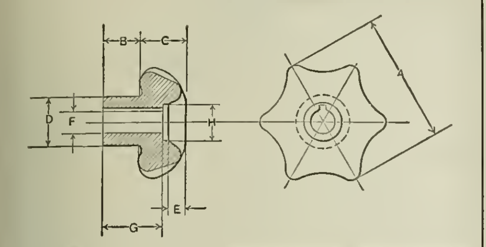
Fig. 1. Six Sizes of Standard Shoulder Screws

In the designing department of the Pratt & Whitney Co., Hartford, Conn., the parts for jigs, fixtures, and gaging devices have been standardized as far as practicable, although in jig and fixture work, standardization is confined chiefly to the minor details, owing to the extremely wide range of work handled in the various departments and the necessity of designing jigs and fixtures which differ greatly, not only in size but also in arrangement. The following examples do not cover all the standardized parts, but they illustrate in a general way the kinds of parts that can be standardized to advantage. The dimensions are given whenever there is a range of sizes, for the convenience of those desiring to adopt similar standards.

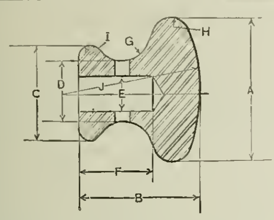
Shoulder Screws

Fig. 1 illustrates six sizes of shoulder screws with body diameters varying from 3/8 to 1 inch. These screws are used as pivots for latches and certain kinds of clamping blocks or plates which require a swinging movement, as when inserting or removing work, but still remain permanently attached to the body of the jig or fixture. The section lines around the largest screw illustrated indicate how they are fitted in place. It will be noted that the body of the screw enters a counterbored recess for some distance, thus giving the screw a rigid support against lateral thrusts. These screws are made of cold-rolled steel, casehardened. The heads should have a free fit when they enter counterbored recesses.

TABLE 1. CAST-IRON AND STEEL KNOBS



A	B	C	D	E	F	G	H	Keyway Width	Keyway Depth
2 3/4	13/16	11/16	7/8	3/8	3/8	1 1/8	1/2	3/32	3/64
3 1/4	1	7/8	7/8	7/16	1/2	1 3/8	3/4	1/8	1/32



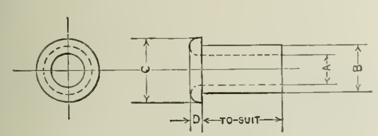
A	B	C	D	E	F	G	H	I	J	Pin Length
1 1/4	7/8	7/8	9/16	5/16	5/8	3/16	1/8	1/16	1 5/16	5/8
1 1/2	1 1/4	1	5/8	3/8	3/4	3/32	3/16	3/32	1 5/16	11/16
1 3/4	1 1/2	1 1/8	11/16	7/16	7/8	3/8	1/4	3/32	1 3/4	3/4
2	1 3/4	1 5/16	3/4	1/2	1	7/16	9/32	3/32	2	13/16

Machinery

Fixture Keys—Standard Knobs

Four sizes of standard fixture keys are illustrated in Fig. 2. These are used for aligning a jig or fixture body with the machine by engaging a slot in the machine table. A tongue is sometimes formed directly on the body of the fixture by planing, but a removable key is generally considered preferable. These keys are all of the same thickness and length, but the widths vary.

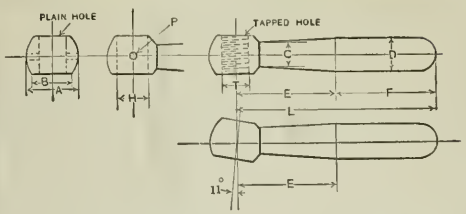
TABLE 2. STANDARD SHOULDER DRILL BUSHINGS



A	B	C	D	A	B	C	D
1/16	3/16	3/8	3/32	9/16	13/16	1 1/8	1/8
1/8	3/16	1/2	3/32	5/8	7/8	1 1/4	1/8
3/16	3/8	9/16	3/32	11/16	15/16	1 3/8	1/8
1/4	7/16	5/8	3/32	3/4	1 1/16	1 9/16	5/32
5/16	1/2	11/16	3/32	13/16	1 1/8	1 5/8	5/32
3/8	9/16	3/4	3/32	7/8	1 1/4	1 7/8	3/16
7/16	5/8	13/16	3/32	15/16	1 5/16	1 15/32	3/16
1/2	11/16	7/8	3/32	1	1 3/8	2	3/16

Machinery

TABLE 3. STANDARD BINDER HANDLES



Dimensions, Inches A	B	C	D	E	F	L	Plain Hole H	P*	Tapped Hole T	Th'ds per In.
13/16	5/8	5/16	1/2	1 3/8	1 1/2	2 7/8	3/8	2	3/8	16
1	3/4	7/16	11/16	1 5/8	2	3 5/8	7/16	3	7/16	14
1 1/8	13/16	1/2	13/16	1 7/8	2 5/16	4 3/16	1/2	4	1/2 9/16	13 12
1 3/8	7/8	9/16	15/16	2 1/8	2 5/8	4 3/4	9/16	5	1/2 9/16 5/8	13 12 11
1 1/2	1 1/8	5/8	1 1/16	2 5/8	3 1/8	5 3/4	5/8	6	5/8 11/16	11 11
1 3/4	1 1/8	11/16	1 1/8	3 1/2	3 7/8	7 3/8	9/16†	5†	9/16† 3/4	12† 10
2	1 1/4	3/4	1 3/16	4 1/8	4 3/8	8 1/2			5/8† 7/8	11† 9

Machinery

*Numbers in column P represent Nos. of taper pin drill used when assembling.

†Binder handles with hole or tap at pin angle.

Two forms of knobs are illustrated in connection with Table 1. The upper section of the table covers two sizes of cast-iron knobs which are keyed to the shaft. The steel knobs listed in the lower section are made in four different sizes, and are secured to the shaft by a taper cross-pin.

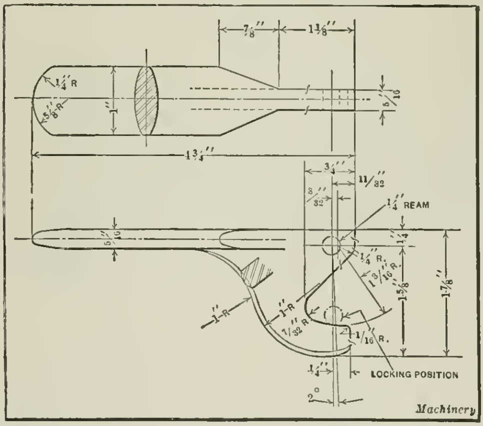
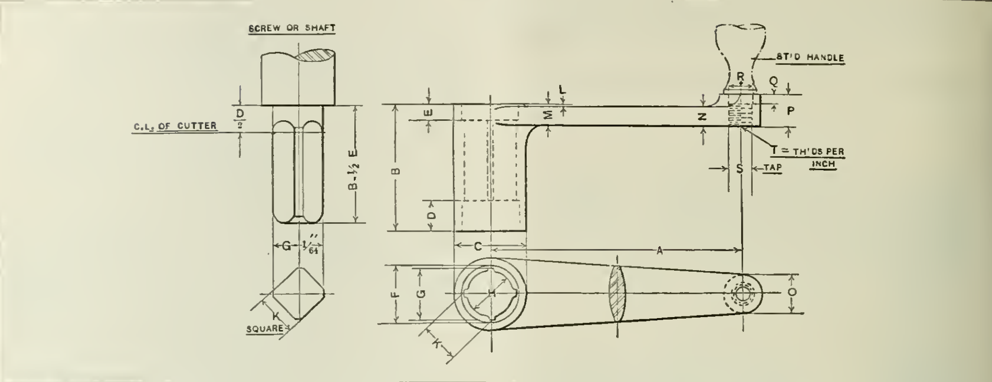


Fig. 3. Drill Jig Clamping Handle of the Cam or Eccentric Type

Shoulder Drill Bushings

Drill bushings of the shoulder type with holes varying from 1/16 to 1 inch are covered by Table 2. These flanged or shoulder bushings are preferred by many tool designers whenever it is practicable to use them. The flange prevents any endwise movement of the bushing, such as might be caused by the action of the cutting tool. If this flange must be flush with the surface of the jig or fixture, it is let into a counterbored recess. These bushings are made of tool steel, hardened and ground.

TABLE 4. STANDARD CRANKS



A	B	C	D	E	F	G	H	K	L	M	N	O	P	Q	R	S	T	Handle*
4	2	1 1/8	1/2	1/4	21/32	5/8	17/32	1/2	1/16	11/32	11/32	5/8	1/2	1/8	7/16	3/8	24	2C
4	2	1 1/8	1/2	1/4	27/32	13/16	21/32	5/8	1/16	11/32	11/32	5/8	1/2	1/8	7/16	3/8	24	2C
6	2 1/2	1 1/2	5/8	5/16	29/32	7/8	23/32	11/16	1/16	13/32	11/32	3/4	5/8	3/16	1/2	3/8	24	3C
6	2 1/2	1 1/2	5/8	5/16	1 5/32	1 1/8	29/32	7/8	1/16	13/32	11/32	3/4	5/8	3/16	1/2	3/8	24	3C
8	2 3/4	1 5/8	5/8	5/16	1 3/32	1 1/16	27/32	13/16	1/16	7/16	3/8	7/8	5/8	3/16	1/2	3/8	24	4C
8	2 3/4	1 5/8	5/8	5/16	1 7/32	1 3/16	31/32	15/16	1/16	7/16	3/8	7/8	5/8	3/16	1/2	3/8	24	4C
10	3	1 3/4	3/4	3/8	1 7/32	1 3/16	31/32	15/16	1/16	1/2	7/16	1	3/4	3/16	5/8	1/2	16	5C
10	3	1 3/4	3/4	3/8	1 13/32	1 3/8	1 3/32	1 1/16	1/16	1/2	7/16	1	3/4	3/16	5/8	1/2	16	5C
12	3 1/4	2 1/4	3/4	3/8	1 13/32	1 3/8	1 3/32	1 1/16	1/16	1/2	7/16	1 1/8	3/4	3/16	5/8	1/2	16	5C
12	3 1/4	2 1/4	3/4	3/8	1 21/32	1 5/8	1 9/32	1 1/4	1/16	1/2	7/16	1 1/8	3/4	3/16	5/8	1/2	16	5C
15	3 1/2	2 1/2	3/4	7/16	1 27/32	1 13/16	1 13/32	1 3/8	1/16	9/16	1/2	1 1/4	15/16	1/4	3/4	5/8	16	6C
15	3 1/2	2 1/2	3/4	7/16	2 1/32	2	1 17/32	1 1/2	1/16	9/16	1/2	1 1/4	15/16	1/4	3/4	5/8	16	6C

Machinery

*See Table 5 for dimensions of handles.

Binder or Clamping Handles—Cranks

Table 3 applies to binder handles, having (1) plain holes with cross-pins, (2) tapped holes, and (3) either plain or tapped holes located at an angle to the handle. The left-hand half of the table gives the general dimensions, and the right-hand half covers the diameters of plain holes, the

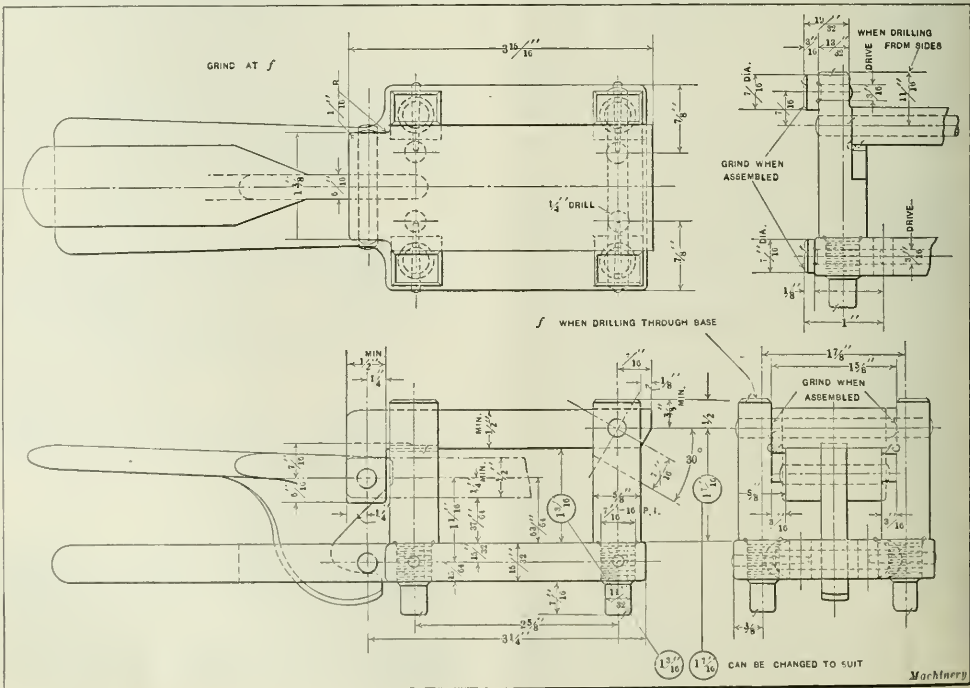


Fig. 4. Drill Jig equipped with a Cam-handle and a Standard Base

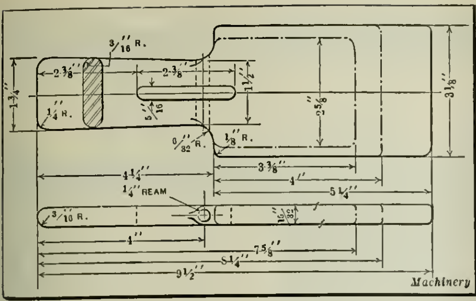


Fig. 5. Standard Bases for Drill Jigs

taper pin drill numbers, the diameters of tapped holes, and the corresponding threads per inch.

Dimensions for different sizes of cranks of the type used for turning adjusting screws, etc., are given in Table 4, which also includes the dimensions of the squares on the screw or shaft. Dimensions for the handles used in connection with these cranks are given in Table 5, which includes additional sizes.

Cam-handles and Drill Jig Bases

A clamping handle of the cam or eccentric type, which has been extensively used, is illustrated in Fig. 3. This is made from a tool-steel forging, and the cam end, which engages a clamping pin, is hardened and tempered. The style of base used in conjunction with this cam-handle is shown in Fig. 5, which gives the dimensions of three standard sizes. The base is made of machine steel, and the sides are ground as indicated by the finish marks. Fig. 4 shows a drill jig equipped with a cam-handle and a standard base. This is the smallest jig of the series, there being medium and large sizes which make use of the medium and large sized bases shown in Fig. 5.

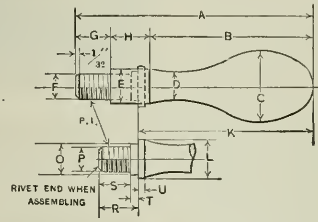
Binder and Centering Plugs

Sometimes it is practicable to standardize an entire unit, consisting of several assembled parts. Such a case is shown in Fig. 6, which illustrates the binder and centering plug for a fixture used for holding rifle bolts. The clamping action is derived from a helical cam surface A on the binder sleeve, which engages a block B attached to the body of the fixture. When the handle at the end of the binder sleeve is swung to the open position C, the projecting end of stop-screw D seen above the binder sleeve is opposite a longitudinal slot E, thus permitting the sleeve to be moved back far enough to insert or remove the work. The latter is held and centered by a plug at one end and a bushing at the other. The same style of binder, modified as regards center and plugs or minor details, is applied to various fixtures.

STANDARDIZATION WORK IN JAPAN AND NORWAY

Standardization work in Japan has recently been given a great impetus by the organization of the Japanese Engineering Standards Committee. The main function of this committee is to serve as a bureau for solving problems involving engineering standardization. The committee consists of seventy members, and the Minister of the Department of Agriculture and Commerce serves in the capacity of president. The details of the work of standardization are handled by seven secretaries who are engineers of the government departments of Agriculture and Commerce, Communications, Railways, Military Engineers and Naval Engineers. The work is being pushed with vigor, investigations already being under way on metals, woods, bricks, screws, electric wires, and electric motors. In Norway a national standardization committee has been organized by the Federation of Norwegian Industries. One of the first projects which is to be taken up by the new committee, after the necessary work on organizational problems, is the standardization of ship machinery and ship details.

TABLE 5. STANDARD HANDLES



No.	A	B	C	D	E	F	G	H	Thds. per In.
0	2 5/8	1 15/16	13/16	11/32	15/32	5/16	5/16	3/8	28
1	2 15/16	2	15/16	13/32	15/32	3/8	3/8	9/16	24
2	3 7/16	2 3/8	1	7/16	1/2	3/8	1/2	9/16	24
3	3 15/16	2 13/16	1 1/8	15/32	19/32	3/8	1/2	5/8	24
4	4 1/4	3 1/8	1 1/4	1/2	19/32	3/8	1/2	5/8	24
5	4 3/4	3 7/16	1 5/16	9/16	21/32	7/16	1/2	13/16	20
6	5 3/16	3 5/8	1 7/16	5/8	3/4	1/2	11/16	7/8	16

No.	K	L	O	P	R	S	T	U	Thds. per In.
2C	2 17/32	9/16	7/16	3/8	9/16	29/64	7/64	3/32	24
3C	3	5/8	1/2	3/8	11/16	33/64	11/64	5/32	24
4C	3 3/8	11/16	1/2	3/8	11/16	33/64	11/64	3/16	24
5C	3 13/16	7/8	5/8	1/2	53/64	21/32	11/64	9/16	16
6C	4 1/8	1	3/4	5/8	1 1/64	25/32	15/64	1/4	16

Machinery

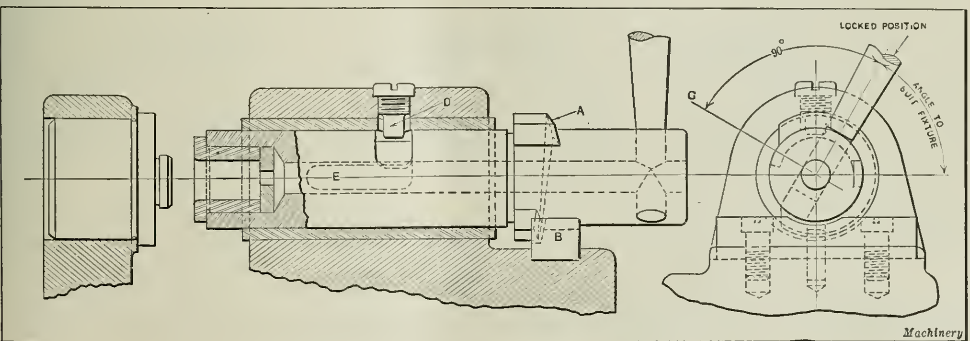


Fig. 6. Example of Standardization applied to a Binder and Centering Plug for a Fixture

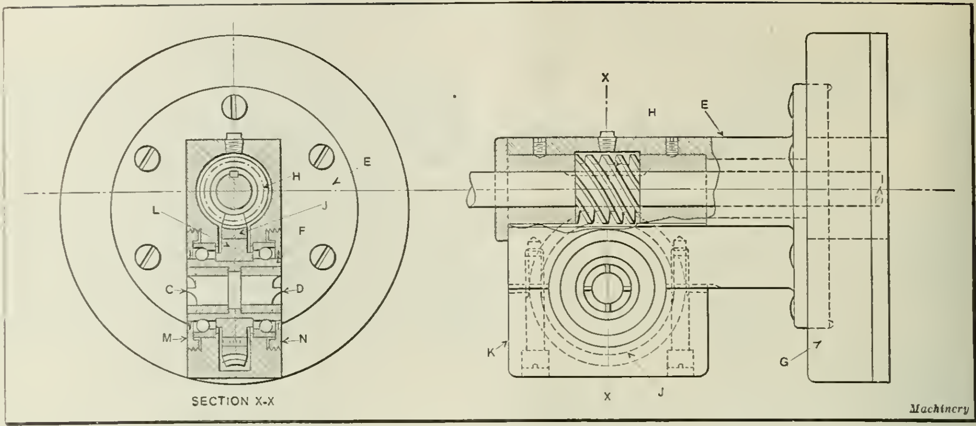


Fig. 1. Auxiliary Spindle carrying Hollow-mills for machining Trunnions A and B of Forging shown in Fig. 2

MILLING SHIFTER FORK TRUNNIONS

By A. H. SCHWAB

In the production of automobile shifter forks, such as shown in Fig. 2, it is necessary to turn the trunnions or bosses *A* and *B* to a diameter of 19/32 inch. The milling machine attachment shown in Fig. 1 was designed for use in performing this operation. This fixture is provided with two hollow-mills *C* and *D*. The axis of the short hollow spindle *F* on which the high-speed milling cutters are mounted is at right angles with the main spindle, and parallel with the milling machine table. Thus, while held in the fixture illustrated in Fig. 3, the work can be fed first to the right for milling the boss or trunnion *B*, and then to the left for milling trunnion *A*.

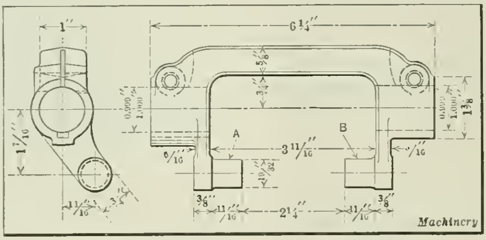


Fig. 2. Automobile Shifter Fork

Referring to Fig. 1, *G* is a cast-iron ring which is bolted to the milling machine. The worm *H* and the worm-wheel *J* are held in a steel housing *E* that is bolted to ring *G*, a recess being cut in the latter part to receive the flange of housing *E*. The housing is bored out to receive the milling machine arbor and is provided with bushings which support the worm and take the thrust. The ball bearings in which hollow spindle *F* is mounted are held in place by cap *K* and the threaded side plates *M* and *N*. Worm-wheel *J* is bored out to enable it to pass over the ball bearing races in order to facilitate assembling. Bushing *L* is made in two pieces so that it fits the recess cut in spindle *F*. Cap *K* is held in alignment by two sets of keys located at right angles to each other.

The hollow-mills *C* and *D* have bayonet slots milled on one side to permit rapid attachment to, or removal from, the spindle. These milling cutters run at 200 revolutions per minute. The fixture shown in Fig. 3 for holding the work is of simple construction and requires very little explanation. The work is placed in this fixture, and locating mandrels *P* and *Q* are pushed into place to support the work as shown. The wing-nuts are then tightened on hook-bolts *R* and *S*, thus clamping the trunnion-carrying arms of the work against set-screws *T*. Screws *U* and *V* are brought into contact with the work to support it against the thrust of the cut.

* * *

The United States Geological Survey estimates that our reserves of petroleum approximate 9,150,000,000 barrels, which is said to be enough to last only twenty years.

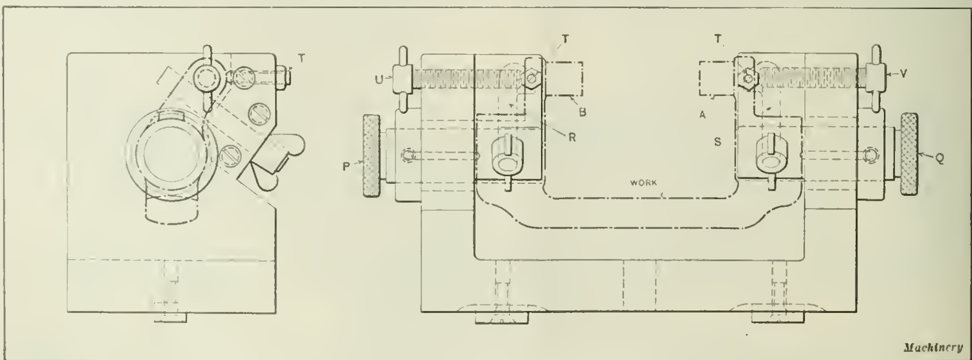


Fig. 3. Fixture for holding Shifter Fork shown in Fig. 2 while milling

The Design of Pull Broaches

Depth of Cut—Pitch—Length—Shape of Teeth—Methods of Attaching Broaches to Machines

By J. LABENSKY and PALMER HUTCHINSON

THERE are few shops that make a practice of manufacturing their own broaching tools, even the larger users of broaching machines having, as a rule, taken the making of broaches away from their own tool-rooms and turned it over to one of the concerns that make a business of manufacturing these tools. This fact is somewhat surprising when one considers that broaches can seldom be purchased from stock like drills, reamers, taps, and dies, but must be made up individually after an order has been placed. This practice may be attributed to the fact that many tool draftsmen are not familiar with the principles governing broach design.

Details in the design of the more widely used styles of broaches have been compiled as empirical data by all the better known broach manufacturers, and although the necessity constantly arises for the design of special tools for which there are no such data, broach usage has progressed far enough for the designer to be able to combine experience gained in making the more common broaches with mechanical common sense, and lay out special broaches that will in nine cases out of ten work successfully when coupled to the draw-head of a machine.

Depth of Cut per Tooth

The first consideration in designing a broach is the amount of stock to be removed from the work by each cutting tooth of the tool. This varies with the material to be cut, the type of broach, and, in some cases, with the length of work, power of machine, and size of broach. When the term "depth of cut," is used in reference to round broaches, it means the total increase in the diameter of a tooth; when referring to spline broaches, the total increase in the diameter of a circular series of teeth; to square, hexagonal, and rectangular broaches, the increase in the measurement across the corners of the teeth; and to keyway cutter-bars, the increase in the height of each tooth. The depths of cut which have proved satisfactory for general cases are given in the following:

ROUND REAMER BROACHES

For steel	0.001 to 0.0015 inch
For brass	0.002 to 0.003 inch
For cast iron	0.002 to 0.003 inch
For babbitt	0.003 to 0.005 inch

SPLINE BROACHES

Ten-spline	0.003 to 0.004 inch
Six-spline	0.003 to 0.005 inch
Four-spline	0.004 to 0.006 inch
Two-spline	0.005 to 0.006 inch
One-spline	0.002 to 0.003 inch

SQUARE, HEXAGONAL, AND RECTANGULAR BROACHES

For steel	0.0035 to 0.004 inch
For cast iron	0.0045 to 0.006 inch

KEYWAY CUTTER-BARS

For steel	0.003 inch
For cast iron	0.004 inch

Pitch of Broach Teeth

The second consideration in the design of a broach, and one of great importance in that the successful cutting action of the tool depends in a degree upon it, and because many of the other broach dimensions are derived from it, is the pitch. Pitch, in its relation to broaches, is defined as the distance between successive teeth, and this distance is controlled by several factors. The pitch determines in part the length of the broach, and so should be made as fine as possible if maximum production is to be attained, because with the modern adjustable-stroke broaching machine, production varies inversely with the length of the cutting tool.

There are limitations, however, to the fineness of the pitch. In the first place, the pitch must be coarse enough to allow ample chip room between the teeth. It will be obvious in this connection that the depth of cut per tooth governs the pitch somewhat. Theoretically, a round broach designed to ream babbitt would have a greater distance between its teeth than a round broach designed to ream steel, because the babbitt-cutting tool would be made to remove a heavier chip than the steel-cutting tool. In practice, this statement would hardly hold, but it is a fact that an ordinary broach has only sufficient room between its teeth to carry off the chips from one cutting stroke. It is for this reason primarily that broach makers emphasize the necessity of brushing the chips from a broach after every stroke of the machine. A few chips left on the tool combined with those of the succeeding cut may tear the work or break the tool. Generally, however, if the other factors that control the pitch are considered, the matter of chip room will take care of itself.

There must always be two, and there should preferably be three, cutting teeth in the work at a time; otherwise, the part being broached will drop down between the teeth. This difficulty may be eliminated, and often is when several thin pieces are stacked for broaching at one stroke, by affixing a support to the faceplate of the machine, which will hold the work rigidly in place. While the number of teeth in the work should never be less than two, there should not be an excessive number cutting at one time. If this is the case, the stress on the tool will be beyond the breakage point or the driving nut of the machine will become heated. Although the amount of pull available at the draw-head of a broaching machine may be readily measured or calculated, there are no adequate data or formulas for determining the power needed to pull the countless sizes and types of broaching tools through the various materials that are broached—from fiber to nickel steel.

From the foregoing it may appear that a draftsman, in deciding on the pitch of a broach, faces a somewhat complicated problem, but such is not the case. Practice has proved

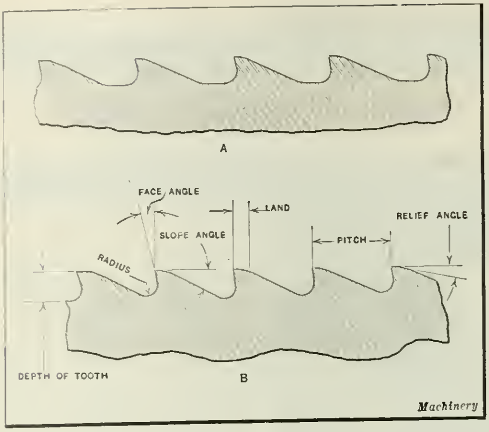


Fig. 1. (A) Flatted Spaces between Broach Teeth; (B) Nomenclature of Broach Teeth

that if the number of broach teeth in the work at a time is somewhere between three and six, all of the considerations relative to pitch are satisfied and the tool will function properly. The broach designer need merely divide the length of the work that the prospective tool is to cut, by a constant in order to determine the pitch, which is calculated to the nearest 1/16 inch. This constant is the number of teeth that should be in the work at one time, and is as follows for several types of broaches: Square broaches, from 3 to 5; spline broaches, from 3 to 6; keyway cutter-bars, from 3 to 6; round broaches, 3; and special-shaped broaches, 3.

Few commercial broaches are made with the pitch over 1¼ inches, and by far the greater part of the work for which broaches are used is less than 10 inches in length. When the work is over 4 inches long, the designer adopts a plan which permits him to keep the pitch 1¼ inches or under in the majority of cases. Teeth 1 inch or more apart are rugged enough to permit the back to be machined away considerably without weakening them to the breaking point; hence the bottoms of spaces between broach teeth of 1-inch pitch and over are usually flatted as shown at *A*, Fig. 1, to give the necessary additional chip room for long work.

Length of Broaches

After the depth of cut per tooth has been determined, the total amount of material to be removed by a broach is divided by this decimal to ascertain the number of cutting teeth required. This number of teeth multiplied by the pitch gives the length of the active portion of the broach or the distance that the tool must taper. By adding to this dimension the distance between three or four straight teeth, the length of a pilot to be provided at the finishing end of the broach, and the length of a shank which must project through the work and the faceplate of the machine to the draw-head, the over-all length of the tool is found. This length is often greater than the stroke of the machine or greater than it is practical to use for a tool of the diameter in question. In such cases, a set of broaches must be used; two, three, four, and five broaches are often necessary to machine a single piece of work, while a set of forty-eight broaches was made during the war to machine the dovetail slots in the recoil cylinders of the U. S. Army 4.7-inch guns. Simple formulas for determining the length of the more common types of broaches in accordance with general practice will be given in the following. In these formulas,

L = length of broach;
S = constant for length of shank (5½ to 6 inches);
W = length of work;
P = pitch of teeth;
T = number of cutting teeth;
B = allowance for sizing teeth on reamer broaches for steel (4 inches); and
F = allowance for pilot on finishing end (¾ to 1 inch).

Round broaches for reaming babbitt or bronze are most often designed with a guiding tooth following each pair of cutting teeth as shown at *A*, Fig. 2. When this is done one of the guiding teeth must always enter the work before the two preceding cutting teeth have left and must not leave the work before the following cutting teeth have entered. Each guiding tooth is made 0.0005 inch less in diameter than the cutting tooth ahead in order to compress the metal and keep the broach from drifting. The reason for making the diameter of the guiding tooth less in diameter than the preceding cutting tooth is because the diameter of the hole becomes less after the cutting tooth passes by, due to the expansion of the metal. The width of the guiding teeth is normally equal to the pitch. The teeth have rounded shoulders instead of keen cutting points, and are neither relieved nor under-cut. Sometimes the guiding teeth are of button shape. This type of tool carries a row of button teeth as shown at *B*, or a long straight section, at the finishing end for burnishing the work. This arrangement gives a compressed and glossy finish to the broached surface. The formula for finding the length of broaches of the type shown at *A* is as follows:

$$L = S + W + 2PT + 8P$$

while for broaches of the type shown at *B*, the length is

$$L = S + W + 2.25PT + 8P$$

Reamer broaches for steel are frequently made similarly to the broaches for softer metals, but are more often made without guiding teeth. In the latter case it is customary to leave three or four straight teeth of the regular pitch at the end of the tapered section, followed by sixteen teeth of equal diameter ¼ inch apart, as shown at *C*. Since these teeth do not remove metal, their pitch may be made as fine as desired. The formula for the length of such a broach is as follows:

$$L = S + W + PT + 3P + B + F$$

The length of square and spline broaches may be determined by the formula:

$$L = S + W + PT + 3P + F$$

The formula for the length of keyway cutter-bars is:

$$L = S + W + PT + 4P$$

Shape of Broach Teeth

In deciding upon the shape of the broach teeth, the considerations are depth of tooth, width of land, radius at base, and the two main tooth angles, which are the face or cutting angle at which the teeth slope forward from the vertical plane, and the slope angle to which the backs of the teeth

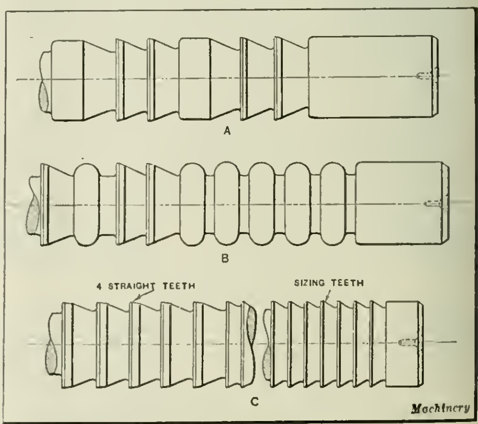


Fig. 2. (A) and (B) Broaches for Soft Metals such as Bronze and Babbitt; (C) Broach for Steel

are ground. This nomenclature will be understood by referring to the diagram at *B*, Fig. 1. The slope is relatively unimportant, as it is developed by connecting the rear of the land with the base of the succeeding tooth before the radius at the base is decided upon. The depth of tooth is usually made from one-third to a maximum of one-half the pitch. On a round broach of 3/4-inch pitch, for example, from 1/4- to 3/8-inch depth of stock would be removed.

The land of broach teeth, as illustrated, is the partially straight and partially angular top of the teeth. It varies in width with the pitch and, on occasions, with the hardness of metal that the broach is to cut. The wider the land, the more times a broach can be sharpened without reducing its size. Consequently, there is a tendency among uninitiated broach users to demand that the tools be made with lands of excessive width; however, if the lands are made too wide for a given pitch they cause the teeth to drag and tear into the work. The following relations between the width of land and pitch have proved satisfactory for general cases:

Pitch, Inches	Width of Land, Inches
1/4	1/32
3/8	1/32 to 1/16
7/16 to 11/16	1/16 to 3/32
11/16 to 1 1/4	1/8

The land is backed off or relieved to an angle of 1 1/2 or 2 degrees for a part of its width, leaving usually from 1/64 to 1/32 inch absolutely flat or parallel to the tool axis.

The arc at the base of broach teeth is by no means a matter to be neglected, either by the designer or by the shop. The shape of this arc must be such as to cause the chip to roll into a compact curl as it is forced down from the cutting point of the tooth. Should the chip strike a flat surface at the base of the tooth, there would be a tendency for it to shatter and be forced out from the space between the teeth. This radius can be determined graphically by simply drawing a smooth curve after the lines defining the face of one tooth and the rake of the preceding tooth have been drawn in. Ordinarily, it will be found that a radius equal to one-half the depth of the tooth gives the desired curve.

The face angle of broach teeth varies with the hardness of the metal to be cut, and determines the cutting keenness of the tool. Teeth on a broach designed for cutting steel usually slope forward from the vertical at an angle of from 8 to 12 degrees, while some slope as much as 14 degrees. For cutting softer metals, such as babbitt or bronze, the face angle is decreased to from 4 to 6 degrees. Broaches for cast iron have the tooth faces ground at an angle of from 6 to 8 degrees in the majority of cases. Efficient broach sharpening demands that the disk wheel of the grinding machine be set to the face angle of the broach teeth and that the sloping surfaces be lightly skimmed with the abrasive, to maintain this face angle throughout the life of the tool.

Methods of Attaching Broaches to Machines

The final consideration in laying out broaching tools is the means of connecting the tool shank to the draw-head of the machine. There are numerous designs of broach shanks;

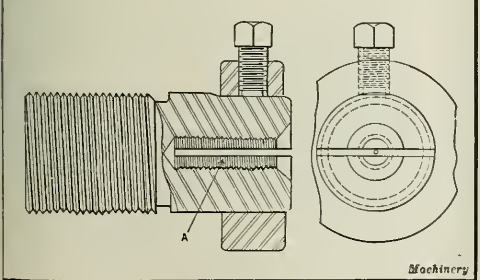


Fig. 3. Pull-bushing intended for Broach with Threaded Shank

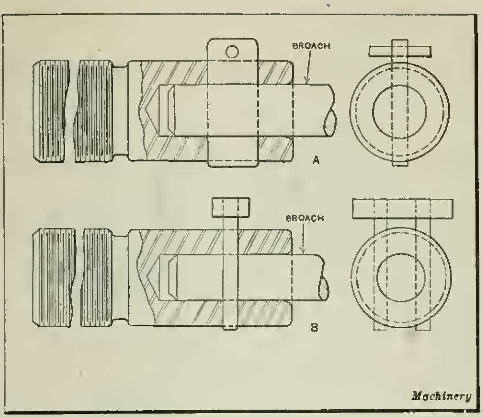


Fig. 4. Types of Pull-bushings employed when Broach must be removed after Each Operation

a common type is the threaded shank, the usefulness of which is limited to keyway cutter-bars or to broaches for machining external surfaces. Broaches of these types do not have to be removed from the machine after each cut. Fig. 3 shows a pull-bushing for a threaded shank broach, the shank being screwed into hole *A*. The large threaded portion of the pull-bushing fits the tapped hole in the draw-head of the machine. Keyway cutter-bars operate in a work-bushing or support. Their shanks are below the outside of the bushing, and so the work may be slipped on the bushing over the projecting end of the bar.

Round, square, hexagonal, spline, and other broaches for machining internal surfaces must be removed from the machine after each cut, and from the standpoint of rapid production it is, of course, impractical to thread the shanks of these classes of tools. Therefore, the shanks of the greater number of broaches in use have a rectangular slot at right angles to their axes. The shanks are inserted in a slotted pull-bushing attached to the draw-head of the machine, and are held in place by a hardened key as shown at *A*, Fig. 4. These shanks must fit snugly in the pull-bushing to prevent the tool from vibrating and possibly breaking under stress.

Many broaches of the sort that must be removed from the machine quickly have two semicircular recesses machined opposite each other on their shanks and at right angles to their axes. These shanks are held in the pull-bushing with a special key, as shown at *B*. This method is particularly applicable when the tools are comparatively light. Occasionally a broach which must be removed quickly is too small in diameter to permit the slotting or milling of recesses or flats on its shank, as in the last of the designs illustrated. In such a case it is the practice to thread the shank to a very fine pitch and grip it by a collapsible pull-bushing consisting of a cam and a split nut, so designed as to release the tool quickly when the cut is completed.

* * *

PROGRAM FOR A. S. M. E. SPRING MEETING

A tentative program for the spring meeting of the American Society of Mechanical Engineers to be held at Atlanta, Ga., May 8 to 11, has been issued. On Monday, May 8, a council meeting will be held in the morning, and the regular business meeting will be held in the afternoon. Tuesday morning, May 9, there will be a joint session of the Textile and the Machine Shop Sections, as well as a meeting of the Material Handling Section. A public hearing will also be held by the Power Test Codes Committee. Wednesday, May 10, there will be another joint session of the Textile and Machine Shop Sections, and also a meeting of the Fuel Section. Thursday, May 11, will be devoted to sessions on management, power, and welding.

Forming and Assembling Dies for Roll Cam

By W. B. GREENLEAF

THE dies described in this article are used in making parts for the roll cam shown at *A*, Fig. 1. The term "roll cam" is applied to this assembled unit for the reason that the two ends or caps serve as rollers, while the central member acts as a face cam. The central member *B* consists of a sheet-metal cylinder with a flanged sheet-metal disk *C* pressed over it, which is shaped in a forming die to give the face or cam surface the required contour. The end caps or rollers, one of which is shown at *F*, are pressed on the ends of the cylinder and must be a tight fit on this member. The assembled roll cam is about 1 1/16 inches long, and the roll ends are 25/32 inch in diameter. The cam has a throw of 0.100 inch. The stock from which these pieces are made is 0.017 inch thick.

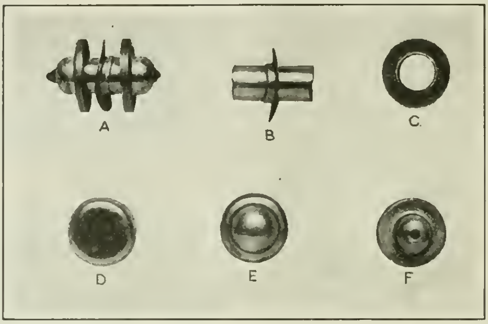


Fig. 1. Sheet-metal Products of Forming and Assembling Dies

Combination Blanking and Forming Die

In Fig. 2 is shown the combination die used to blank and perform the first forming operation on the cap shown at *F*, Fig. 1. The first forming operation is accomplished in two stages. After being blanked by punch *G* the continued downward movement of the press ram causes the blank to be formed over forming punch *H* to the shape indicated at *D*, Fig. 1, the relative positions of punch *G* and pressure-ring *I* being shown in the upper right-hand corner of Fig. 2. Ring *I* is just long enough to release the shell from all pressure between punches *G* and *H* at this stage.

The second stage of the forming operation, which forms the shell to the shape shown at *E*, Fig. 1, is completed at the end of the downward stroke of punch *G*. At this stage of the forming process, punch *G* has depressed pressure-ring *I* until it rests on the thin hardened steel washer *K*, and has forced the forming punch *H* and the heavier hardened steel washer *L* downward against the pressure of springs *M*. This action carries the blank down over the punch *N*, forming it to the shape indicated at *E*, Fig. 1. On the return stroke of the ram the blank is stripped from punch *N* by the forming punch *H* which is forced upward by pins *O*, actuated by springs *M*. Pressure-ring *I*, actuated by spring *J*, and acting through the four pins *P*, strips the blank from forming punch *H*. At the end of the upward stroke, knock-out *Q* comes into action and ejects the formed shell from punch *G*. The shell now has the shape indicated at *R* in Fig. 2 and at *E*, Fig. 1.

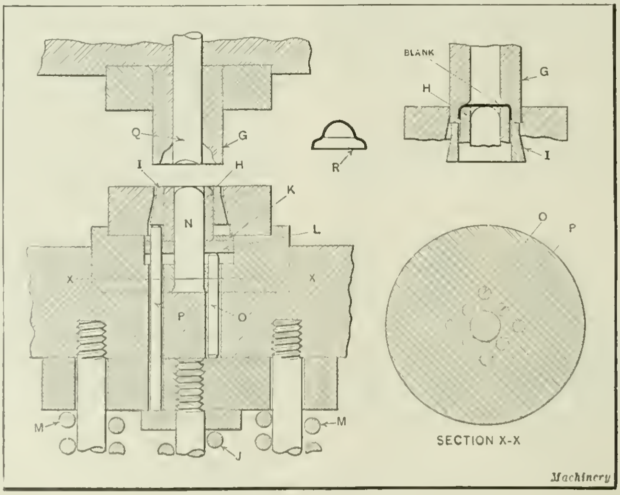


Fig. 2. Combination Blanking and Forming Die for Part F, Fig. 1

Piercing and Second Forming Punch

The piercing and the final forming operation which brings the piece to its finished form, as shown at *F*, Fig. 1, is performed by the die shown in Fig. 3. After being blanked and formed by the die shown in Fig. 2, the piece is placed on the die *T*, Fig. 3. On the downward stroke of the ram, punch *U* surrounds the outer edge of the flange of the work and holds it in the recess in the top of the die while the cap part is redúced to the proper size and the hole is pierced by punch *V*. At the end of the downward stroke sufficient pressure is exerted on the top of the flange to square the corners, flatten out any inequalities in the upper surface, and also flatten out irregularity in the edge caused by the drawing operation.

Blanking, Piercing, and Flanging Die

In Fig. 4 is shown a die for blanking, piercing, and turning up the flange on the cam blank shown at *C*, Fig. 1. The die- and punch-holders *A* and *B* are similar to those used in the dies in Fig. 2. The work is blanked by the tool-steel die *C* and pierced and flanged by die *D*. The tool-steel knock-out pad *E* is actuated by a spring *F*, acting through three pins, one of which is shown at *G*. The point of screw *H* projects into a slot in pad *E*, and thus serves to retain the latter member in the blanking die. *I* is the tool-steel blanking die, and *J* the piercing punch, which is supported in a machine-steel block *K*. The tool-steel knock-out pad *L* is a close sliding fit in punch *I*, and as it is also a close fit over punch *J*, it serves to support and keep the latter member in proper alignment. The two pins *M*, which pass through holes in washer *N*, are actuated by the press knock-out at the end of the upward stroke, thus causing the knock-out pad *L* to strip the work from the punch. From the illustration it will

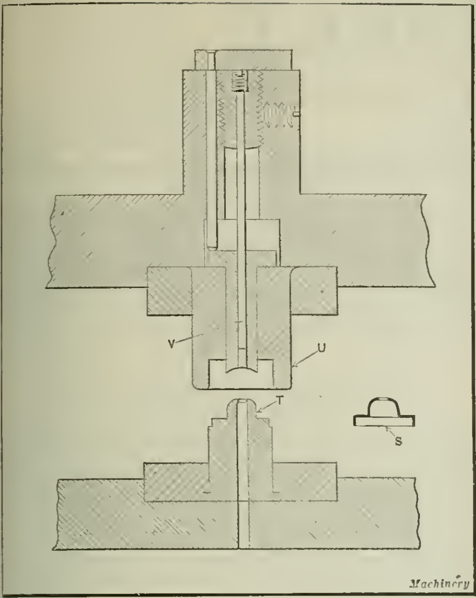


Fig. 3. Die for Piercing and Final Forming Operation

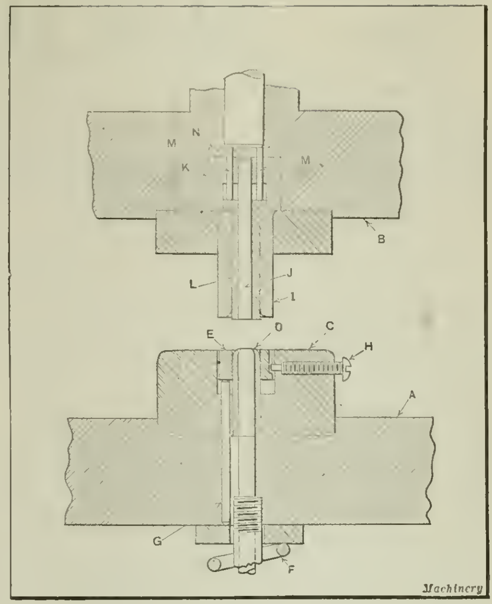


Fig. 4. Die for blanking, piercing, and turning up Flange

be evident that the center hole is pierced first, after which the piece is blanked and a flange formed as the punch continues downward. This die and the two previously described are used in inclined presses so that the pieces drop out at the back.

Assembling Die

In Fig. 5 is shown the die employed to assemble the flange *C*, Fig. 1, on the metal cylinder, and at the same time give the face or cam surface the required contour. In operating this die, the cam-plate is set on die *A* with the flange down and fitting into the recess provided for it. The cylinder is then inserted in die *B*, in which it is a loose fit. The cylinder also fits snugly over the end of punch *C*, which serves to hold it in position. On the downward stroke of the press ram, the cylinder is driven through the cam-plate until it rests in the seat in die *A*. While the piece is held in this position the punch or mandrel *C* passes through the entire length of the cylinder.

The final step in the assembling operation is the bending of the plate into the form of the cam. This bending also contracts the hole so that the flange grips the cylinder with sufficient force to hold it in this position. It should be mentioned here that the end of die *B* is formed to the shape of the cam contour, as is also the mating surface on die *A*, although this is not shown in the illustration.

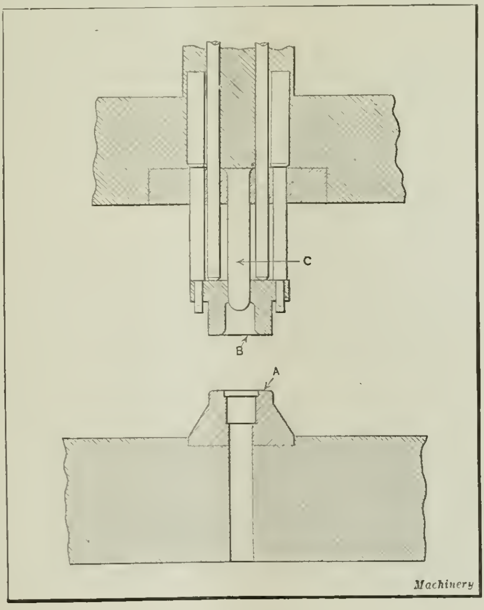


Fig. 5. Assembling and Cam-forming Die

CALITE—A HEAT-RESISTING ALLOY

Calite, an alloy containing iron, chromium, nickel, and aluminum, is the result of experiments conducted by metallurgists of the General Electric Co., for the purpose of finding an alloy that would withstand high temperatures, could be quenched repeatedly, and would be highly resistant to oxidation. Annealing boxes made from calite have been run for 1500 heat-hours without warpage, growth, or failure. The metal runs freely when molten, and any casting which can be made of steel can also be produced from this alloy. Sections as low as 3/16 inch in thickness have been successfully cast. Calite cannot be machined in the cast condition nor cut with an oxy-acetylene torch; hence, it must be finished by grinding.

This new alloy is said to resist oxidation up to about 2375 degrees F., but a working temperature of 2200 degrees is recommended. Calite is practically non-corrosive, samples having been polished and subjected to a spray of saturated sea-salt solution at 100 degrees F. for 200 hours without any effect on the polish. The physical properties are: Melting point, 2780 degrees F.; softening temperature, 2500 degrees F.; specific gravity, 7.03; weight per cubic inch, 0.25 pound; Brinell hardness when annealed, 286; scleroscope hardness when annealed, 40; thermal conductivity, 25 per cent that of iron; and tensile strength, 36,800 pounds per square inch.

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NEW TOOLMAKING CENTERS

In June MACHINERY an article reviewed the gradual westward movement of the machine tool industry, which forty years ago was almost entirely located in New England, New York, New Jersey and Pennsylvania. During the interval, the industry so developed in the Middle Western states that at the present time a line drawn north and south through Rochester, N. Y., would divide the machine tool building business almost equally.

In the making of jigs, fixtures, power press dies, gages and small tools, New England also had but little competition until recent years; but many plants of considerable size producing such tools are now located in the Middle West. This is a natural result of manufacturing conditions in the Middle West, where there are many large plants that require special tooling equipment, the manufacture of automobiles being centered in Detroit; and large plants are located throughout Michigan, Ohio, Indiana and Illinois. Within the last ten years several of the cities in these states have become important tool-building centers, particularly Dayton, Columbus and Urbana, Ohio; Detroit and Chicago. Some of the plants in these cities have been very highly developed for the purpose of building special tools, partly because of the exacting requirements of the automobile business and partly because of the demand for tooling equipments and gages for war materials and munitions during the war. Entirely new tool building centers have been developed to supply the demands of the great Middle Western territory, which, during the last two decades, has developed so rapidly in metal-working and manufacturing. Meanwhile, New England tool manufacturers continue to hold their own, the increased industrial activities of recent years providing an outlet for the greater tool building capacity.

* * *

THE CENSUS OF MACHINE TOOLS

February MACHINERY recorded for the first time in the history of the industry the census figures giving the total number of machine tools of various types built in this country, and their value. The Department of Commerce has done the industry a distinct service by compiling these statistics, for such information is of practical value to our manufacturers. The statistics published covered 1919, but in future a similar census will be taken every other year. The Bureau of Census is now collecting figures covering the production in 1921; and, as such information loses value by delay in publication, it is hoped that this material will be available for publication much sooner than were the 1919 figures. Even with all the delay in the publication of those returns, the Bureau established a record for the prompt handling of such material.

Manufacturers should aid the Census Bureau to the utmost extent in collecting data of this kind. All information given to the Bureau is confidential, and only figures showing totals are published. No individual manufacturer's name is disclosed, and in case a manufacturer produces only a single line of machines so different in classification that it could be identified if grouped alone, it will be classed with a broader group of machinery so as to absolutely prevent the identification of any concern's output in the published report.

In addition to figures relating to production and the value of the product, the machine tool census in future will give the number of men employed and the percentage of employment in the industry. These statistics will refer not only to the entire country, but also to each of the most important machine tool manufacturing states. The information which the Census Bureau is endeavoring to supply has been needed greatly by machine tool manufacturers, and they should facilitate the work by making prompt returns on the blanks furnished them by the Bureau, which will thereby be enabled to give out the figures for early publication.

* * *

SYSTEMATIZED COST REDUCTION

In a well-known plant recently visited, a systematic effort is being made to improve manufacturing methods and reduce operating costs. A committee of the leading mechanical men is devoting its time during the prevailing depression to a thorough study of methods employed throughout the entire works. This committee takes up one department at a time, beginning with that where the raw material is received, and continuing its study all the way to and including the shipping department. The work is not done in a hurry, and no process or operation is considered too unimportant for careful thought. The department foremen are interviewed and their suggestions carefully noted, and the men operating the various machines are also given an opportunity to offer suggestions for increasing the output or improving its quality.

Much lost motion has been eliminated by improvements in methods, tooling equipment and machines. Sometimes the machinery is rearranged to facilitate the operations. Old machines have been scrapped and new ones to replace them investigated and decided on, even if not ordered.

Before changes are made, the practical points are usually talked over with both the foremen and operators, so as to insure their approval and cooperation. In this way harmonious relations are maintained, and when a new method is put into operation or a new machine installed, all do their best to help make it successful. This practical attempt at systematized cost reduction is not yet completed, but what has been accomplished so far shows that it is possible to reduce costs materially and meet the new level of prices at a profit. This method of reviewing the entire manufacturing process of a plant is easy to carry out under present conditions, and is recommended to manufacturers generally.

* * *

THE DEFINITION OF "DEDENDUM"

In spite of all the efforts to standardize engineering nomenclature, the meaning of many engineering terms is still vague and subject to different interpretations. A technical term without a definite and accepted meaning is likely to cause serious confusion, and an important step in standardization work is to agree on the precise definitions of terms.

In the gearing field the meaning of most of the terms used has been, through common usage, generally established, except the term "dedendum," which is used by some manufacturers and in some books of reference as meaning "the distance from the pitch circle to the root of the tooth," thus including the clearance allowed at the root; whereas others use the term as meaning "the distance from the pitch circle to the clearance circle." In the latter instance the dedendum, in standard-tooth gears, is equal to the addendum.

The American Gear Manufacturers' Association is giving serious consideration to the definition and standardization of terms used in gearing, and doubtless will soon settle what is actually meant by the term "dedendum."

Service of the Tool and Contract Shop

FIFTEEN years ago comparatively few shops were engaged exclusively in the designing and making of special tools, jigs, fixtures, gages, etc., on a contract basis for other manufacturers. Today there are a great many contract shops all over the manufacturing area of the United States, and some have so developed in size and reputation that they stand on a par with the great manufacturing shops. This remarkable development is due to the highly specialized service such shops can render, combined with a wider recognition of the importance of well-designed tool equipment as a means of increasing the efficiency of machine tools.

Toolmaking versus Manufacturing

All large manufacturing plants maintain tool designing departments and tool-rooms for designing and making the tooling equipment required in the regular manufacturing routine and for equipment maintenance; but it is usually found impracticable to maintain a designing force and a toolmaking department extensive enough to adequately meet the requirements for complete tooling equipments to put new products on a manufacturing basis. In cases of that kind it has been found more profitable to call in the tool specialist—the shop that devotes all its time to designing and building special tools, jigs, fixtures, and gages. In so doing the manufacturer utilizes the special experience of men trained in developing manufacturing equipment, men who from year to year handle manufacturing problems in many different industries, and acquire a knowledge of manufacturing problems much wider than can be obtained in any other way.

The Economy of Specialization

The tool and contract shop is simply a logical development of the modern principle of specialization in manufacturing. In the early days many manufacturers built their own machine tools for making machines for other purposes—in fact, some of the well-known machine tool builders in the country started as makers of other products—rifles, sewing machines, textile machinery, etc. In the course of time they found it necessary to develop machine tools for use in building these machines and devices, and ultimately they became known as machine tool builders rather than as makers of their original products. The time has passed, however, for the makers of other lines to undertake the manufacture of their own machine tools. It is far more economical to buy machine tools from those who specialize in them and who thereby have brought the American machine tool industry to the highest standard established anywhere in the world.

In regard to special tools, jigs, and fixtures, we are passing through a transition period. Up to a few years ago it was the common practice of all manufacturers to make most of their own tooling equipment—at least all equipment that could not be obtained directly from the manufacturers of machine tools. Now the tendency is more and more to have tooling equipments built by specialists in this branch, just as machine tools are built by specialists in that field. In New England and in the Middle West we find large shops devoted exclusively to supplying other manufacturers with tools, fixtures, and gaging equipments; and while years ago, when a new enterprise was started, the first thing was to find a corps of tool designers and toolmakers, today all this preliminary work may be handed over to shops especially fitted to do it. Hence, the plant can be equipped right from the start to do manufacturing instead of tool work.

Just as it makes for economy and efficiency to have specialists build machine tools, so it is found that it makes for economy and efficiency to have specialists design and make tooling equipments of all kinds. The next ten years will probably see a still further development along these lines, with a higher degree of specialization and consequently a greater degree of economy and service.

The Influence of the War upon the Tool Shops

The peculiar value of the tool shop became apparent during the war period, when many shops, unable to provide their own tools, were obliged to turn to outside sources for assistance. Hundreds of tool and contract shops were started during this period—a great many more, in fact, than could be profitably employed during normal peace times. Some of these are out of business, but many have survived and will continue. The experience they gained during the war period will prove invaluable to them and to the industries in peace times.

It is safe to say that the remarkable rapidity with which the United States entered into war production was due, in no small measure, to the experience, skill, and ability displayed by the tool and contract shops. Accuracy and refinement in mechanical processes were demanded of them to an extent never before required in interchangeable manufacture, and they measured up to these exacting requirements in a remarkable degree. Some of the accurate measuring and inspection devices now finding increased application in the mechanical industries were developed by the contract shops during this period. Methods of grinding threads, for example, were first placed upon a commercial basis in the making of thread gages in quantities for munitions and ordnance. Some of the very large machine tool plants, in fact, were turned into contract shops for the time being, and their main business consisted in supplying the war industries with the equipment required for manufacturing and inspection.

Standardization in Tooling Equipment

With the general development of the tool and contract service came definite efforts toward standardization in tooling equipments. While this work has not advanced very far yet, there is no doubt that the next few years will see great progress along these lines, which should materially reduce the cost of making jigs and fixtures. The contract shop with thoroughly standardized parts for such tools can produce a manufacturing equipment much cheaper than a tool-room in which each jig and fixture, and each separate part, must be made as a separate unit. The up-to-date contract shop has a great advantage and a real opportunity.

Another line along which standardization has progressed is in the making of interchangeable gage units of various types, so that when a gage unit which is subjected to the greatest wear becomes unsuitable for further use, this unit may be replaced. In the past, gages were generally so designed that when one part was worn, the gage was discarded.

The value of specialization in the tool equipment field cannot be over-estimated. The tool and contract shop has made a definite and highly important place for itself, a place that will become increasingly important with the multiplication of products and of manufacturing processes, and the realization of greater refinement in mechanical procedure. We have a well defined and well developed machine tool industry and a definite small tool industry, and it is confidently expected that within a few years we shall have a large and important tool equipment industry.

GAGING AND ASSORTING PISTON-RINGS

By HARRY LEVENE

In order to gage or measure accurately finished piston-rings of the regular split type, it is necessary to employ special gages and exercise considerable care in performing the gaging operations. A method of measuring piston-rings that has proved especially useful in separating an assortment of rings of the same nominal diameter into their respective over-size lots is described in the following. This method was developed by the Wilkening Mfg. Co., Philadelphia, Pa., and is used in this company's plant with excellent results.

In gaging or measuring a ring, it is first placed in a cylinder or gage of a known internal diameter. The diameter of the gage should be approximately equal to that of the ring. While performing this operation care should be taken to see that the ring lies in a plane perpendicular to the walls of the cylinder. One of the three following conditions will be observed when the ring is properly located in the gage: (1) The ring will fit the cylinder or gage properly; (2) the gap opening will be larger than the normal opening, showing that the ring is under size; and (3) the ends will be in contact or will overlap, showing that the ring is over size.

Ring of Correct Diameter

The normal gap of a ring is that gap *G*, Fig. 1, which exists when the ring is placed in a cylinder of exactly its own diameter. The width of this gap varies with the make of the ring, but 0.002 inch per inch of ring diameter represents an average value. If the measured gap of the ring fulfills this condition, the diameter of the ring is the same as the diameter of the cylinder.

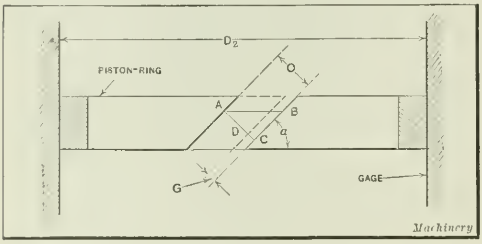


Fig. 1. Under-size Ring in Gage

Under-size Rings

When the opening is greater than the normal gap of the ring, it indicates that the diameter of the ring is less than that of the gage. The amount of the opening, that is, the distance between the ends of the ring, measured on a line at right angles to the angular surfaces of the ring ends, is determined to the nearest thousandth inch by means of a thickness gage. This value *O*, indicated in Fig. 1, the known values of gage diameter, and the angle at which the ring is split, are substituted in the following formula to find the diameter of the ring.

$$D_1 = D_2 - \frac{O - G}{\pi \sin a} \quad (1)$$

in which D_1 = diameter of ring;
D_2 = diameter of gage;
G = normal gap of ring = DC;
O = opening = AC;
a = angle at which ring is split.

Over-size Rings

The third condition—the ends of the ring being in contact or overlapping as shown in Fig. 2—indicates that the diameter of the ring is greater than that of the gage. The amount of this overlap can be measured by means of a thickness gage, and substituting this value *O*, Fig. 2, in the formula

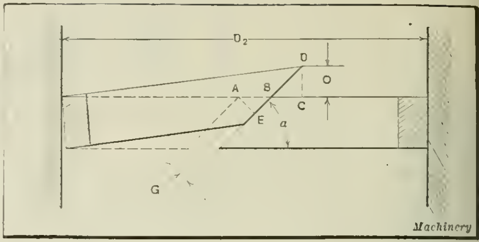


Fig. 2. Over-size Ring in Gage

$$D_1 = D_2 + \frac{G + O \cos a}{\pi \sin a} \quad (2)$$

will give the diameter of the ring. In this formula,
D_1 = diameter of ring;
D_2 = diameter of gage;
G = normal gap = AE;
O = overlap = DC;
a = angle at which ring is split.

The angle at which the ring is split is usually 45 degrees, but it is occasionally made 30 degrees. If the angle is not known, it can, of course, be readily measured. Formula (2) for the third case is not applicable to step-joint rings or to any kind of ring in which the ends cannot slide upon each other. Formula (1), however, can be used for step-joint rings, such as shown in Fig. 3, in which case the angle at which the ring is split is 90 degrees, and the formula thus becomes

$$D_1 = D_2 - \frac{O - G}{\pi} \quad (3)$$

Actually none of these formulas gives absolutely exact results, because they are based on the assumption that the ring will be in contact with the cylinder wall at all points on the circumference, but, nevertheless, they will prove of sufficient accuracy for practical purposes, provided the diameters of the gage and the ring do not differ by more than 0.040 inch.

The separation of an assortment of rings of the same nominal diameter into their respective over-size lots, is easily accomplished by using a gage having a diameter 0.040 inch over size, and employing Formula (1) for rings split on an angle, and Formula (3) for step-joint rings. All the factors in the formulas, except the diameter of the ring and the opening of the gap, remain constant. A table which gives the opening corresponding to each over-size diameter can be made up for this work. A table of this kind will give, without further calculation, the diameters of the over-size rings, and will greatly facilitate the work of separating the rings into different lots so that those of the same diameter will be grouped together.

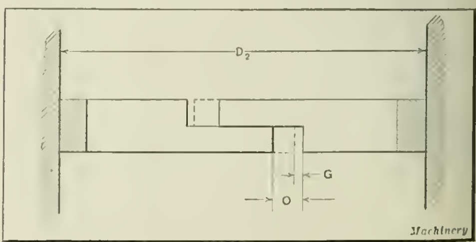


Fig. 3. Under-size Step Ring in Gage

The British Machine Tool Industry

From MACHINERY'S Special Correspondent

London, March 10

THE engineering industry in this country is dependent on the carrying out of several important projects that were delayed by the war. Chief among these is the conversion of many existing sections of railways, not only here but all over Europe, in the Far East, and in South America, from steam to electric power. The General Electric Co., Witton, has recently been awarded an important contract in connection with the extension of the electrified sections of the London Brighton & South Coast Railway, and several other English railways have similar projects that will soon be carried out. The machine tool industry is bound eventually to feel the good effects of these and other long delayed but far-reaching developments; at present, however, few direct results are to be noted.

General Industrial Conditions

During January there was a record output of shipbuilding, the total tonnage launched on the Clyde being 52,000. As very little new work is in hand, such an output brings the worst days nearer. There is some activity in the foundries and sheet-metal industry, aluminum, malleable and cast iron workers being in greater demand than for the last twelve months. Press-tool makers are also in demand.

C. A. Vandervell & Co., Ltd., the well-known manufacturers of electric lighting and starting equipment for automobiles, have undertaken at their Brighton works the manufacture of small tools on a quantity basis. Although they have been occupied with this work for only nine months, they already have a good output of a wide range of these tools, which include plain and spring type inside and outside calipers, spring dividers, toolmakers' parallel clamps, clamp vises, V-blocks, scribing blocks, tap wrenches, and toolmakers' squares.

British Industries Fair

Although the exhibits at the British Industries Fair, now being held in Birmingham and London, are too diverse to be truly representative of any trade, it is significant to note that the number of exhibitors is in excess of previous years and now totals over 500. The general engineering group of exhibits includes machine tools and small tools, hydraulic equipment, sheet-metal working machines, measuring and testing apparatus, heat-treating equipment, foundry, drop-forging and die-casting equipment, and conveying and lifting appliances.

The Machine Tool Trades Association, Inc., reports a successful year, and is able to point to much useful work on behalf of firms who are members of the association. The membership now stands at 142. In a recent ballot on the question of protecting the British machine tool market from being flooded with foreign machines, a motion was carried to the effect that the government should place import duties on all machine tools coming from countries where exchange values had collapsed. The Board of Trade is now giving consideration to these suggestions.

Foreign Trade

In foreign markets, India is the most active machine tool buyer, although of late there has been rather more demand from Australia and Japan. January showed, as compared with the preceding month, a slight increase in imports as well as in exports. The figures for the month were as follows: Imports, 275 tons, valued at £30,538, or £111 per ton. Exports, 1096 tons, valued at £167,021, or £152 per ton. A mean line taken through a graph of the exports of machine tools for last year shows that both in value and in tonnage exports declined at a steady rate, and at the end of the year were only half the figures for the beginning of 1921.

Iron and Steel Trades

The iron and steel trades are slowly reviving. Orders are coming in steadily from home consumers, and some fairly good business has been booked for overseas in the commoner varieties of steel. Crucible steels are also in better demand. It is reported that a further huge surplus stock of high-speed steel has recently been discovered at Constantinople, packed as it left the Sheffield Works some years ago for Russia. This adds to the heavy surplus, said to be sufficient to cover munition-making requirements for twenty years, which was discovered some months ago in the possession of the government. Apart from these stocks, the United States continues to be the best customer for high-grade steels, and there is a moderate demand from India and Japan; home inquiries are also becoming more numerous.

Better feeling prevails in the pig-iron industry, and makers are beginning to reap some benefit from their recent action in cutting prices. A number of important sales are understood to have been put through recently, and from present inquiries it appears that there is a fair amount of business to be placed by home consumers. A notable feature is the export of several thousand tons of pig iron to Germany. In amount the business is comparatively trivial, but this shipment is significant when it is remembered that during the greater part of last year conditions were such that Great Britain, from her former position as an exporter, came to be an importer. Thus the import figures for the three months ended December 1921, were 315,800 tons, as compared with a monthly average of 18,000 tons, during 1912-1913.

Conditions in the semi-finished material field are developing on similar lines. In the majority of cases British manufacturers have nothing to fear from Continental competitors in the overseas markets, and while India and Far Eastern countries are still taking German materials, the bulk of the business is passing into British works.

Developments in Machine Tools

Machines for cutting accurate gears are, perhaps, the outstanding development of recent years in the machine tool industry in this country. The advances are illustrated by statements recently made by leading gear-cutting machine manufacturers: J. Parkinson & Son, Shipley, state that one of their 5A rack type cutter machines will cut 132 feet of finished teeth per hour in cast iron, the gears machined having 156 teeth of 12 diametral pitch and 13/16 inch face. Muir & Co., Manchester, say that they are cutting in one of their rack type cutter machines 180 feet of ½-inch pitch teeth per hour, the cast-iron gears having 44 teeth, 1½ inches wide. On steel quadrants they are cutting 1½-inch pitch teeth, 5 inches wide, at the rate of 50 feet per hour. The Power Plant Co., Ltd., West Drayton, tells of cutting, in an 8½-hour day, 400 cast-iron gears having 44 teeth, 1¼ inches wide, of 6 diametral pitch. The machine was equipped for the purpose with six pinion type cutters operating simultaneously. The Power Plant Co., Ltd., has also aroused considerable interest with a one-tooth pinion meshing with a 63-tooth wheel. The pinion tooth is of the double-helical type and the pitch circle diameters are 0.508 inch and 32.004 inches, respectively. The gear has transmitted 10 horsepower at 1000 revolutions per minute.

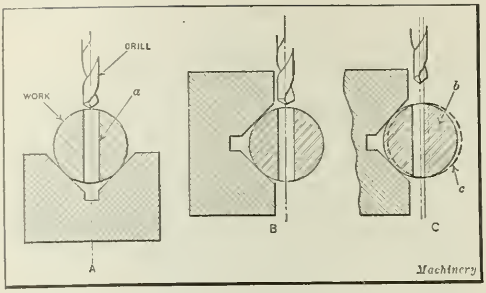


Fig. 1. Effect of Location of V-block on Accuracy of Work

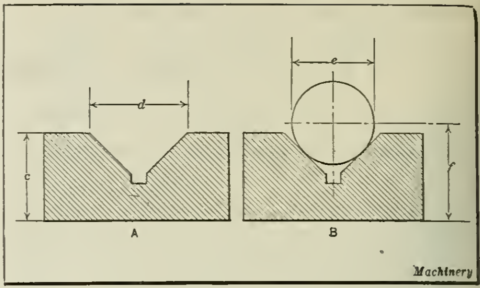


Fig. 2. Methods of dimensioning V-blocks

GENERAL DETAILS OF V-BLOCK DESIGN

By GENE PHELPS

The use of V-blocks in the design of tools often receives too little consideration from the designer. A careful analysis will show that many errors resulting from the incorrect application or design of V-blocks could easily be avoided. It is the purpose of this article to make clear the conditions that govern the use of various types of V-blocks in the shop, and to point out methods of avoiding the mistakes most commonly made by designers and draftsmen in designing V-blocks or in making provision for their use.

The limits of accuracy required on the work must first be considered, since this governs the general design. The view at *A*, Fig. 1, shows a round shaft in the position it occupies while the hole *a* is being drilled. In this view the V-block is shown in a horizontal position while at *B* it is shown tipped up, or in a perpendicular position. If the work is located and drilled as shown at *A*, any variation in its diameter does not affect the center line of the drilled hole, whereas if it is located as shown at *B*, a variation in diameter results in throwing the center of the work out of line with the center line of the drill. In the view at *C*, work *b* is of the correct size, while that indicated by the dotted lines at *c* is a little over-size. It will be apparent that a difference of 0.002 inch in diameter, for instance, will result in throwing the center line of the drilled hole more than 0.001 inch out of line with the center of the work. For strictly interchangeable work, where the accurate location of a hole such as that indicated at *a* is required, the location of the V-block must be given careful consideration.

Dimensioning V-block Drawings

Drawings for V-blocks are often dimensioned incorrectly as shown at *A*, Fig. 2. It is impossible to obtain satisfactory results when this method of dimensioning is employed, especially if the center line of the work is required to be located a given distance above the table on which the V-block is to be placed. The view at *B* shows the proper method of dimensioning a drawing of a V-block required for accurate work. It will be noted that the diameter *e* of the work is given, and that the distance *f* from the base of the block to the center line of the work is also given. This method of dimensioning should invariably be employed if the center of the work, when placed in the V-block, is required to have a definite position relative to some other point.

Grinding V-blocks

The grinding of the sides or angles of a V-block intended for production work is one of the most common mistakes made in the tool-room. At *A*, Fig. 3, is shown a V-block which is ground on the sides *b* and *c*, and provided with a groove *d* to facilitate the grinding and machining operations. A V-block of this type, if intended for production work, is not practical, as it is evident that a round piece of work would bear only on two points. As these bearing points wear very rapidly, the result would be that of constantly lessening the distance between the center of the work and the base or bottom of the block. If the work is not required to be very accurate, this slight wear can, of course, be ignored. At *B* is shown a V-block of similar design to that shown at *A*, but which is lapped at the locating points *f* and *g* instead of having ground sides. The lapping operation produces small lands at *f* and *g* which locate the work very accurately. It is obvious that the location of the work is as accurate with the block shown at *B* as with that shown at *A*, and that the increased bearing surface of the lapped block gives added assurance that it will maintain its accuracy much longer. In making drawings for V-blocks of this kind, the dimension *h* from the base to the center line of the work should be given. In machining the block, proper allowance should, of course, be made for lapping.

The deep relief or groove cut in V-blocks to facilitate machining often causes cracking as shown at *c*, Fig. 4, when the block is hardened. This is especially true of shallow V-blocks of the type shown at *A*. It is evident that the small amount of stock indicated by dimension *b*, together with the sharp corners at the bottom of the groove, make it difficult to harden the block properly without producing cracks. At *B* is shown a V-block in which the neck has been eliminated. It will be noted that the dimension at *c* is considerably increased in this case, which greatly lessens the danger of cracking when hardening. When this type of block is used for production work, it will be found advisable to employ the lapping method of finishing, as indicated at *B* in the illustration Fig. 3.

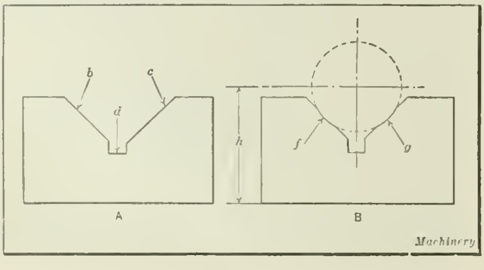


Fig. 3. Ground and Lapped V-blocks

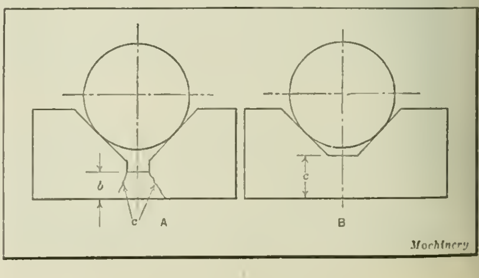


Fig. 4. Shallow V-block Design

INDUSTRIAL CONDITIONS IN FRANCE

By MACHINERY'S Special Correspondent

Paris, March 13

French business men are watching with interest the rising value of the franc in relation to the dollar and pound sterling, because it is felt that any considerable increase in the value of the franc would cause a grave reaction on the economic situation. It would be necessary to reduce salaries proportionately, and, furthermore, stocks would depreciate in value. A reduction of ½ per cent on the tax payable on interest received from state bonds is seriously considered. Such a measure would have an excellent effect on trade.

Business in General

There has been no marked improvement in business conditions taken as a whole, although there is considerable activity in the automobile field. The Renault company has taken on 5000 workmen during the last few months. Besides automobiles, this concern also manufactures locomotive parts, Diesel engines, and a few machine tools. The machine tool field continues to be very quiet. The output of the coal mines in the Bassin du Nord region increases daily, and the deficiency caused by Germany's defaulting in the delivery of coke has been made up. The production in the devastated regions during 1921 was about 5,365,000 tons—a considerable increase over the figure for 1920 of 2,450,000 tons. In 1913 the production was 18,660,000 tons.

Effect of New Customs on German Machine Tools

The heavy duties imposed by France on German machine tools lead American and British dealers to look forward to increased sales. The increase in the value of the franc also tends toward that end. The duties imposed on German machine tools cf various weights are as follows, considering the value of the franc as 9 cents:

Weight	Francs per 100 Kilograms	Dollars per 100 Pounds
Over 25,000 kilograms (about 27.5 tons)........	132	5.40
From 5000 to 25,000 kilograms (5.5 to 27.5 tons).	158.4	6.50
From 1000 to 5000 kilograms (1.1 to 5.5 tons)...	211.2	8.60
From 250 to 1000 kilograms (550 pds. to 1.1 tons).	316.8	12.90
250 kilograms and under (550 pounds)..........	660	26.90

The duties imposed on other foreign machine tools are only one-fourth those levied against German products.

Taking a double-head Lincoln-type milling machine of German make, as an example, the method of calculating the final price would be as follows: Price quoted, 4125 francs; customs duty, 2217 francs; importation tax, 45 francs; and customs clearance fee, 26 francs, making a total of 6413 francs (about $580).

According to quotations, the prices of other standard German machine tools, considering the mark worth 5.5 centimes, are approximately as follows: A continuous vertical milling machine weighing 4000 kilograms (about 4.4 tons) costs 22,450 francs (about $2000) or about 5.6 francs per kilogram; a vertical boring mill weighing 8000 kilograms (about 8.8 tons) costs 37,900 francs (about $3400) or 4.73 francs per kilogram; a Landis-type threading machine weighing 1050 kilograms (about 2300 pounds) costs 6090 francs ($550) or 5.8 francs per kilogram; and a lathe weighing 4300 kilograms (4.75 tons) costs about 21,700 francs ($1950) or about 5.05 francs per kilogram.

Prices of American Machine Tools

The prices of high-grade American machines, based on the weight, range between 8 and 10 francs per kilogram (32.6 to 40.8 cents per pound). A vertical milling machine of well-known American make, weighing 1300 kilograms (2870 pounds), is offered for sale at 13,000 francs (about $1170) which amounts to 10 francs per kilogram. A universal milling machine weighing 3200 kilograms (3.5 tons) sells for 31,360 francs ($2820) or 9.8 francs per kilogram. Taking price and quality into consideration, one of the large French dealers handling German and American machines believes that there is little difference from a sales standpoint between the machines received from the two countries. French buyers, however, are still tempted by the lower price of the German machines, this being partly due to the effective work of German salesmen. The price of French machine tools varies from 8 to 10 francs per kilogram, which is the same as for American machines.

* * *

MACHINE TOOL INDUSTRY IN SWEDEN

The building of machine tools in Sweden began to be of some importance between the years 1840 and 1850. In the early development of the industry each machine shop made all the machine tools required in the manufacture of its particular product, but after a few years a number of shops began to specialize on certain machines and build them as a commercial product; and machine tools eventually became their principal line.

As far as quantity and variety are concerned, the production of machine tools in Sweden cannot compete with that of the United States, Germany, or England, all of which have enormous domestic markets. The Swedish manufacturers of machine tools have based their production on the home consumption and have not paid much attention to the export market. The natural result is that the manufacture of machine tools in Sweden embraces only the types and sizes which are most in demand by Swedish industrial enterprises. They are those general utility machines which can be produced in considerable quantities even though the area of the market is limited. As a general rule it may be stated that heavy and expensive machines and special-purpose machines of the type of which only one or a few are required in any one factory, are not manufactured in Sweden.

Lathe Production and the Market for Lathes

Lathes form the major part of the machine tools manufactured in Sweden. In 1914, prior to the war, there were at least three Swedish concerns of considerable size engaged in the manufacture of modern types of lathes—the Köping, Munktell, and Lidköping Works. In fact, the Swedish production of standard types of lathes had at that time grown to such proportions as to meet the domestic demand. An export market had also been obtained in the neighboring Scandinavian countries, as well as in Finland, Russia, and some of the other smaller countries. At the Baltic exhibition in Malmö in 1914 the design and quality of workmanship of the Swedish lathes aroused favorable comment by German engineers, and by the German technical press.

The war brought on an enormous demand for lathes and some of the European belligerent countries were unable to supply the manufacturers of war material with the necessary quantity of these machines. This presented an opening for the Swedish machine tool builders, which they were not slow to take advantage of. Not only did the previously established machine tool manufacturers engage in supplying this demand, but many other manufacturers started building lathes, with the result that a large export trade with Russia, England, France, Germany, and Austria was developed. Although most of this export trade was of a temporary nature, it resulted in the older establishments enlarging their plants and improving their methods so that they are now better prepared to compete with those of foreign make than before.

Machine Tools other than Lathes

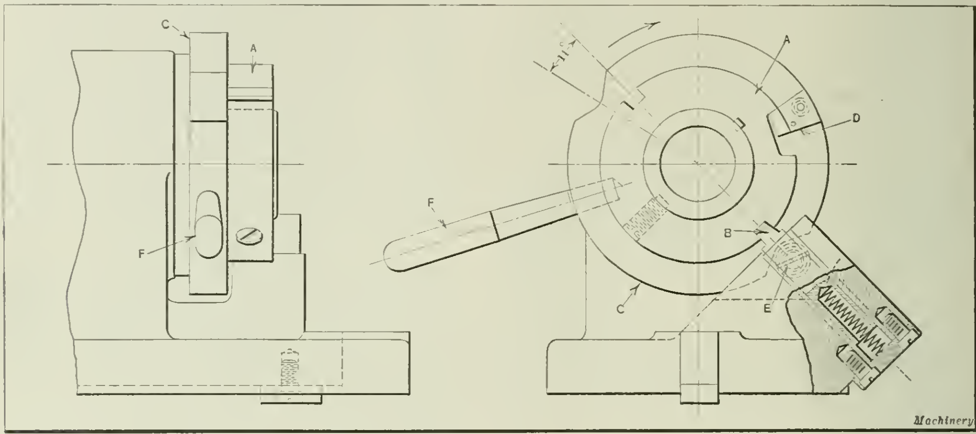
Planers and shapers of standard types are manufactured in Sweden in sufficient numbers to satisfy the domestic demands. Before the war there had been some export trade developed with the neighboring Scandinavian countries. Power presses, drop-hammers, and forging machines of different types are also among the machines produced by the oldest of Swedish machine tool manufacturers. Very few machines of these classes are imported into Sweden. Other kinds of machine tools manufactured in Sweden are drilling machines, milling machines, and boring machines.

INDEXING MECHANISM WITH AUTOMATIC PAWL RELEASE

Many designs of jigs and fixtures require an indexing movement for locating work in different positions relative to the cutting tool. It is common practice to so arrange the indexing device that the locating plunger or pawl must be released with one hand while the work-spindle is turned with the other. The indexing mechanism shown in the accompanying illustration is so arranged that the locating pawl is automatically released and the work-spindle can be rotated from one position to the other by means of a single hand-lever *F*.

This indexing mechanism is arranged for holding the work-spindle in two positions, 180 degrees apart, as governed by the notched locating plate *A*, which is engaged by plunger *B*, the latter being pressed inward against the plate by a spring. Adjacent to the notched locating disk there is a pawl-releasing plate *C*. This plate has two curved recesses, and one of these must be opposite roller *E* on the pawl whenever the latter is in engagement with the locating plate. When plate *C* is turned clockwise, as indicated by the arrow, roller *E* rides up on the periphery of *C*, thus forcing the pawl back out of engagement with the locating notch. As the work-spindle cannot rotate until the pawl is withdrawn, plate *C* is permitted to turn independently about 14 degrees, or far enough to allow roller *E* to be forced backward out of the locating plate.

This independent movement of plate *C* occurs while dog *D* is moving across to the opposite side of a slot formed in plate *A*. The movement of disk *C* relative to the work-spindle also causes the roller recess on the other side to move around 14 degrees, or until it is in alignment with the locating slot on that side; consequently, the pawl is free to engage this slot after the work-spindle has been turned one-half revolution. This indexing mechanism is used by the designing department of the Pratt & Whitney Co., Hartford, Conn., whenever such a device is required for jig and fixture work.



Indexing Mechanism with Automatic Pawl Release

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An international exhibition of foundry equipment and materials will be held in Birmingham, England, June 15 to 24 in connection with the annual convention of the Institution of British Foundrymen. The exhibits will be shown in Bingley Hall, and will embrace every phase of foundry work.

TEN YEARS' EXPORTS OF MACHINE TOOLS TO GREAT BRITAIN

In 1912 Great Britain imported $2,678,995 worth of machine tools and metal-working machinery from the United States; by 1914 her imports of American machines had increased to $3,174,333. Owing to the war demands, the British market rose abnormally during the period 1915 to 1918, reaching a maximum in 1916 when $20,434,934 worth of American machines were imported. This represented an advance of nearly 600 per cent over the 1914 market. Since the war there has been a rapid decline from this high level. During the last two years there has been a growing tendency for Great Britain to increase her exports of machine tools and metal-working machinery, with a corresponding decrease in imports of these machines, the imports of American machine tools and metal-working machinery for 1921 amounting to only $2,698,321.

The statistics show that in 1912 Great Britain consumed 22 per cent, in 1913, 21 per cent, and in 1914, nearly 23 per cent of the total American exports of machine tools and metal-working machinery. Although in 1921 Great Britain consumed only 14 per cent of the total exports, this 14 per cent represented, in dollars, slightly more than the 22 per cent taken in 1912, as the amounts in the table show.

Detailed statistics are not available for the years previous to 1918, but it is interesting to note from the table the changing demands for various kinds of machines during the last four years. In 1918, 1919, and 1920 American machine tools were in much greater demand in Great Britain than other metal-working machinery, but during 1921 the market for the latter rose slightly above the demand for machine tools.

VALUE OF MACHINE TOOLS AND METAL-WORKING MACHINERY EXPORTED TO GREAT BRITAIN, 1912-1921

Year*	Lathes	Sharpening and Grinding Machines	Other Machine Tools	Total of Machine Tools	All Other Metal-working Machinery	Total of Machine Tools and Metal-working Machinery
1912	....	....	....	....	....	$2,678,995
1913	....	....	....	....	....	3,411,143
1914	....	....	....	....	....	3,174,333
1915	....	....	....	....	....	12,292,312
1916	....	....	....	....	....	20,434,934
1917	....	....	....	....	....	16,296,923
1918	$5,122,556	$2,095,703	$4,506,135	$11,724,394	$6,671,134	18,395,528
1919	2,895,800	1,620,892	4,385,274	8,901,966	6,307,914	15,209,880
1920	1,772,918	1,202,833	3,275,285	6,251,036	4,748,061	10,999,097
1921	134,630	177,497	754,967	1,067,094	1,631,227	2,698,321

Machinery

*Amounts given are for fiscal years up to and including 1918 and for calendar years thereafter.

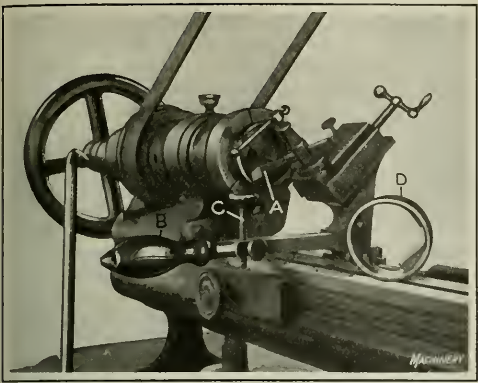


Fig. 1. Set-up employed for threading the Bezel Case of a Dial Gage on a Bench Lathe

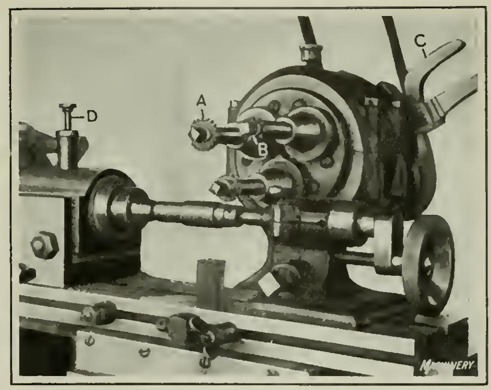


Fig. 2. Milling Machine with Special Cutter-head for machining Gage Train Wheels

Tooling Equipment and Methods Used in Making Dial Gages

Some Interesting Operations Performed in the Stickney & Randall Plant, Waltham, Mass.

By ROBERT MAWSON

THE thickness dial gage manufactured by Stickney & Randall consists of a stand, on the upright part of which there is fitted, by a tongue and groove construction, a vertical bearing for the stem of the table. The table and the stem are integral, and adjustment and location are obtained by means of adjusting screws. Fig. 3 shows the application of the gage for testing the location of a hole in the dial case. This case is fitted to the top part of the casting, which is machined to receive it, and through it extends the gaging spindle *A*, which is operated by the lever shown at the left side of the gage. The registry mechanism for the dial provides for obtaining readings in thousandths of an inch by means of the long hand, and in ten-thousandths of an inch by the short hand.

The first operation to which attention is directed is performed with the set-up shown in Fig. 1 and consists of threading the bezel case. This part is cast from a special hard composition and is held in the chuck of a Stark bench lathe. The threading tool *A* is fed to the correct depth by operating handle *B* which is carried by the lead-screw at the rear of the lathe. The proper depth of thread is obtained by the adjusting screw *C* which, after the adjustment has been obtained, can be locked in the correct position by means of the knurled screw on the side of the arm of the attachment. The case may be clearly seen at *D*, the casting being 2 inches in diameter and containing 32 threads per inch cut internally with the equipment shown.

Fig. 2 shows a Stark bench milling machine equipped for machining the steel train wheels of the dial gage. Twenty-five of these wheels, or gears, are placed on an arbor at a time and the outside diameter is machined to the correct measurement by cutter *A* carried on one of the three spindles of a special index milling head. The second spindle, which is the one shown in position for machining the wheels, is used to rough-cut the teeth, and the third spindle *B* performs the finishing operation on the teeth. In machining brass wheels spindle *B* is not required. For machining the outside of the wheels, both the cutter *A* and the arbor revolve, the speeds and feeds being so arranged that the spiral cut taken will reduce the diameters of the stack of blanks to the size required. After the head has been indexed by operating the lever *C*, the arbor is held stationary by pin *D* in the index-head during the cutting of the teeth. The blanks are machined with 100 teeth and the index-head is operated by a gear and index-pawl at the extreme end of the head.

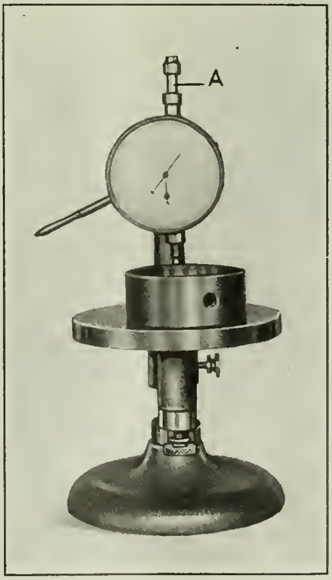


Fig. 3. Gaging the Location of the Spindle Hole in the Dial Case

Use of Jeweling Caliper to Obtain Force Fit

A number of small pinions and the staffs or studs on which they are assembled are shown on the ways of the bench lathe in Fig. 4. It is important that the staffs and pinions of all the gages have the same degree of fit, and to obtain this result a jeweling caliper, commonly used in the watchmaking industry, is employed. The staffs are made on an automatic and there is some slight variation in their diameters, so that some method must be employed to compensate for this variation. The pinion is bored out with the tool carried on the end of the push-spindle *A*. The radial adjustment of this tool to provide the necessary degree of fit is obtained by placing the staff between the jaws of the caliper as shown at *B* and using

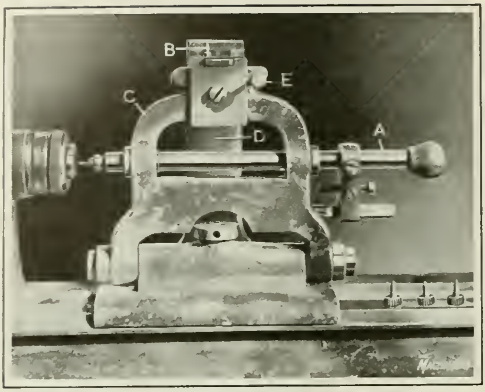


Fig. 4. Jeweling Caliper for obtaining Force Fit between the Pinions and the Staffs

it to gage the amount of metal removed in the boring operation on the pinion, which is later to be assembled on the staff. The pinion is chucked from the outside diameter as shown, and the arm *C*, which fulcrums on a shaft at the base of the tool, is swung forward until its jaw grips the staff. The stationary jaw (which does not show clearly in the illustration) is carried on the column *D*. If it is desired to bore the pinions with a larger hole than is required for a force fit, the necessary adjustment is obtained by the adjusting screw *E*, the point of which is brought up against an ear on the stationary column *D*.

After the arm which carries the spindle has been properly located, the operator pushes the boring tool into the revolving pinion, the spindle being provided with long bearings to maintain the correct alignment. By this method the pinion staff hole is bored slightly smaller than the outside diameter of the shaft or just enough to allow a good drive fit. After the gage has once been set, it requires no readjustment until all the parts have been completed. The length of travel of the spindle is governed by a stop on the spindle near the rear bearing.

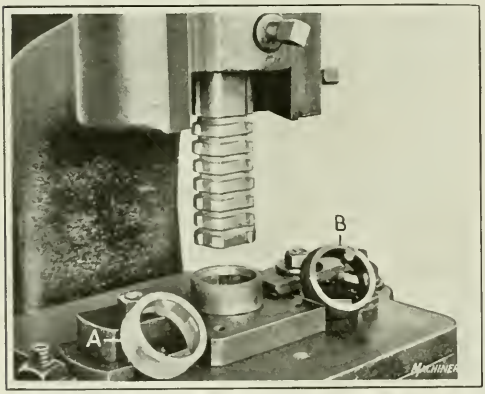


Fig. 5. Broaching the Inside of the Dial Case

Operations on the Dial Case

The broaching of the inside of the case is shown in Fig. 5. This work is done on a screw press—a bench tool commonly used in watchmaking and similar work. The casting is placed on the table of the machine and is located in relation to the cutting edges of the broach by a short pilot. The pilot and the broach are of special shape as required by the irregular contour machined. A casting before and after broaching is shown at *A* and *B*, respectively, and another case partly machined is shown in position under the broach.

The drilling of the bushing holes in the cases is shown in Fig. 6. The bushings that are assembled in these holes furnish the bearings for the gaging spindle or stem *A*, Fig. 3, and these holes must be drilled accurately to bring the center line of the gaging spindle parallel with the face of the case. Previous to this operation the outside of the case is turned and ground to size; it is located in the jig shown by means of adjustable V-blocks and stop-pins at the rear fitting against the lugs on the inside of the case. The V-blocks slide in the jig and may be clamped in the desired position by machine screws. The holes to be drilled are not radial, and so in order to start the drill correctly and prevent it from pushing over to one side when starting, the spotting tool shown at the left is first employed. After a hole has been drilled through from one side, the spotting

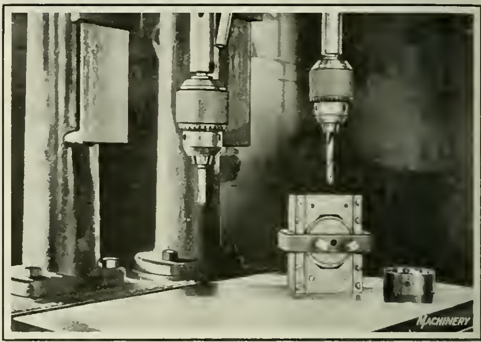


Fig. 6. Drilling the Holes through which the Gage Spindle operates

and drilling operation is repeated on the opposite side by simply reversing the position of the jig on the table.

For inspecting the parallelism of the spindle hole in the case and for checking its location relative to the face, the work is placed on the table of a regular thickness dial gage, as shown in Fig. 3, and the spindle *A* provided with a wide foot to extend into the hole and register its location from the surface of the table. By repeating the operation on the opposite side of the case the parallelism can also be checked. It is important to hold this degree of parallelism to the closest possible limits so that the gage stem will slide smoothly in its bearings.

Drilling Pillar Plates for Train Wheels

A bench type of multiple drilling machine which is used for drilling the train wheel plates of the dial gage is illustrated in Fig. 7. The plates, which are simply plain circular

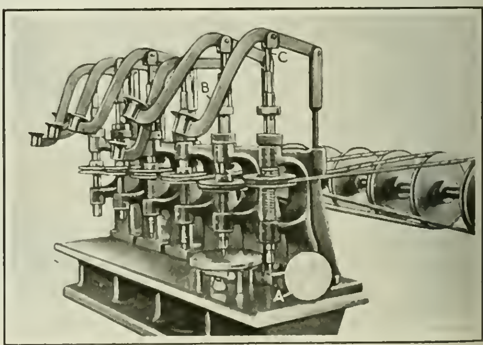


Fig. 7. Bench Type Multiple Drilling Machine on which the Pillar Plates are drilled

disks shown at *A*, are located in a four-legged drill jig, being clamped on the under side by a circular cover-plate which fits the outside of the work. To load this fixture, it is simply necessary to invert it, slip the work under the clamping straps, and tighten the wing-nuts which bind the clamping dogs firmly in place.

The drilling machine has six spindles, driven by twisted rawhide belts from a countershaft at the rear of the machine. The countershaft is adjustably supported so that it may be raised or lowered when changing the tension on the belt. Hand feed is used, the operator simply forcing down lever *B* which hinges in the yoke end of connection *C*, the opposite end of this connection being fitted to the end of the spindle by a loose ball and socket joint. When lever *B* is released

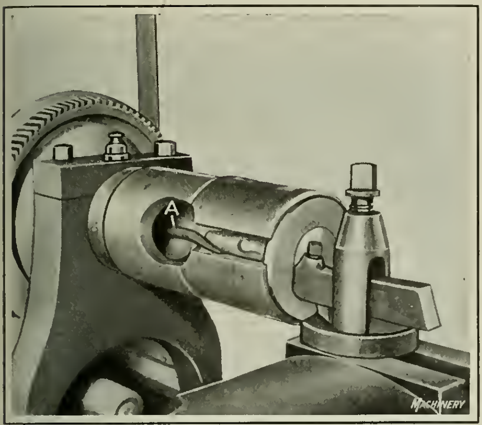


Fig. 8. Equipment used in facing the Base of the Gage Stand

at the completion of the drilling operation, the coil spring interposed between the spindle driving pulley and the lower bearing, returns the spindle and drill to the upper position. Multiple-spindle drilling machines of the bench type, such as this one, are extensively used in the manufacture of various parts of dial gages.

Machining the Gage Stand

The first operation performed in machining the gage stand —facing the base—is shown in Fig. 8. The design of the piece being machined is shown at *A* in Fig. 10. It will be seen that there is a pad on the part of this stand to which the bearing for the table stem is fitted. In facing the base,

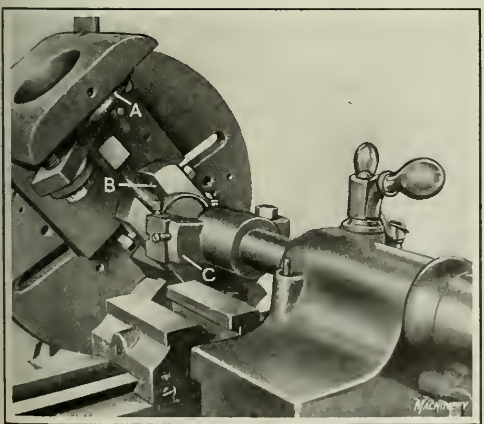


Fig. 9. Lathe Set-up for machining the Stand to receive the Gage Head

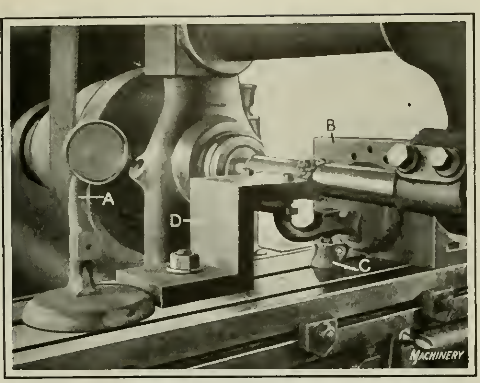


Fig. 10. Milling the Pad to which the Table Stem Bearing is attached

the casting is placed in a cylindrical fixture, seated on the end, as shown in Fig. 8, the upright part extending in and being drawn firmly into position by a hook *A*, which engages the casting back of the dial case cup section; this hook is operated similarly to a draw-in chuck. The nut is screwed up by the operator until the casting is located against the face of the fixture, after which the facing operation is performed in the usual manner.

The stand is then machined to fit the gage head, in the fixture shown in Fig. 9, which is attached to the faceplate of a lathe. The base *A* of the casting is located against a foot on the angle-plate fixture and clamped by means of straps. A slot *B* locates the work properly relative to the center of rotation and also drives it through two screws

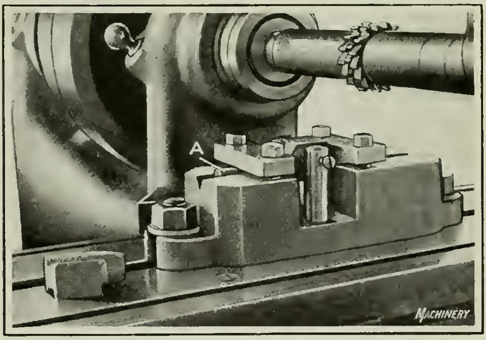


Fig. 11. Equipment used for milling the Surfaces by which the Table Stem Bearing is fitted to the Stand

which bind the work in place. The operation consists of turning the outside and inside surfaces of the circular wall within which the dial indicating mechanism is contained. and the work is performed with a special tool-head *C* in which both the tools required for the operation are carried.

In machining the pad to which the table stem bearing is attached, care must be taken to machine this surface so that when the table is assembled in the bearing, the center line of the stem will be normal to the base of the gage. The pad is machined with a tongue, using a gang of three plain milling cutters. A simple angle-plate fixture *B*, Fig. 10, is employed and a screw-jack *C* for supporting the piece during the operation and preventing distortion caused by the thrust of the cutters. The gage-head end of the casting is clamped to the double angle-plate *D*, both this plate and the one against which the base is attached being located on the machine table by tongues engaging the central table slot. By this set-up the machined surfaces are maintained in correct relationship to each other.

Other Equipment Used in the Manufacture of the Gage

Equal care must be taken when machining the fit for the table stem bearing casting. This casting is shown lying on the table of a milling machine in Fig. 11 before being machined, and located in the fixture after the operation has been completed. Before the work comes to this machine, the stem hole is drilled and reamed in a lathe, no special equipment being employed. The casting is then placed on an arbor *A* which fits the reamed hole and extends beyond at each end, being located on the fixture by a V-groove in which the projecting ends of the arbor rest. The gap in the fixture allows the casting sufficient clearance space, and the chips from the cutters accumulate in this cut-out section instead of in the V-groove. The casting is located in an upright position between two adjusting screws carried in posts at opposite sides of the fixture, and is secured to the fixture by ordinary spring-supported straps. The method of locating and clamping the work should be apparent from the illustration. A gang of three milling cutters is employed to mill the groove corresponding to the tongue on the pad of the gage stand, which was milled with the equipment illustrated in Fig. 10.

Fig. 12 shows the grinding operation performed on the face of the gage table *A*. The turned stem of the casting is held in the fixture *B* by a clamp bolt which tightens the split bearing in which the stem fits. A very simple type of workhead is employed, which is mounted rigidly on the table of the machine and driven by a belt in the regular way. After the work has been secured in the fixture, the table of the machine is fed in and then traversed back and forth across the grinding wheel until the desired results are obtained. This gives the surface of the gage table a smooth finish and assures that it will be exactly at 90 degrees with the center line of the stem and consequently parallel with the base of the stand.

The final inspection of the indicator is made with the device illustrated in Fig. 13. The finished indicator is attached to a disk *A* which has a stem by means of which the disk is locked and adjusted radially in a split bearing *B* in the head of the shaft *F*. This allows for inspecting indicators of various sizes. It will be noticed that the indicator is not shown in the position that it would occupy if it were actually attached to the disk, but is tipped so that the readings on both the indicator and the micrometer thimble *C* may be observed. The micrometer head may be located on shaft *F* by means of a pin lever which binds the split bearing where desired. Final longitudinal adjustments of the micrometer spindle are accomplished by the knurled screw *D*, and the spindle itself may be removed from its bearing for convenience in changing the arm *E* in which it is carried. With the instrument located so that the indicator spindle is in alignment with the micrometer spindle, the micrometer spindle is brought into contact with the end of the indicator spindle, both readings registering zero. As previously mentioned the adjusting screw *D* is used to bring the micrometer reading to the exact zero mark on the micrometer thimble. If the indicator is correct, the readings on the micrometer head and on the gage dial will correspond as the micrometer thimble is turned. Shaft *F* carrying the entire set-up may be revolved in its bearing and located to obtain the best lighting effect for the inspector.

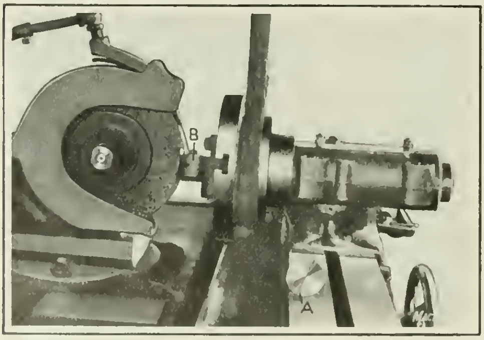


Fig. 12. Grinding the Face of the Gage Table

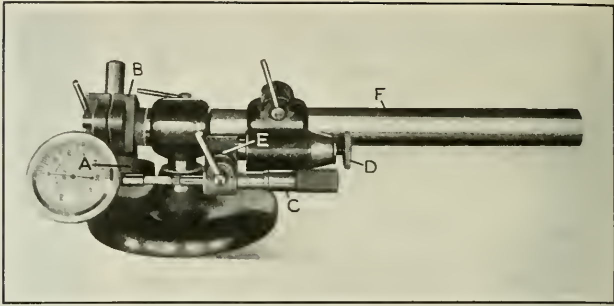


Fig. 13. Equipment used in the Final Inspection of the Indicator

* * *

STANDARDIZATION ACTIVITIES

The American Engineering Standards Committee has just completed arrangements by which cooperation with the standardizing bodies in other countries will be made more effective. In order that all standards shall be available to the industries of the various countries, it is planned that each national body will sell the approved standards of the other bodies. The American Engineering Standards Committee, 29 W. 39th St., New York City, has available the publications of the standardizing bodies in Austria, Belgium, Canada, France, Germany, Great Britain, Holland, Sweden, and Switzerland.

The work of standardization in the iron and steel field in the United States has been furthered by the addition of two new member bodies—the American Railway Association (Engineering Division) and the Association of American Steel Manufacturers—to the American Engineering Standards Committee. The Association of American Steel Manufacturers is an organization of forty iron and steel manufacturing companies. Its activities are limited to the standardization of rolling mill practices, and to the standardization and inspection of iron and steel products. The American Railway Association, which represents practically all the steam railways of the country, has four great technical branches, each having its own secretary, the Engineering and the Mechanical Divisions, the Signal, and the Telephone and Telegraph Sections.

* * *

The feasibility of arc-welding alloy steels has been demonstrated by the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. With adequate mechanical treatment and heat-treatment, tensile strengths of 130,000 pounds per square inch have been obtained in the weld. The possibility of forging arc-deposited metal has been clearly demonstrated, as well as the resistance of the forged metal to fatigue stresses; this widens the field of application of the process. Progress has also been made by the company in percussive welding. It has been shown that materials can be quickly and efficiently welded by this method, which cannot be so united by any other known method, and uniform welds can be produced.

REFITTING BEARINGS IN AUTOMOBILE CRANKCASES

A specially designed boring-bar and fixture is used in the shop of the Detroit Cadillac Motor Car Corporation, New York City, for line-boring the bearings of automobile crankshafts. This equipment, which was made especially for Cadillac automobile repair work, has been the means of greatly increasing the accuracy of the job and decreasing the time required to perform it.

When the crankshaft journals of a Cadillac motor have been found to be worn so far under size and out of round that it is impracticable to fit bearings to them, the crankshaft is removed from the case and the three journals are ground to a uniform diameter, depending on the condition of the crankpins. In fitting new bearings to this reground shaft by the old method, a large amount of hand scraping and fitting was required. By the new method, the cases are first fitted with three under-sized bearings supplied by the factory, and these are placed in position in the crankcase after the shaft has been reground, and are then line-bored. A view showing the top of the crankcase with the boring-bar and fixture in place is shown in Fig. 1, and Fig. 2 shows the underneath side of the fixture.

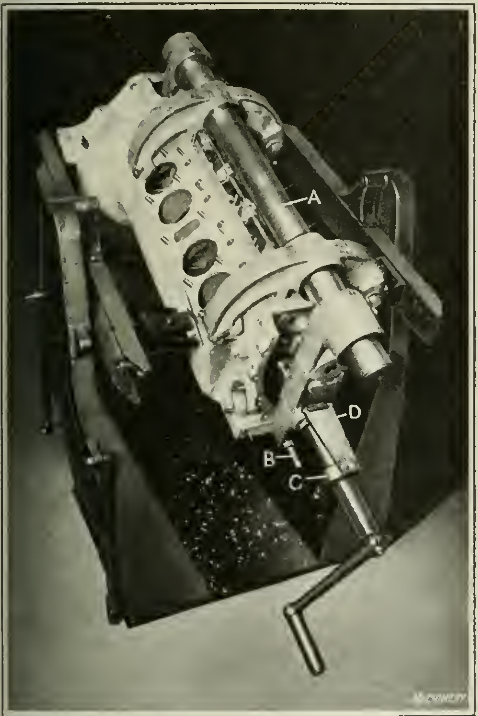


Fig. 1. Boring-bar and Fixture used for refitting Main Bearings of Crankcases

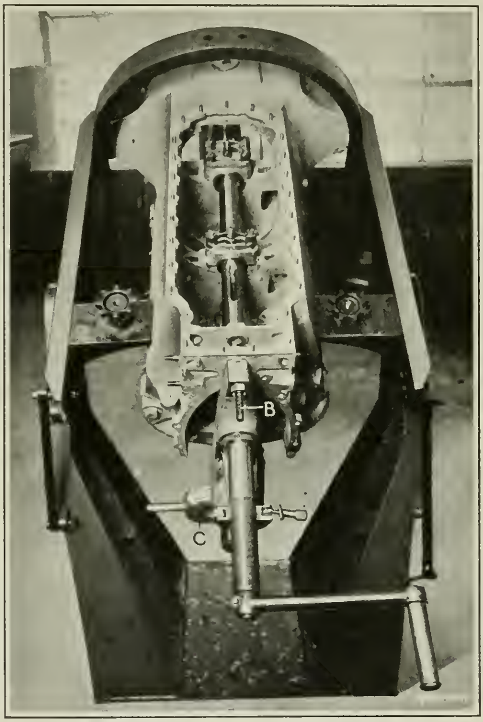


Fig. 2. View of Reverse Side of Crankcase, showing Interior and Bar in Place

This boring-tool consists of a single bar in which three cutters are carried, the cutters being set radially 120 degrees apart. The cutters operate simultaneously, one on each bearing. A rigid fixture is provided for supporting the bar, as shown in Fig. 1. This consists of a heavy steel bar *A*, to which two heavy double-armed castings are fitted, the extending ends of which carry accurately ground pads, which are designed to rest accurately on the crankcase cylinder block faces. As a secondary means of location, a locating pilot *B* is used at the front end of the fixture which is inserted into the oil-pump drive shaft bushing on the casting.

Fig. 2 shows the method of supporting and clamping the case while the bearings are being bored, as well as the method by which the bar is located and the feeding arrangement. Here the feed-nut *C* which is hinged over the threaded boring-bar is shown open for the purpose of illustrating how the nut is closed and clamped on the bar. This nut is carried by an arm *D*, Fig. 1, which may be swung into a vertical position when the tool is not in use; then the hinged member of the nut is closed around the bar as shown. The threaded part of the boring-bar, which constitutes the feed-screw, is of very fine pitch, and the cutters are fed through the bearing by turning the handle at the end of the bar.

The three cutters on the boring-bar are set to bore out under-sized bearings to a diameter 0.002 inch greater than that of the ground crankshaft journals. Great care has been exercised in the manufacture of this boring-bar, and it is stated that even with the bar pulled out so that no support is afforded at its further end, the end will not run out more than 0.0005 inch. The operation of fitting these main bearings, including setting up the bar and its cutters, takes approximately one hour. The former method of fitting these bearings to a reground shaft took about ten hours and could not be done even then with the same degree of accuracy that is possible with this tool.

* * *

NATIONAL FOREIGN TRADE CONVENTION

The ninth national foreign trade convention will be held in Philadelphia May 10 to 12. Some of the important topics to be considered at this meeting are the following: Financing foreign trade; the merchant marine; foreign investment; taxation; education for foreign trade; banking facilities; sales promotion; foreign competition; foreign credits; combination for export; foreign advertising; and the stimulation of foreign trade.

Organization of a Large Tool Division

Duties of the Various Members and Units of an Organization Responsible for the Development of Quantity Production Tools

By H. P. LOSELY, Industrial Engineer, Detroit, Mich.

THE manufacture of a new product in a plant in large quantities and with a sufficiently low cost to compete with other manufacturers of the same product necessitates the making of special tools, jigs, and fixtures, the number of which depends, of course, upon the number of component parts of the product and the operations on each part. In addition to this, although special tools are being used in the making of an established product, increased competition occasionally necessitates the redesigning of tooling equipment to permit the product to be more economically or satisfactorily made. The supplying of a large plant with tools of this class obviously involves a tremendous amount of work, and tool superintendents are frequently unable to handle it efficiently, due mainly, to the system under which the tool division operates. In the following, a description is presented of a tool division organization which is based on the experiences of four manufacturing concerns, three of which developed tools for a new product, while the fourth constantly makes tools to suit contract orders.

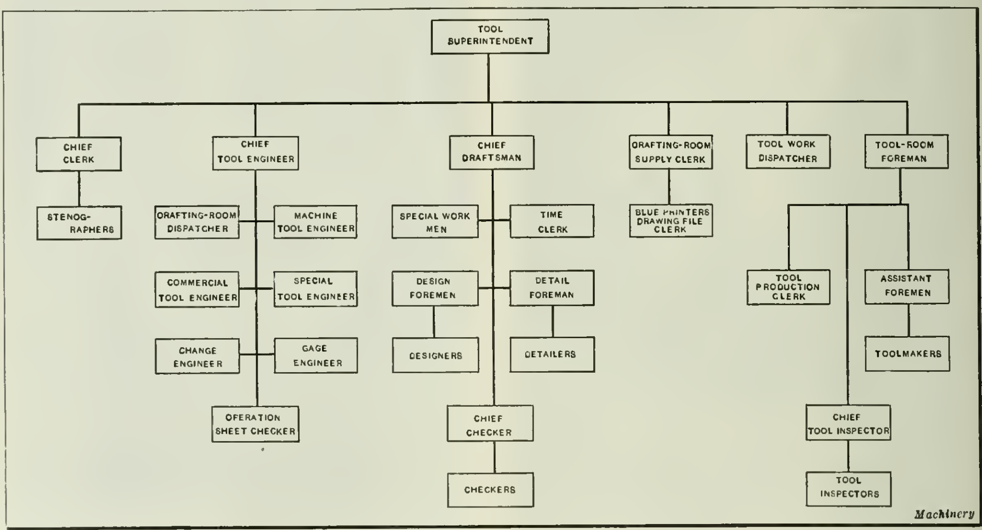


Fig. 1. Organization Chart for a Large Tool Division

Graphic Representation of Tool Division

A chart showing the arrangement of the members and units of the tool division to be described is illustrated in Fig. 1. In this organization it is intended that between one and two hundred men are to be employed on the activities covered; with a smaller organization, some of the functions assigned to several men should be combined and assigned to one. Objections may be raised that there are too many bosses and too much overhead with this scheme. The fact is that in cases where the design foremen attend to all the functions here assigned to separate men, they cannot supervise many designers without neglecting them and often making them wait for work. This causes a waste of time more costly than the employment of a few specialized men to line up all the details of operation. Above all, the lack of centralized responsibility for each division of the work is certain to cause a lack of coordination, which requires a great deal of trouble to straighten out, or if not discovered, results in inefficient plant operation—for instance, excessive or insufficient equipment may be used, or work may not be assigned to the most suitable department.

The main burden of preparatory work falls on the chief tool engineer and his assistants, and their duties will be detailed at length. If their work is properly done and the drafting-room is well directed, the tool-room will get correct orders in the proper sequence. Furthermore, orders will be so distributed that the tool-room can meet the required deliveries. In adapting this plan to the needs of any particular plant, the chief point to bear in mind is that it is only a means of supplying the manufacturing departments with real tool service, that is, supplying them with the right tools at the right time. The duties of the men and units connected with the actual making of tools will not be described, because they will be evident from the titles.

Functions of the Tool Superintendent

The tool division is responsible for all activities relative to a tool up to the delivery of the inspected tool to the production department. This centralizes final responsibility for tools in the tool superintendent, and it is part of his problem to maintain harmony between the tool designing and tool making sections of the division as well as among their individual members. It cannot be too strongly emphasized that the tool superintendent should be a broadgage executive. It is an old rule that an executive must be thoroughly acquainted with the technical part of his work, but still more he must be able to handle his men, consider the needs of his co-executives, and so dispose his forces as to get maximum results from minimum efforts. The tool superintendent then, must be thoroughly familiar with general machine shop practice, and know what can and what cannot be done in the way of machining and processing, but his main duties are to coordinate the activities of his department and foresee the needs of other departments affected by his work. His problem is not one of ordering new equipment and designing tools, but is essentially determining in which direction he can most economically provide good tool service.

If a million dollar plant lies idle while waiting for the completion of tools when there are orders on hand which should be yielding a profit of $1000 a day, it is the duty of the tool superintendent to plan so as to cut down the idle time to a minimum, balancing the extra expense of overtime work against the reduction of loss on idle time. If deliveries of products are being retarded because one or two parts cannot be manufactured fast enough, the tool superintendent should see that he is properly informed, then determine whether extra tools are needed, and, if so, what

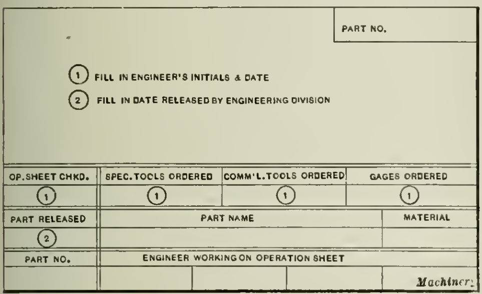


Fig. 2. Card used for keeping Track of Jobs while making up the Operation Sheets

would be a reasonable amount of money to spend on them. While such problems in their origin may be the concern of the production manager, their final solution devolves upon the tool superintendent, and the more his viewpoint is that of the broad business man rather than a purely technical one, the better will be his decisions. It is for this reason that, in the organization outlined, all technical duties are delegated to subordinates.

At the beginning of any tooling process, the tool superintendent should spend enough time on his organization and system to have it well lined up. A feverish start with the idea of turning out a great number of drawings and orders in a short time usually proves costly. At the same time forethought for the continuity of the personnel is necessary; to have key men leave the organization when a job is half complete may prove very disconcerting. It should be a point of honor with the key men not to leave work in an unfinished condition, and there should be a distinct understanding to that effect. If a bonus can be arranged for completion of a job within a definite time, it will be an additional advantage. Just how far to go with such a bonus system, of course, depends upon circumstances.

One of the first things to do on a job is to get an estimate of the amount of work to be done. The nature of the work precludes obtaining an accurate estimate; nevertheless past experience should be a good guide. For instance, the tooling of a complete high-class automobile involves designing some 10,000 special tools at an average of 30 hours drafting work, or a total of 300,000 hours. If an analysis of this description is made at the outset, the most economical size of tool division can be rapidly decided upon, and a plan mapped out for the distribution of work. In determining the outline of this plan, consultation with the financial, sales, and production departments is necessary, and as soon as the organization is settled upon, the tool superintendent should exert every effort to insure the fulfillment of the schedules agreed upon.

Duties of Chief Tool Engineer and Drafting-room Dispatcher

Chief Tool Engineer—The chief tool engineer determines the general lay-out of operations on a part, and is responsible for the correctness of all operation sheets, all designs issued for special tools, and the completeness of orders issued for commercial tools. In other words, he must see that everything issued by the office is technically correct. It is evident that the person holding this position must be a man with a good technical knowledge and wide experience. In an organization of any size, he will find it necessary to delegate a considerable portion of his work to assistants as outlined on the chart, and should, therefore, be a good leader. The position of chief tool engineer is second only in importance to that of tool superintendent, and no pains should be spared in getting it filled properly.

Drafting-room Dispatcher—The function of the drafting-room dispatcher is to so distribute work to the tool engineering and designing sections that tool orders, both special

W & S #2 INV. NO. 212

PART-OPER.	MINUTES PER OPERATION	CUMULATIVE MINUTES
1025-25	55	55
1026-25	40	95
1182-12	85	180
1197-5	25	205
1328-32	40	245
1329-32	40	285
1424-10	115	400

Machinery

Fig. 3. Card used for keeping Record of Amount of Work assigned to a Machine

and commercial, are sent out in the best possible sequence. The main qualifications for this position are a knowledge of tools and tool design; an appreciation of the relative importance of parts, both as to the amount of preparatory work involved and whether or not the parts can be made with improvised tools in case of emergency; steady habits; an ability to systematize work; and persistence in following up orders.

Dispatching Work through the Engineering Section

In dispatching work through the tool engineering section, it is first necessary to consider whether any particular work needs urgent attention. For instance, the machine tool engineer may report a shortage of machines for a certain class of work. It might then be advisable to have the operation sheets made out for parts requiring the use of such machines, before dispatching anything else, in order that the machine tool engineer will have definite information on which to base requests for additional equipment. Of equal importance is the dispatching of complicated parts requiring many operations and expensive tooling. Whether work should be dispatched first to the machine tool engineer or to the special tool engineer depends upon the relative time necessary to get the machines or special tools. It is well to remember that when an operation sheet has once been made out by the tool engineers, several draftsmen can work simultaneously on the various tool designs and the making of tools can be distributed among different shops, so that a great deal can be accomplished in three months. On the other hand, if there is a shortage of equipment, and deliv-

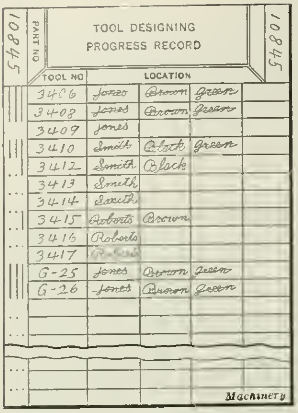


Fig. 4. Tool Designing Progress Record

eries of new machines will take six months or more, it will be more important to find out exactly what additional equipment must be purchased so that it can be ordered in ample time.

The dispatcher must have a complete list of the parts for which tools are to be made, and this list must be kept up to date. This is taken care of by routing all engineering release notices of parts over the desk of the dispatcher, the latter marking the release date on the form shown in Fig. 2, which will be discussed later. Occasionally parts are provisionally released, in order to make preliminary studies of tooling. These notices follow the same route as regular release cards, but they are specially marked. In order that the dispatcher and tool engineers may have ready access to the drawings of parts, it is advisable to keep an open file of all part prints for the use of the chief tool engineer's staff.

It is assumed that there are at least fifty jobs being handled in the tool design department at a time. The best way of following up these jobs is to list them on visible index cards somewhat similar to the one illustrated in Fig. 2. These cards are used for keeping track of jobs while the operation sheets are being worked out. As the jobs are assigned to the various engineers, the cards are marked accordingly. It is thus possible to tell at a glance how the engineering stands. When making out the card, the dispatcher should look into the probabilities of the part, and estimate roughly how much and what class of tooling work there will be. He must keep in mind the two main factors—getting work out on time, and keeping everybody supplied with work—and dispatch accordingly.

Dispatching Work through the Designing Section

If a plant is doing contract work, to get effective results, it should have a manufacturing schedule, and this schedule, if made in detail, should specify the date of each operation on a part, and thus automatically determine the priority sequence of tool orders. The dispatcher must then make every effort to have tools out on time to enable the manufacturing department to keep up with the schedule. However, in the majority of cases, it is a question of either supplying tools to permit the quantity production of a new article or to change existing manufacturing methods, and in such instances the priority question becomes more difficult to solve. The usual procedure is for the production manager to decide which tools he wants first; unfortunately this method is often unsatisfactory, primarily because no comparison of various requirements is made, the requests being usually based on the vociferousness of the different foremen's claims, or on what the production manager happens to see.

One method having good features is to insist on an estimate of savings to be accomplished by the use of any new tools ordered, as against present tools or no special tools, in the case of new production. Where a tool in new production is absolutely necessary on account of interchangeability, it may be marked "must" on the request. It will then be evident to the dispatcher that a tool which will save $3 a day is more important than one which will save only $1. Tools marked "must" will, of course, have the preference, as they are absolutely necessary. If, in addition, an estimate is marked on the order of the amount of time required for the designing and making of the tool, the dispatcher will have a chance to dispatch work so that the tools will be finished about in the correct sequence.

In Fig. 4 is shown a visible index card for recording the progress of tool designing. All tools for each part are listed by number on this card as soon as the order is issued. As the work is given out, the name of the man or company receiving it is noted under "Location." When the design is approved, the first vertical line to the left of the tool number is drawn; when the detail drawings are completed, the second line is filled in, and when the drawings are all checked and sent to he blueprinted, the third and last line is filled in. A horizontal line is drawn under the vertical lines when all the tools required for the part have been listed. This line is necessary, because the individual tool numbers are not visible without withdrawing the card from the index. The file thus shows graphically, at a glance, how the work stands on any part. This card is filed in a horizontal position, rather than in the vertical position shown in the illustration.

Duties of the Tool Engineers and Operation Sheet Checker

Machine Tool Engineer—The function of the machine tool engineer is to determine on which machine any given job shall be done. In doing this he must consider the following factors: The most suitable machine; other demands for the same machine; the available equipment; the capacity of the available equipment; and the advisability of using the equipment over-time or purchasing additional equipment to suit. A card should be kept for each machine, showing the size and location of the machine and having space for listing all work assigned to the machine and the estimated time required for each operation. While an elaborate card may be out of place, at least a plain 3- by 5-inch card should be used. If the manufacture of one general product only, is being planned, a cumulative total of the time the machine will be in use, can be carried, either per operation, as shown in Fig. 3, or, if a definite schedule is decided on, for the total average daily production. If a varied class of products is made, the problem will be complicated by the fact that the schedule on one or all of the products may be changed independently of others. If there are not too many products, a solution may be found by using a larger card such as illustrated in Fig. 5, carrying a separate column for each product and adding the time per unit of each product separately. Pencil figures may be used for a compilation of the total machine load according to the individual schedules in force. In this manner, any overload on a given piece of equipment will be quickly revealed. In such cases the machine tool engineer should consult with the chief tool engineer to find out whether the overload can be avoided. If not, steps can be immediately taken to run the equipment over-time, purchase new equipment, or have some of the work done at an outside plant.

W & S NO 2		EQUIPPED WITH 8" CUSHMAN 2 JAW CHUCK 6" UNION 3 JAW CHUCK				INV. NO. 212	
MOTOR	MIN	MODEL A	MIN.	MODEL B	MIN	MODEL C	MIN.
1025-25	5	1283-20	7	1384-20	7	1355-20	7
1026-15	3	1393-15	5	1394-15	5	1395-15	5
1105-8	10	1397-35	10				
1106-10	5						
TOTAL MIN. PER UNIT	24		22		12		12
NO OF UNITS	15		5		7		3
TOTAL MIN.	360		110		84		36

Fig. 5. Method of recording Work assigned to a Machine when a Variety of Products is manufactured

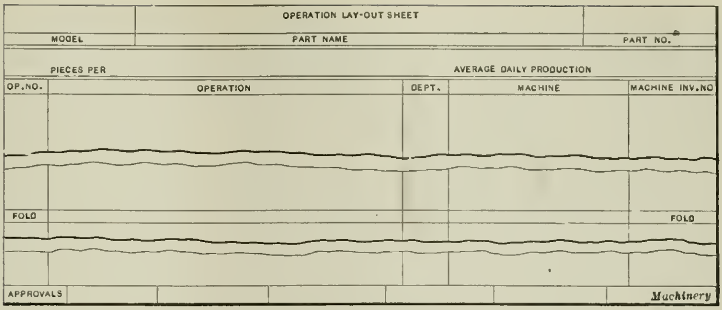

OPERATION LAY-OUT SHEET
MODEL | PART NAME | PART NO.
PIECES PER | AVERAGE DAILY PRODUCTION
OP. NO. | OPERATION | DEPT. | MACHINE | MACHINE INV. NO
FOLD | FOLD
APPROVALS
Machinery

Fig. 6. Sheet showing the Complete Sequence of Operations on a Part

This feature of protecting the manufacturing schedule from unintentional overloading of the equipment will often pay many times over for the work spent on compilation. Cases have been known where a delivery promised in two months could not have been completed in a year with standing equipment; the management of any concern will naturally appreciate prompt information about such conditions while there is a chance to remedy them and make the promised delivery. In planning the duties of the machine tool engineer, the production planning department should be consulted. It may be found that the latter requires and keeps records which will fulfill the needs of the tool designing section either without change or with slight amplification. If such is the case, arrangements can be made for the cooperation of the tool engineers and the planning department, and this function of the machine tool engineer can be eliminated.

Special Tool Engineer—The function of the special tool engineer is to work out the details of each machining operation. He receives from the drafting-room dispatcher the operation sheet shown in Fig. 6, on which is given the operation lay-out already decided upon by the chief tool engineer. From this sheet and the part drawing, the special tool engineer decides what machine will be best suited to each operation and what sort of jigs and fixtures will give the most economical results. When commercial tools can be used he should specify them. He should make rough sketches of the fixtures desired, and when the lay-out is clearly in mind, he should consult with the foremen of all the departments concerned and get their viewpoints, which should be valuable.

The man in the shop responsible for actual results should always have a chance to express himself before the means by which he is to get the results, are decided upon. To shut oneself up in an office and design something for shop use, whether a tool, a machine or just a form, and then thrust it on the shop without introduction, is the best way to make shop men suspicious of office conceptions and eager to condemn them. Once a tool lay-out is settled upon, detail operation sheets of the sort illustrated in Fig. 7, are made out and orders issued for each tool required. It will happen occasionally, of course, that the tool designers will find modifications necessary, and so final distribution of operation sheets should be withheld until all designs are approved.

Gage Engineer—The gage engineer has the same function on inspection operations as the special tool engineer on machining operations. His method of procedure is therefore very similar, except that he consults with the inspection department instead of with the manufacturing foremen.

Commercial Tool Engineer—The function of the commercial tool engineer is to issue all orders for small commercial tools required. The detail operation sheet in Fig. 7 provides the basis for these orders. Occasionally substitutions will have to be made on account of deliveries or stock-room standards, and for this reason the commercial tool engineer should be familiar with the general run of tools used. In this connection, it is well to arrange for chucks to be assigned to certain machines and considered as part of those machines, rather than to consider them as commercial tools listed on operation sheets. The writer has still a vivid recollection of helping to straighten out a badly tangled situation caused by considering chucks as commercial tools and not paying any further attention to the subject on the operation sheets. The result was that when the commercial tool engineer began to order chucks, there were duplications on some machines and shortages on others. The loss in time of men working to clear the situation amounted alone to several hundred dollars, not to mention delayed production. By arranging for equipping certain machines with chucks, listing these, and assigning parts requiring chucks to the proper machines, not only will confusion be avoided, but also the investment in tools will be reduced to the minimum.

Change Engineer—Changes in tools may be required because their design has been found faulty or requires modification, or because the part may be changed, so that the tools need to be adapted. Where the design is faulty, the trouble should be brought to the attention of the change engineer by the production foreman. These men should go over the matter carefully and decide on remedial measures to be taken. The change engineer should then issue an order to the chief draftsman, stating in some detail just what changes are to be made. In the majority of cases, the order can be so issued that the draftsman can make the changes on the drawing without necessitating a trip into the shop. On the other hand, if a vague order is issued, the draftsman usually goes over all the ground again, wasting his own time and that of the men in the shop who resent having to explain things over again.

When a part is to be changed, if the engineering department is functioning properly, the change engineer receives a notice of the change, which also states whether the part as redesigned can be used to replace any old parts that may be out

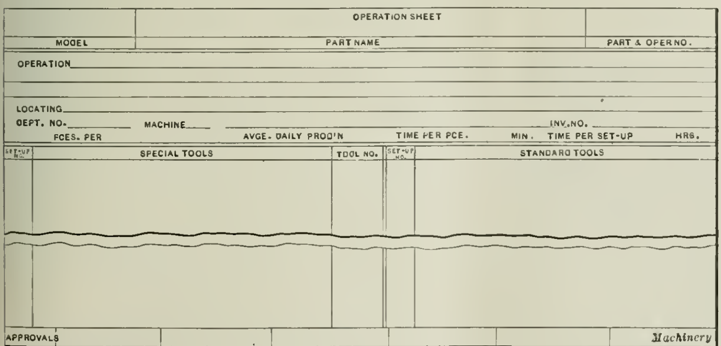

OPERATION SHEET
MODEL | PART NAME | PART & OPER NO.
OPERATION
LOCATING
DEPT. NO. | MACHINE | INV. NO.
PCES. PER | AVGE. DAILY PROD'N | TIME PER PCE. | MIN. | TIME PER SET-UP | HRS.
SET-UP NO. | SPECIAL TOOLS | TOOL NO. | SET-UP NO. | STANDARD TOOLS
APPROVALS
Machinery

Fig. 7. Detail Operation Sheet filled out in the Engineering Section of the Tool Division

in service. If so, the tool may be changed without any complications ensuing; the engineer can get out the new blueprint of the part and issue any necessary order for changing the tool. If, however, old parts are out in service and the new part cannot be used for replacements, care must be taken to change the tool in such a way that replacement parts can still be manufactured, and if that is impossible, a new tool must be made.

Operation Sheet Checker—The usual procedure of making out operation sheets is to first develop a rough lay-out of operations; from this the special tool engineer makes rough copies of the detail operation sheets on which he bases his special tool orders and from which the commercial tool engineer issues orders for small tools. Changes will frequently be made on these sheets as the work progresses, and this fact makes it desirable that the entire batch of sheets on each part be checked as soon as all orders are issued. Carbon paper backing should be used in typing the operation lay-out and detail operation sheets so that good blueprints can be made from the originals. The checker should then take the complete set of sheets on the part and check (1) the technical correctness of operation sequence, that is, see that the part can be made as planned; (2) the provision of all necessary tools and operation sheets; and (3) order files to see that all orders have actually been issued. When the sheets have been found correct, necessary blueprints can be made and distributed to those requiring them.

PART NO.	TOOL DESIGN RECORD	DATE OF T.O.	TOOL NO.
TOOL NAME		PART NAME	
TO CHIEF DRAFTSMAN	DATE	TO DETAIL FOREMAN	
		TO CHIEF CHECKER	
DES.APPR.BY		COMPLETED	

Fig. 8. Card used in the Designing Section to record Draftsmen working on Each Job

General Notes on Tool Engineering Section

The fewer men that can be used to cover the activities of the tool engineering section, the better will be the results, as references to other men will be less needed. In a small organization one good man should be able to attend to all tool orders—special, commercial, gages and changes. Distribution of other activities will depend upon the qualification of the men available. Only in large organizations should there be more than one man on each sub-activity shown on the chart in Fig. 1.

Duties of Men in the Tool Designing Section

Chief Draftsman—Under the plan of organization here mapped out, the chief draftsman has little to do with the details of designing; the main outline of a tool required is decided by the special tool engineer and the shop foreman who is to use it, and the details are worked out by the designer with the advice of the design foreman. The function of the chief draftsman is mainly a disciplinary one; certain rules of conduct must be enforced, and established standards of office practice maintained. For the chief draftsman to develop both efficiency and harmony in a large office will entail his possessing considerable tact, firmness, and ability to judge the competency of his men and guide and direct them. Needless to say he should have practical experience and be a good tool draftsman himself so that he will be able to judge both the quality and quantity of work turned out by the individual men.

The chief draftsman may either have the drafting-room dispatcher distribute work to the foremen or have the dispatcher mark the tool orders with priority numbers and distribute them himself according to priority. Where a great many designs are being worked on at a time it is necessary to keep a check on the whereabouts of each one. The card shown in Fig. 8 can be used for this purpose, the name of the man working on the drawing being entered each time the drawing is given out, and the cards filed numerically. In order that the chief draftsman may know what each man accomplishes, he may either make the rounds every day to each board, having the foremen accompany him, or he may have the completed drawings passed over his desk. In either case it is highly desirable that some method be developed to rate the value of each man. While this presents considerable difficulties, it can be done provided common sense is applied in the use of the ratings. The features to be considered are correctness, legibility, and improvements suggested; amount of work produced; habits and character; and general value to the company through knowledge of the business and possibility of developing to hold a responsible position.

Records could be kept separately of each item, and with a proportion of relative values of each, a composite figure built up which would give a fair rating for each man. However, the general experience in efficiency work is that if a quantity measurement of work performed is made and quality inspection rigidly enforced, the quantity measurement alone will suffice; this is because the quality defects produced on unchecked work are usually due to lack of attention, and as soon as an incentive to concentration is offered, quality improves as well as quantity. Owing to the unstandardizable nature of drafting work, accurate estimates are impossible, and it would therefore be incorrect to use these ratings as bases for any of the bonus methods used on regular production. On the other hand, if cumulative totals are kept of actual time worked and total estimated time plus allowances for improvements and changes accepted, these figures over a certain period of time should serve as an excellent guide in making wage rate adjustments. However, no allowances should be made for time consumed in correcting errors of the draftsmen. Unless the company has a special department of standards, the chief draftsman should make up standard practice instructions for designers and checkers and keep these up to date. He should also see that all machine data are accessible.

PART NO.	TOOL DRAWING RECORD	DATE DWGS COMP	TOOL NO.
TOOL NAME			
PART NAME			
PATTERN NO.			
SHEETS IN SET	D		
	C		
	B		
	A	AA	*Machinery*

Fig. 9. Form on which a Record is kept of Tool Drawings sent to the Blueprint Room

Time Clerk—If a record is required of the cost of each tool, it will be necessary for the men to turn in tickets showing the time they worked on each tool. In this case a time clerk should be provided to check up the time tickets. It should be remembered, however, that the tool cost is influenced by so many casual factors that any attempt at extreme accuracy of cost finding is out of place; time to the nearest half-hour should be close enough for work of this kind. The men should be instructed accordingly so that they do not spend too much time in making out the tickets. Anyone using the cost records should understand that only approximate tool costs are given. The time clerk should keep on file a card for each man on the department payroll, record of the working time of the man being kept on the card. The time clerk will probably have ample time to prepare reports required by the chief clerk and fill out drawing records for the chief draftsman.

Designers, Detailers, and Checkers, and their Foremen—While there is no question but that the checkers should be separate from the draftsmen and under the supervision of a checker foreman, there are cases where it is advisable to have the detailers under the same direct supervision as the designers. However, if the force is a relatively large one, it will be preferable to have a separate detail foreman in charge of the men doing detail work. This will enable the flow of the work to be more evenly distributed. The detail foreman should be chosen for his ability to instruct and develop men rather than for having wide experience, while the design foremen should be widely experienced men with the ability to foresee difficulties and give designers good technical assistance.

Drafting-room Supply Clerk—The function of the drafting-room supply clerk is to provide draftsmen with all materials, drawings, blueprints, and auxiliary data, and keep records of those to whom such things are given. After long experience in attempting to keep up a large number of standard books, the writer has come to the conclusion that the best way to handle standard sheets is to keep several copies of each sheet, preferably mounted on pasteboard or at least printed on linen, in the supply room in a special file. The index to this file should be posted in an accessible place. Then any man requiring a data sheet can look up the number, draw it out against a receipt, and when through with it, return it to the file. A selection of sheets commonly required may be made and firmly bound together (not in a loose-leaf binder), and every man supplied and charged with a numbered copy. Unless every man is given a copy, it will be difficult to hold anyone responsible for one lost.

Blueprinters and Drawing File Clerk—Orders for the making of blueprints can be made on simple requisition blanks put up in pads. As each drawing is checked, the chief checker should fill out one of these requisitions as authority to print the necessary amount of blueprints, and no tool prints should be made without this authority. Any other blueprints required should be authorized by the chief draftsman; this will serve as a check on indiscriminate printing. As each set of drawings comes to the blueprint room a card, such as shown in Fig. 9 should be made out by the drawing file clerk and filed. This card should be generally accessible; it will prove a time-saver to have the assembly sheet number marked on the card. Standard filing cabinets should be installed to fit the drawing sizes used, and each sheet filed in a drawer of its own size. Drawing sizes and filing methods were discussed in an article entitled "Standard Blanks for Tool Drawings," which appeared on page 786 in April, 1921, MACHINERY.

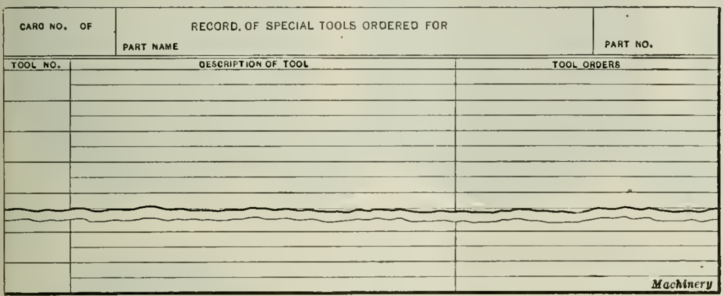


Fig. 10. Record of Special Tools ordered to facilitate the machining of a Part

Work of the Chief Clerk and Tool Work Dispatcher

Chief Clerk—The function of the chief clerk is to see that all clerical work is done promptly and correctly, that record files are properly maintained, and that necessary reports are brought to the attention of the tool superintendent. Copies of all orders issued should be on file and separate sections maintained for incomplete design orders, complete design orders, incomplete shop orders, and complete shop orders. This file is the control point for issuing shop orders, and any special handling desired for the orders can be attended to by placing "ticklers" in this file. It is also necessary to provide a record of all tool orders issued on each part. The card shown in Fig. 10 was designed for this purpose. It will be noticed that provision is made for a full description of the tool, and under "Tool Orders" the symbol and number of tools ordered are to be recorded. The symbol is the designation added to the tool number for indicating what kind of order was issued. Thus on tool No. 582-J-2, if a second repeat order was issued, making the third request for this tool, the order number would read 582-J-2-3.

Regular correspondence files should be kept, and if letters are handed out to men in the drafting-room, receipts should be exacted for them, and these placed in the regular folders until the letters are returned. It is desirable that progress reports be rendered to the tool superintendent by the chief clerk, covering the conditions of the drafting-room and tool-room and the progress of the whole job. The report should show the estimated amount of work in hours and number of designs immediately ahead of the designers, detailers, and checkers, the number of men engaged on each of these activities, the number of men on staff activities, that is, tool engineers, and the number of absentees. The report should also show the total number of tools being manufactured by the tool-room and outside tool concerns, the number of men in the tool-room and the estimated hours of work ahead of them. Since it is assumed that a schedule has been made, it is important to follow up closely the total progress, and it is equally important to check up the accuracy of the estimates. Hence, the chief clerk should furnish a daily report of tools made and corrections of estimates.

Tool Work Dispatcher—The function of the tool work dispatcher is to distribute the orders for tools, after the design is completed, in such a manner as to permit the desired deliveries with the utmost possible economy. Since it is usually the duty of this man to approve bills and pass on estimates, it is evident that the main qualifications for the position are an intimate acquaintance with toolmaking practices, a knowledge of reasonable time charges, and reliability. Since the tool work dispatcher must keep posted on what work the different shops can do, he should have a file showing the equipment of each shop; this will assist him to distribute work economically.

The follow-up file of the tool work dispatcher may consist of cards similar to the one shown in Fig. 4. These will enable him to keep track of the location of all tools on each part and the progress made on each tool. The first vertical line may indicate that castings or forgings are finished, the second, that all parts are finished, and the third, that the tool is completed and has been checked. If the company's tool-room has sufficient capacity to make all, or nearly all the required tools, the duties of the tool work dispatcher should be delegated to the tool-room foreman, who can have a production clerk attend to the follow-up of tools and see that orders are given preference according to the priority numbers marked by the drafting-room dispatcher.

Hand- and Machine-Lapped Surfaces as Seen Through a Microscope

THE manufacture of precision gages, such as gage-blocks and plug gages, requires, first, some method of producing gaging surfaces that are true enough to meet practical requirements, and second, some precise method of checking the gage dimensions. If a gage has a flat surface, the truth of this surface is in proportion to the "effective area" or the amount of "high land" which lies in the same plane. A cylindrical gage is true in proportion to the area coinciding with a true cylindrical surface of given diameter. The term "effective area," therefore, refers to the area of that part of the surface which would make contact with a perfect plane in the case of a flat gage, and with a perfect cylinder when the gage is cylindrical. It is important to note that the finished surface, whether flat or cylindrical, may be highly polished and appear true to the naked eye, when in reality it has a relatively small effective area. Such a surface, if highly magnified, is shown to be a mass of ridges and grooves, which may have considerable polish and yet not form a true surface.

It is evident that a surface having a large percentage of effective area is not only better for precision gaging purposes, but that it also offers much greater resistance to wear, because there is a larger area of contact surface, and for a given amount of metal removed there is less reduction in diameter. In precision gages or the finest grades of work in machine manufacture, the variations between good surfaces and poor ones depend upon differences which are extremely small and yet very important, and in order to carefully study these differences a microscope is employed.

Several interesting examples of photomicrographs made by the Pratt & Whitney Co., Hartford, Conn., in connection with a study of the characteristics of different surfaces, as obtained by various methods, are shown by the accompanying illustrations. Each of these photomicrographs represents a small part of a cylindrical surface, and the different views are so arranged on the page that the imaginary axis of the cylinder is in a horizontal position in each instance. The original views were magnified 280 times, but these halftone reproductions have been reduced so that they show a magnification of about 220. All these views are to the same scale and they have been supplemented by cross-sectional diagrams, Fig. 6, which illustrate the relative depths and numbers of the grooves. These diagrams are conventional representations of an average count of scratches over considerable area of the various blocks. In all photomicrographs of lapped surfaces, the preliminary grinding marks have been removed by lapping. The scratches are due entirely to the lapping abrasive.

Fig. 1. Exceptionally Good Ground Surface

Fig. 2. Hand-lapped Plug Gage

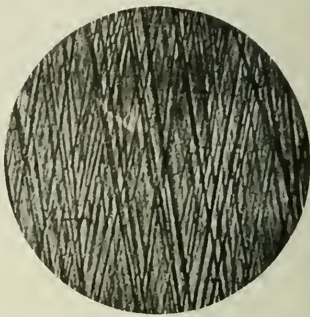


Fig. 3. Better Example of Hand-lapping

These photomicrographs show examples of ground, hand-lapped, and machine-lapped cylindrical surfaces magnified about 220 times. Each engraving is located with the axis of the cylindrical surface illustrated, in a horizontal position. Figs. 4 and 5 illustrate what has been accomplished in producing exceedingly accurate cylindrical surfaces by a mechanical lapping process which is a modification of that used for flat surfaces.

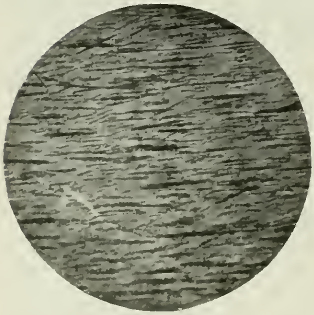


Fig. 4. Machine-lapped Plug Gage

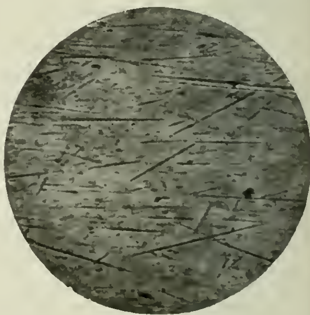


Fig. 5. Exceptionally Fine Machine-lapping

Results Obtained by Hand-lapping

Fig. 1 shows the surface of a commercial plug gage which has been ground but not lapped. This is an example of an exceptionally good ground surface. Fig. 2 shows the surface of a hand-lapped commercial plug gage, but this does not represent good lapping practice. Another example of hand-lapping is shown in Fig. 3. This is a Pratt & Whitney master plug gage. A comparison of this hand-lapped surface with the one illustrated in Fig. 2 shows that the former is much more uniform, and has a much larger effective or highland area.

Results Obtained by Machine-lapping

Figs. 4 and 5 illustrate what can be accomplished by machine-lapping, assuming that it is done in the right way. A first-class finish for a precision plug gage is represented by Fig. 4. While its surface has been machine-lapped, no attempt has been made to give it the extreme degree of finish or polish represented by Fig. 5. Both of these surfaces, however, are practically the same, so far as wearing qualities and usefulness are concerned, but to produce a finish like that shown in Fig. 5 requires probably eight times as long as to secure the surface shown in Fig. 4. For this reason, one is regarded as a commercial finish for precision gage work, whereas the other is more in the nature of a "stunt." It should be remembered that the commercial finish represented by Fig. 4 is a very fine and highly polished surface, and that it is only by extreme magnification that the minute scratches on the surface are revealed.

It will be noted that the scratches seen in Figs. 4 and 5 are short, and either parallel with the axis of the plug or slightly inclined. On the contrary, scratches on the hand-lapped gages extend diagonally around the work, due to the use of a ring lap which is given a traversing movement. The finer surfaces on the machine-lapped plugs are obtained by performing a lapping operation between two flat cast-iron plates having very true surfaces and operating in such a way that the plugs receive a combination of rolling and sliding action. These lapping machines are similar in principle to the ones used for lapping the flat surfaces of precision gage-blocks, which were described in April, 1920, MACHINERY, beginning on page 702 of the article entitled "How Precision Gage-blocks are Made." However, the lapping of true cylinders between flat plates requires an interesting modification of the process utilized for flat surfaces. The "Trilock" reversible plug gages made by the Pratt & Whitney Co., are finished by this modified process, which has also been applied to other commercial products, such, for example, as automobile piston wrist-pins.

In developing this process, the original aim was to produce a cheaper quality of working plug gage by eliminating the expensive hand-lapping operation. It was soon found possible to produce much more accurate results than by hand-lapping and at a fraction of the cost, assuming that the machine-lapped process is applied to the production of duplicate pieces on a quantity basis. This mechanically derived lapping action is not merely one of polishing, but as the photomicrographs indicate, it generates a surface that is practically perfect. A number of these cylindrical gages or other parts are lapped simultaneously, and by systematically and repeatedly transposing them and averaging the errors, the entire lot is finished to a true cylindrical form to within, say, 0.00001 inch or less. Some essential features of this process are covered by patent applications now pending, so that this ingenious method of machine-lapping cylindrical parts cannot be fully described at the present time.

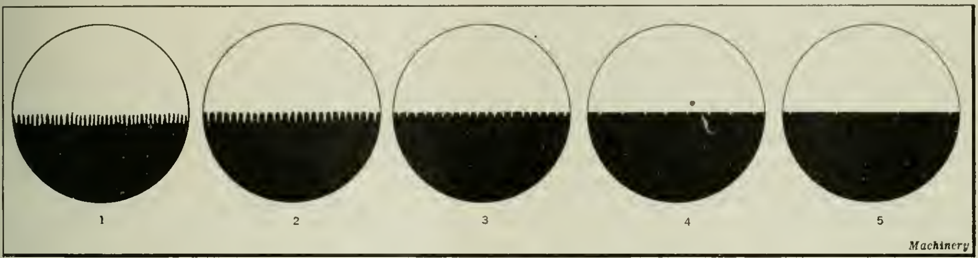


Fig. 6. Conventional Representations of Scratches on Lapped Surfaces. The Diagram Numbers are the Same as Figure Numbers of Corresponding Photomicrographs

RELATION BETWEEN OUTPUT AND COSTS

By JOHN D. RIGGS

At this time when everybody is making an effort to reduce manufacturing costs it is important to understand fully the relation between rate of production and final cost. When the rate of production on a certain article is increased, it is frequently assumed that there has been a corresponding decrease in the cost. A careful analysis of the elements of cost would often show, however, that there are large factors that are independent of the time consumed; for example, the material used is sometimes a large factor in the cost.

Not all innovations are improvements in regard to cost reduction. As an example, imagine the results if the machines in a mill for making wire nails were run at double the ordinary speed without making any other changes in these machines. Production might be doubled forthwith, but the number of machines which an operator could handle would be cut in half. Furthermore, the maintenance cost would probably be quadrupled, and the useful life of the machines might be reduced to about one-fourth. As a result, the cost of nails per keg would certainly not be materially reduced.

Another example is the case of a plow works which, after having grown from a small beginning to a plant employing over 3000 men, decided to rearrange its share department. The making of a plowshare involves about seven operations, apart from the final polishing and painting. These operations were all performed at a satisfactory rate, except the fifth one. A diagonal and beveled end had been trimmed on a grinder after several attempts at shearing it had failed. The superintendent finally ordered a machine for trimming these ends, and in due time a shearing machine, arranged with an automatic hold-down and adjustable stops, so as to accommodate about twenty-five of the thirty-seven varieties was produced and installed. This shear did in about two seconds what had taken one minute on the grinding machine; it was also a cheaper machine. The superintendent was delighted, but the owner and manager did not enthuse. To him a reduction of one cent in the cost of a plowshare which sells at retail for about $4, was not of the greatest importance.

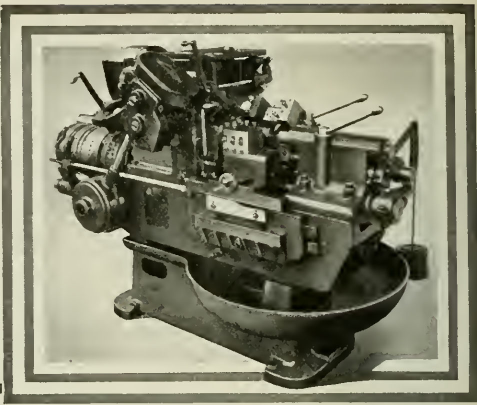
Of the two men looking at the same device one saw an increase in production of from twenty to thirty times the past records, while the other saw a reduction of about ½ of 1 per cent in the production cost of the article, or ¼ of 1 per cent of its retail selling price, coupled with the cost of a new machine.

* * *

The Patent Office relief bill, which has been before Congress almost continuously for the last three years, has been passed by both the House and the Senate. The bill provides for increasing the salaries of the principal examiners from $2700 to $3900 a year, and the pay of the assistant examiners has been raised by $150 to $900 a year. The Commissioner's salary has been increased from $5000 to $6000 a year.

Tooling Equipment for Automobile Hubs and Pistons

By RALPH E. FLANDERS,
Manager, Jones & Lamson Machine Co., Springfield, Vt.



THE front wheel hubs of automobiles are usually malleable castings and can be machined rapidly and accurately without severe cutting strains resulting, if they are properly annealed. The set-up of a double-spindle production lathe for machining the ball-race seats of front hubs is illustrated in Fig. 1. The work is first held in an air-operated chuck in the rear spindle and the inside of the large end is bored, the outside rough-turned, and the end faced and chamfered. The cross-slide is then shifted to bring the sizing reamer and finish-turning tool into position.

After the part is machined by these tools, it is changed to the front spindle and the end just finished is drawn against a hardened adapter by means of an air-operated draw-bar having a T-head that engages ribs cast in the interior of the hub for this purpose. This example illustrates the service that the designer of parts to be machined can render the tool designer if they keep in touch with each other. Without these ribs the part would be difficult to hold. The operation on the small end of the hub is similar to that on the large end.

The usual procedure is to have the bolt holes in the flange drilled or punched next, and then to have the outer bearing races pressed into place. After these operations, the hub is sent to a Fay automatic lathe in which it is supported on taper plugs mounted on the main and tail spindles, as shown in Fig. 2. The tail-spindle is mounted on ball bearings and revolves with the work. With the hub thus accurately mounted on its bearing races, true running of the part when it is completed is assured.

To perform the roughing step in the shortest possible time, both the facing and the long turning cuts of this operation are divided between two tools, which are first fed at an angle relative to the work, as shown by the arrows in the illustration, until they have reached the desired depth. The work is driven by a dowel engaging a bolt hole in the flange. The finishing operation, the tooling equipment for which is shown in Fig. 3, is similar to the roughing operation. In this case, however, the cuts are not divided between two tools, and extra tools are provided for rounding corners and for necking. The output of one roughing or finishing machine and one operator is seventy-five hubs per hour, provided the castings are well annealed.

Operations on Rear Hub Forgings

A typical rear hub made from a steel forging is machined in a double-spindle flat turret lathe with the tooling equipment shown in Fig. 4. The tools are all fed end on, and their arrangement is self-explanatory. While this hub is only occasionally made of malleable iron, it should be possible in such cases to machine it on a double-spindle production lathe similar to that used for the front hub, provided the hole is first drilled in a heavy-duty drilling machine. Fig. 5 shows the manner in which the hub is rough-turned and rough-faced in a Fay automatic lathe, the work being mounted on a taper arbor and driven by a dowel engaging one of the bolt holes in the flange which is drilled prior to this operation. The turning and facing cuts are each divided between two tools, as in the case illustrated in Fig. 2. The finishing operation on the part is illustrated in Fig. 6. Tooling equipment for a hub of a similar type is illustrated in Fig. 11.

A stamped hub flange is machined in a Hartness automatic equipped with the tooling shown in Fig. 7. The operation is simple; the upper tool-holder carries a rough-boring tool which operates while the holder is being fed toward the work, and a finish-boring tool which operates while the holder is being withdrawn, both cuts being short. The facing cut is a long one, and is divided between two tools in the lower holder, one facing from the outside toward the center and the other facing from the center to the periphery. It would, of course, be possible to both rough- and finish-face the part in this operation if that should be necessary.

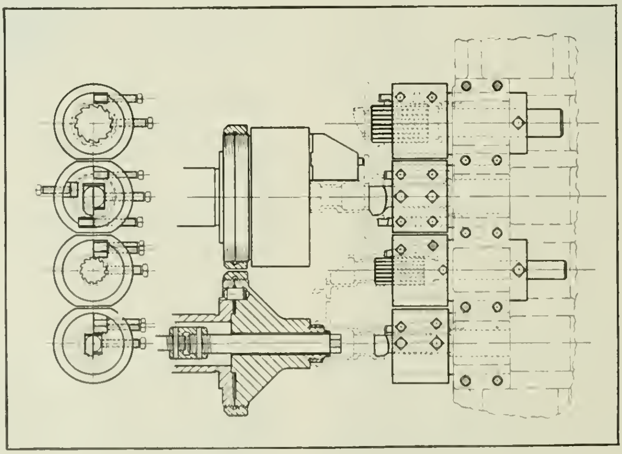


Fig. 1. Set-up of Double-spindle Production Lathe for machining the Ball-race Seats of Automobile Front Hubs

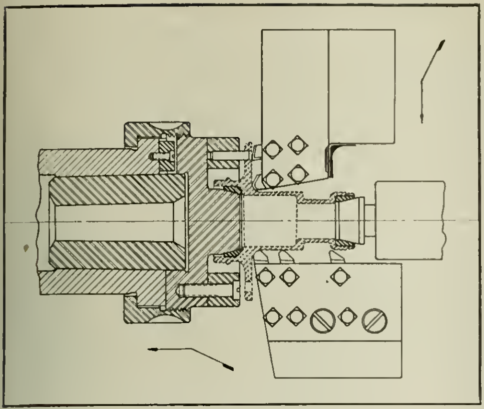


Fig. 2. Hub supported by the Ball Races for the Rough-facing and Rough-turning Steps

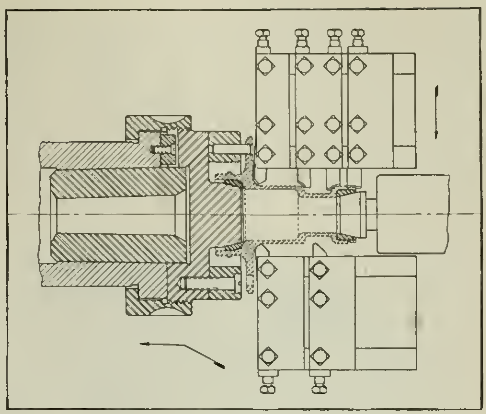


Fig. 3. Finishing Operation in which the Work is supported in the Same Manner as in Fig. 2

Finishing Aluminum Pistons

The machining of aluminum pistons made from die-cast blanks is simple and, owing to the fact that the pistons come from the permanent molds with walls of uniform thickness, no special precautions are required in chucking. In the first operation, which is performed in a Fay automatic lathe, the tool set-up shown in Fig. 8 is employed. The tools in the rear holder rough-bore and rough-face the skirt, while those in the front holder finish-bore, finish-face, and chamfer this end. Meanwhile, a high-speed center-drill driven through the spindle of the machine is advanced to center the boss on the closed end, which is gripped by the chuck jaws. Steps in the jaws locate the piston longitudinally. It should be observed that the skirt is projected far enough beyond the jaws to be free from clamping strain. Only a light pressure of the jaws is required to hold the work in place. This operation is performed so fast that one man can run only one machine, and the output is largely determined by the dexterity of the operator in loading and unloading the work.

The second operation is also performed in a Fay automatic lathe. The piston is held against an

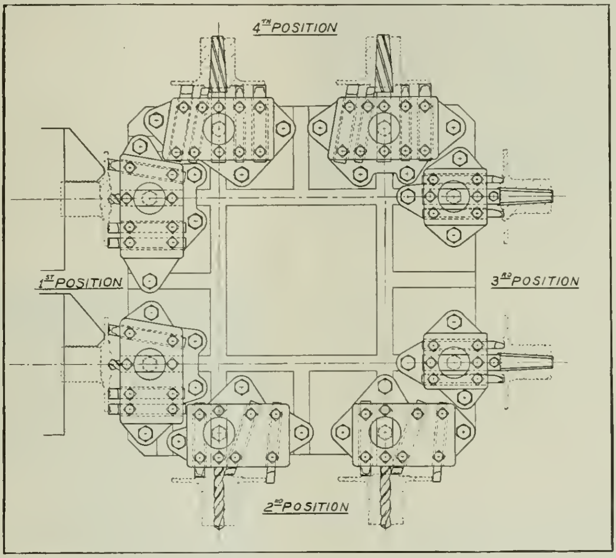


Fig. 4. Tooling Equipment used on a Double-spindle Flat Turret Lathe for machining an Automobile Rear Hub

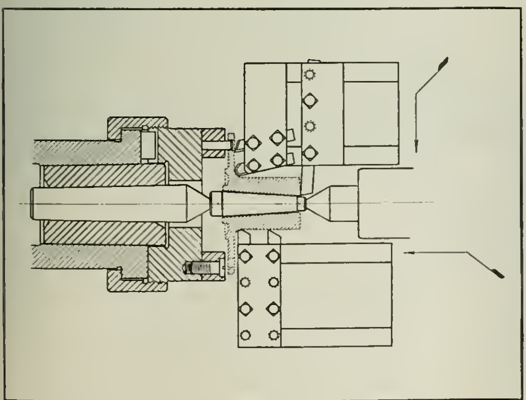


Fig. 5. Rough-turning and rough-facing the Rear Hub in a Fay Automatic Lathe while mounted on a Taper Arbor

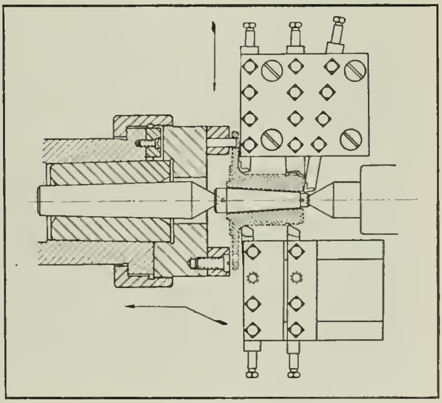


Fig. 6. Finishing Operation on the Rear Hub which is also performed in a Fay Automatic Lathe

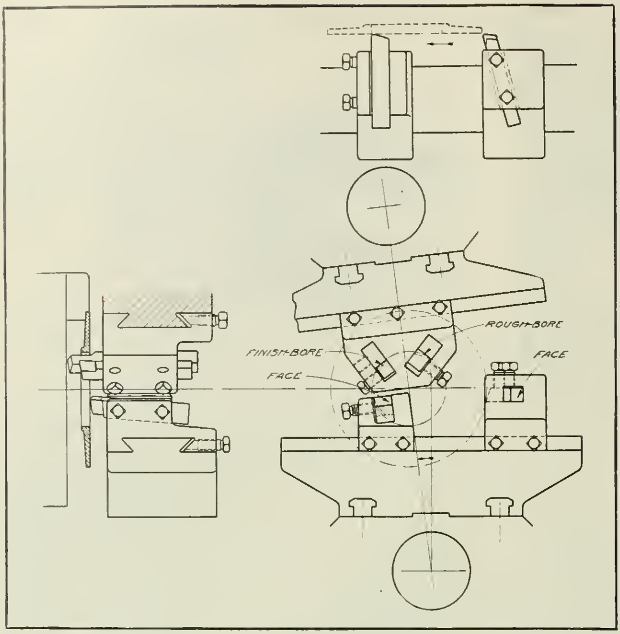


Fig. 7. Tooling Equipment for boring and facing a Stamped Hub Flange in a Hartness Automatic

adapter on the spindle by a ball-bearing tail-center, as shown in Fig. 9, and is driven by a floating fork that engages the wrist-pin bosses. The rear holder is fed radially so that the tools can face the closed end and rough out the grooves. Meanwhile the front holder goes through the somewhat complicated movement shown by the arrow. The turning tool first feeds to depth and then turns the length of the piston, after which the tool-holder feeds in radially once more to bring the tools into position to finish the grooves. The back arm, in the meantime, returns to its original position during which movement the facing tool takes a finishing cut over the closed end.

Only one cut is taken across the outside cylindrical surface, because this surface is ground later. By supporting the work with the tail-center shown, end play of the spindle is taken up and grooves are produced whose side surfaces are planes that match the ground sides of the rings. This obviates a finish-grooving operation in an engine lathe, such as is frequently necessary with first-class work. The machine provided with this tooling is shown in operation in Fig. 10. The operation is extremely rapid, the speed of the work being between 500 and 600 feet per minute, and the production per hour one hundred pistons. One man can run only one machine. The tools can be used several days without requiring resharpening.

Equipment for Machining Cast-iron Pistons

The machining of cast-iron pistons will be described somewhat in detail, as the sequence of operations is the result of a long study and the experience of many makers. This is an excellent example of the interdependence of various operations. The castings are first annealed; this makes them easier to machine, but the primary purpose is to retain the accuracy of the different surfaces after the scale has been removed. Pistons should be made with a good sized boss on the closed end so that a deep center can be provided for supporting the work on the various machines. High production is obtained by taking heavy cuts, and so a small center will not be satisfactory. In the first operation, the piston is placed on a mandrel and centered true with the rough core in an operation on a drilling machine. The inside of the piston head locates on the top of the mandrel, and a stop-collar is used on the machine spindle.

The second operation is performed in a Fay automatic lathe equipped with the tooling shown in Fig. 13. A revolving ball-bearing center holds the head of the piston against an internal mandrel, insuring an even thickness of wall at the head. The plugs of the mandrel are expanded by air pressure and center the piston true with the core at the open end. This arrangement, together with the true center, insures an even wall thickness throughout. A balanced driving member engages the wrist-pin bosses. The tools in the back holder rough-face the open and closed ends and rough-groove the work. Meanwhile the tools carried by the front carriage rough-turn the piston, a sufficient number of tools being provided to turn the entire length of the work in the short time required for facing the closed end. The latter step establishes the cutting time for the whole operation. The production rate of this machine on 3¾-inch diameter pistons is from forty-five to fifty per hour. By having an operator run two machines, from ninety to one hundred pistons can be turned out per hour.

Third and Fourth Operations on the Piston

The wrist-pin holes are rough-drilled in the third operation by using a fixture in which the work is located by the outside cylindrical surface and the finished end, and angularly by means of the internal bosses. This operation completes the removal of scale and the bulk of the material. A little time for seasoning should be allowed at this point.

The fourth operation consists of machining the skirt in another Fay automatic lathe with the tooling shown in Fig. 14. Since the outside cylindrical surface was turned true

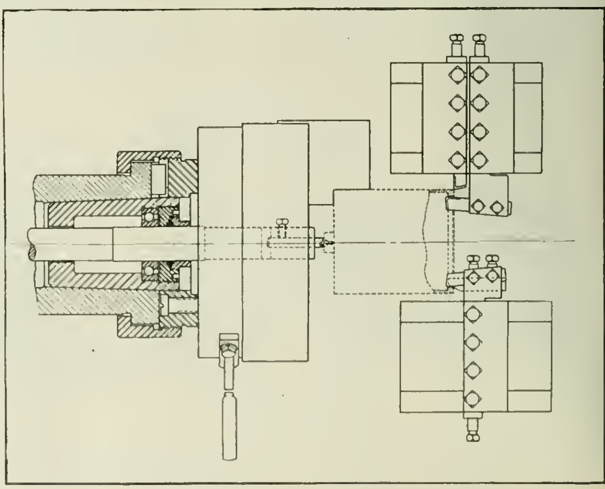


Fig. 8. Roughing and finishing Skirt of Aluminum Piston and centering Closed End

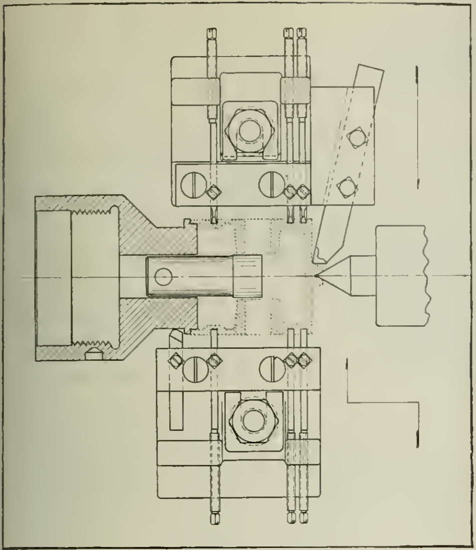


Fig. 9. Turning, facing, and grooving the Aluminum Piston

with the core in the second operation, this surface is utilized in holding the part for finishing the skirt. The piston should project far enough from the jaws to be free from distortion resulting from the gripping of the jaws. The tool in the rear holder rough-bores the work while the front tools finish-bore and chamfer it. The boring is kept within limits of plus or

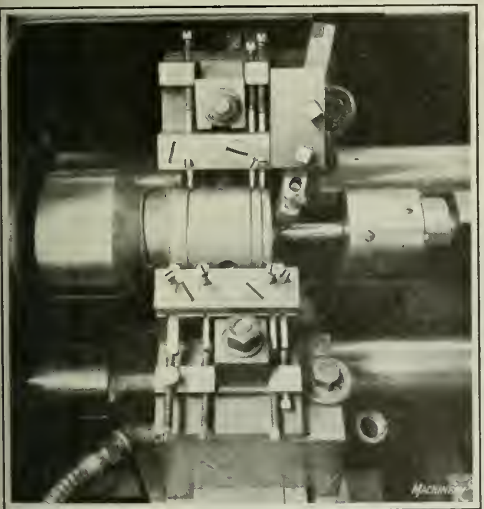


Fig. 10. Machine provided with the Tooling Equipment illustrated in Fig. 9

minus 0.001 inch so that the skirt will be a good fit on the fixtures used later in finish-turning, grinding, and other operations. The possible production in the fourth operation is from 150 to 180 parts per hour, depending upon the rapidity with which the operator can change the work. He can run only one machine at a time in this step.

Finishing Operations—Turning, Grooving, and Facing

In the fifth operation, the piston is finish-turned, finish-grooved, and finish-faced in a Fay automatic lathe provided with the equipment shown in Fig. 16. Here the open end is centered on a hardened seat of the spindle fixture, while the closed end is supported on a ball bearing center, the same as in the case illustrated in Fig. 13, and a balanced drive is used on the wrist-pin bosses. The construction of the center is shown in Fig. 16. A central air-operated plunger strips the work from the fixture when it fits too tightly, and a lever type of tailstock is used for pressing the work on the fixture. The tooling arrangement is nearly identical with that used in the second operation. The outside cylindrical

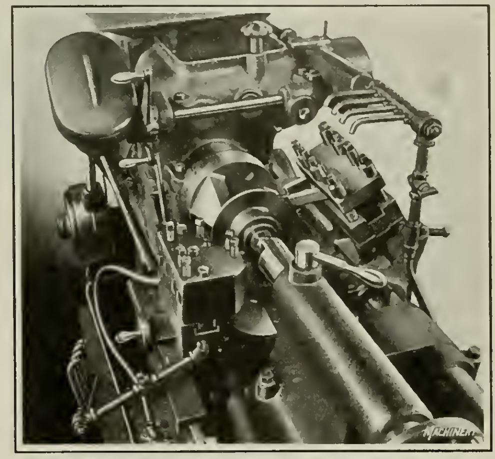


Fig. 11. Another Tooling Equipment for machining a Rear Hub in a Fay Automatic Lathe

surface of the piston is finish-turned for grinding, while the open and closed ends are finish-faced and the grooves finish-turned to the final dimensions.

An intermediate cut is taken on the grooves by tools in a supplementary holder provided beneath the work, as shown in Fig. 15. Thus, the finishing tools of the grooves have little to do and retain their size for a long time. This removes one of the chief annoyances of piston manufacture, which is the holding of the ring grooves to the small tolerance demanded. Advantage is also taken of the pressure of

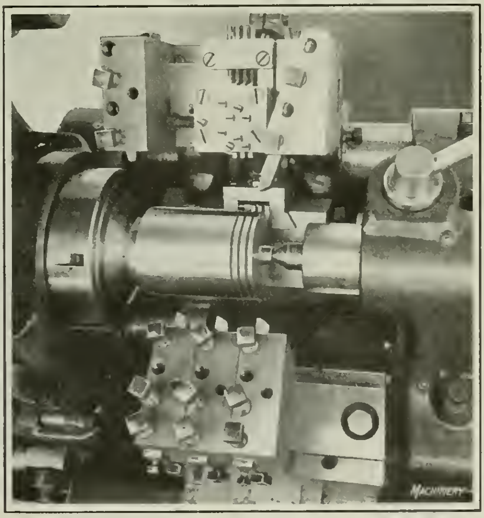


Fig. 12. Close-up View of a Machine engaged in finishing a Cast-iron Piston

the tail-center to eliminate end play of the spindle, and so the grooves in the piston are machined with true faces.

The machine used for this operation is shown in the heading illustration, and a close-up view of the tooling is shown in Fig. 12. The turning tools are automatically relieved on the return movement to prevent scoring the work. The production in roughing and finishing the piston is about the same—from forty-five to fifty pieces per hour, per machine, for a 3¾-inch diameter piston, or ninety to one hundred pistons per hour on two machines run by one operator. The speed used in finishing is higher than that used in roughing, but a finer feed is employed.

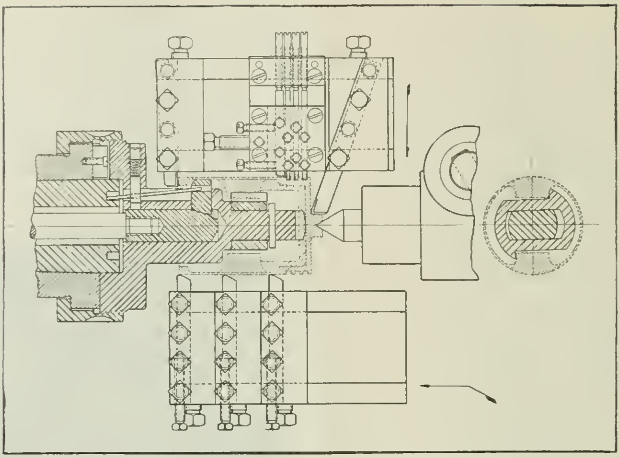


Fig. 13. Tooling used for taking Roughing Cuts on a Cast-iron Piston. Special Attention is called to the Means of supporting the Work

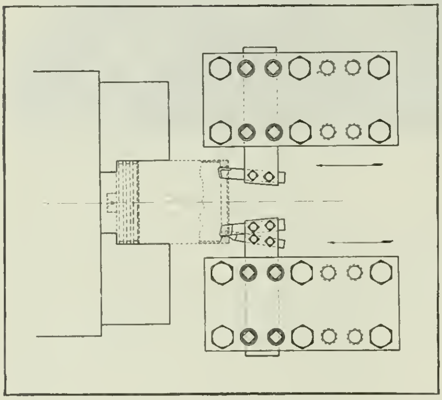


Fig. 14. Rough- and finish-boring and chamfering the Skirt of the Piston

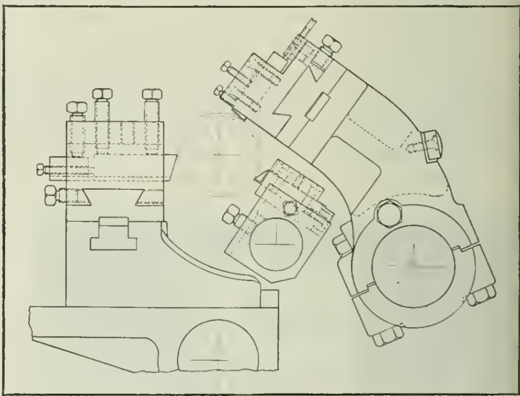


Fig. 15. Illustration showing the Intermediate Holder of the Tooling in Fig. 16

Final Operations on the Piston

The remaining operations on the cast-iron piston are as follows: In the sixth operation, the portions of the piston opposite the wrist-pin holes are relieved. In the seventh operation, the wrist-pin holes are finish-bored and reamed. In the eighth operation, the oil-holes, etc., are drilled. In the ninth operation, the chamfer of the skirt is ground to eliminate distortion (this operation is often omitted). In the tenth operation, the outside cylindrical surface of the piston is finish-ground, being located by the chamfer of the skirt, while the closed end is supported by a dead center. In the eleventh operation, the center boss on the closed end is removed on a hand milling machine. In the last operation, the closed end is disk-ground. Further refinements with a somewhat decreased production are required for the very thin-walled cast-iron pistons found in some engines of recent design.

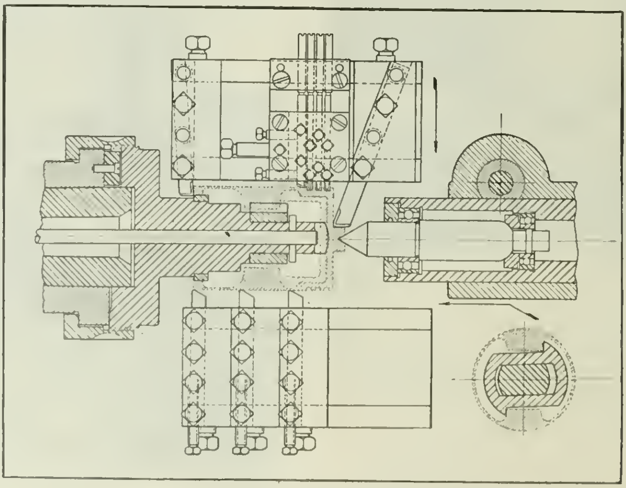


Fig. 16. Finish-turning, grooving and facing the Piston with Tooling Similar to that shown in Fig. 13

* * *

It is estimated, according to a statement that was published in a recent number of *Review of Industry*, that the world's production of iron and steel in 1921 aggregated 64,623,000 gross tons, as compared with 118,093,000 in 1920 and 98,464,000 in 1919.

Cutting Spur Gears on Gear Shapers

Use of Machines Operating with a Planing or Shaping Action and Forming Gear Teeth by Generating and Formed-cutter Processes

Third Article of a Series on the Use of Different Types of Gear-cutting Machines for Cutting Various Classes of Gearing

THE gear-cutting machines referred to in previous articles in this series form spur gear teeth either by using a cutter which reproduces its shape, or by using a cutting tool that is guided by a templet or master former. Tooth curves produced by these two general types of machines are the result of what might be called a copying process. When cutting spur gears by using a generating type of machine, the gear teeth are formed as the result of certain relative motions between gear blauk and cutter, instead of simply reproducing the shape of a formed cutter or controlling templet. This particular article is confined to machines which operate with a planing or shaping action, and the first ones dealt with are generating types. A very common type of spur gear generator forms the teeth by milling with a revolving cutter or hob, and the next article of this series will deal with the use of machines of this kind.

Principle of Generating Process of Forming Gear Teeth

When a series of formed cutters is used for cutting spur gears, it is evident that the curvature of any cutter of a set can only be absolutely correct for a given number of teeth. Theoretically, there should be a different cutter for every number of teeth of a given pitch, but in practice this is not necessary. While the error in shape for other tooth numbers within a limited range may be negligible for ordinary requirements, nevertheless it was considered desirable in the development of gear-cutting processes to utilize a method, especially for certain classes of work, that gives the required curvature even though the number of teeth varies. This may be accomplished by a generating method, but the use of a generating type of machine does not always result in greater accuracy than the use of well-made formed cutters, since much depends in either case upon the condition of both machine and cutter and other factors of a mechanical nature. However, a generating process has the inherent advantage of being theoretically correct and of enabling a cutter of a given pitch to cut gears having different numbers of teeth to the correct shape, except for purely mechanical errors such as occur in varying degrees with any method.

In order to illustrate the principle of the generating process of gear-cutting, assume that a finished gear having teeth of correct form is revolved while in contact with a blank, which for purposes of illustration is assumed to be made of some soft, plastic material. The nature of this rolling action would be to generate teeth on the plastic blank. Thus, the teeth on the finished gear, as they roll into contact with the blank, form teeth having the curvature required for meshing properly with the generating teeth. This is a simple illustratiou of the principle of the generating process. Now, if this tooth forming or generating gear were hardened, and its teeth given suitable clearance, the cutter thus formed could be used to generate teeth in a cast-iron or steel blank, provided the cutter had a reciprocating action parallel to the axis of the blank, while both cutter and blank slowly revolved together, the same as two gears in mesh. This method of using a gear-shaped cutter is employed on a type of machine which will be dealt with later.

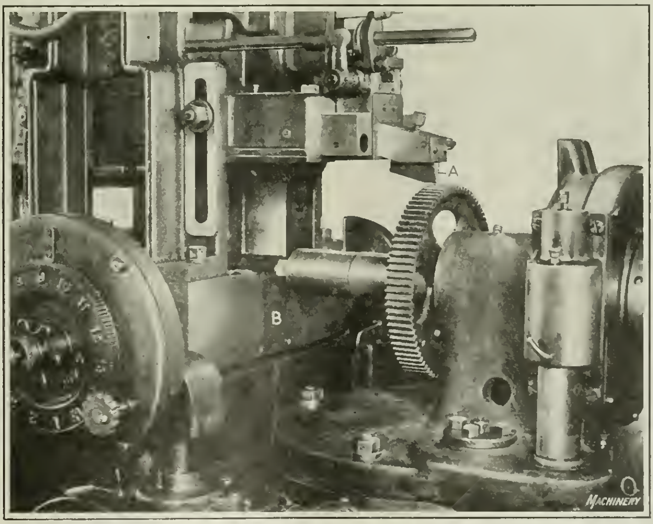


Fig. 1. Gear Planing Machine which generates the Teeth as the Tool, representing a Rack Tooth, feeds laterally

Another method of generating gear teeth is to give the gear blank a rolling movement relative to a rack-shaped cutter. It is possible to employ either a gear-shaped or a rack-shaped cutter for the following reason. A rack can be designed, for any system of interchangeable gearing, which will mesh correctly with a range of gear sizes of the same pitch. Moreover, all gears that will mesh properly with the rack will also mesh with one another. Generating processes of cutting gears are based on this interchangeable feature, which also accounts for the fact that one cutter may be used for cutting various sizes of gears of the same pitch. The cutter represents either a rack or a gear of the interchangeable series, and it cuts or generates teeth as the uncut gear blank and cutter are given movements, relative to each other, similar to a finished gear running in mesh either with a rack or with another gear, depending upon the type of cutter that is used.

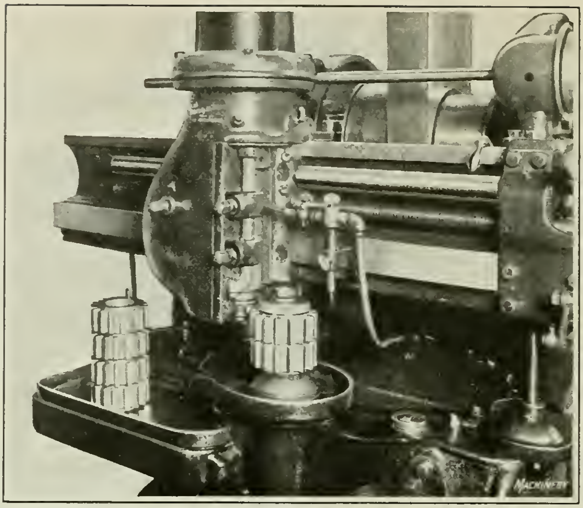


Fig. 2. Gear Shaper which generates the Teeth as the Reciprocating Cutter and Work slowly rotate like Two Gears in Mesh

Relation of the Rack to Gear-cutting Processes

Several types of gear-cutting machines that form gear teeth by generating methods use cutting tools which are shaped like the teeth of a rack, at least so far as the cutting edges are concerned. For instance, one type of spur gear shaper or planer uses a tool that is like a single rack tooth; another type of planer uses a tool having several teeth and resembling a short rack section; then there is the gear-hobbing machine that uses a rotating hob having rack-shaped teeth. The common types of machines for cutting bevel gears by a generating process use tools having cutting edges which represent the sides of crown gear teeth, the relation between a crown gear and a bevel gear being similar to that of a rack and a spur gear.

In order to understand different generating processes and why rack-shaped tools are often used, it is essential to know how the rack tooth form is derived and how it is related to the tooth curves of mating gears. The most important fact about a rack for the involute system of gearing which is now in general use, especially regarding its relation to gear-cutting processes, is that the sides of the teeth are straight. (In actual practice, the perfectly straight tooth form frequently is not used, as, for example, when it is altered somewhat to prevent interference with a pinion or when a rack is milled by using a cutter that is applicable either to racks or spur gears of large radius. This modification of the rack tooth form, however, need not be considered at present, since it pertains more particularly to rack cutting.) Another important fact about a rack tooth is that each side of a given tooth inclines from a plane perpendicular to the pitch line of the rack an amount equal to the pressure angle of the gearing (usually 14½ degrees, but often 20 degrees). Just why the sides of involute rack teeth are straight and why their inclination is the same as the pressure angle will be apparent when the development of tooth curves for involute gearing is understood. By studying the principles underlying these tooth curves, and particularly the relation between a rack and its mating gear, a clearer understanding of the generating processes of gear-cutting will be obtained.

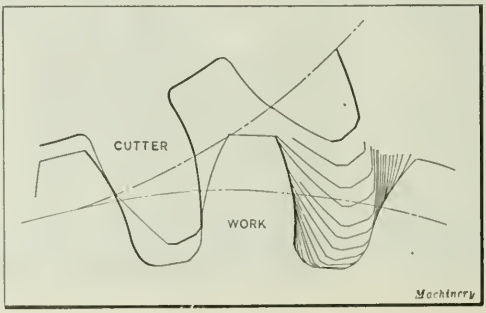


Fig. 3. Diagram illustrating Action of Gear Shaper shown in Fig. 2

The fact that an involute rack tooth is straight-sided is of considerable practical value, as applied to the making of cutters for different types of machines which form gear teeth by a generating method. It is evident that there is a decided advantage in having either a straight-sided tool or a straight side as a basis to work from. For example, if a gear-cutter is in the form either of a single rack tooth or of a short rack section, the work of making an accurate cutter is much simpler than it would be if the cutter teeth had to be given some special curvature. Similarly, if the cutter, instead of representing a rack tooth, is in the form of a gear (like the cutters used on Fellows gear shapers) the practical advantage of the straight-sided rack tooth is obtained, because the teeth of these cutters are ground to correct curvature by rolling the cutter in contact with the straight side of a grinding wheel. The grinding wheel, in this case, represents the rack tooth, and the curvature of the cutter is the result of a generating process.

Cutting Spur Gears on Machine of Generating Planer Type Using Single Rack-tooth Cutter

The first gear-cutting machine of the generating type to be considered is the Bilgram machine, which is shown in Fig. 1 cutting a spur gear. This machine is made by the Bilgram Machine Works, Philadelphia, Pa. The cutting tool *A* represents a single rack tooth, and it is attached to the end of a crank-driven slide which has a reciprocating motion like the ram of a shaper. It is evident that this tool, shaped like a rack tooth, would generate a tooth space of correct shape provided it were slowly traversed laterally between successive cutting strokes, assuming that the gear also received a rotary motion such as would be derived from a rack moving laterally at the same rate as the tool. However, if the machine operated in this manner, it would form only one tooth at a time, and it would be necessary to return the tool and repeat the lateral traversing movement for cutting each tooth space. This is avoided and all the teeth are formed while the tool is slowly traversed from one side of the blank to the other, by giving the gear blank an indexing movement after the completion of each cutting stroke.

Lateral Traversing and Indexing Movements

During each return stroke the tool is lifted automatically to clear the gear, by a suitable mechanism, and the gear blank is indexed; consequently, the tool passes through a succeeding tooth space each time it moves forward. Since the tool is slowly feeding in a lateral direction as though it were a rack in mesh with the gear being cut, the indexing movements exceed the circular pitch of the gear, just enough to com-

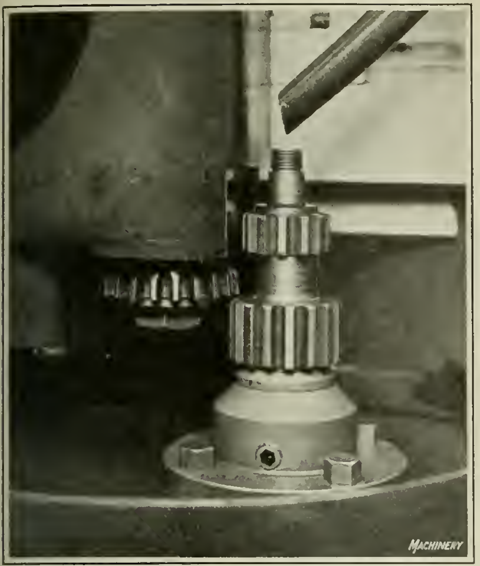


Fig. 4. Gear Shaper which is arranged for cutting on the Push or Downward Stroke of the Cutter

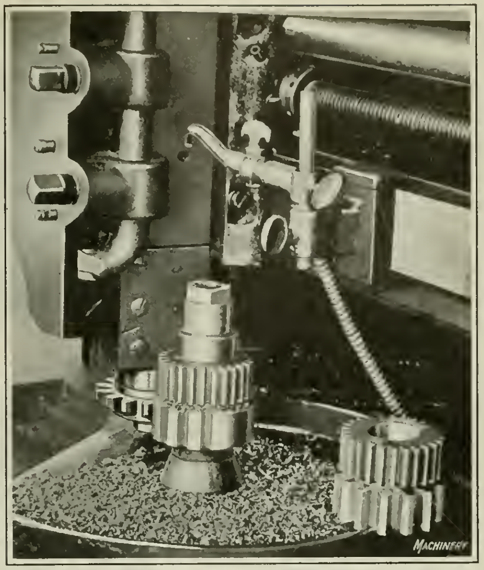


Fig. 5. A One-piece Double Gear cut by using the Pull Stroke for the Lower Section and the Push Stroke for the Upper Section

pensate for the lateral motion of the cutting tool. In other words, the gear blank is not only indexed relative to the pitch, but receives an additional rotary motion so that the tool and gear being cut act just as though a finished gear were rotating slowly in mesh with a rack, one tooth of which is represented by the tool. These rolling and traversing movements are controlled by change-gears selected according to the pitch. The lateral motion of the tool is obtained by the movement of slide *B* upon which the shaper mechanism is mounted. A cutter for a given diametral pitch is suitable for all numbers of teeth, which is true of any machine of the molding-generating type. Incidentally, the same machine can be used for cutting spiral gears, in which case the head carrying the work-spindle is adjusted about a vertical axis to conform to the helix angle of the gear to be cut.

Cutting Spur Gears on a Gear Shaper

When the teeth of spur gears are cut by a generating process on a machine which operates with a planing or shaping action, a gear shaper of the type shown in Fig. 2 is used in most shops. This gear shaper, made by the Fellows Gear Shaper Co., Springfield, Vt., is shown cutting two spur gears at the same time. The cutter has tooth outlines conforming to a gear of the same pitch as the ones being cut. This cutter is reciprocated vertically, and in starting to cut a gear it is first fed in to depth; then one gear tooth after another is formed as cutter and work slowly rotate together just as though two finished gears were in mesh. The action is illustrated by the diagram, Fig. 3. Successive positions of one cutter tooth are indicated by the succession of outlines. The feeding movement per stroke of the cutter will, however, be much less than the amounts shown by these outlines. As the tooth curves on this cutter are ground by a generating process after the cutter is hardened, very accurate gear teeth can be produced by this method.

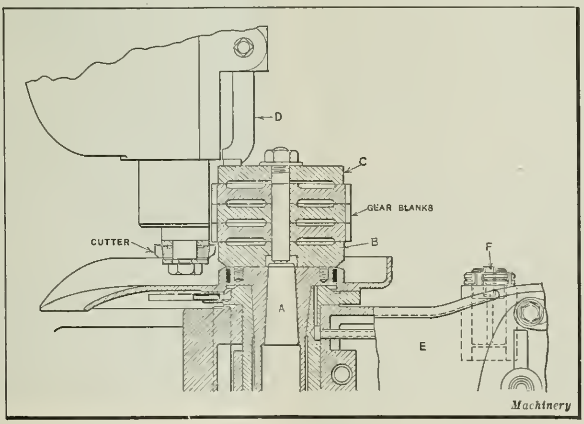


Fig. 6. Typical Method of holding Stack of Three Spur Gears

The gear teeth can be finished in one revolution of the gear blank, although a light finishing cut is often taken. In cutting transmission gears for automobiles, it is common practice to take a roughing cut followed by a light finishing cut. The machine may be arranged to take these two cuts automatically, but when gears are required on a large scale, it is generally considered preferable to use certain machines for roughing and others for finishing.

The rotation of the gear blank and cutter at the correct relative speeds is controlled by means of change-gears. When a machine has been properly adjusted for cutting gears of given pitch and number of teeth, all movements after starting the machine are controlled automatically. The gear blank is withdrawn from the cutter upon the return stroke to prevent dragging, the work-arbor being held by an apron actuated by a relieving mechanism. A cutter of given pitch may be used for any number of teeth of the same pitch, within the range of the machine, since this is a generating process.

Cutting during Upward or Downward Strokes

The cutter is ordinarily attached to the end of the ram with the cutting face upward or so as to cut on the pull or upward stroke. The machine in Fig. 2 is arranged so as to cut in this way. Sometimes there is not enough clearance to permit holding the cutter in

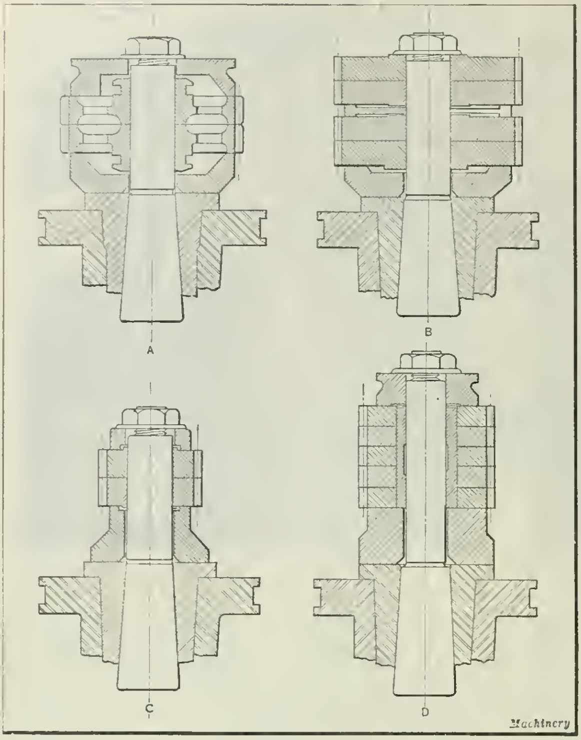


Fig. 7. Different Methods of locating and holding Spur Gears

this way, and then its position is reversed. For instance, this is done when cutting internal gears or whenever there is a shoulder or other part located close to the lower ends of the teeth. Fig. 4 shows a machine cutting a gear with the cutter reversed because of the small amount of clearance at the lower ends of the teeth.

The example shown in Fig. 5 illustrates how the gear shaper can be used to advantage when there is little clearance between two gears formed of one solid piece. In this particular instance, the manufacturing cost was greatly reduced by making the gear in this way. One side of this double gear is 10 diametral pitch, and the other side 5 diametral pitch. This double gear was intended for a cylinder boring machine, the object being to eliminate chatter. The teeth on one side are staggered relative to those on the other in order to split up the tooth action and secure smoother operation. The 10-pitch side of the gear was cut with the shaper operating on the push stroke, whereas the 5-pitch side was cut by means of the pull stroke. The illustration shows the machine cutting the lower side and operating with the pull stroke.

Methods of Holding Gears for Cutting

The simplest method of holding ordinary spur gears of the transmission type is shown in Fig. 2. The gears are mounted on a faceplate resting on the work-spindle, and they are located centrally by an arbor which also provides means for clamping. A similar arrangement is illustrated by the diagram Fig. 6, which shows a stack of three gears. The work-arbor *A* has a reverse taper, and is drawn up tight into the work-spindle when the nut at the top of the arbor is screwed down on the upper clamping plate. The gear blanks, together with the faceplate *B* and the upper plate *C*, are thus clamped rigidly against the end of the work-spindle.

Whenever practicable, the rigid work support *D* is used to take the direct thrust of the cut, assuming that the cutting is during the upward stroke. On apron *E*, which carries the work-spindle, there is a roller *F* for supporting a large faceplate, internal gears, or special fixtures for holding internal gears. Another roller held by a special bracket attached to the apron is used when it is necessary to locate the roller closer to the work-spindle, as when gears or fixtures of smaller diameters must be supported. The design of clamping plates or fixtures for holding either external or internal gearing is, of course, varied more or less to suit the shape and size of the work. A few examples illustrating different methods of holding and clamping will be described to show, in a general way, certain typical as well as more or less special applications.

Holding Gears Having Extended Hubs

Diagram *A*, Fig. 7, shows an approved method of holding sliding transmission gears having extended hubs. The two plates between which the gears are clamped are cupped out to provide clearance spaces for these extended hubs, and to permit the plates to bear directly against the gear rims. In this way, the gears are clamped just inside the root circle where support is needed, and as the lower plate rests directly on the flange of the work-spindle, the pair of gears is held rigidly.

Diagram *B* shows a method of holding gears having hubs which project slightly on one side only. In this instance four gears are placed on the arbor, and between each pair there is a spacing washer which clears the hubs but supports the gears close to the outside of the blank. The faceplate, resting on the work-spindle, is cupped out slightly to clear the lower gear blank hub. Diagram *C* shows an arrangement for two gears.

Arbor Bushings and Special Fixtures

Different sizes of bushings, adapters, or special fixtures are often used in conjunction with the central arbor, and some-

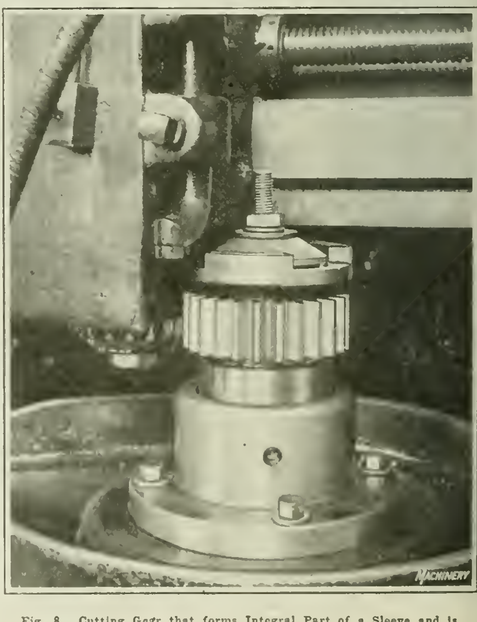


Fig. 8. Cutting Gear that forms Integral Part of a Sleeve and is Close to a Shoulder

times the latter is dispensed with, as, for example, when a gear has a long shank which must extend down into the work-spindle. Diagram *D*, Fig. 7, shows an approved method of holding a stack of gears when the holes are large enough to require a bushing on the arbor.

A type of gear which is rather difficult to hold is shown in Fig. 8. This gear is formed integral with a rather long sleeve, and it is also close to a shoulder, but the gear-cutting operation is readily performed on the gear shaper. The lower end of the sleeve is held in a centering bushing in the machine spindle, and the upper part in an adjustable fixture. Before clamping this fixture, it is centered by placing a dial indicator in contact with the bearing surface of the work. The latter is clamped down in the fixture by means of a bolt passing through the work-spindle. A slotted washer is used so that the work can be removed readily as soon as the nut is released.

Fixtures for Crankshafts with Integral Gears Located Close to Web or Shoulder

An example of work illustrating the application of the gear shaper to the cutting of gears having a small clearance space at one end is shown in Fig. 9. This gear is formed integral with a crankshaft. The lower end of this crankshaft is inserted in an adjustable fixture that is clamped on top of the work-spindle. The push stroke is used, and the crankshaft is stiffened by placing between the webs a small jack formed of a bolt and nut. Each crankshaft is located in the same position by means of a stop which comes into contact with the crankpin.

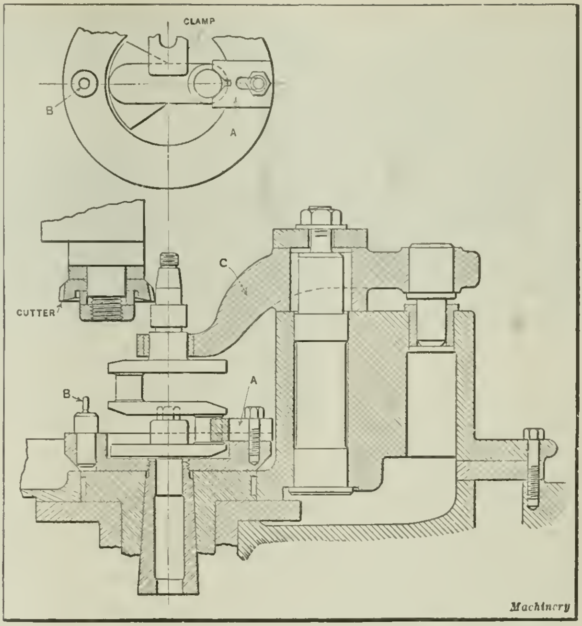


Fig. 10. Method of holding Crankshaft while cutting Gear Near Upper End

A more elaborate method of holding a crankshaft for a similar gear-cutting operation is shown in Fig. 10. The work is centered by a special hollow arbor held in the spindle by a faceplate. This faceplate carries a V-shaped locating stop *A*, and also a cutter locating pin *B*. This pin is required in order to locate the cutter in a certain position relative to the crank, because it was necessary to have the gear teeth in a certain relation to the crankshaft. After the cutter has been set, the V-shaped locating stop serves to hold each succeeding crankshaft in the proper position. The upper supporting arm *C*, containing a bushing which fits the shaft bearing, not only serves to center the upper end but also prevent excessive deflection of the shaft due to the thrust of the cut.

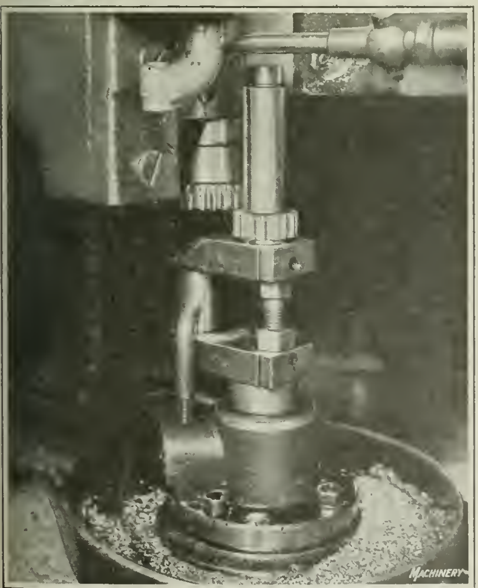


Fig. 9. Cutting Gear Teeth Close to Crankshaft Web, using Push Stroke

Cutting Spur Gears on Shaper of Multiple-tool Type

The usual method of cutting gears is either by forming one tooth or tooth space at a time, or by progressively cutting all of the teeth as the gear blank revolves to present the entire circumference to the cutting tool. Gang cutters which completely form more than one tooth at a time have been used to some extent, especially in connection with the formed milling cutter process. The multiple type of gear shaper developed by the Stevenson Gear Co., Indianapolis, Ind., is so designed that all tooth spaces may be cut at the same time, although for some classes of work it is considered preferable to cut, say, one-half or one-third the tooth spaces simultaneously. The usual method, however, is to equip the machine with as many tools as there are teeth in the gear to be cut, these tools being located radially around the circumference of the gear. When the machine is in operation, the gear blank (or blanks) is given a reciprocating motion past the cutting tools, which remain stationary except for a radial in-feeding movement which gradually sinks the cutters in to the required depth.

This is a formed-cutter process, the tooth spaces receiving their shape from the formed ends of the cutting tools. Each tooth space, however, is not formed by a single tool because the work is indexed after each cutting stroke. The object of this indexing is to equalize any slight irregularities which may exist in the different tools, thus making the teeth uniform in shape by causing each tool to operate in a succeeding space every stroke. To insure uniformity of tooth spacing, the tools are held at the full-depth position while the gear blank makes a complete revolution, thus permitting light finishing cuts to be taken. One or more gears may be cut at a time, depending on the face width of the blanks. The blank or blanks, as the case may be, are held on an arbor having a tapered shank which fits into the ram or work-spindle. When cutting plain, external spur gears, usually from two to ten blanks can be placed on an arbor. As soon as the teeth are cut, this arbor is removed and replaced by one holding uncut blanks. This type of machine cuts gears rapidly, the actual cutting time varying from 1 to 4 minutes for an arbor of gears, the time depending upon the total face width and the depth of the teeth.

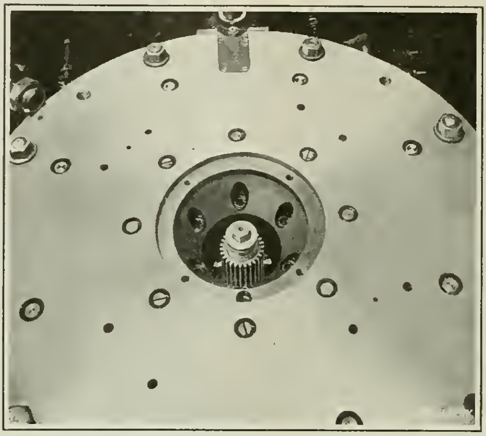


Fig. 12. Gear Shaper designed for cutting all of the Teeth in a Stack of Gears simultaneously

There are two different types of Stevenson multiple shapers, designated respectively as the "up-stroke" and the "down-stroke" types. The up-stroke machine is intended primarily for cutting plain spur gears, which can be passed through the tool-head, whereas the down-stroke type is designed more especially for cutting internal gears, cluster gears, or any form which will not pass through the tool-head. A detailed view of the up-stroke machine cutting a stack of spur gears is shown in Fig. 12. This is a view looking down on the cutter-head. The gears seen at the center are at the top of their stroke and the tools are largely concealed. In operating this machine, the changing of arbors involves stopping the machine, removing the arbor containing the cut gears by means of a foot-pedal, and dropping another arbor into place through the tool-head. In changing arbors on the down-stroke machine, which is illustrated in Figs. 13 and 14, it is necessary to stop the machine and then elevate the ram to provide additional working clearance so that the arbor may be dropped down and removed. After another arbor with uncut blanks is inserted in the spindle and fastened, the ram is lowered and the machine started. As this requires a somewhat longer time than changing arbors on the up-stroke machine, the latter type is preferable for the class of gears which it is adapted to handle.

Each machine has two tool-heads, so that while one is in use, the tools in the other may be sharpened and reset. The outer end of each tool bears against a cam attached to a ring (see Fig. 14) which is given a slow rotary movement for feeding the tools inward, this motion being controlled through change-gears. As these cam sections are adjustable relative to the ring, the radial position of each tool can also be varied. After every cutting stroke the cam ring is given a reverse movement to withdraw the tool far enough to provide relief during the return stroke. During the cutting stroke the tools are clamped to hold them rigidly, and are released at the end of the cut to permit the relieving and feeding movements. The feeding movement is limited by an adjustable micrometer stop located on the tool-head.

The arrangement of the tools varies for different classes of work. For instance, the tool-head is sometimes provided with roughing and finishing tools located alternately. The roughing tools, which may either be of the "square-nose" or stepped form are adjusted so as to remove most of the stock. This combination of roughing and finishing tools is recommended for teeth coarser than 6 diametral pitch. Another arrangement consists in using a special cam which feeds a single finishing tool forward after the other tools have roughed out the teeth. Gang tools so formed that each tool cuts several teeth may also be used for the finer pitches.

* * *

The manufacture of automobiles is the third industry of the nation, according to the *Review of Industry*. Of the 10,000,000 automobiles that are now registered, more than 3,000,000 are said to be owned by farmers.

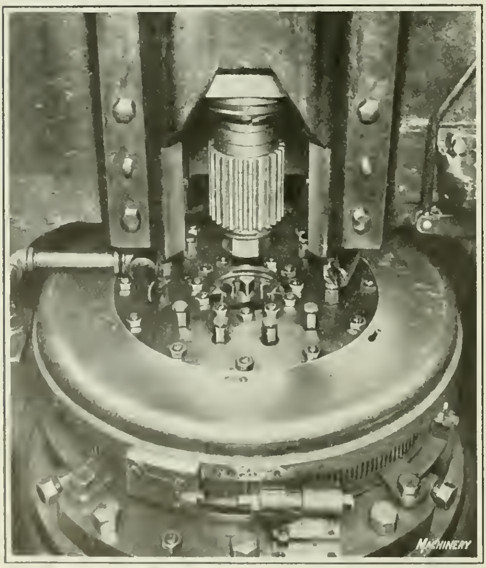


Fig. 13. The "Down-stroke" Type of Multiple-tool Shaper

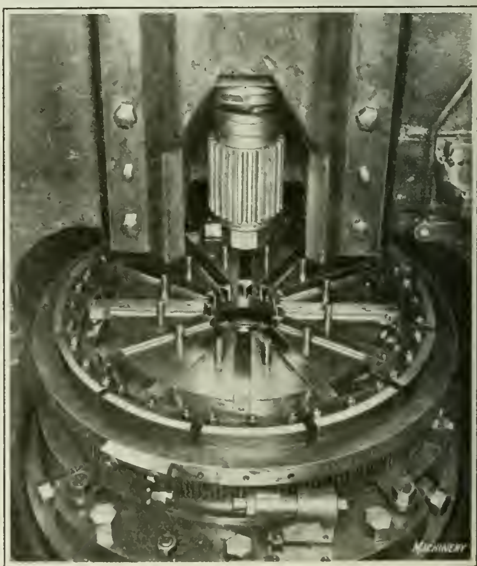
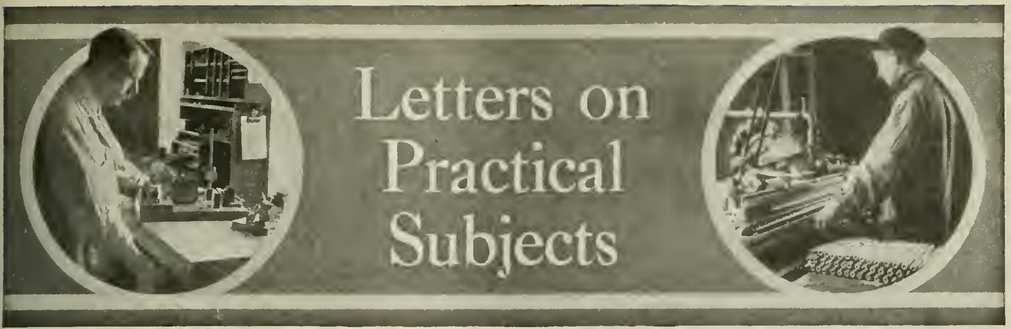


Fig. 14. Arrangement of Tools and Feed-cams on Multiple-tool Shaper



CENTERING DEVICES

The centering devices shown in the accompanying illustrations are being used in the screw product plant of the National Acme Co. at Cleveland, Ohio, for centering parts on a production basis in a hand screw machine. While these tools do not involve a strictly new principle, they nevertheless embody an adaptation of considerable merit, and they are daily increasing production fully 100 per cent over methods previously used. The possibility of adapting these devices to any production centering problem will be obvious.

In the plant referred to, which is devoted entirely to the production of screw products of the milled and upset varieties, much of the work intended for automotive and accessory construction must be heat-treated and ground. A considerable portion of this product consists of shafts, bolts, pins, and various special parts. These parts, upon leaving the automatic screw machine department, invariably require some secondary operation before heat-treating and grinding, and in addition, the cut-off end must be centered to facilitate holding during the grinding operation, if the nature of the part requires that it be held between centers.

The necessity of cutting the second center hole in the part in alignment with the first center hole and concentric with the periphery is readily understood. The centering tool shown in Fig. 1 is placed in the turret of a hand screw machine or in the tailstock of a lathe. This tool is intended for centering shafts or special parts of a similar nature which have a uniform diameter at and for some distance back from their uncentered end so that this portion can advance through the tool and up to the centering cutter the necessary distance.

The three rolls on the tool are adjusted by screws and lo k-nuts to the diameter of the work. In addition, they are adjusted so that their contact points are at an equal distance from the center of the part so as to insure the proper locati n of the center hole. The rolls and pins on which they revolve are hardened and ground. A suitable centering cutter is placed in the holder and held firmly by a set-screw. The part to be centered is placed in the chuck and the turret advanced. The rollers receive the work, and revolving with it, guide it until the centering tool has cut to the required depth and the turret has been backed off. This tool has a range for centering work from ¼ to 1 inch in diameter.

The device shown in Fig. 2 is being used in centering parts which have, on their cut-off or uncentered end, a head or shoulder of a nature that prevents the part from entering and being guided by the rollers of the tool shown in Fig. 1. This device consists merely of a pair of hardened and ground rollers pivoted in a bracket which is fastened in the tool-holder on the cross-slide of the machine.

The two rollers are brought forward by the cross-slide, which is adjusted to the proper height. They are then adjusted by screws and lock-nuts to receive or roll against the part to be centered. The part is placed in the chuck and the turret or tailstock equipped with a plain centering tool is advanced. The centering tool enters the work while it revolves against the guide rollers and in this manner is held true.

Cleveland, Ohio — W. F. Honer

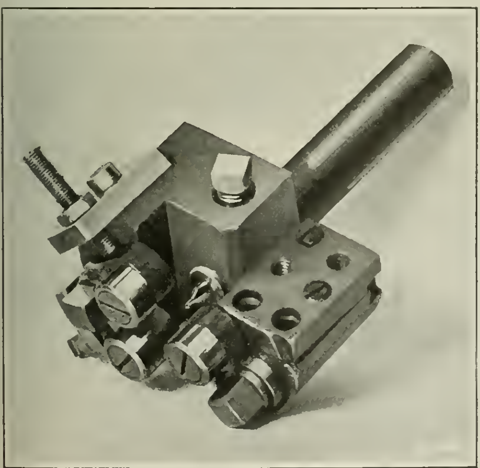


Fig. 1. Centering Tool provided with Guide Rolls

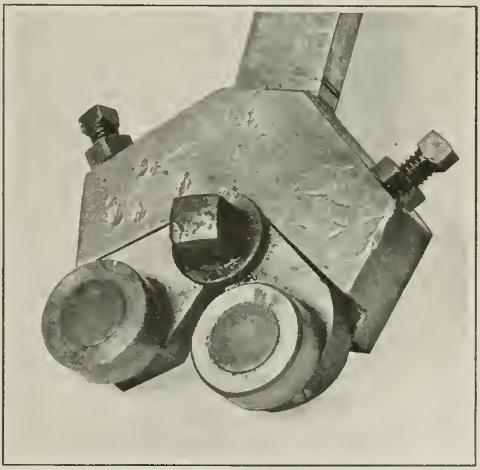


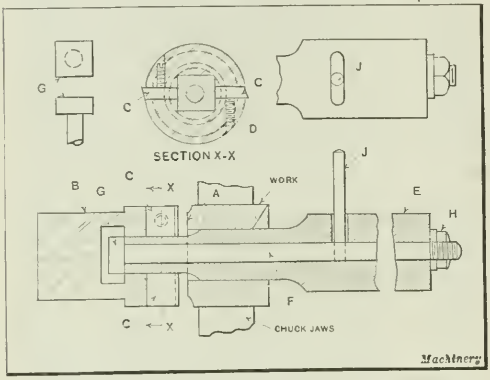
Fig. 2. Guide Roll Tool used in Centering Operations

BACK-FACING TOOL

The tool shown in the accompanying illustration is designed for back-facing surface *A* so that the work can be bored, reamed, taper-turned at the front end, and back-faced at one chucking in a hand screw machine. Part *B* is made a running fit in the spindle of the lathe, the front end having a square broached hole as indicated in the sectional view. The front end of part *B* is also slotted to hold two high-speed cutters *C*. A recess is cut at the back of the square hole, and the cutters are held in place by headless screws *D*.

The shank of part *E* is made to fit the hole in the turret, and the front end is turned to fit the reamed hole in the work. The front portion of this end is milled square to fit the square hole in part *B*. Part *E* is drilled through the center to receive the piece *F*, which has a square head *G* on the front end that is the same size as the square end of part *E*. Part *F* is threaded on the back end for a nut *H*. The body of part *E* is slotted to accommodate a lever *J* which is driven into a hole in part *F*.

The action of the tool is as follows: Part *B* is inserted in the spindle of the lathe, and the work gripped in a three-jaw chuck. After the boring, drilling, and reaming operations are completed, the back-facing tool is advanced, with lever *J* in such a position that the squared end *G* will be in line with the squared end of part *E*. When *E* has advanced far enough (as determined by a stop on the machine) to allow the square end of part *F* to enter the recess in part *B*, lever *J* is pulled over, which brings the squared end of part *F* out of line with the square hole in part *B*. The corners of the squared end *G*, coming in contact with the face of the recess in part *B*, permit the facing cutters to be brought into contact with the work by pulling the turret back. After the work has been back-faced, the two members *E* and *B* are disengaged by pushing lever *J* over to its former position, and withdrawing *E* from the work.

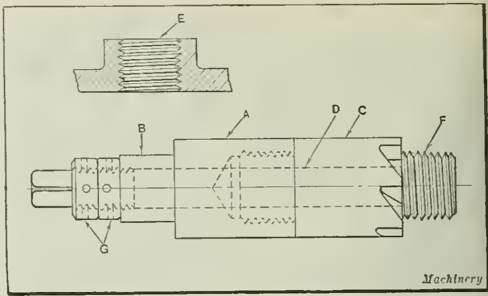


Back-facing Tool

HARRY MOORE
Rosemount, Montreal, Canada

FACING TOOL FOR SPARK PLUG BOSSES

Difficulty experienced in facing the spark plug bosses on automobile engine cylinder castings led to the development of the tool shown in the accompanying illustration. Referring to the sectional view above the facing tool, *E* represents the surface of the spark plug boss that is required to be faced square with the tapped spark-plug hole. In the view of the tool, *A* is a machine steel body having a 15/16-inch square section milled at *B*. A high-speed steel cutter *C* is screwed into the other end of part *A*. The threaded pilot *D* passes through cutter *C* and body *A*. The thread on the pilot end *F* is cut exactly the same size as that on the spark plug. A 3/8-inch square is milled on the left-hand end of pilot screw *D*. The pilot screw is made a slip fit in cutter *C* and body *A*, and is held in place by lock-collars *G*. To operate the tool, end *F* of pilot *D* is screwed into the tapped hole until the cutter *C* comes in contact with the spark plug boss. The tool and cutter are then revolved by means of a special wrench applied to the squared end *B* of body *A*. Another wrench is applied to the squared end of pilot *D* and manipulated to feed the cutter to the work, one-eighth turn being made to each revolution of the cutter. When the cutter has faced the boss to the required depth, the pilot is simply unscrewed from the hole.



Facing Tool for Spark Plug Bosses

Chicago, Ill. HAROLD A. PETERS

SPECIAL SCREW MACHINE CHUCKS

A chuck of unusual design, intended for use on a hand screw machine, is shown in Fig. 1. The object in designing this chuck was to retain the desirable features of the spring collet, with which the machine was regularly fitted, and in addition to provide a hardened and ground bushing for the purpose of piloting reamers and counterbores. The piloted tools were required in performing finishing operations on parts like that shown by the dot-and-dash lines at *A*, which were roughed out from brass castings in a preceding operation. The method of obtaining this combination will be seen in Fig. 1. At *B* is shown the chuck cap, and at *C* the collet retainer which is threaded into the cap to permit inserting the bushing or pilot guide *D*, the three segments of which are pressed into *C* with a light press fit. The spring collet *E* is milled out in three equally spaced sections to allow *D* to be located in the retainer *C* before the latter is screwed into the chuck cap *B*. This construction permits the guide bushing to be located close to the work.

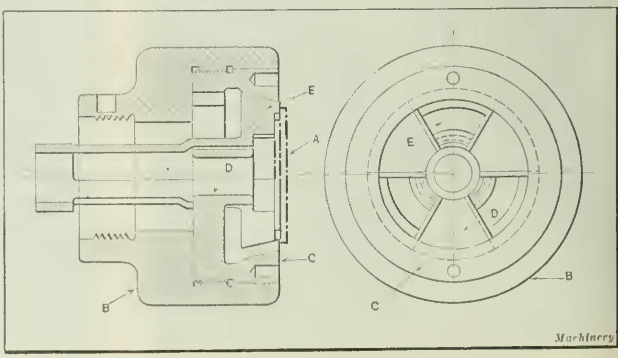


Fig. 1. Collet Chuck provided with Pilot Bushing

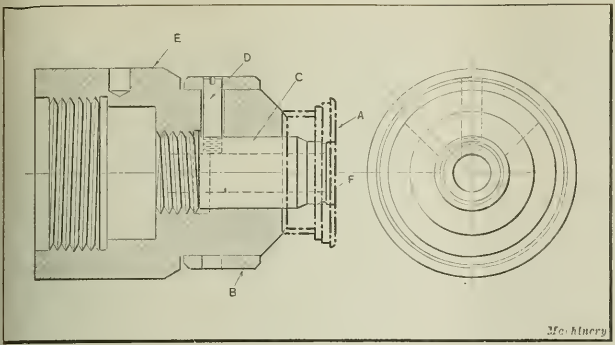


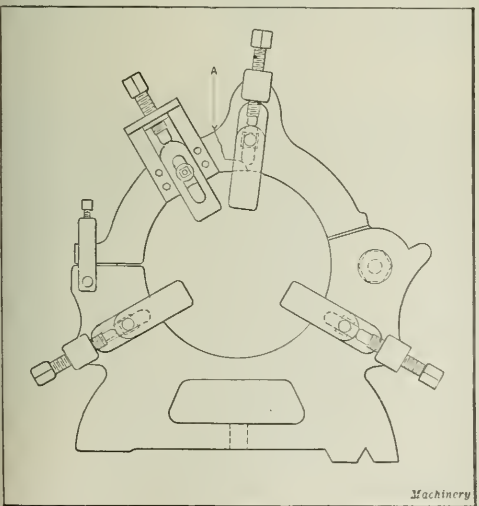
Fig. 2. Screw Chuck provided with Arbor and Pilot Bearing

The chuck illustrated in Fig. 2 was designed for the rapid production of the piece shown at *A*, which is required to be formed, faced, and counterbored with tools piloted in the work-arbor. The work is of brass, and the outside is required to be concentric with the hole at *F* in which a fine-pitch thread has previously been cut. The knurled operating ring *B* is connected to the combination arbor and pilot bearing *C* by screw *D* which passes through a slot in the chuck cap *E*. The work is clamped in place when the arbor is screwed into the chuck cap by rotating ring *B*, and although the cutting action may cause the work, with its fine-pitch threads, to tighten on the arbor, it may be readily removed without injury by unscrewing or loosening arbor *C* from cap *E* by operating knurled ring *B*.

Waynesboro, Pa. D. A. Nevin

STEADYREST FOR HEAVY PIPE

A length of steel pipe 6 inches in diameter having ¾-inch walls was to be cut into sections. The pipe was set up in a lathe, using a regular chuck and steadyrest. The cutting-off tool was held in a special holder which gave it great rigidity, but from the first it was apparent that the steadyrest was too weak for the job of cutting the heavy "stringy fibered" pipe. The tool finally stuck in the cut and the work "climbed," with the result that the steadyrest frame cracked close to the upper jaw on the broken line at *A*.



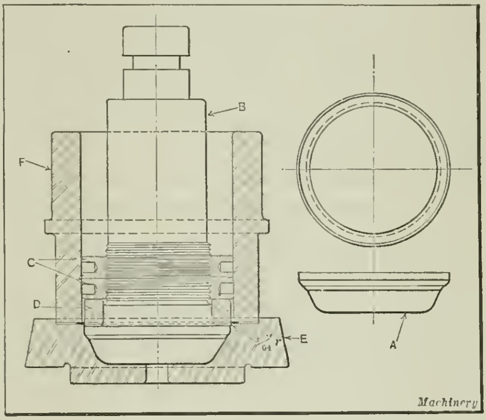
Steadyrest provided with Extra Jaw

The broken frame was welded, but it was obvious that some means of strengthening the steadyrest must be provided. A study of the work in motion showed that when the tool stuck, it acted as a pivot, so that the work was forced to "climb," thus exerting undue force on the upper jaw. The illustration shows how the trouble was remedied by providing an additional jaw at the left of the upper jaw. In this position it acted against the forces pushing the work upward, and allowed the work to be completed without further trouble.

Worcester, Mass. Roland Ljungquist

BLANKING, DRAWING AND CLIPPING DIE

In producing drawn sheet-metal parts that have to be trimmed or clipped, it is customary to blank and form the part in one operation and trim the drawn part in a separate operation. The punch and die shown in the illustration was designed to eliminate the second operation, so that only one operation is required to blank, draw, and clip the part.



Blanking, Drawing and Clipping Die used in Double-action Press

A double-action press of standard make, with a knock-out for ejecting the shell after the operation is performed, is employed. The shell shown at *A* is of sheet brass, 0.015 inch thick, and the blank diameter is 4.625 inches. The view at the right shows the shell after having been blanked, formed, and clipped. By referring to the illustration of the die it will be seen that the drawing punch *B* is threaded at the lower end, and that two check-nuts *C* hold the clipping ring *D* in place. The clipping ring should be 0.0015 inch smaller than the mouth of die *E*. In this instance, ring *D* and die *E* measure 3.4355 inches and 3.437 inches, respectively. To insure a good running fit, the blanking punch *F* should be bored to a slightly larger diameter than the check-nuts *C* which, in turn, should be from 1/64 to 1/32 inch larger than the clipping ring. The clipping ring is thus saved from unnecessary wear.

The radius at the mouth of die *E* is given as 3/64 inch, in this case, but it could be made as large as ¼ inch, if necessary, or as small as 1/64 inch, depending on which would work to the best advantage. In assembling the tools, clipping ring *D* should be so set that it will have trimmed the shell by the time that drawing punch *B* has reached its lowest position in die *E*, or within a distance from the bottom of the die recess equal to the thickness of the metal being formed, which in this instance is 0.015 inch. Some toolmakers call this the "pinch-off" method of clipping.

A die of the type described will increase production and therefore decrease the production cost. Dies of this type can be used satisfactorily on both sheet brass and steel. The wear on the tools is no greater than that on tools used to perform the same work in two separate operations. All the parts of the punches and dies are made of tool steel except the lock-nuts *C*, which are of machine steel. G. H. C.

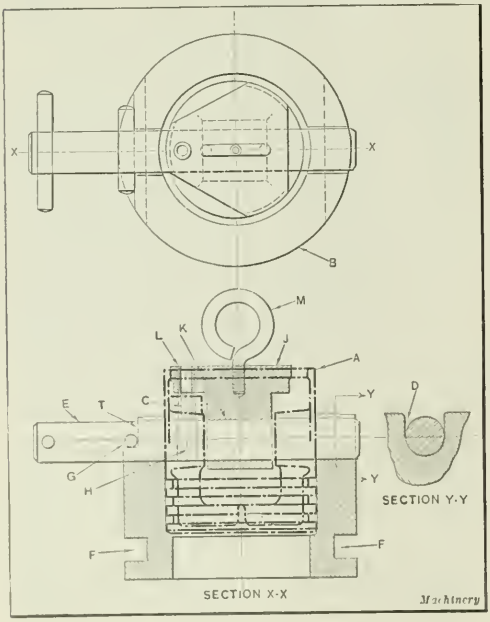
DRILL JIG FOR WRIST-PIN HOLE

The jig shown in the accompanying illustration is used for holding the engine piston *A* while drilling the wrist-pin set-screw hole at *C*. The body *B* is a round iron casting bored out to receive the piston after it has been ground on the outside. It also has a slot cut across the top, as shown at *D*, to receive the locating pin *E*. Slots *F* guide the fixture as it is slid from one spindle to another for drilling, spot-facing, and tapping the hole. The flat at *T* is used for locating the pin *E* by means of the cross-pin *G* so that the clearance hole *H* in the piston will be in line with the drill bushing *L*.

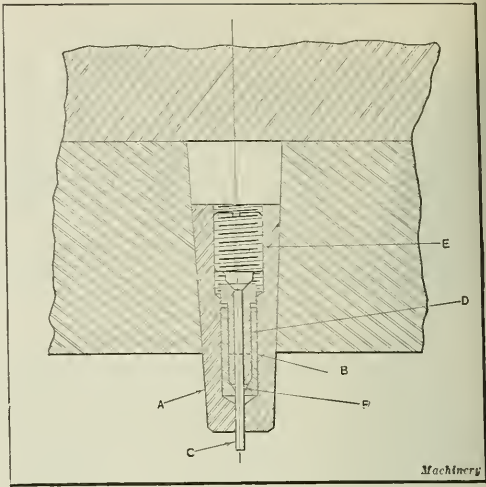
The bushing plate *J* is made of steel, and has a three-point bearing at the top that fits into the skirt bore of the piston, while at the bottom it has a ground hole *K* through which the locating pin *E* passes, lining up the plate *J*, ready for drilling the piston. The bushing plate is hardened and holds the drill bushing *L*. An eyebolt *M* is screwed into the top of plate *J* to facilitate handling. When using this jig, the bushing plate is dropped down into the piston and the locating pin *E* thrust through the wrist-pin hole, thus lining the plate up with the piston.

After this has been done the piston and plate are dropped into the jig body *B*, and the pin *E* pushed into the slots *D* and located by the flat *T* and the pin *G*. The hole is then drilled and the jig slid over to the next spindle. The pin *E* and plate *J* are next removed and the hole spot-faced, after which the jig is slid under the next spindle, where the hole is tapped and the piston removed from the jig. This jig has proved accurate and rapid, and has eliminated much wrist-pin locating trouble on the motor assembling floor.

Pittsburg, Pa. WILLIAM OWEN



Jig for locating Wrist-pin Set-screw Hole



Method of holding Small Piercing Punches

HOLDER FOR SMALL PIERCING PUNCHES

It is difficult to prevent the occasional breakage of small piercing punches, even when they are held in a rigid frame. Of the many holders that have come to the writer's notice, none seems so compact and rigid as the one shown in the accompanying illustration. This holder permits the punch to be easily replaced in such a manner that its location will not be disturbed. Thus all other subsequently pierced holes will be in alignment.

In the illustration, *A* is a punch-holder of any desired taper, which is driven tightly into the punch-plate. Part *B* is a hardened steel bushing which is a slip fit in *A*. The punch *C* is driven lightly into the holder *D*, which is slotted across the tapered end to give it spring, similar to a spring collet. Holder *D* is machined so that it will be a slip or sliding fit in *B*. Punch *C* is made of drill-rod so that it can easily be replaced in case it is broken, although breakage seldom occurs when a holder of this type is used. The upper end of the punch is riveted over, as shown, and retained by a set-screw *E*. When the set-screw *E* is tightened, the holder *D* is forced down against the angular surface *F*, thus gripping the punch *C* firmly.

Trenton, N. J. I. BERNARD BLACK

A PRODUCTION DRILL JIG

In the production of pieces having a drilled and reamed hole, it is customary to provide the drilling machine with a quick-change chuck and the drilling jig with slip bushings. For each piece completed, two changes of tools and two changes of bushings have to be made, and where only a short hole is to be drilled, a large portion of the operation time is consumed in changing tools and bushings. Fig. 1 shows a fixture for drilling and reaming a 3/4-inch hole through 3/4- by 5-inch steel pieces, in which the necessity of changing tools and bushings has been entirely eliminated.

The jig is used on a small drilling machine of the hand-feed type. The piece to be drilled is held in the V-block *B* by a clamping screw *C*, and is located by the stop-pin *D*. A large cast-iron sleeve *E* is made a good turning fit in the jig body and is held from axial movement by the nut *F* shown in the sectional view, Fig. 2. This sleeve carries two hardened tool-steel spindles *G*, located 90 degrees apart. One spindle carries the drill and the other the reamer. An index-plunger *H*, Fig. 1, secured to the sleeve *E*, permits either of the spindles to be locked in position over the work. The upper end of each spindle has two clutch teeth *J* that match those in the hardened steel driver *K* which is held in the spindle of the drilling machine.

The teeth are so formed that their engaging sides form an angle of about 20 degrees with the vertical. Vertical movement of the drilling machine spindle automatically engages or disengages the tool-spindles. Thus the only movements required of the operator are the manipulation of the drilling machine feed-lever and the changing of the spindles *G* from the drilling to the reaming position by means of the index-plunger *H*. Hardened bushings *L*, Fig. 2, guide the drill and reamer. The lower portions of the spindles are made larger in diameter and are held in position by retaining straps *M*, Fig. 1. Light coil springs *N* and thrust washers *O* help withdraw the tools and hold them out of contact with the work while not being used.

A pilot *P* in the driver *K* enters a corresponding hole in the upper end of each spindle and helps to steady it. The driving teeth on the end of the spindles are made with inclined faces so as to cause them to follow the upward movement of the drilling machine spindle on the return stroke. A Graham shank twist drill is used, and is secured in the spindle by four headless set-screws, the points of which enter the two V-grooves in the drill shank. The reamer shank is made a loose fit in the spindle and is driven by a loose pin so that it has a chance to float slightly. By removing the screws *R*, the spindles may be taken out of the sleeve for inspection or sharpening of the cutting tools.

Obviously the use of such a fixture is not confined to the drilling and reaming of round work, as this type of fixture could be used equally well for drilling and counterboring work of any shape, drilling body and tap drill holes, and similar operations.

Meadville, Pa. H. H. Manning

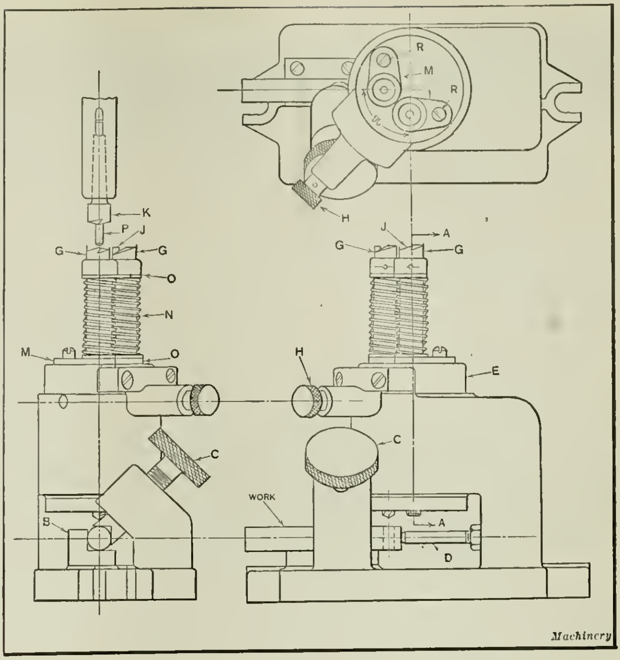


Fig. 1. Combination Self-contained Drilling and Reaming Jig

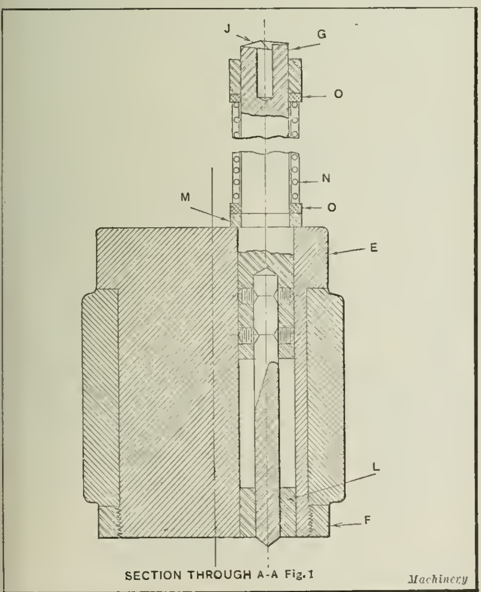


Fig. 2. Sectional View showing Drill Spindle Construction

SALVAGING WITH THE ACETYLENE TORCH

A concrete example showing the value of the oxy-acetylene torch for machine shop salvaging work is given in the following. In a large plant building a line of medium sized machinery and having its own iron foundry, a careful record was kept of every job for a period of about six weeks. This record was then used for calculating the approximate savings realized by employing the oxy-acetylene torch to repair defective and broken castings and broken parts of shop equipment. All costs for welding mixture and other incidental supplies were combined with labor costs to obtain the following figures, which show the result of the investigation:

Number of jobs	160
Total number of hours worked	290
Total weight of work repaired, in pounds	41,000

SALVAGE COSTS

Welding mixture and incidentals	$450
Iron scrap (valued at $0.006 per pound)	246
Cost of remachining after welding	800
Wages of one welder and assistant (at a rate of $1.54 per hour)	447
Total cost of salvaging	$1943

As the total value of the product salvaged was $3400, the net saving is obviously $3400 — $1943 = $1457. Of the entire 160 jobs referred to, only 104 represented work done on the product, the other 56 being odd jobs such as cutting off material and making repairs to small tools and equipment, the cost of performing the latter work being included in the totals given. In calculating the value of parts salvaged, none of the equipment repair jobs were included, because the value of these miscellaneous items was difficult to determine. Account was taken of the value of parts only up to the point of breakage. It is evident then that had the savings in respect to tools and equipment been included, the item of net profit would be much larger than the amount recorded.

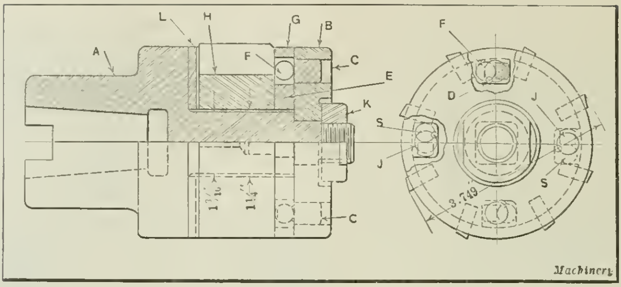


Fig. 1. Floating Reamer for reaming Automobile Engine Cylinders

The work on 76 out of the 104 parts repaired consisted of filling small blowholes and similar defects in castings that did not show up until the greater part of the machine work had been done. In the case of the other 28 parts, the repairs consisted of welding on pieces of flanges or other projections that had been broken off. All the jobs were relatively small ones, but nevertheless sufficient to make the part useless unless repaired, and these repairs could be satisfactorily accomplished only by welding.

In addition to the actual savings shown, many of the parts repaired were of such a nature that considerable and serious delays in production schedules would have resulted had it been necessary to recast and entirely replace them. It is hardly necessary to point out that a reduction in the number of defective castings and shop breakage is to be continuously striven for, but when one considers that the figures given here for the number of pieces repaired comprise but a fraction of 1 per cent of the total number of good parts produced, it is evident that no out-of-the-ordinary opportunities for using the welding torch were presented by the conditions under which the tests were made. The same possibilities exist in hundreds of other plants.

Cambridge, Mass. FREDERICK A. POPE

FLOATING REAMER

A "front-drive" floating reamer that has proved very satisfactory for reaming automobile engine cylinders is shown in Fig. 1. Some of the more important details of the reamer are also shown in Fig. 2, the same reference letters being used as in Fig. 1. The shank *A* is provided with a ground section 7/8 inch square which fits snugly into a square hole in the driving plate *B*. The driving plate has two tool-steel pins *C*, which are assembled in the plate and held in position by 1/8-inch pins *D*, while their projecting ends are milled to the shape shown in the detail view at *C*, Fig. 2. After the pins are machined, they are hardened and drawn.

The equalizing drive-plate *E* is provided with four equally spaced slots, the sides of which are ground where they make contact with the pins *C* and *J* and the 3/8-inch hardened steel balls *F* and *S*. A collar or ring *G* is pressed over the drive-plate *E* to retain the 3/8-inch balls.

The reamer body *H* is also provided with two pins *J* which are duplicates of those used in plate *B*. A nut *K* draws plate *B* up tight against the shoulder on shank *A*. In order to insure a good fit, or rather to allow the desired floating action, a thrust plate *L* is provided, which has three slightly raised portions on one face, as shown in Fig. 2. This plate is pack-hardened and ground to the proper thickness to compensate for any discrepancies that may exist in the thickness of the reamer body, driving plate, or length of shank. Details of the reamer blade used in the reamer body are shown in the lower right-hand corner of the illustration Fig. 2.

Lakewood, Ohio H. G. FRANTZ

* * *

STEEL TREATERS' SECTIONAL MEETING

A number of interesting papers were read before the New York sectional meeting of the American Society for Steel Treating, held at the Hotel McAlpin, New York City, on March 3. These papers included "New Developments on the Influence of Mass in Heat-treatment"; "Calite—a New Heat-resisting Alloy"; "Stainless Steel in Cutlery Use"; "Cold-headed Bolts—their Metallography and Heat-treatment"; "The Magnetic Testing of Small Casehardened Chain"; "Perfecting a Drop-forging"; and "The Manufacture of Steel." Several of the papers were illustrated.

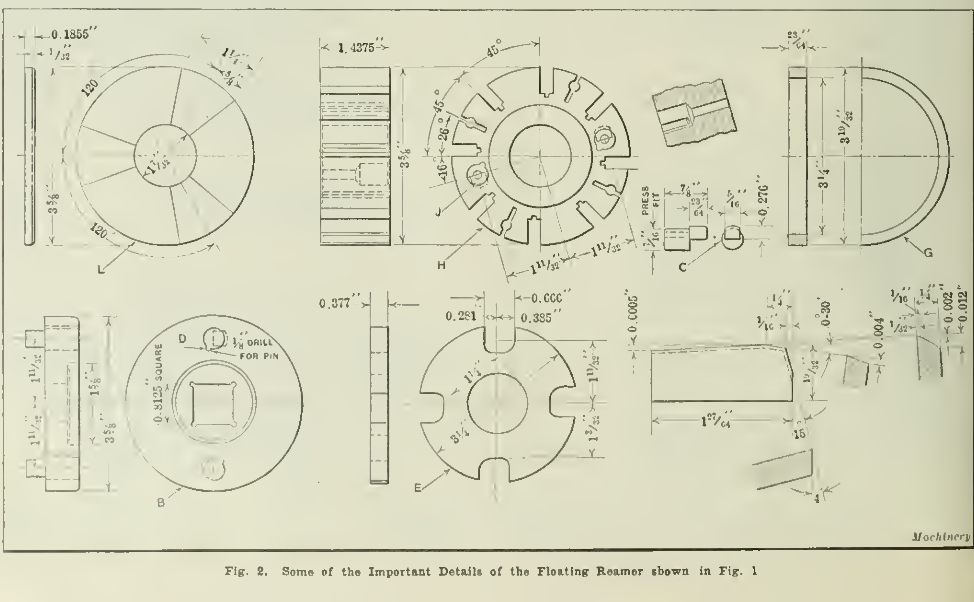
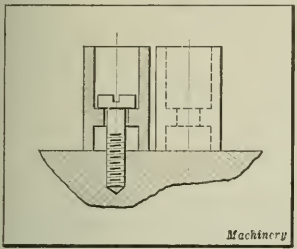


Fig. 2. Some of the Important Details of the Floating Reamer shown in Fig. 1

SHOP AND DRAFTING-ROOM KINKS

CENTERING AND LOCATING BUTTONS

The toolmakers' buttons shown in the accompanying illustration may be used to advantage when it is necessary to locate two or more buttons so close together that an indicator cannot be employed in the usual manner. Referring to the cross-sectional view, it will be noted that the button is counterbored to receive the head of the screw that is used to attach the button to the work. The counterbored hole is ground true or concentric with the outside of the button, so that the indicator contact point can be applied to the surface of the counterbored hole instead of to the outside of the button.



Centering and Locating Buttons

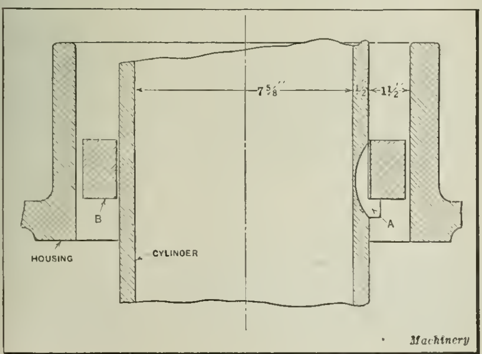
Ontario, Cal. CHARLES HOMEWOOD

SECURING COLLAR TO HOLLOW CYLINDER

The writer was recently confronted with the problem of securing a collar to the outside of a hollow cylinder in such a manner that it would withstand considerable end thrust, be easily and quickly removable in the direction of the thrust, and operate inside a circular housing which was concentric with the cylinder and 1½ inches from it all around as shown in the illustration. The use of set-screws or shoulders was out of the question, as screws could not be conveniently inserted or removed, and a shoulder would prevent removal of the collar.

Three keyways were finally cut, 120 degrees apart, on the outside of the cylinder, with a half-inch wide milling cutter. The gib keys, one of which is shown at *A*, were made with clearance enough to permit of their removal with the fingers or with a pair of pliers. To assemble the parts, collar *B* is pushed on the cylinder past the center of the keyways, the keys are inserted, and the collar drawn back over the keys until it rests against the gibs. To remove the collar the operation is reversed.

Montreal, Canada A. L. MORGAN



Method of securing Collar to Hollow Cylinder

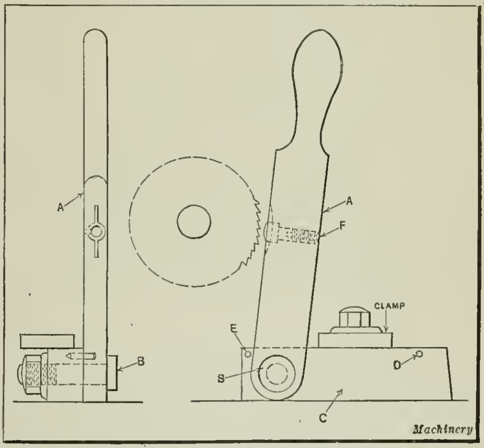
CENTERS MADE FROM DRILL SHANKS

The taper shanks of high-speed drills which are generally thrown away when the drills are worn out can be easily converted into lathe centers by hardening one end and grinding it to the required 60-degree angle. Centers made in this way are obviously inexpensive, and they will be found to give excellent service when used in lathes, grinding machines, etc.

Wilkinsburg, Pa. BERNARD E. LITOT

FIXTURE FOR SLOTTING SCREWS

A screw-slotting device which can be operated quite rapidly is shown in the accompanying illustration. The lever *A* is pivoted on the stud *B* held in base *C*. Lever *A* is drilled and counterbored to receive the screw to be slotted, the counterbore being deep enough to allow the screw-head to come about flush with the face of the lever. The screws can be slotted without chatter when held in this way. A pin *D*, driven into the base, enters a slot *F* cut into the side of the screw hole in lever *A* and provides for ejecting the screw when the lever is brought down after the slotting operation has been performed. The pin *E* prevents lever *A* from being pushed too far forward, and thus eliminates the danger of cutting the slot too deep. The device is clamped to the saddle of a lathe, or if a small speed lathe is used it is clamped to the slide-rest.



Screw-slotting Fixture

Rosemount, Montreal, Canada HARRY MOORE

FASTENING HAMMER TO HANDLE

A method of fastening a hammer to its handle so that it will not come off is to first secure the handle to the hammer by means of three iron wedges set in the usual H form, and then boil the hammer and handle in linseed oil for several hours. A hammer thus treated has been in fairly constant use for thirty years without showing the slightest sign of coming off the handle. The handle is made of good hickory.

Wilkinsburg, Pa. WILLIAM S. ROWELL

HOW AND WHY

QUESTIONS ON PRACTICAL SUBJECTS OF GENERAL INTEREST

PROBLEM INVOLVING VOLUME OF A CONIC FRUSTUM

A. R. I.—Can any reader of MACHINERY show how to find the depth of water in a tank which is in the form of a frustum of a cone, when the tank is only partly filled? If a tank is 9 feet in diameter at the top, 10 feet in diameter at the bottom, and 5 feet high, what is the depth of water when it is one-quarter full?

ANSWERED BY W. W. JOHNSON, CLEVELAND, OHIO

Referring to the accompanying diagram, let *ABCD* represent the vertical section of the given frustum taken

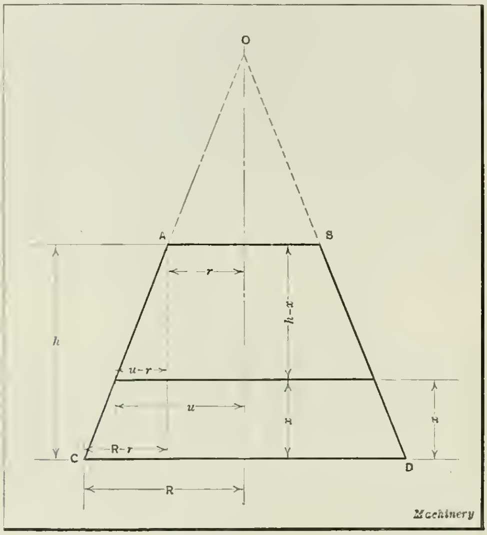


Diagram illustrating Solution of Tank Problem

through the center. Also, let r equal the radius of the top of the tank; R the radius of the bottom of the tank; h the height of the tank; n the number of parts in the total volume of the frustum, that is, the denominator of the fraction representing the part of the tank which is filled; and x the depth of water when the tank is $\frac{1}{n}$ full.

Denote the volumes of the three cones whose bases are circles having radii r, u, and R by the letters A, B, and C, respectively.

Then,

$$A:C = r:R \quad \text{and} \quad B:C = u:R$$

since corresponding volumes vary as the cubes of the radii or altitudes.

Therefore

$$A = \frac{r^3}{R^3}C \quad \text{and} \quad B = \frac{u^3}{R^3}C$$

Volume of water: volume of frustum = 1 : n

Then

$$\frac{\text{Volume of water}}{\text{Volume of frustum}} = \frac{C - B}{C - A} = \frac{C - (u^3 \div R^3)\,C}{C - (r^3 \div R^3)\,C}$$

$$= \frac{R^3 - u^3}{R^3 - r^3} = \frac{1}{n}$$

from which

$$u^3 = \frac{R^3(n-1) + r^3}{n} \quad \text{and} \quad u = \sqrt[3]{\frac{R^3(n-1)+r^3}{n}} \qquad (1)$$

From the theorem of similar triangles,

$$\frac{u - r}{R - r} = \frac{h - x}{h} \quad \text{or} \quad u = R - \frac{x}{h}(R - r) \qquad (2)$$

Solving (1) and (2) for x, we find

$$x = \frac{h\left[R - \sqrt[3]{\dfrac{R^3(n-1)+r^3}{n}}\right]}{R - r}$$

Reducing all dimensions to inches and putting $n = 4$, $R = 60$, $r = 54$, and $h = 60$ in this formula, we find $x = 13.97$. Hence, the depth of the water when the tank is one-fourth full is 13.97 inches.

HEIGHT OF CREST ON WHITWORTH THREAD

H. H. G.—A lap is to be made for lapping the crests of Whitworth thread gages, and the height x (see accompanying illustration) must be determined. How can this be calculated?

A.—The vertical depth x from the crest of a Whitworth thread to the horizontal line intersecting the points where the crest and straight sides meet may be determined by the

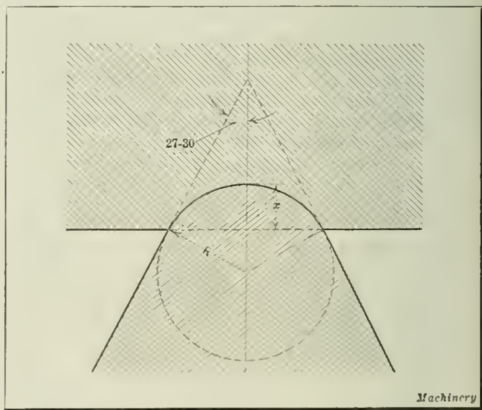


Diagram used in finding Height of Crest on Whitworth Thread

following formula, in which x equals the required height of the crest, and R equals the crest radius:

$x = R - R \sin 27$ deg. 30 min.; or $x = R - R \times 0.46175$

The radius $R = 0.1373 \times$ the pitch of the thread.

THREADED PIPE JOINTS

J. G. H.—What is the best material to apply to pipe threads before making up the joints in order to obtain a tight joint that will resist the action of gases or liquids?

A.—Red lead mixed with pure boiled linseed oil has been widely used and is very satisfactory. This mixture should have a heavy fluid-like consistency, and if applied to a clean, well-cut thread will give an excellent joint.

LOCATING A POINT ON THE HYPOTENUSE OF A TRIANGLE

F. I. D.—Referring to the illustration, ABC is a right triangle. Please show how to find distance x.

ANSWERED BY W. W. JOHNSON, CLEVELAND, OHIO

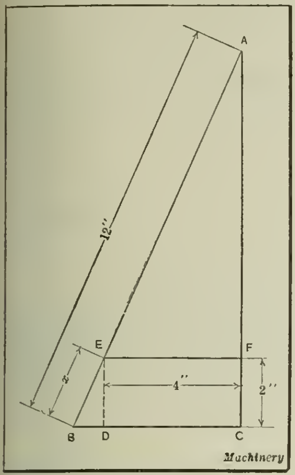


Diagram used in the Solution of a Trigonometric Problem

The triangles AEF and EBD are similar, as they are right triangles having angle B in common.

Hence,

$$\frac{EF}{AE} = \frac{BD}{EB}$$

Now, $EF = 4$ inches; $AE = 12 - x$; $BD = \sqrt{x^2 - 4}$; and $EB = x$. Then,

$$\frac{4}{12 - x} = \frac{\sqrt{x^2 - 4}}{x}$$

or

$$4x = (12 - x)\sqrt{x^2 - 4}$$

Squaring both sides and combining,

$$x^4 - 24x^3 + 124x^2 + 96x - 576 = 0$$

Solving this equation by Horner's method, we have

$$x = 2.1904 \text{ inches}$$

STANDARD ANGLES FOR RIVET HEADS

J. F. G.—Is there a standard angle for countersunk rivet heads, and does this angle vary for different classes of work?

A.—An included angle of 80 degrees has been adopted by the American Boiler Manufacturers Association for countersunk rivet heads, but this angle is not invariably used; for instance, the angle adopted by a prominent rivet manufacturer is 78 degrees. According to the handbooks of prominent steel manufacturers, an included angle of 60 degrees is the standard for bridge and structural work.

MASTER TOOL PROBLEM

L. M. S.—The profile of a master tool is outlined in the accompanying illustration. In making this tool, it is required to find dimension AB. Please show how dimension AB can be obtained when the known values are as follows: Angle FEN equals 40 degrees; angle NEJ, 60 degrees; diameters of circles R and S, 0.5 inch; dimension DC, 0.875 inch; ED, 0.125 inch; and radius CT, 1.375 inch.

ANSWERED BY GEORGE WARMINGTON BEVERLY, MASS.

First draw line CK parallel to JE making angle HCK equal to angle NEJ, or 60 degrees. Then draw line AK from A perpendicular to KC, and line CL from C perpendicular to KC, making CL equal to JK. Next draw line CI parallel to EF, making angle ICG equal to angle FEN, or 40 degrees, and draw line BI from B perpendicular to CI; also draw line EM from E perpendicular to CI and equal to FI.

$$CE = \sqrt{ED^2 + CD^2} = \sqrt{0.125^2 + 0.875^2} = 0.8839 \text{ inch}$$

Cot $PEC = 0.875 \div 0.125 = 7$ and $PEC = 8$ degrees 8 min.

As angle $LEP = 30$ degrees, $LEC = 30$ degrees $+ 8$ degrees 8 minutes $= 38$ degrees 8 minutes.

$$CL = CE \sin LEC = 0.8839 \sin 38 \text{ degrees } 8 \text{ minutes} = 0.8839 \times 0.61749 = 0.5458 \text{ inch}$$

Now

$$AK = AJ + JK = AJ + CL = 0.250 + 0.5458 = 0.7958 \text{ inch}$$

and

$$AC = 1.375 + 0.250 = 1.625 \text{ inches}$$

Then

$$\sin ACK = AK \div AC = 0.7958 \div 1.625 = 0.4897$$

and

$$ACK = 29 \text{ degrees } 19 \text{ minutes}$$

Also

$$HCA = HCK - ACK = 60 \text{ degrees} - 29 \text{ degrees } 19 \text{ minutes} = 30 \text{ degrees } 41 \text{ minutes}$$

and

$$HA = AC \sin HCA = AC \sin 30 \text{ degrees } 41 \text{ minutes} = 1.625 \times 0.5103 = 0.829 \text{ inch}$$

Also

$$HC = AC \cos HCA = AC \cos 30 \text{ degrees } 41 \text{ minutes} = 1.625 \times 0.86 = 1.3975 \text{ inches}$$

Angle $ECG = 90$ degrees $- PEC$

Then

$$ECG = 90 \text{ deg.} - 8 \text{ deg. } 8 \text{ min.} = 81 \text{ deg. } 52 \text{ min.}$$

Also

$$\text{Angle } ECM = ECG - ICG = 81 \text{ deg. } 52 \text{ min.} - 40 \text{ deg.} = 41 \text{ degrees } 52 \text{ minutes}$$

$$EM = CE \sin ECM = CE \sin 41 \text{ degrees } 52 \text{ minutes} = 0.8839 \times 0.6674 = 0.5899 \text{ inch}$$

$$BI = IF - BF = EM - BF = 0.5899 - 0.250 = 0.3399 \text{ inch}$$

$$BC = 1.375 + 0.250 = 1.625 \text{ inches}$$

$$\sin BCI = BI \div BC = 0.3399 \div 1.625 = 0.2091$$

and

$$BCI = 12 \text{ degrees } 4 \text{ minutes}$$

Now

$$BCG = ICG + BCI = 40 \text{ deg.} + 12 \text{ deg. } 4 \text{ min.} = 52 \text{ degrees } 4 \text{ minutes}$$

and

$$BG = BC \sin BCG = BC \sin 52 \text{ degrees } 4 \text{ minutes} = 1.625 \times 0.7887 = 1.2816 \text{ inches}$$

and

$$GC = BC \cos \text{ angle } BCG = BC \cos 52 \text{ degrees } 4 \text{ minutes} = 1.625 \times 0.6147 = 0.9989 \text{ inch}$$

Now draw line BO parallel to EP and AO perpendicular to BO. Then

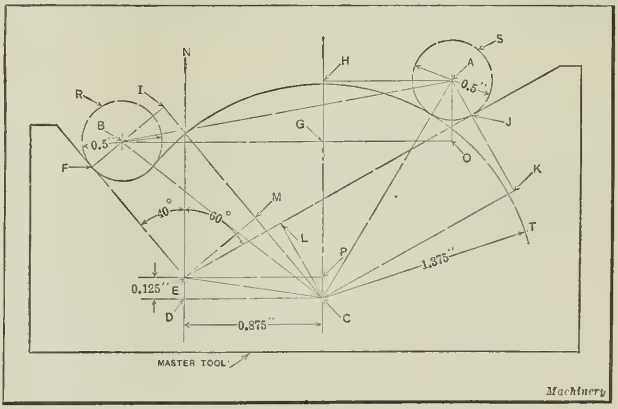


Diagram used in solving Master Tool Problem

$$AO = HG = HC - GC = 1.3975 - 0.9989 = 0.3986 \text{ inch}$$

and

$$GO = HA = 0.829 \text{ inch}$$

$$BO = BG + GO = 1.2816 + 0.829 = 2.1106 \text{ inches}$$

Therefore

$$AB \; \sqrt{AO^2 + BO^2} = \sqrt{0.3986^2 + 2.1106^2} = 2.147 \text{ inches}$$

Methods of Computing Pitch of Spur Gears

By GEORGE F. NORDENHOLT, Instructor in Mechanical Engineering, Lehigh University, Bethlehem, Pa.

WITH the exception of Equation (4), which was derived by the author, the methods of computing the pitch of spur gears, as here presented, were originated and developed by Professor P. B. de Schweinitz, of the Department of Mechanical Engineering of Lehigh University. The Lewis formula is employed in these formulas in such a way that they may be readily applied to the solution of spur gear problems without resorting to the cut-and-try methods commonly employed. The pitch obtained by the use of Formula (4) will be the smallest that may be used under the conditions specified and will accordingly result in the smallest gears permissible. In cases where the center-to-center distance of the shafts is not specified this is a distinct advantage.

The well-known Lewis formula for the computation of the pitch of spur gear teeth is often presented in the following form:

$$P = fpby \qquad (1)$$

where

P = load on tooth;
f = allowable tooth stress;
p = circular pitch;
b = width of tooth; and
y = Lewis factor.

By means of simple algebra, the foregoing equation may be transformed to read:

$$p = \frac{P}{fby} \qquad (2)$$

In designing gears, the ratio of the width to the circular pitch is always an important matter, and is chosen by the designer to meet the proper conditions, the usual value for this ratio being 2½ or 3. This ratio may be incorporated in the above formula by dividing the denominator on the right side of the equation by p and multiplying the left side of the equation by p also. If we then designate the reciprocal of the Lewis factor by c, we get

$$p^2 = \frac{Pc}{\frac{b}{p} \times f} \qquad (3)$$

As c is determined by the number of teeth, and the number of teeth depends upon the pitch, it is evident that this equation could not be solved as it stands, except by a cut-and-try method. In order to eliminate this, substitute the term $\left(\frac{2\pi r}{z}\right)^2$ for p^2. This gives the equation

$$\frac{cz^2}{4\pi^2} = \frac{r^2 f \times (b \div p)}{P} \qquad (4)$$

in which z = number of teeth in pinion; and
r = radius of pitch circle of pinion.

When the problem is to design a pair of gears to transmit a certain horsepower at a given speed and velocity ratio, and the center-to-center distance between the shafts is specified, the right-hand member of Equation (4) may readily be solved, basing all computations on the pinion, which, having the smaller number of teeth, will have the weaker tooth. In this case

$r = \frac{C}{R+1}$, in which R is the velocity ratio and C the distance between the shaft centers.

The value $\frac{b}{p}$ is chosen by the designer and P may be obtained from the formula $Pr = 63025 \frac{H}{n}$, where H is the horsepower transmitted, and n is the number of revolutions per minute of the pinion. The allowable tooth stress f may be the value recommended by Lewis, or it may be obtained by Barth's formula, or the Reuleaux formula. The accompanying table contains the reciprocals of the Lewis factor in the second column. The third column is the reciprocal multiplied by the square of the corresponding number of teeth, the result being divided by $4\pi^2$, thus giving $\frac{cz^2}{4\pi^2}$.

Having computed the value of $\frac{cz^2}{4\pi^2}$ from Formula (4),

TABLE OF GEAR CONSTANTS FOR 15-DEGREE INVOLUTE SYSTEM

No. of Teeth z	Reciprocal of Lewis Factor c	$\frac{cz^2}{4\pi^2}$	$2\pi c$	$\frac{2\pi c}{\sqrt[3]{720}}$	No. of Teeth z	Reciprocal of Lewis Factor c	$\frac{cz^2}{4\pi^2}$	$2\pi c$	$\frac{2\pi c}{\sqrt[3]{720}}$
12	14.90	54.4	93.6	10.43	45	9.25	474.4	58.1	6.49
13	14.10	60.4	88.5	10.10	50	9.09	576.6	57.1	6.37
14	13.30	66.0	83.5	9.30	55	8.93	684.2	56.1	6.26
15	12.80	73.0	80.4	8.97	60	8.85	804.5	55.6	6.20
16	12.30	79.8	77.3	8.62	65	8.77	939.0	55.2	6.16
17	11.90	87.1	74.8	8.35	70	8.74	1085.0	54.9	6.12
18	11.60	95.2	72.9	8.13	75	8.70	1239.0	54.7	6.10
19	11.40	104.2	71.6	8.00	80	8.66	1404.0	54.5	6.08
20	11.10	112.5	69.7	7.88	90	8.60	1764.0	54.0	6.03
21	10.90	121.8	68.5	7.64	100	8.55	2165.0	53.7	5.99
22	10.80	131.9	67.5	7.53	120	8.48	3093.0	53.3	5.94
23	10.60	142.0	66.6	7.43	140	8.40	4170.0	52.8	5.89
24	10.40	151.7	65.3	7.29	160	8.36	5420.0	52.5	5.86
26	10.20	174.6	64.1	7.15	180	8.32	6828.0	52.3	5.83
28	10.00	198.6	62.8	7.00	200	8.30	8409.0	52.2	5.82
30	9.90	225.9	62.2	6.93	250	8.25	13060.0	51.9	5.79
33	9.70	267.6	61.0	6.80	300	8.22	18736.0	51.7	5.76
36	9.50	311.9	58.7	6.55	Rack	8.06	a	50.7	5.65
40	9.33	378.2	58.6	6.53	...	....	....	....	....

Machinery

find the next smaller value in the table, and the number of teeth corresponding to it will be the maximum number of teeth the pinion should have. Dividing by the pitch diameter, gives the diametral pitch, from which the next lower standard diametral pitch may be chosen.

Solution when no Distance between Shafts is Specified

When no distance between the shaft centers is specified, the solution is as follows:

$$r = \frac{pz}{2\pi}$$

Then

$$P = \frac{Pr}{r} = Pr\,\frac{2\pi}{pz} \qquad (5)$$

Substituting this value of P in Equation (3), we obtain:

$$p^2 = \frac{2\pi c Pr}{zf \times (b \div p)} \qquad (6)$$

As z may be chosen by the designer, $2\pi c$ is obtained directly from the table and the value of p can thus be computed, provided we are able to determine the proper tooth stress. To do this, we may use Reuleaux's formula,

$$f = \frac{S}{\sqrt[3]{V}} \qquad (7)$$

where S is the allowable stress for velocities up to 1 foot per second, and V is the velocity at the pitch line in feet per second. It should be noted that if V were less than one foot per second, f would be greater than S, which, of course, is not permissible. Hence if the velocity is equal to or less than one foot per second, S should be used in place of f, in Equation (6), and p may then be solved for. If the velocity, however, proves to be greater than 1 foot per second, we may substitute for V in Equation (7) its value $\frac{z\,p\,n}{720}$, and place this value for f in Equation (6), which, when solved to obtain p, results in

$$p^8 = \left(\frac{\frac{2\pi c}{\sqrt[3]{720}} \times Pr}{\frac{b}{p} \times S} \right)^3 \times \frac{n}{z^2} \qquad (8)$$

This equation may be solved from the data given, using the value of $\frac{2\pi c}{\sqrt[3]{720}}$ as given in the table.

Equation (8) has an added advantage in that even a considerable error made in computing the right-hand member of the equation is practically eliminated when the square root is taken three times consecutively in order to obtain the eighth root; for example, if the arithmetical work had resulted in $p^8 = 2088$, while the result should have been $p^8 = 6561$, then in the first case $p = 2.6$ while in the second case $p = 3$; both of which would call for a standard diametral pitch of 1¼. Even if the error makes the right-hand member come out within 200 per cent of what it should be, the final resulting error would be only about 9 per cent.

Having obtained the required standard diametral pitch, the diameter may be obtained by dividing the value of z used in solving Formula (6) or (8), by the diametral pitch obtained. After obtaining the diameter, the pitch velocity should be computed to make certain that the proper formula, either (6) or (8), has been used, which depends on whether the velocity comes out less than or greater than one foot per second. For instance if the velocity is thus calculated to be less than one foot per second it shows that Formula (6) is the correct one to use.

Comparison of Allowable Stresses

The value of S to be used in the Reuleaux formula may be the same as that used in the Barth formula. Up to a velocity of about 1.1 feet per second, the Reuleaux formula gives a higher unit stress. Then up to a velocity of about 14.2 feet per second, the Reuleaux formula gives slightly lower values for the allowable tooth stress. At a speed of 14.2 feet per second the resulting values are the same in both cases, while above this speed, the Reuleaux formula gives higher stresses. The accompanying chart shows a comparison of stresses when using the values recommended by Lewis and those obtained by the Barth and Reuleaux formulas.

It is not claimed that the Reuleaux formula gives more accurate results, but it is simple algebraically, which enables it to be combined with other formulas, as in the development of Formula (8). An attempt to use the Barth formula here would result in a very cumbersome equation, while the

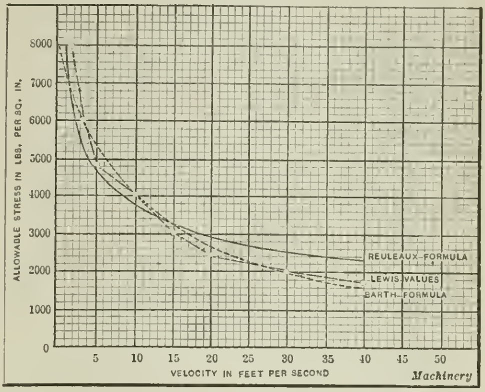


Chart showing Comparative Values obtained by Three Well Known Formulas, allowing an Initial Stress of 8000 Pounds per Square Inch in Each Case

Lewis value could not be used at all. With slight modifications, and using mean values, the formulas here developed may be applied to bevel gears for the determination of the proper pitch.

Application of Formulas

The application of the method for computing the pitch of spur gears, as outlined in the foregoing is illustrated in the following examples:

Example 1—Given the center-to-center distance C between two shafts as 40 inches, and the revolutions per minute of the pinion and gear as 90 and 30, respectively; what should be the diametral pitch if 100 horsepower is to be transmitted?

$$R = \frac{90}{30} = 3 \quad \text{and} \quad r = \frac{C}{R+1} = \frac{40}{4} = 10 \text{ inches}$$

$$Pr = \frac{63025H}{n} = \frac{63025 \times 100}{90} = 70{,}000 \text{ (approximately)}$$

Also

$$P = \frac{Pr}{r} = \frac{70000}{10} = 7000$$

aud

$$V = \frac{2\pi rn}{720} = \frac{2\pi \times 10 \times 90}{720} = 8 \text{ feet per second (approx.)}$$

Using Formula (7) and assuming that the allowable stress $S = 6000$ pounds per square inch, we have

$$f = \frac{6000}{\sqrt[3]{8}} = 3000 \text{ pounds per square inch}$$

Choosing a value for $\frac{b}{p} = 3$ and substituting the numerical values, we obtain from Formula (4):

$$\frac{cz^2}{4\pi^2} = \frac{r^2 f \times (b \div p)}{P} = \frac{100 \times 3 \times 3000}{7000} = 128.6$$

Referring to the table, it will be noted that the nearest value, less than 128.6 in the third column is 121.8. Hence the pinion may have 21 teeth, which will be equivalent to a diametral pitch of $\frac{21}{20} = 1.05$. The next lower standard diametral pitch is 1, and this pitch or any coarser standard pitch may therefore be used. Using a diametral pitch of 1, we would have 20 teeth in the pinion and 60 teeth in the gear.

Example 2—Four horsepower is to be transmitted from one shaft to another through spur gearing. The pinion is required to make 25 revolutions per minute and the gear 5 revolutions per minute. No center distance is specified. The gears are to be made of cast iron and as small as it is practicable to make them. Find the proper diametral pitch.

As the speed of the pinion is only 25 revolutions per minute, or less than half a revolution per second, we will assume that the peripheral velocity will be less than one foot per second, and hence base our calculations on Formula (6). To obtain the desired velocity ratio, we may use 12 teeth in the pinion, and 60 in the gear. Considering the tooth of the pinion, which is the weaker,

$$Pr = \frac{63025H}{n} = \frac{63025 \times 4}{25} = 10{,}000 \text{ (approximately)}$$

Referring to the table, we find that the value c for a gear having 12 teeth is 14.9, and $2\pi c = 93.6$

Now taking a value for $f = 6000$ and a value for $\frac{b}{p} = 3$ and substituting these values in Formula (6) we obtain,

$$p^3 = \frac{93.6 \times 10{,}000}{12 \times 3 \times 6000} = 4.33$$

$$p = \sqrt[3]{4.33} = 1.63$$

The nearest standard diametral pitch is 1¾. The pitch diameter would therefore be 12 ÷ 1¾ = 6.857 inches, which gives a peripheral velocity of about $\frac{3}{4}$ feet per second, which is less than one. Therefore we were correct in using Formula (6). Had the velocity proved to be greater than one foot per second, we would have had to recalculate, using Formula (8) instead of Formula (6).

Example 3—The revolutions per minute of two shafts are to be 45 and 135, respectively. The horsepower to be transmitted is 100. The other conditions are to be the same as in Example 2.

Here the speed ratio is 1 to 3. As the velocities are considerable, it might be preferable to use gears having 15 and 45 teeth, rather than 12 and 36; the latter would be really smaller in diameter, yet they would probably not run as smoothly. The peripheral velocity may be assumed to be greater than one foot per second, as the pinion makes 135 revolutions per minute. Hence we will use Formula (8).

From the table we find that the value of $\frac{2\pi c}{\sqrt[3]{720}}$ for 15 teeth = 8.97

$$Pr = \frac{63025H}{n} = \frac{63025 \times 100}{135} = 47{,}000 \text{ (approximately)}$$

Take $\frac{b}{p} = 3$ and $S = 6000$,

Then from Formula (8), we get

$$p^3 = \left(\frac{8.97 \times 47000}{3 \times 6000}\right)^2 \times \frac{135}{225} = 7860$$

$$p^6 = \sqrt{7860} = 88.6 \text{ and } p^3 = 9.4 \text{ and } p = 3.06$$

The next larger circular pitch corresponding to a standard diametral pitch is 3.1416, which is a standard diametral pitch of 1. With 15 teeth, this gives a pitch diameter of 15 inches. The peripheral velocity of the gears would then be about 8.8 feet per second. As this velocity is greater than one foot per second, we were correct in using Formula (8). Had it figured out less, we would have had to recalculate, using Formula (6).

* * *

MAGNETIC TESTING OF DEPTH OF CASE

A demonstration of a magnetic method of determining the depth of case on small carburized and casehardened chain links was one of the interesting features of the recent New York sectional meeting of the American Society for Steel Treating. The demonstration was conducted by A. V. de Forest, research engineer of the American Chain Co., Bridgeport, Conn. The magnetic apparatus consisted of a simple form of inductance bridge operating on 60-cycle commercial current. The chain tested, which was made from wire ranging from 0.192 to ⅜ inch in diameter, is used as the cross-member of automobile tire chains, and consequently is subjected to wear from hard roads and from shocks produced by pounding over car-rails and cobblestones. If the case of the chain links is too thin, they wear out quickly, and if the case is too thick, they break in an even shorter time than it would take for soft links to wear out. It was to determine whether or not the depth of case is within the desired limits that the magnetic testing apparatus was developed.

The apparatus has a peculiar type of separately excited galvanometer which is used as an indicator, while a small rheostat and ammeter control the current operating the instrument, about 0.2 ampere at 110 volts being used. Resistance coils control the sensitivity of the instrument, and the deflections of the indicator can be adjusted to any desired limits. An adjustable resistance which balances the galvanometer is altered to compensate for different sizes of chain links or to change the scale of the instrument.

The magnetizing coil will operate on 1/16-inch wire, chain formed of ⅜-inch wire, or bar stock up to 1¼ inches in diameter. The outfit requires no setting up beyond connecting to an alternating-current lighting circuit. In testing a chain, several links are lowered into the magnetizing coil, the indicator of the galvanometer immediately moving across the dial and showing whether or not the depth of case is within the specified limits. Modifications of this apparatus would probably prove practical for testing other parts.

* * *

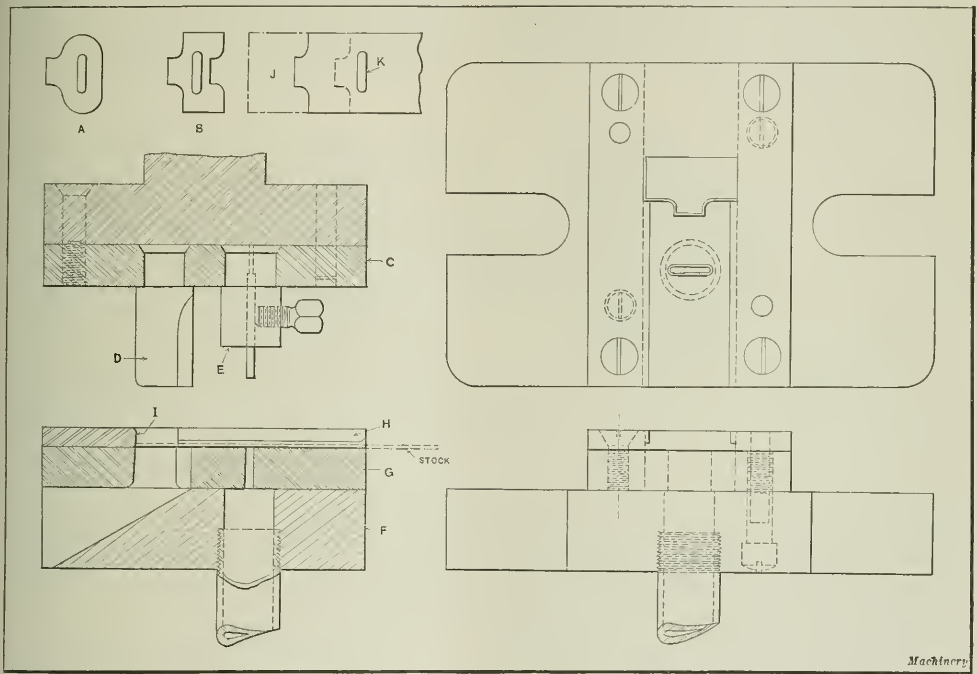
POWER TESTS OF A HEAVY LATHE

In order to determine the power and endurance of a certain type of lathe, the Houston, Stanwood & Gamble Co. recently conducted a series of tests on a 60-inch heavy engine lathe, driven by a Westinghouse 35-horsepower variable-speed motor. The results of these tests were as follows: At a speed of 15 feet per minute, and ¼ inch feed, a huge steel roll was reduced 3¾ inches in diameter, the depth of cut being 1⅞ inches. The ampere reading during the test showed that the motor was developing between 74 and 80 horsepower. Running the lathe at a higher speed of 35 feet per minute, with ¼ inch feed, a depth of cut of ¾ inch was next taken. The tests were completed by taking an eccentric cut, and one of the chips measured was found to be 1½ inches wide and 1 inch thick. In view of the fact that the motor was greatly overloaded in each particular case, the cuts were run for short periods only. In some instances the motor was relieved of the extreme strain by passing a continuous spray of air through it.

FOLLOW-DIE FOR SHEET-METAL KEYS

By S. A. McDONALD

The accompanying illustration shows a follow-die designed by the writer for manufacturing box-opener keys. The original design of these keys was as shown at *A*, but it was realized that by changing the design slightly, considerable stock could be saved. Accordingly, the key was redesigned as shown at *B*, which enabled a simpler die to be constructed. The construction of the die is as follows: A machine-steel punch-holder carries the machine-steel punch-plate *C* in which the shearing punch *D* and the machine-steel punch-holder *E* are riveted. The shearing punch is shaped to the contour indicated at *J*, which represents the shape of the stock cut off from the end when first fed into the die, and this punch is hardened only on the front cutting edge. The tool-steel piercing punch is secured in the holder *E* by a set-screw, so that it can be easily removed for regrinding. The die-block or shoe *F* is made of machine steel, and supports the hardened tool-steel die *G*, which is fastened by screws and dowel-pins to it. The stripper plate *H* is a machine-steel member, and serves not only as a stripper, but also as a backing plate for the shearing punch *D*.



Dies used in making Key from Strip Stock

The stock is fed into the die until it abuts against the stripper plate at *I*. The shearing punch *D* then descends, cutting out the piece *J*, and at the same time the piercing punch produces the hole *K* in the strip. On the next downward stroke of the ram a second piece is blanked out without a hole, and it is not until the third stroke that a completed piece, as shown at *B*, is punched out. By providing a suitable stop for the stock, even these two pieces of stock could be saved, so that there would be no waste except the punching from holes *K*. The keys are pushed through the die and slide down the inclined surface of the die-block and into a suitable receptacle. The scrap from the hole passes through a tube screwed into the under side of the die-block. A press of the inclinable type was used, operating at 200 revolutions per minute.

REPRODUCING LARGE DRAWINGS

By H. R. BOWMAN

A slide-rule can often be employed to advantage in making small-scale reproductions or copies of large drawings for notebooks, record files, etc., when no great accuracy is required. In using the slide-rule, first find the over-all length of the drawing and determine the corresponding length of the small-scale drawing to be made, and set the slide-rule so that the graduations on the C scale representing one dimension will be opposite the graduation on the D scale which represents the other dimension.

This gives the proportion between the two drawings; for instance, if the length of the large drawing is 27 inches and the corresponding length of the small-scale drawing is to be 9 inches, the proportion would be 9 to 27, or the small drawing would be one-third as large as the original. The 9 on the C scale would be placed over 27 on the D scale, or 1 on the C scale over 3 on the D scale. As the ordinary slide-rule has an inch scale on one edge, it can be readily used to scale the dimensions on the larger drawing.

After locating the graduation on the C scale that is equivalent to the measurement taken on the large drawing, the corresponding dimension for the small drawing can be read directly opposite on the D scale. The writer has found this method a very convenient one for properly proportioning the lines on a small-scale drawing, especially where the scale of the smaller drawing is one not generally employed.

* * *

Firms who have occasion to employ the services of legal advisers in foreign countries will be interested to learn that the Division of Commercial Laws, Department of Commerce, is compiling a list of names of attorneys practicing in foreign countries who have been recommended by trustworthy sources as competent in their profession and in a position to care for American interests. These names will be furnished to American business houses on request.

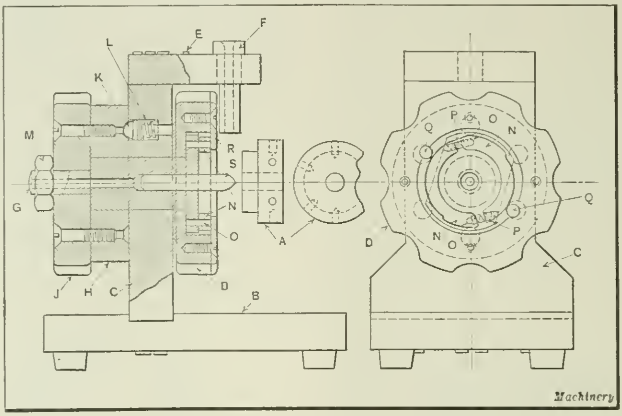
INDEXING DRILL JIG

By C. G. YOUNGQUIST

A quick-acting indexing drill jig designed to lower production costs is shown in the accompanying illustration. The work for which this jig was designed consists of drilling six equally spaced radial holes on the outer edge or circumference of an aluminum piece such as shown at *A*. The holes are required to be spaced quite accurately, as the drilled piece is made to serve as a sprocket by driving short pins into the holes. The fixture is mounted on a base *B* which has four short feet. An upright *C* is fitted into a slot in base *B*, and fastened by screws. Upright *C* is made narrower at the top so that handwheel *D* can be easily gripped.

A plate *E* carrying bushing *F* is fastened to the top of upright *C*. A shouldered stud *G* carries on one end the handwheel *D*, and on the other the index-plate *H* and the handwheel *J*. The latter is fastened to the index-plate by means of screws as shown. Both handwheels are notched so that a good grip can be obtained. The face of the index-plate in contact with upright *C* has six countersunk holes in it, equally spaced on a circular line. A plunger *K* engages the indexing holes, and is held against the plate by a coil spring *L*. The plunger has a half-spherical head and a shank of small diameter, and is made a sliding fit in a hole in upright *C*.

Both index-plate *H* and plunger *K* are hardened. Handwheel *J*, index-plate *H*, and stud *G* are held together by nut *M*. These parts, being rigidly fastened to each other, operate as one solid piece. Wheel *D* is counterbored to receive the head of stud *G* and the two clamping jaws *N* which swing on pins *O*, driven into holes in the head of stud *G*. The jaws are semicircular in shape and are located centrally from their inner surfaces; they are held apart by two small springs *P*. The springs are located in the holes drilled in the ends of jaws *N* as shown.



Indexing Drill Jig with Quick Loading and Unloading Features

The outside surface on each jaw is also semicircular, but is offset in such a way as to provide a clamping action when acted upon by pins *Q* embedded in handwheel *D*. Pins *Q* and jaws *N* are hardened. A guard plate *R* is fastened to the outside of handwheel *D*, to keep the chips out and to hold the jaws in place. The guard plate is omitted in the end view in order to show the chuck jaws more clearly. A locating pin *S* is driven into a reamed hole in stud *G*. This hole is extended through the stud to provide for driving the pin out in case this should become necessary.

The head of stud *G* is milled away on two opposite sides to give the necessary clearance for pins *Q*. The movement of handwheel *D* relative to stud *G* is limited by the clearance spaces milled on the head of stud *G*. In loading the jig, wheel *J* is held in a fixed position, while wheel *D* is turned to the left to give the jaws the largest possible opening. The work is then centered on pin *S*, and pushed up against guard plate *R*. Wheel *D* is then turned to the right until the work is securely clamped by jaws *N*. After drilling a hole, the drill is withdrawn and the wheel *J* turned until the spring-actuated plunger *L* is forced out into the next countersunk spacing hole in the index-plate *H*, which locates the work for drilling the next hole. This operation is repeated until the six holes are drilled. To obtain the best results, the jig is clamped in position on the drilling machine table and the drill set to the desired depth. The quick and effective loading and unloading feature of this jig, combined with the simple convenient method of indexing, not only resulted in lowering the production cost, but also made it possible to maintain a uniform quality of work.

* * *

BRITISH MARKET FOR SMALL TOOLS

According to a special report just issued to its members by the American Chamber of Commerce in London, there is practically no market for American small tools in Great Britain at the moment, but it is generally agreed that when trade becomes more normal, certain small tools, for which there was previously a good market will again be in demand.

The presence of large stocks in the hands of the government and dealers, and severe foreign competition aggravated by depreciated exchanges are the chief factors affecting American trade. In addition, the price of American precision tools has been considerably increased by the imposition of an import duty of 33 1/3 per cent owing to these tools being scheduled as a key industry under the Safeguarding of Industries Act.

The report further discusses the future position of American small tools, pointing out that in some instances American designs have been copied and are now being manufactured by British firms. Hints on marketing are also given, and American firms that contemplate entering the British market are advised to take up the question with the American Chamber of Commerce in London, which is always willing to give the benefit of its experience to such firms. Full details are available only in the report which has been circulated to members, but firms interested can secure copies by writing to the American Chamber of Commerce in London.

* * *

OBTAINING CHINESE TRADE

A forward-looking innovation in the development of foreign trade has been made by the South Bend Lathe Works, South Bend, Ind. This company has published an instruction book in Chinese containing eighty pages relating to lathe operation. The book is a translation of the company's well-known text-book, entitled "How to Run a Lathe," which has been widely distributed among trade schools. This is undoubtedly a step forward in the development of Chinese trade, because it is generally recognized that the manner in which this trade will be obtained is by American machinery gaining a place in Chinese trade and technical schools. In many instances the book contains the English names of machine tool parts and processes, doubtless because there is no equivalent word in the Chinese language, and before long these English words will be accepted and become incorporated into the Chinese language. The Far Eastern trade in machine tools has increased rapidly during the last ten years, and machine tool builders who keep in touch with the developments in that section of the country will doubtless find it worth while, even if immediate results should not be obtained.

TAPPING AND TAP DESIGN

By J. C. NICHOLSON

In tapping bottoming holes in cast iron, the use of a great amount of oil is objectionable. When too much oil is used, the fine chips or particles of cast iron invariably float into the spaces back of the cutting edges where the tap is backed off for clearance. These particles cause the tap to wedge in the hole as it is being backed out, making it more difficult to remove, besides causing the lands or clearance to be worn down more rapidly. If just enough oil to make a stiff paste of the chips is used, these difficulties will be avoided. The advantage of getting most of the chips out of the hole, thus leaving it clean for the part that is to be screwed into it, will also result from this practice.

The foregoing applies particularly to hand tapping, although it should not be disregarded in tapping by power. In the latter case, since the work is done more rapidly, more oil may be required to insure its reaching the right point soon enough to have the desired effect. In any case, however, cast iron requires but little lubricant when being tapped, and may even be tapped without it, though the practice is not recommended on all classes of work.

Tapping Holes in Steel

In tapping a bottoming hole in steel—particularly tough steel—the requirements are exactly the opposite. Here it is absolutely necessary that a copious supply of lubricant reach the cutting point. In order that it may do so, one of two courses must be followed: Either the tap must operate very slowly and be flooded with oil under pressure, or it must be stopped and backed up just a little at frequent intervals in order to allow the lubricant to reach the front of the cutting points. In tapping steel by hand, it is common practice with machinists to back the tap frequently until the chip is broken, the idea being that this allows the tap to cut more freely. The fallacy of breaking the chip may easily be proved by backing the tap only a very little at frequent intervals, putting no stress whatever on the reverse side of the lands. This allows the lubricant to reach the front of the cutting side of the lands where it is needed, and it will be found that the work proceeds just as well as when the tap is backed a sufficient amount to cause the back side of the land to shear off the chip. Breaking the chip does not help matters, and the lands were never designed for this purpose. It is evident therefore that the only useful purpose served by backing up the tap is that of permitting the oil to reach the proper place.

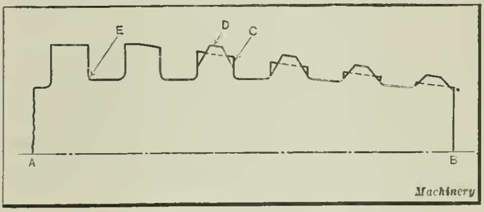
Of course, if a hole is very deep it may become necessary to remove the tap in order to clean out the chips that fill the flutes. In any case these chips will be found broken, and it is the breaking of the chips that consumes much of the power required for the tapping operation. Anything that obstructs the free movement of the chip—even at some distance from the cutting point—will have a decided effect upon the cutting action. If, for instance, in turning a shaft, some obstruction is placed squarely in the path of the chip, even though it is two or three inches from the tool point, the additional resistance to the chip will produce a noticeable effect on the work. The work will be left rough and the tool will heat more rapidly as a result of obstructing the chip. Of course, in the case of a tap, the chip is being more or less violently obstructed at all times—especially when tapping material that does not easily break in pieces—and this no doubt makes lubrication in such cases all the more necessary. The shape of the flute will, of course, have some influence on the cutting action.

Difficulty in tapping is sometimes due to the taps being so made that too little stock is removed by each cutting point. Many taper taps have a longer taper than is desirable for general use. A plug tap will often do the work from the beginning and operate almost as easily as a starting tap. The writer believes that taper taps in general would be improved by making the tapers about half as long as they are usually made. The practice of making pipe taps with half the cutting points removed is excellent.

Tool for Tapping Square Threads

In tapping square threads in steel there is a tendency for the chip to bind in the groove, which often results in breaking the tap. A tap made as described in the following will effectively overcome this difficulty. Referring to the accompanying illustration, *AB* is the center line of the tap. The tap has four flutes, and as far as the tapered portion extends, two opposite lands have threads of truncated V-shape as shown at *D*. The other two lands have square threads as shown at *C*. The last few threads on the tap are all alike, thus insuring the finishing of the thread to the correct size and form. In the illustration two adjacent lands are shown superimposed one upon the other in order to indicate more clearly how the tap is made.

It will be seen that for most of the tapered distance the diameter across the truncated V-lands is greater than that of the other two lands. The truncated points will therefore cut deeper than the square ones, thus leaving a slight V-thread in the bottom of the square thread, so that as the succeeding square points begin to cut, the chip will be in two parts. This prevents the objectionable binding in the grooves previously mentioned. For instance, as the tap is turned to the right, land *D* takes a cut of truncated V-form, while land *C* following this cut removes metal only at its corners.



Tooth Profiles of Tap used for cutting Square Threads

The taper and other features are purposely exaggerated in the illustration in order to make clear the principle involved. The tap is made by first cutting a square thread having the same taper and diameter as the truncated lands. After it is fluted, two of the opposite lands have the threads formed to the shape indicated at *D*, while the other two are made as shown at *C*. This work may all be done with a file, since uniformity is unimportant and in fact undesirable in many cases. A tap of this design was thoroughly tried out in tapping nuts for pipe wrenches. Although the pipe wrench nuts were made from tough steel, the tap cut rapidly and produced accurate threads when used with a drilling compound as a lubricant. The corners at the bottom of the tap thread are filleted slightly, as shown at *E*. In this way all burrs were removed from the nut so that the thread was left smooth.

* * *

It has been asserted that one of the causes of high railway rates is the large salaries paid to executives of the road, and that the first step in decreasing expenses should be to reduce these salaries. In this connection the following facts, taken from the *Review of Industry* are illuminating. If all salaries of general officers of steam railroads in the United States in 1920 had been abolished, rates and fares could not have been reduced as much as 1 per cent. If the total of all general officers' salaries of 1920 had been added to the employes' payroll for that year, it would have increased the men's wages only 1.3 per cent. It will be seen from the foregoing that the item of salaries of general officers in such an extensive business as railroading is not a major part of its expense.

The Machine-building Industries

It is gratifying to be able to report a slow but definite improvement in the metal-working industries. This improvement is especially noticeable in the automobile manufacturing districts of Michigan, northern Ohio and Indiana, and in the Ohio and Pennsylvania iron and steel districts. The demand for standard lines of machine tools is still very small, but a majority of the machine tool builders we have seen state that their sales for the last three months exceed the sales for any similar period during the last eighteen months. The demand for special and single-purpose machine tools, on the other hand, is increasing to a considerable extent. Several of the makers of machine tools of this type say that their February business was 50 per cent, or more, of the average for the first three months of 1920, which has been taken as a basis of comparison by the National Machine Tool Builders' Association.

Another indication of increased activity is found in shops specializing in pressed parts, especially in the Central States, where several shops are running at 100 per cent capacity, one, at least, even employing a night shift. The tool and contract shops in and around Detroit, Toledo, and South Bend—the centers where the automobile business shows the greatest activity—also report a satisfactory volume of business, but competition is keen and prices consequently very low. Other evidences of increasing business in the machine-building field are improvements in the sales of ball bearings and better business in bearing bushings for machine tools and other lines of machinery.

General Conditions in the Machine Tool Industry

It is impossible at this time to make a general statement about conditions and prospects in the machine tool industry that would cover the industry as a whole. Conditions vary greatly according to locality and lines of machines manufactured. Some manufacturers report that during the last two months there has been a very active demand for gear-hobbing machinery and for small electrical grinders. In the lathe field the demand has been mainly from technical and trade schools, and four orders are under way for over forty machines each from this source. But on the whole the current trade school's demand for machine shop equipment has been somewhat overestimated because of the relatively light demand for machines for general industrial purposes.

The garage and repair shop demand for machine tools is still fairly active, but price is so important a consideration that some machine tool builders are considering building cheaper tools than their standard products in order to meet the specific needs of the repair shop.

Although the demand for standard types of machine tools has been quite small during the last year, the industry as a whole is in a healthier condition than it was a year ago. Early last summer most of the manufacturers ceased adding to their stocks, and the total stocks of practically all standard tools are materially reduced, compared with last June. In the case of upright drilling machines, present stocks are only 60 per cent of what they were nine months ago.

Taking Care of Excess Plant Capacity

Many machine tool manufacturers are turning to other fields of machine-building and metal-working as an outlet for their excess shop capacity. It is generally recognized that plant capacity in the machine tool field is from 30 to 40 per cent in excess of probable requirements for several years to come. This excess capacity is being gradually utilized for other purposes. Pistons, piston-rings, woodworking machinery, foundry machinery, bakery machinery, excavating and road-building machinery are among the lines upon which machine tool builders have entered, in addition to those previously mentioned in MACHINERY—laundry and domestic washing machines, printing presses, motorcycles, automatic refrigerators, automatic ice-cream freezers, etc.

The machine tool industry has gradually adjusted itself to the reduced volume of business that seems inevitable during the next two or three years compared with the war period. Some of the firms doing from 50 to 60 per cent of the business of the peak period have accepted this as normal business, and others now doing 30 per cent of their peak business figure this to be 50 per cent of a normal business. Many machine tool builders have so reduced their greatly expanded overhead and their organizations that they are able to make a profit when operating at 30 per cent capacity, and some have readjusted their business to a pre-war basis. These steps are even more important for the healthy advancement of the industry at the present time than an increasing volume of business. The heaviest drag on the industry has been the war-time overhead which was out of all proportion to the demands likely to be placed on the industry within the near future.

Prices of machine tools have been reduced by many makers to a definite low level, and it would undoubtedly be for the benefit of the entire industry if all manufacturers would definitely determine upon selling prices that can be maintained, and then adhere to those prices without deviation. The uncertainty as to prices that exist in some lines of machine tools retards the resumption of buying.

Reduced Costs Due to Improved Machine Tools

In this review in March MACHINERY several examples were given showing how costs have been reduced by the application of modern machine tools. Other examples have come to MACHINERY's attention offering comparisons of unusual interest. In one case an automobile manufacturer employed eight machines of a standard type, working two shifts and requiring sixteen operators, the production being 50 pieces in 22 hours. The cost of the machine and tool equipment was $26,000. This equipment was replaced by a single-purpose machine occupying considerably less floor space, which requires only four operators, working in one shift. The cost is only $11,000 and the production 63 pieces in 9 hours.

In another case two machines and two men produced 25 pieces per hour, while a new machine requiring but one operator produces 37 pieces per hour. The cost of this machine is $2300, and the direct saving is $1800 a year.

The Automobile Industry

It is frequently stated that the automobile industry is operating at from 50 to 60 per cent capacity, but it is also generally conceded that the normal demand on the industry for some years to come will not be materially above 60 per cent of the total output capacity of existing automobile plants. Hence many of the plants that now operate at from 60 to 75 per cent capacity might well be said to operate at a normal rate of output. The competition in the automobile field is very keen, and certain standard makes of cars appear to have taken a definite lead over their competitors, by reducing costs and prices to the lowest practicable levels Some of the leading plants are carefully and thoroughly revising their manufacturing methods, and are installing machinery that will reduce costs.

The substance of this month's review of the machine-building industries is that the period of decline is definitely ended, the heavy liquidation is about completed, and the slow climb upward has really started.

NEW MACHINERY AND TOOLS

THE COMPLETE MONTHLY RECORD OF NEW AMERICAN METAL-WORKING MACHINERY

The New Tool descriptions in MACHINERY are restricted to the special field the journal covers—machine tools and accessories and other machine shop equipment. The editorial policy is to describe the machine or accessory so as to give the technical reader a definite idea of the design, construction, and function of the machine, of the mechanical principles involved, and of its application.

Walsh Power-press Push or Pull Feed

Automatic feeding of stock of various widths on any make of power press may be accomplished by means of a mechanism now being placed on the market by the Walsh Press & Die Co., 4709 W. Kinzie St., Chicago, Ill. An application of this mechanism is illustrated in Fig. 1, and a close-up view of all members except the connecting-rod and eccentric crank is shown in Fig. 2. The casting on which the members shown in Fig. 2 are mounted is attached to the bolster plate of the press by means of four cap-screws which pass through slots in the casting. This method of attachment permits shifting the cap-screws to suit the holes in a bolster plate.

Power for the mechanism is derived from the eccentric crank *A* which is mounted on the main shaft of the press. Adjustment of the pin by means of which connecting-rod *B* is attached to this crank provides for obtaining any desired feeding movement of the stock past the die. At the lower end of the connecting-rod is a vertical rack which meshes with a pinion on one end of a horizontal shaft. A second pinion mounted on the opposite end of this shaft meshes with rack teeth on the under side of pusher-rod *C*. The stock is held in grooves machined in the inside faces of pusher rod *C* and the stationary rod *D*. During each return stroke of the press ram, rod *C* moves toward the right and pushes the stock forward (when the mechanism is arranged for pushing the stock to the die).

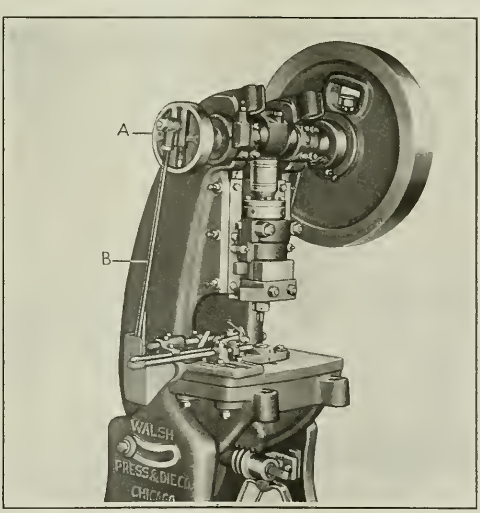


Fig. 1. Application of a Power-press Stock-feeding Mechanism placed on the Market by the Walsh Press & Die Co.

Gripper *E* holds the stock and causes it to move forward with rod *C*. When the stock has been advanced to the required position over the die a trip on the gripper comes into contact with the adjustable dog *G* and releases the hold of the gripper on the stock. Rod *C* then pulls the gripper back, and while this movement takes place an adjustable retaining pawl *I* prevents the stock from moving. When the gripper has returned to the desired point the trip engages a second adjustable dog *J*, which re-engages the stock for the next operation. A handle on the gripper provides for releasing its hold on the stock at intermediate points when necessary.

Ordinarily a V-point is used on the gripper, but a floating flat-ended contact point may be substituted. This will insure that a secure grip is obtained on the stock without marring the surface in any way. From the description it will be evident that the operation of the device is positive and that by adjusting the positions of the dogs G and J, the stock may be fed to the die without unnecessary waste of material.

When it is desired to use the mechanism for pulling the stock to the die instead of pushing it, the position of crank A is changed 180 degrees on the press shaft. The stock will then be pulled from the right instead of being pushed from the left. Crank A is mounted on a plate by means of cap-screws placed in circular slots. This design provides for readily adjusting the movement of the feeding mechanism to the proper relation with the movement of the press ram.

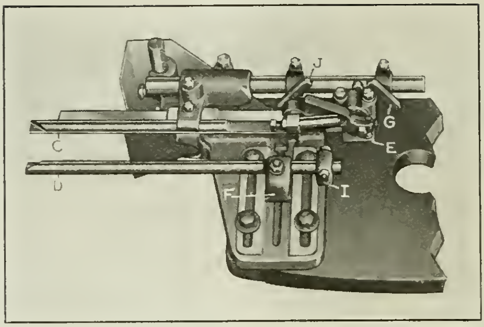


Fig. 2. Close-up View of Walsh Stock-feeding Mechanism for Power Presses

After the device has been attached to a press and the correct relation has been obtained between the feed and the ram movements, the next step is to adjust the mechanism to suit the width of stock to be handled. This is done by shifting the position of bracket F which holds rod D. The bolt on this bracket serves the double purpose of clamping the bracket to the attachment in the proper transverse position to suit the width of the stock and also of setting the rod in the desired longitudinal position relative to the die. The pinion under the reciprocating rod C is next released from the rack teeth of this rod and the rod moved longitudinally to the desired setting, after which the pinion is again placed in mesh with the rack. The mechanism is now set for operation.

HOLLANDER ADJUSTABLE BROACHES

The broaching of square and hexagonal holes, splines, keyways, and round grooves in small lots of work may be accomplished economically by using adjustable broaches made by the Edward Hollander Tool Co., 142 Miller St., Newark, N. J. These broaches are intended to be attached to the spindle of a drilling machine, ram of a shaper or arbor press, toolpost of a lathe carriage, or other machine members suitable for traversing a tool without rotating it. The broaches are made in various styles, the square and hexagonal types being regularly made in all sizes from 1/4 to 3/4 inch across flats. As will be seen in Fig. 1 at A, the broach is held in a holder having a micrometer adjustment. Each broach is hollow, the front end being ground to the shape of the hole to be produced and split. The rear end is threaded as shown at D and E to screw into the holder.

A rod extending through the hollow broach has a pilot screwed on the forward end after the broach has been assembled. This pilot is of the same diameter as the hole to be machined, and thus serves to keep the entire unit steady in an operation. The pilot is provided with ribs which engage the splits of the broach and keep the cutting edges of the tool from swerving sidewise. A detail view of a pilot is illustrated at C. The pilot is also employed for adjusting the cutting edges. Prior to the first cut, the ribs of the pilot only slightly engage the splits of the broach. Then, after the broach has been given one pass through the work, the pilot is pulled back to engage the splits a greater amount. In doing this, the taper surface of the pilot causes the cutting edges of the broach to be expanded.

The adjustment of the pilot is accomplished by revolving the knurled member of the holder the desired number of graduations, each of which represents an expansion of 0.001 inch of the cutting edges. By forcing the broach through the work a number of times and making an adjustment after each traverse, the work may be machined satisfactorily to the required dimensions. Each broach is supplied with a gage ring for setting the cutting edges properly to take the first cut. A number of parts finished by broaches of this type are illustrated in Fig. 2.

WARNER & SWASEY STAYBOLT THREADING MACHINE

A machine intended for threading staybolts in railroad shops has been placed on the market by the Warner & Swasey Co., Cleveland, Ohio. This machine is really the No. 4 turret lathe manufactured by this concern provided with a special attachment instead of the regular turret slide and saddle. When not required for staybolt threading, the attachment may be replaced by the regular turret slide and saddle and the machine used for the production of the miscellaneous studs and bolts ordinarily required in railroad shops. The machine is capable of cutting any size of thread on crown, buttonhead, and swivel staybolts up to 40 inches in length. Self-opening die-heads are supplied to meet the requirements of the particular shop in which a machine is installed. In an operation on upset buttonhead forgings which were taper-formed under the head and on which a thread was cut both under the head and on the opposite end, the production rate was one staybolt per minute.

The rough forging is passed through the forward die-head into the square collet of the automatic chuck. The die-head has an enlarged hole in the shank, and the chasers open

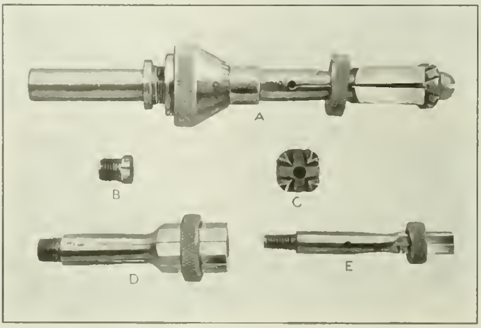


Fig. 1. Adjustable Broach made by the Edward Hollander Tool Co.

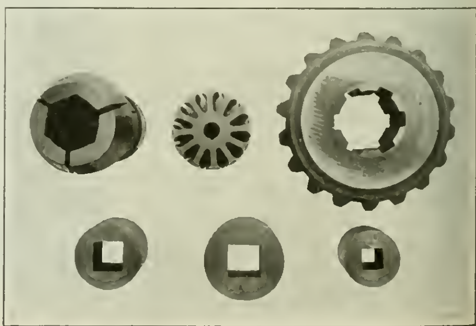
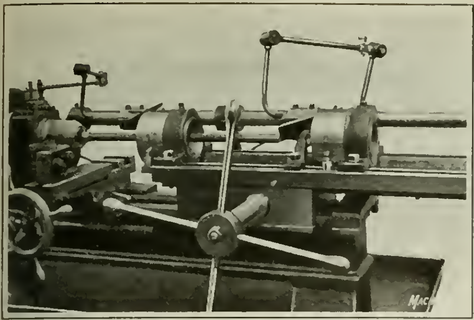


Fig. 2. Specimens of Work produced by using Adjustable Broaches



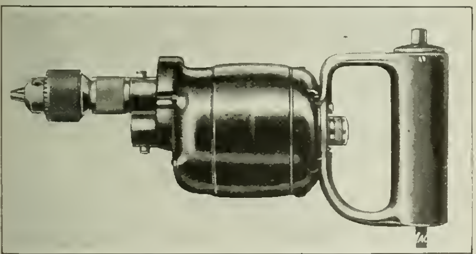
Staybolt Threading Machine built by the Warner & Swasey Co.

exceptionally wide to enable the staybolt to be chucked in this manner. After the work has been chucked, the staybolt carriage is fed forward until the extended end of the bolt is supported in the steadyrest between the two die-heads. The head end is then formed by a cutter on the cross-slide, after which the staybolt carriage is again fed forward during which time the die-heads, being operated by cams at the rear, close automatically and cut the threads.

When the die-heads have passed the cams, the die-heads again open. The carriage is then returned to the back end of the machine. As the action of the heads is dependent on the contour of the cams, the latter are made to suit the job. The threads on both ends of the staybolt are cut in a continuous lead, the thread on the extended end being cut without any previous machining.

JONES PORTABLE ELECTRIC DRILL

A portable electric drill of 1/4-inch capacity equipped with a high-speed universal motor operating on either direct or alternating current, has been placed on the market by the Consolidated Instrument Co. of America, Inc., 41 E. 42nd St., New York City. The gears are of the helical type, cut from tool steel, heat-treated and mounted on shafts ground to size. Ball bearings are provided to take the end thrust of the spindle. The spindle is equipped with a No. 1 Jacobs chuck. The housing is an aluminum casting having a black finish. The over-all length of this tool is 10 inches; the greatest diameter of the motor, 3 inches; and the weight of the equipment, about 4 pounds.

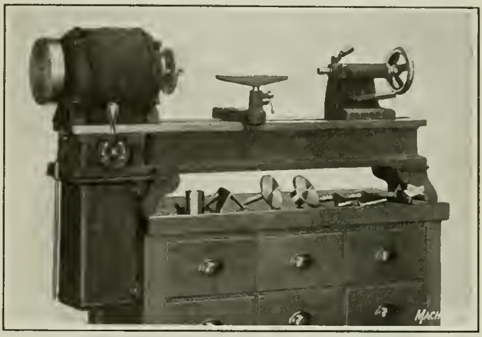


Jones Portable Drill placed on the Market by the Consolidated Instrument Co. of America, Inc.

BLOUNT MOTOR-HEADSTOCK PATTERN-MAKER'S LATHE

Patternshop foremen and vocational school instructors will be interested in a bench wood-turning lathe, having a 12-inch swing, which is now being placed on the market by the J. G. Blount Co., Everett, Mass. From the illustration it will be apparent that the driving motor is contained in the headstock. The rotor, outside frame, and necessary windings of the headstock are supplied by the Westinghouse Electric & Mfg. Co. Openings at the bottom of the motor frame provide for connecting leads to the controller directly beneath. The motor end brackets are without openings, and so the unit is fully enclosed. The spindle bearings are mounted in dustproof housings, S K F bearings being furnished. A handle on the front of the bed beneath the headstock is manipulated for starting and stopping the motor. The controller has four running positions giving spindle speeds of 575, 1160, 1750, and 3450 revolutions per minute.

The spindle is made from 0.45 per cent carbon steel, is ground, and has a hole 5/8-inch in diameter bored throughout its entire length. A No. 2 Morse taper hole receives the center. By providing a taper hole of this size, a larger hole may be bored through the spindle than would otherwise be possible. The spindle nose is threaded to receive faceplates, screw or hollow chucks, and other similar equipment. The bed is made in 4-, 5-, and 6-foot lengths, the maximum distance between centers on the 4-foot bed being 25 inches.

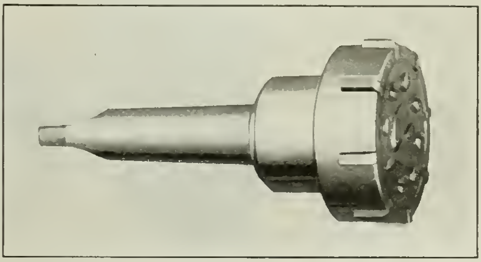


Alternating-current Motor-headstock Wood-turning Lathe made by the J. G. Blount Co.

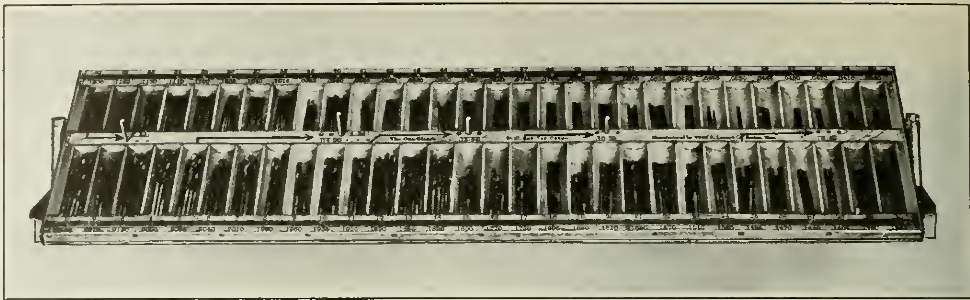
CAMPBELL EXPANDING CYLINDER REAMER

A reamer or boring head intended for refinishing automobile cylinders and having an expansion of approximately 3/8 inch has been brought out by the Campbell Auto Works, 238-240 N. El Dorado St., Stockton, Cal. This head may be screwed on the end of a boring-bar for application on machines of different types. The adjustable members of the reamer are concealed within the head so that dirt or chips cannot interfere with the making of an adjustment. During an adjustment the blades remain in the same relation to one another, and so do not require regrinding to true them up.

An adjustment is quickly and accurately made by first loosening the eight screws on the face of the head which hold a plate securely on the cutters. As the screws are loosened,



Expanding Reamer or Boring Head brought out by the Campbell Auto Works



"One-glance" Drill and Tap Crib made by the Victor R. Lawson Co., which makes it Possible to determine quickly what Drills may be used with a Given Tap

the plate is raised by four coil springs in the body, after which the cutters are free to slide easily in the radial slots in which they are contained. By finally turning the center adjusting screw on the face, the blades are forced outward or inward as desired, and after an adjustment the eight screws are retightened to lock the blades. This reamer is made in different sizes up to 4½ inches in diameter. It has a wide application in turret lathes and similar machines. Application has been made for a patent on this tool.

AMERICAN AMPLIFYING GAGE

An amplifying gage which differs from a larger gage of this type manufactured by the same concern, in that it is limited in range and does not have all the attachments supplied with the larger gage, is now being introduced to the trade by the American Gauge Co., Dayton, Ohio. The new gage is made in two sizes, one of which is intended for work from ¼ to 2 inches in diameter, and the other for work from 2 to 4 inches in diameter. The larger amplifying gage was described in detail in April, 1918, MACHINERY and several of its applications were mentioned in the article entitled "The Delco Inspection System" which appeared in September, 1921, MACHINERY.

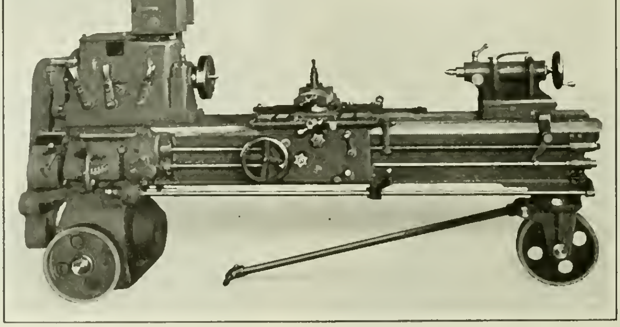
LAWSON DRILL AND TAP CRIB

A drill and tap crib in which gaging holes readily show the proper compartment in which a drill should be placed according to its size has been placed on the market by the Victor R. Lawson Co., 35 Hartford St., Boston, Mass. Another feature of the crib is that the location of the holes for the taps indicate the drills with which a tap of a given size may be used. As will be seen from the illustration, this crib has sixty semicircular drill compartments arranged in two rows. Just above the top row and below the bottom row is a series of gaging holes in a hardened steel strip. Above each of the holes is the number of the drill for which the compartment adjacent to the hole is intended. Beneath the hole is the decimal diameter of the drill. The holes for the taps are located in the maple strip separating the two rows of drill pockets, the taps being held in a perpendicular position. There are three holes for each tap size, each set of holes being arranged adjacent to the correct drills for drilling either a full-, three-quarter-, or half-thread hole. For example, 14-20 taps are in line with the pocket for No. 10 drills. This signifies that a drill of this number is suitable for drilling a hole to have a full thread when tapped by means of a 14-20 tap. The arrow line running from the tap holes to the pocket for No. 5 drills indicates that a drill of that number is the largest that may be used with a tap of this size, a No. 5 drill thus being suitable for drilling a hole in which a half thread is to be tapped.

Each tap hole has sufficient clearance for the tap body except at the bottom where the hole is just small enough to prevent the tap from sliding through. The next smaller size of tap will slide through, and this indicates that it is not the size for which the hole is intended. This crib is mounted on supports which permit it to be tilted to different angles.

LEHMANN PORTABLE GEARED-HEAD LATHE

For use in railroad and other shops handling comparatively large work, where it is often necessary to bring the machine tool to the job, the Lehmann Machine Co., 3560 Chouteau Ave., St. Louis, Mo., has brought out a portable geared-head lathe which, except for the portable feature, is similar to the Lehmann lathe described in January, 1921 MACHINERY. The lathe dealt with in the present article is motor-driven through a belt and pulleys, the speed of the motor being 1800 revolutions per minute. The motor is mounted in the cabinet of the lathe at the head end of the machine. All driving members are covered by suitable guards. The headstock gives sixteen spindle speeds through ten heat-treated gears. The shafts of the headstock run in ball bearings, with the exception of the spindle, which has phosphor-bronze bearings. Two surfaces of different diameters are provided on the spindle nose for faceplates and chucks. Forward or reverse rotation of the spindle is obtained through patented friction clutches which run in oil and are operated by two handles located on the control rod.



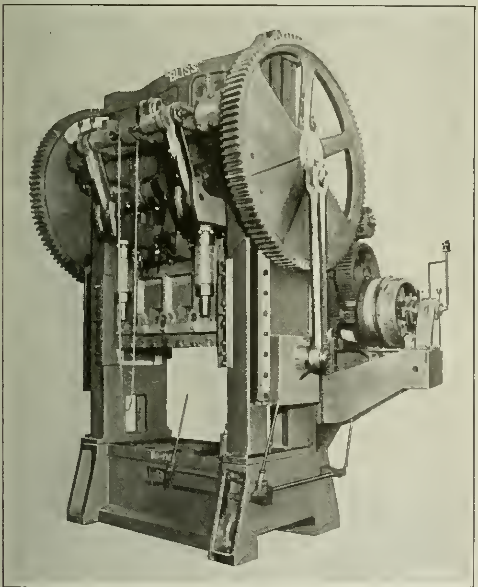
Portable Geared-head Lathe built by the Lehmann Machine Co.

BLISS DOUBLE-CRANK TOGGLE PRESS

During the last few years rapid strides have been made in the development of steel stampings to replace castings, especially in the automobile industry. In order to keep pace with such requirements, it has been necessary to build power presses of sizes and capacity far beyond the dreams of a decade ago. The accompanying illustration shows a press built by the E. W. Bliss Co., Brooklyn, N. Y., for the purpose of drawing pressed-steel axle housings for automobile trucks. These housings are drawn in two sections from steel 3/8-inch thick, which are later welded together. The press is of the tie-rod construction, twin-driven and triple-geared. The ratio of the gearing is 85 to 1. All gears are made of steel, and have machined teeth.

Power is transmitted from the main driving gears to the outside slide or blank-holder through a series of toggles, a dwell of 120 degrees being obtained. In order to keep the construction simple, and at the same time avoid torsional strains, power is transmitted to the blank-holder from both sides of the press. This method is also followed for driving the crankshaft that operates the inner slide, the crankshaft having a driving gear on each end. A 15-horsepower motor mounted on the front of the crown furnishes power for adjusting the inner slide or plunger. The press is driven by a 100-horsepower motor through a hand-actuated friction clutch of the double-grip type.

Some of the principal dimensions of the machine are as follows: Distance from bed to inner slide (stroke down and adjustment up), 59 inches; distance from bed to outer slide (stroke down and adjustment up), 56 inches; stroke of inner slide, 28 inches; stroke of outer slide, 20 inches; area of blank-holder face, 5 feet by 8 feet 6 inches; and area of plunger face, 3 feet by 7 feet 3 inches. The weight of this press is about 300 tons.

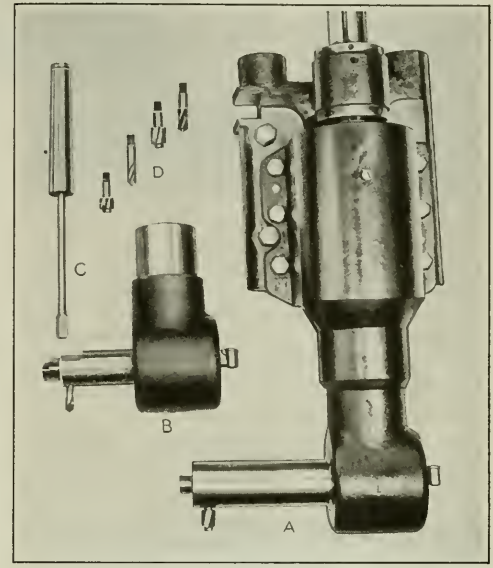


Double-crank Toggle Press built by the E. W. Bliss Co.

HARRIS OFFSET DRILLING ATTACHMENT

Port holes and grooves in pneumatic drills, hammers, and riveters can be conveniently drilled, milled, countersunk, and counterbored by the use of an offset drilling attachment brought out by the Harris Engineering Co., Bridgeport, Conn. Another style of offset drilling attachment made by this company for use in standard lines of manufacture was described in September, 1917, MACHINERY. The attachment here dealt with is made to reach into the main bore of the work, and to drill or mill from the inside. It is possible to drill to a specified depth and mill circular, transverse, or longitudinal slots.

Owing to the long overhang under which the tool must work, the offset arm is made as large in diameter as the bore of the air chamber and the depth of the drilling or milling will permit. The entire patented transmission and the offset arm are made from vanadium tool steel and heat-treated. The drills, mills, and counterbores are ground and lapped to fit the spindle in the outer end of the arm. They can be quickly interchanged, and have a limited adjustment for depth which allows for grinding, setting, etc.



Offset Drilling Attachment made by the Harris Engineering Co.

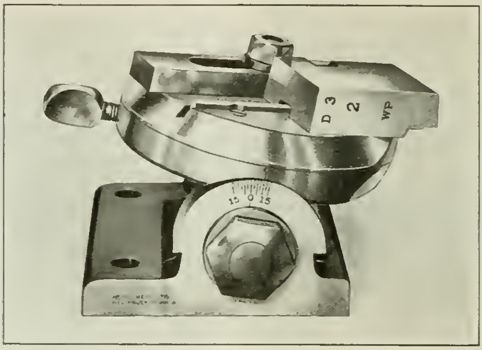
An attachment mounted in a special bracket provided on a vertical milling machine is shown at *A* in the accompanying illustration. To the left of this at *B* is an attachment having a shorter arm which is interchangeable in the special bracket. Spindle *C* has a taper shank that is inserted in the regular machine spindle, while the lower end is squared to fit a hole in the attachment and thus transmit power to it. Several tools for the attachment are shown at *D*. This equipment may also be used for the inside drilling or milling of oil-grooves, straight or spiral holes for holding babbitt in bearing boxes, blind keyways to retain a feather or key, etc.

GEOMETRIC CHAMFER GRINDING FIXTURE

One of the essential points in thread chaser grinding is that the chamfer be ground an equal amount on all chasers of a set. When the chamfer is ground unevenly, the burden of cutting comes on one or two of the chasers with the result that threads are cut out of lead, tapered, or with other irregularities. In order to grind thread chasers satisfactorily, the Geometric Tool Co., New Haven, Conn., has brought out the fixture here illustrated. This fixture is intended principally for grinding chamfers on the Geometric milled form of chasers, but it may also be used for grinding chasers of the tapped form. With chasers of the latter form, however, the grinding is straight and does not conform to the contour of the chaser threads.

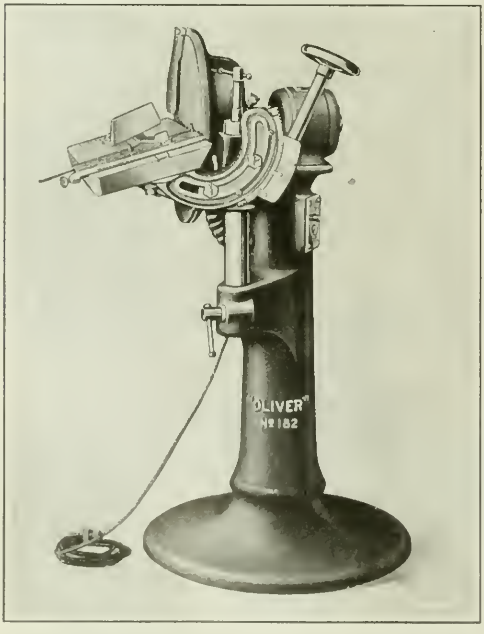
The table of the fixture is graduated and may be set for grinding long or short chamfers. The narrow key engages the keyway of the chaser and acts as a guide while grinding. An adjustable stop governs the position of the chaser with respect to the grinding wheel. The side of the fixture is also graduated to enable the table to be tilted accurately to the desired angle of chamfer clearance. One fixture accommodates all sizes of chasers, and left- as well as right-hand chasers can be ground. When used for 5/16-inch chasers, it is necessary to remove the key, and guide the chaser in the keyway.

When the fixture is bolted to the table of a grinding machine, the chaser must be slid forward by hand to the wheel and against the stop provided on the fixture. However, on machines that permit of so doing, the chaser may be fed forward by means of the machine handwheel or lever to a stop arranged on the machine. The fixture may also be mounted on a machine slide, and the chaser ground by passing it back and forth across the edge of the grinding wheel.


Thread-chaser Grinding Fixture brought out by the Geometric Tool Co.

OLIVER MOTOR-DRIVEN DISK SANDER

Patternmakers will be interested in a motor-driven disk sander now being placed on the market by the Oliver Machinery Co., Grand Rapids, Mich. This machine is particularly adapted for accurately sanding segments, angular sections, core-prints, and circular and taper work. It can also be used in machine shops for medium and light metal work.



No. 182 Motor-driven Disk Sander placed on the Market by the Oliver Machinery Co.

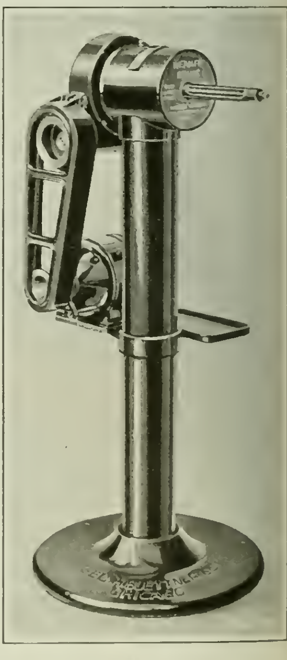
The steel disk plate which is 15 inches in diameter, is removable for renewing the sandpaper or emery cloth on its front face. The disk travels at a speed of 1725 revolutions per minute.

The table has a groove to receive angle, and circle, segment and duplicating gages. It tilts 45 degrees downward from the horizontal plane and 25 degrees upward, a graduated index showing the angle at which it is positioned. A vertical adjustment of six inches provides for handling a variety of work. The angle gage is graduated from 0 to 45 degrees both to the right and left to enable accurate settings. Either an alternating- or direct-current motor is provided, the motor being coupled to the disk shaft in such a manner that it does not receive thrusts from the latter. The controlling switch is of the push-button type, and is located on the column. This machine is portable and is intended to receive electric current from a lighting circuit.

BLETTNER REAMER DRIVING MACHINE

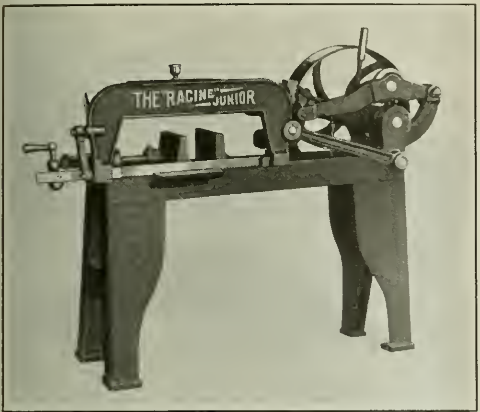
Reaming finished holes to size in the assembly of machines or mechanical units is facilitated by a machine produced by the George H. Blettner Co., 1841 W. Jackson Blvd., Chicago, Ill., which is shown in the accompanying illustration. This machine drives hand and machine reamers of various styles up to 1½ inches in diameter. The driving mechanism is located at the top of the pedestal, and driven from a 1/6-horsepower alternating- or direct-current motor through a round belt. A three-step pulley provides three spindle speeds of 10, 20, and 30 revolutions per minute, respectively. The operator stands directly in front of the machine, and, while holding the work in his hands, feeds it on the slowly revolving reamer which centralizes itself.

The spindle is fitted with a 5-inch Cushman geared scroll chuck. All end thrust in the machine is taken up by ball bearings, and the gear-case is oil-tight so as to retain the lubricant. The electric current switch is of the self-contained tumbler type. It is said that by using this equipment holes will be given a better finish than when sizing by hand, and the work can be done more quickly. The distance from the floor to the center of the spindle is 38 inches, and the weight of the machine is approximately 145 pounds.


Reamer Driving Machine made by the George H. Blettner Co.

RACINE HIGH-SPEED HACKSAW MACHINE

Light-gage or hand hacksaw blades may be used advantageously on the "Junior" medium-duty hacksaw machine built by the Racine Tool & Machine Co., Racine, Wis., because of the positive mechanical lift on the non-cutting stroke of the blade. The machine operates on the draw-cut principle, gravity alone being relied upon for feeding the blade an amount suitable for the different grades of metal being cut. An automatic knock-out stops the saw when a piece has been cut through. The saw-frame guide is held automatically at any height, which is a convenience when plac-



Racine "Junior" Metal-cutting Machine built by the Recine Tool & Machine Co.

ing stock in the vise. Adjustment for wear is provided on the saw frame guide which slides on V-ways. The normal capacity of this machine is for stock 4 by 4 inches, but by a simple adjustment the capacity may be increased to 6 by 6 inches. The stroke range of the machine is from 60 to 100 per minute, and the stroke is 6 inches in length. The weight of the equipment is 150 pounds.

DAVIS-BOURNONVILLE TUBE-BENDING MACHINE

The bending of No. 22 gage 7/16-inch diameter tubing to the shape of a tennis racket frame is accomplished by means of a machine built by the Davis-Bournonville Co., Jersey City,

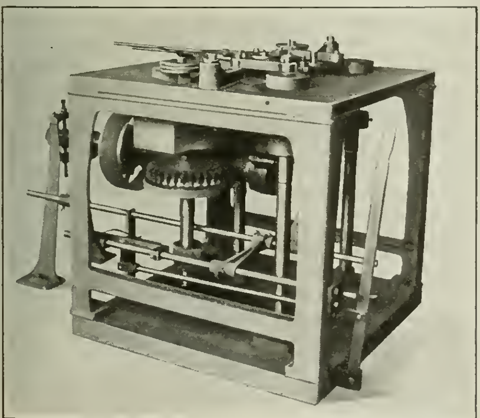


Fig. 1. Tube-bending Machine built by the Davis-Bournonville Co.

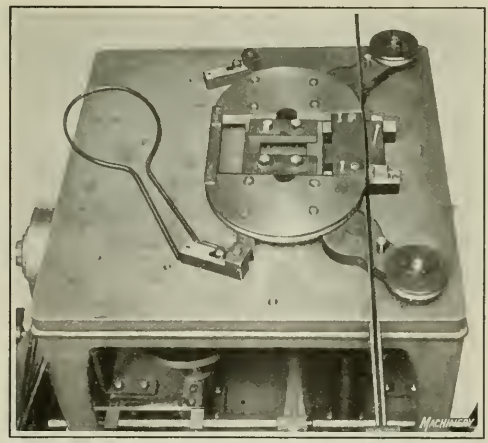


Fig. 2. Tool Set-up for the Preliminary Bending Operation

N. J. A general view of this machine is shown in Fig. 1. Two separate operations are required to complete the bending, the machine being first set up for giving a preliminary bend to a quantity of work, and then arranged for giving these parts a subsequent bend. The preliminary shape is obtained by bending the tube around a form on the table by means of two arms or cranks keyed to vertical oscillating shafts. These members are clearly shown in Fig. 2. The cranks are driven through worm-gearing and a crank motion beneath the table, a clutch being provided for starting and stopping their operation. The rollers on the end of the

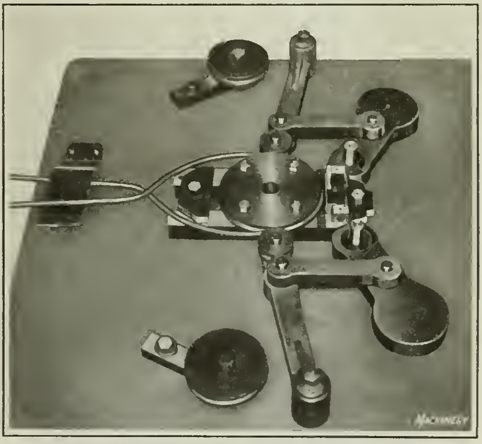


Fig. 3. Final Operation in bending Tubing

cranks engage the tube and bend it around the large form. The normal cycle of steps in this operation is to bend and release the part and stop the machine, the operator then removing the part and replacing it with another straight tube.

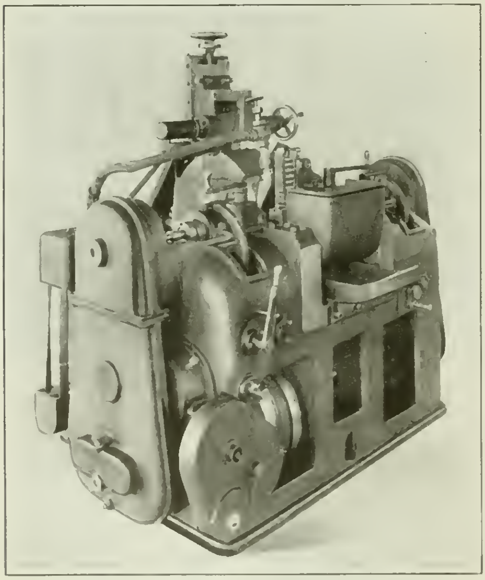
After a quantity of frames has been run through the first operation, the bending tools are changed for those shown in Fig. 3. It will be noted that the rollers on the crank ends have been removed and are employed as stops. They are so positioned that the partly bent frame, when placed on the machine for this operation, will be located by the rollers midway on the form at the center. Links which are connected to studs midway on the crank arms are attached at their opposite ends to another pair of swinging arms having small rollers which engage the tube. In the second operation the frame is closed by the rollers on the swinging arms as the cranks are operated, one leg of the frame passing under the clip at the left of the table, and the other riding over the top. It is necessary to bend the frame through a greater angle of curvature than is actually desired on the finished part, in order to overcome the spring and allow the tubing to set.

The machine normally operates at an average rate of 600 bends per hour, the speed of the driving shaft being 300 revolutions per minute. On normal production, the machine is started and stopped for each bend, but when facility in handling the work has been acquired and maximum production is essential, the clutch latch may be thrown out and the machine then operated without stopping to insert the tubes and remove the bent shapes. The production is thus increased to about 1000 bends per hour.

FRASER AUTOMATIC CYLINDRICAL GRINDING MACHINE

Shackle and king bolts, valve tappets, piston-pins and other parts having cylindrical surfaces to be ground may be handled rapidly in large quantities on the automatic grinding machine here illustrated. This machine has been patented and is now being built by the Warren F. Fraser Co., Westboro, Mass. The work is held either between centers or in a draw-in chuck. The wheel-head is heavy, and the spindle of generous proportions to enable it to carry grinding wheels 18 inches in diameter and up to 6 inches in face width. Force-feed lubrication is furnished for all bearings, and all controls can be easily and quickly reached. The machine is self-contained, being driven by a 15-horsepower motor through a 4½-inch belt. However, the machine may also be driven from an overhead countershaft or jack-shaft through a constant-speed belt.

The time required for setting up this machine for a job is no greater than for rigging up an automatic screw machine, and in grinding piston-pins ⅞ inch in diameter and 3¼

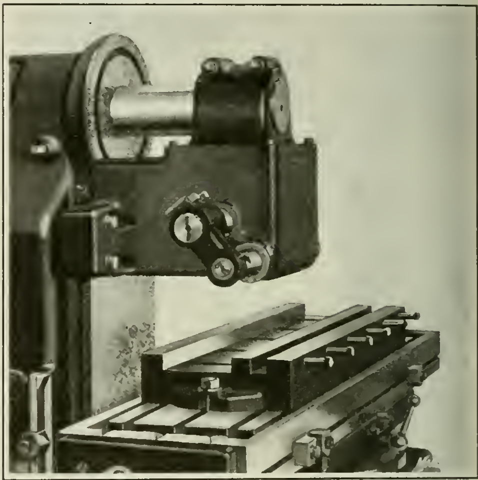


Automatic Cylindrical Grinding Machine brought out by the Warren F. Fraser Co.

inches in length, an average production of five pins per minute was attained. One operator can run as many as four machines. This machine will grind pieces from ½ inch in diameter upward, and up to 6 inches in length, the maximum distance between centers being 10 inches. The machine weighs approximately 7000 pounds. This company also has a small machine in the process of development which will weigh about 4000 pounds and will grind surfaces from ⅛ to 1½ inches in diameter and up to 2 inches in length. The maximum length of work which can be placed between the centers of this machine will be 8 inches.

ROCKFORD RACK CUTTING AND INDEXING ATTACHMENTS

Rack cutting and indexing attachments designed especially for application to the heavy-duty and No. 1½ milling machines built by the Rockford Milling Machine Co., Rockford, Ill., have been placed on the market by the same concern.



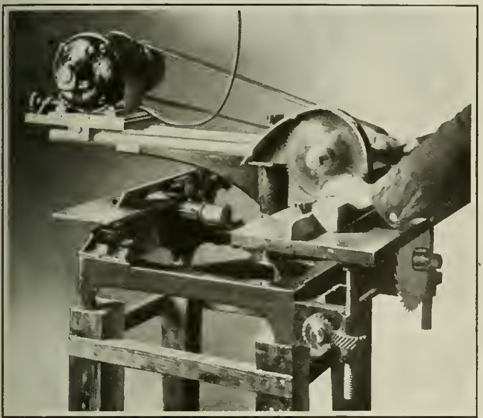
Rack Cutting Attachment and Special Vise added to the Equipment made by the Rockford Milling Machine Co.

The rack cutting attachment is securely clamped to the face of the column and is further supported by the overhanging arm at a point directly above the attachment spindle, where there is the greatest strain. The attachment is driven through a shank held in the machine spindle by means of the tang and a drawback. A hardened spur gear keyed and pinned to the shank drives a second gear keyed to a double-lead worm. The latter engages a worm-wheel which has two spur gears keyed to it, one on each side. These transmit power to the attachment spindle through gears cut solid on this member. The attachment spindle is made of alloy steel, and runs in bronze taper bearings that have means of adjusting for wear.

The rack indexing attachment (which is not illustrated) is fastened to the left-hand end of the table by means of the central T-slot. It consists of a bracket carrying an indexing and locking disk and change-gears. This device permits of cutting rack teeth and making other settings without relying on the usual dial. Various gear combinations enable racks of different pitches to be indexed by making one-half, one, or two turns of the locking disk. The cutting of racks to the following diametral pitches is possible by means of the eighteen change-gears furnished: 3 to 6 by half pitches, all pitches from 7 to 16, and all even pitches from 18 to 32. Racks having circular pitches of from 1/16 to 1 inch may also be cut. The special rack vise shown in the illustration has jaws 30 inches long, which have a maximum opening of 5⅝ inches.

HUTCHINSON COMBINATION WOODWORKING MACHINE

Fifteen different operations may be performed on a small combination woodworking machine brought out primarily for pattern shop use by the Hutchinson Mfg. Co., Inc., Norristown, Pa. This machine can be employed as a swing saw, for cross-cutting square ends of long stock, for mitering and for dadoing. In performing such work, the operator can always clearly observe the cuts being taken. The machine is especially suitable for routing out core-boxes, cutting all kinds of segments, jointing, and planing. The table moves up and down while the machine is in operation and may also be swiveled. Another advantage of this design is that two men can work on opposite sides at the same time.

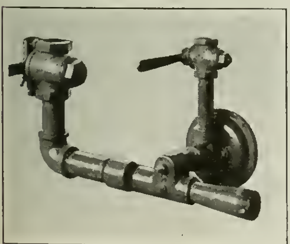


Small Combination Woodworking Machine brought out by the Hutchinson Mfg. Co., Inc.

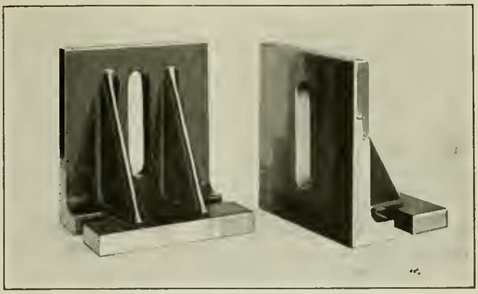
The machine may be mounted on a small stand having rollers which will enable it to be readily moved about the shop. It is driven by a ½-horsepower motor, and weighs 245 pounds.

SURFACE COMBUSTION AIR-GAS INSPIRATOR

The low-pressure air-gas inspirator supplied in past years on furnaces built by the Surface Combustion Co., 362 Gerard Ave., Bronx, New York City, has been redesigned so as to be applicable to other makes of gas furnaces. The entire operation of a furnace equipped with this device is controlled through one valve. An increase or decrease in the air supply automatically causes the amount of gas delivered to be also increased or decreased, so that the mixture proportions remain in a constant ratio. The gas cock is operated only when starting or stopping the heating of a furnace, and is either altogether on or off, no intermediate positions being required. It is said that no explosive mixtures are possible in any part of the distribution mains, as the gas and air are mixed only at the point of supply to the burners. The advantages claimed are an automatic supply of air and gas in the desired proportions under all conditions, thorough mixing of the air and gas just prior to entering the furnace, and an instantaneous combustion.



Air-gas Inspirator made by the Surface Combustion Co.



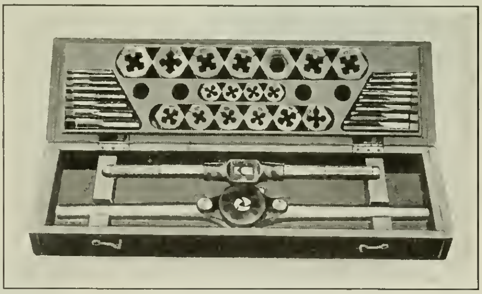
Precision Angle-irons made by the Simplex Tool Co.

SIMPLEX PRECISION ANGLE-IRONS

Two of a set of precision angle-irons made in three sizes, to provide for a variety of combinations suitable for the general run of machine shop work are shown in the accompanying illustration. These irons are manufactured by the Simplex Tool Co., Woonsocket, R. I. They are made of a high grade of cast iron, and the clamping surfaces are accurately finished. Slots provide a means of holding the irons to surfaces of machine and other parts. The sizes in which the angle-irons are made are 4 by 5 by 5 inches; 6 by 6 by 8 inches; and 8 by 10 by 12 inches.

WELLS SCREW-PLATE SET

A screw-plate set having several new features has just been brought out by the Frank O. Wells Co., Inc., 305 Wells St., Greenfield, Mass. It will be seen from the illustration that the dies of this set are hexagonal. The die-stock is made of an aluminum alloy, and the tap wrench is made of steel and has hollow handles to reduce its weight. The dies are made adjustable by splitting one side and providing a fillister-head screw for drawing the split ends together. By holding these ends in this manner the dies may be turned with an ordinary socket wrench instead of using the stock. This is convenient when working under cramped conditions.



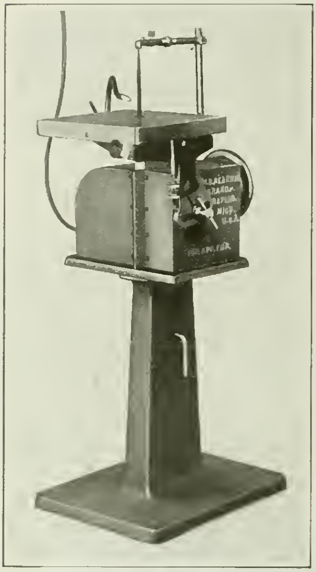
Hexagon-die Screw-plate Set introduced to the Trade by the Frank O. Wells Co., Inc.

The dies are of standard form and chip clearance, and are intended to cut full and perfect threads. A hexagonal adapter turnished with the set provides for holding dies that are small in outside diameter in the same stock. Attached to the stock by means of knurled-head screws is an adjustable guide which may be swung to one side to permit the changing of dies after the screws have been loosened. When retightened, the screws hold the guide in position over the center of the die and lock the jaws of the guide so that they will not move while threading a number of pieces of one size. The cutting faces of the dies are formed by broaching, the correct shape being produced and an equal distance maintained between all cutting lands in this way. The set is made with both U. S. standard and S. A. E. forms of thread.

REARWIN DIE-FILING MACHINE

A No. 4 small-size die-filing machine which may be mounted on a bench or on a pedestal having elevating rollers has been added to the line of die-filing equipment manufactured by W. D. Rearwin, 716 Monroe Ave., Grand Rapids, Mich. When the rollers are lowered and the pedestal raised the machine can be conveniently moved about the shop. After it is taken to a desired location, the base of the pedestal furnishes a solid foundation when the rollers are again raised. Power for driving the machine may be obtained from any electric light socket. A 1/8-horsepower motor running at 1720 revolutions per minute is provided, which is fully enclosed in a sheet-metal case to protect it from filings and dirt.

The file is reciprocated by a ram driven through a crank and connecting-rod. By adjusting the throw of the crank it is possible to obtain any length of stroke up to 3 inches. The effective length of the connecting-rod can also be adjusted to bring the working section of the file into any desired position relative to the work. Three changes of speed are obtained through a cone pulley, namely 200, 300, and 400 strokes per minute.

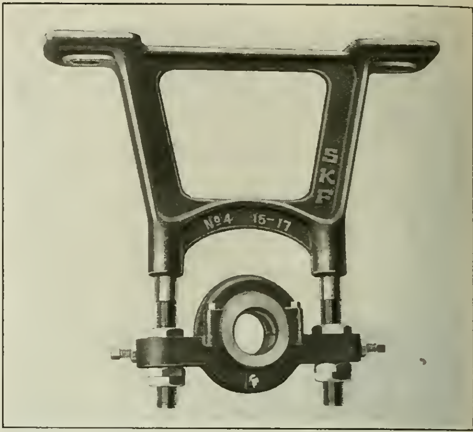


Die-filing Machine built by W. D. Rearwin

To enable various degrees of clearance to be filed in dies, the work-table is pivoted on a yoke, and this, in turn, is pivoted on the frame of the machine. Each of these pivotal supports has a graduated dial which facilitates rapid and accurate setting of the table to the desired clearance angles. There is an outboard support for the file, and files of standard or special types can be used. The table is at a convenient height for a man sitting on a stool. The table is 12 inches square, and the entire machine weighs about 80 pounds. A smaller size machine built along the same lines and known as the No. 3 is made with a table 8 inches square and a file stroke of 1½ inches.

SKAYEF BALL-BEARING HANGER

An improved ball-bearing hanger with a two-point suspension for the bearing box is now being manufactured under the supervision of the S K F Industries, Inc., 165 Broadway, New York City. The self-aligning ball bearing incorporated in the old type hanger is also included in the new. The bearing is contained in a split housing rigidly held by two suspension rods. This arrangement gives a compact unit, easily assembled, located, or inspected. Vertical or horizontal adjustments can be readily made at the end of the housing by means of lock-nuts and set-screws. This obviates the possibility of applying pressure to the bearing while making adjustments.

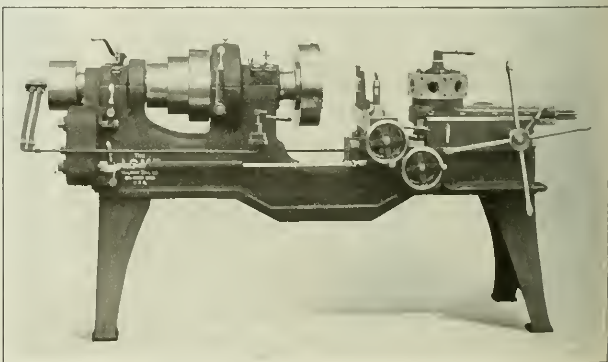


Skayef Ball-bearing Hanger

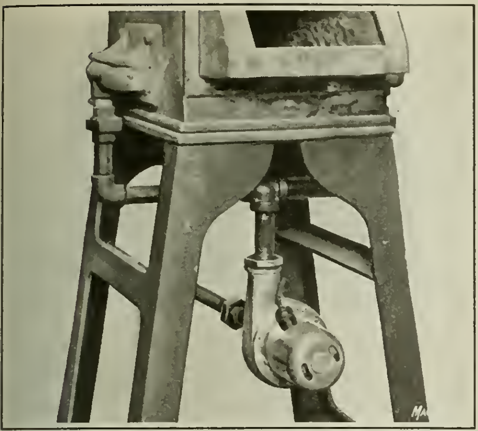
The self-aligning feature of the bearing allows the shaft to turn freely at all times with a minimum amount of friction and subsequent heating. Millwrights will appreciate the fact that when using these hangers for an installation the shaft may be laid out on the floor with the bearings in plain view and then raised into position for final adjustment with the upper half of the housings off.

CINCINNATI ACME GAP TURRET LATHE

A departure from the standard design of turret lathes has been made by the Acme Machine Tool Co., Cincinnati, Ohio. in bringing out the gap turret lathe here illustrated. This machine was designed particularly for the handling of chucked work that is large in swing relative to its length. Many castings and forgings which ordinarily cannot be machined on a turret lathe of corresponding nominal size can thus be accommodated because of the gap. The machine is made to the dimensions of the regular 20-inch Cincinnati-Acme turret lathe built by the same concern, except that the gap provides for a maximum swing of 28 inches. The length of the gap from the front end of the spindle is 9⅛ inches. The machine is equipped with an air chuck, and has a power feed for the cross-slide and a longitudinal power feed for the turret. The minimum distance from the end of the spindle to the turret face is 14¾ inches; the minimum distance from the end of the spindle to the inside edge of the cross-slide, 8⅛ inches; the transverse movement of the cross-slide, 7 inches, and the lateral movement, 4 inches.



New Design of Turret Lathe built by the Acme Machine Tool Co.



Gas Furnace equipped with Electric Blast made by the Clements Mfg. Co.

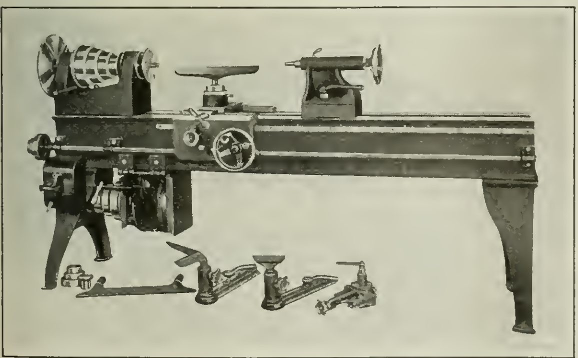
CADILLAC ELECTRIC GAS-FURNACE BLAST

An electrically operated blast intended for application to gas furnaces for regulating the mixture of air and gas delivered to the furnace is now being placed on the market under the trade name of "Cadillac" by the Clements Mfg. Co., 606 Fulton St., Chicago, Ill. This blast is driven by a 1/6-horsepower universal motor and delivers 210 cubic feet of air per minute at a motor speed of 10,000 revolutions per minute. Current for driving the motor is taken from a lighting socket; this offers a convenient means of heating a furnace after regular working hours.

The functioning of the device is similar to that of an automobile carburetor. The mixture of air and gas should be rich until the furnace has been warmed up, after which a damper on the blast adjacent to the blower should be gradually opened to admit more air. This blast is not dependent upon a normal gas pressure, a sufficient amount of gas being drawn from the mains to heat a furnace without variation.

IMPERIAL PATTERNMAKER'S LATHE

A motor-driven patternmaker's lathe built in sizes of 16-, 20- or 24-inch swing and with standard bed lengths of 8 and 10 feet, is a recent product of the Imperial Metal Products Co., Ionia and Newberry Sts., Grand Rapids, Mich. This lathe has a headstock which can be swung about five degrees each side of the center to provide for turning tapers. The spindle is threaded on both ends for the accommodation of faceplates. Double-row self-aligning S K F ball bearings take the end thrust of the spindle as well as radial loads. The tailstock is of the open-side type and may also be set over for turning tapers. The compound rest is graduated to enable quick settings to be made at various angles.

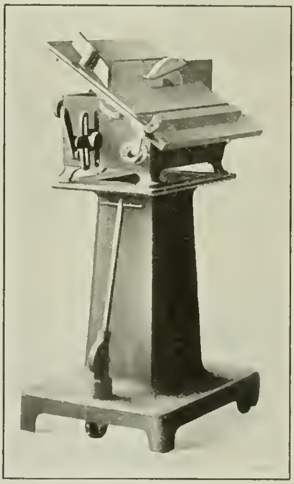


Porter Patternmaker's Lathe manufactured by the Imperial Metal Products Co.

The carriage is regularly furnished with a power feed, but a hand-fed carriage can also be supplied. On the power-fed machine, the feed can be started or stopped by turning a friction knob on the apron, or reversed by the manipulation of a lever. The two-horsepower motor with which the machine is equipped is mounted on an adjustable base which allows for tightening the driving belt. Belt shifters and a controlling box are conveniently located. A brake lever operating on the inside of the spindle cone pulley enables the rotation of the spindle to be stopped instantly. The machine may also be equipped for driving from a countershaft.

UNION PORTABLE SAW BENCH

A universal saw bench mounted on a pedestal having rollers and a handle which facilitate its transportation about the pattern shop is now being introduced to the trade by the Union Machine Co., 30 Ottawa Ave., N. W., Grand Rapids, Mich. The saw is driven by a ½-horsepower motor, and will cut stock up to 2 inches thick. The table can be tilted to any angle up to 45 degrees and locked in place, a graduated dial and pointer indicating its position.



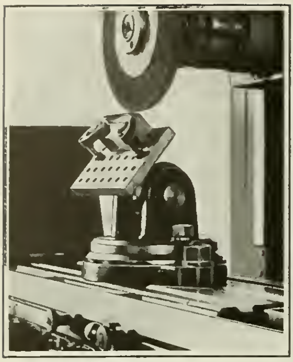
Portable Saw Bench made by the Union Machine Co.

The cross-cut gage may be used on either side of the saw, and can be quickly set to any angle and clamped in position. The ripping gage may also be used on either side of the saw. This gage is automatically lined up with the saw when locked in position. The saw is seven inches in diameter, and may be either of the ripping or cross-cut type, or a combination of the two suitable for both classes of work. A splitter guard keeps the stock from pinching the saw. The saw arbor yoke is hinged so that it can be raised and lowered to adjust the height of the saw above the table surface.

Two rollers at the back of the pedestal and two stationary feet at the front furnish a firm support on the floor when the machine is in operation. Pulling the handle forward raises the feet and brings the weight of the front of the machine on a third roller carried on a swivel bearing that moves with the handle.

KRAG UNIVERSAL ANGLE FIXTURE

Tool-room jobs in which it is necessary to hold the work in angular positions while being machined may be performed readily by using the "Little Bob" universal angle fixture made by E. L. Krag & Co., 50 W. Randolph St., Chicago, Ill. This device has a work-holding plate which may be swiveled 90 degrees on either side of a horizontal



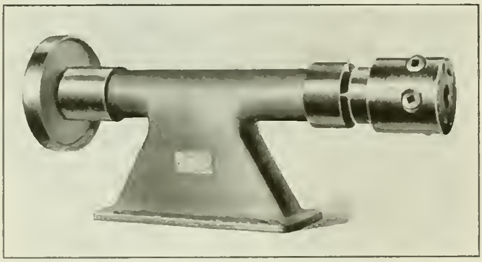
Universal Angle Fixture made by E. L. Krag & Co.

plane and which may also be revolved around an entire circle. Graduated dials facilitate the settings. All surfaces of the plate are ground square with each other, and this member has a series of holes which provide for the quick clamping of work by means of patented clamps.

The plate is hinged on a 3/4-inch stud, threaded on one end, which is used to clamp the plate in desired positions relative to the horizontal plane. Large flanges on the plate engage the faces of bosses on the yoke lugs and produce a sufficient friction to hold the plate fast under all conditions. The yoke casting revolves on a 1 1/2-inch pilot at the center of the base, the yoke being secured by two 1/2-inch bolts which ride in a circular T-slot machined in the base. The size of the fixture plate holding surface is 3 3/8 by 4 3/4 inches, and the weight of the entire fixture, 25 pounds.

MARVIN & CASLER LAPPING AND FILING LATHE

To provide for lapping and filing small work without tying up a lathe or other more expensive equipment, the Marvin & Casler Co., Canastota, N. Y., has brought out the lapping and filing head or "lathe" shown in the accompanying illustration. This head consists essentially of a casting which supports a spindle running in ball bearings. The spindle is driven by a pulley mounted on one end, while at the other end is attached either a Casler twin-screw drill chuck or a three-jaw chuck. The twin-screw chuck was described in April, 1919, MACHINERY. The casting is designed to permit the ready attachment of a guard for the driving belt. The base of the casting is 10 3/4 inches long and the distance from the pulley to the drill chuck is 14 3/8 inches.

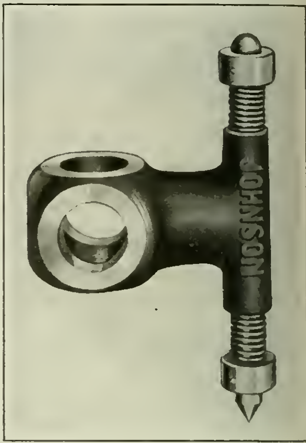


Lapping and Filing Head made by the Marvin & Casler Co.

JOHNSON CENTER-LOCATING PUNCH

Toolmakers and diemakers will appreciate a means for quickly and accurately locating centers of holes on such work as jigs, dies, etc., without relying on the button method. The combination prick-punch and scriber here illustrated has been designed for this purpose, and is manufactured by Bernard F. Johnson, 3476 Boulevard, Jersey City, N. J. One method of using this device is to mount it on the cutter-arbor of a milling machine, with the punch perpendicular, and with the part to be laid out attached to the machine table. Then the centers of holes to be bored later may be located by shifting the work beneath the punch, using the adjusting screws of the table and saddle. By reference to the dials of these screws, centers for holes may be located within the limits of the accuracy of the machine. After each adjustment, a prick mark is made by tapping with a hammer on the upper round head of the punch. Then, when all centers have been located, the work may be mounted on the faceplate of a lathe and drilled and bored in the customary manner after centering by means of an indicator. It will be apparent that the coil springs normally hold the punch from the surface of the work.

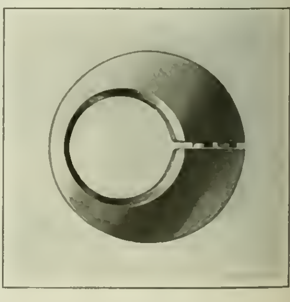
The tool may also be placed in a horizontal position for locating on perpendicular surfaces, and it may be conveniently employed while horizontal or perpendicular in connection with a dividing head for locating holes at an angle. By pressing the lower end of the punch against the work, the sharp point may be used for scribing lines as the work is moved past the tool. This application is especially useful for laying out dies. The punch is hardened and ground all over, and lapped where it is contained in the bearing. The collars on the punch are of equal size and facilitate the alignment of the tool. The holes in the supporting member of this device provide for mounting it on either 3/4- or 7/8-inch arbors.



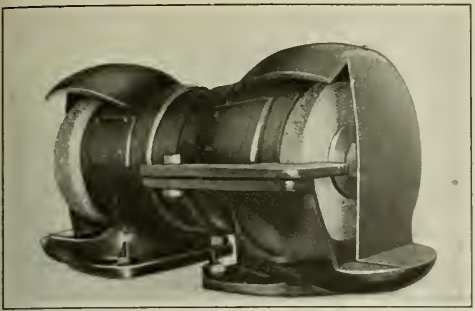
Precision Punch and Scriber manufactured by Bernard F. Johnson

ADJUSTABLE TEMPLET THREAD GAGE

Templet thread gages which are made adjustable by the provision either of one half-way slot leading from the threaded hole or two half-way slots at the periphery, were described in March MACHINERY. These tools are products of the Superior Thread Gage Mfg. Co., Inc., 1985 Troy Ave., Brooklyn, N. Y. Another adjustable ring gage in which the threaded hole is located eccentrically relative to the periphery, in order to obtain the necessary spring for adjustment, is now being made by the same concern. This gage, which is here illustrated, is adjusted in the same manner as the other ring gages referred to, that is, by tightening up a screw placed perpendicular to the split ends of the gage. A hardened drill-rod pin at these split ends keeps the gage from twisting. The outside diameter of gages of this type is considerably less than when half-way slots are provided for obtaining the adjustment. The gage is made in all sizes from 3/16 inch up, for special threads as well as for standard threads.



Thread Gage made by the Superior Thread Gage Mfg. Co., Inc.



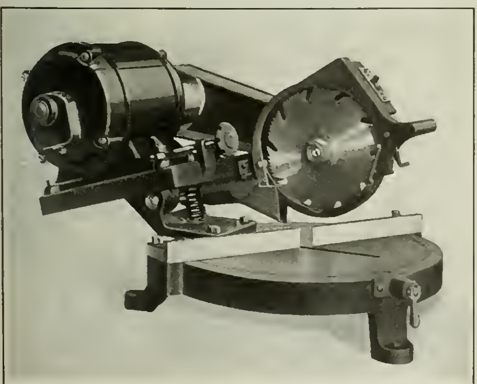
Self-contained Centrifugal-fan Grinder made by Forbes & Myers

FORBES & MYERS GRINDER

The provision of self-contained centrifugal fans for exhausting the dust is the principal new feature of an improved grinder added to the line of products manufactured by Forbes & Myers, 178 Union St., Worcester, Mass. These fans are adjacent to the outside bearings of the grinder spindle and blow the dust directly back through an exhaust pipe. The grinding wheels are located outside of the fans. The motor is of ½ or ¾ horsepower, of the induction type, fully enclosed, and operates on single-, two- or three-phase current. Hess-Bright bearings are used in the construction of this grinder. In the illustration only one wheel is supplied with the tool-rest; however, each wheel may be so equipped or tool-rests may be omitted altogether. While the exhaust action of the fans is effective, they are not intended to take the place of large exhaust systems, for blowing dust through long pipes.

TANNEWITZ PORTABLE SAW BENCH

The accompanying illustration shows a portable wood-cutting saw bench in which the motor and saw are mounted on a frame which swivels 45 degrees each side of a central position. This permits both right- and oblique-angle cuts to be taken. A locking pin engages slots in the periphery of the swiveling member so that the saw can be held at any desired angle. The saw and motor support is pivoted, which enables the saw to be depressed to cut through stock. A coil spring elevates the saw as the operator releases the pressure on the handle used for depressing the saw. The motor is controlled by a simple finger-switch adjacent to this control handle. An adjusting screw provides for varying the tension of the driving belt. This equipment is built by the Tannewitz Works, Grand Rapids, Mich.

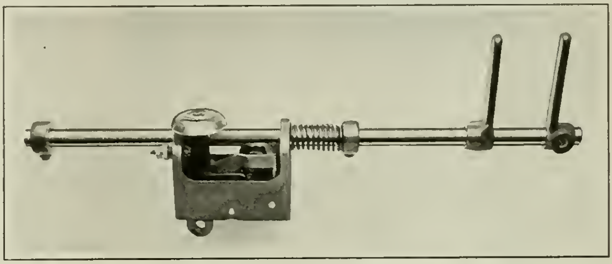


Portable Wood-cutting Saw Bench made by the Tannewitz Works

"SIMPLEX" ELECTRIC SAFETY STOP

Instantaneous operation of a clutch or shifting of a belt on various types of automatic machines in the event that the stock is over-size, under-size, over-fed, or under-fed, or in case some other irregularity occurs, is possible by employing the "Simplex" electric stop. This device is manufactured by the Atlantic Co., 452 Classon Ave., Brooklyn, N. Y., and is intended to be used on a lighting circuit, although it will also function on battery or generator current. Among the various applications of this stop may be mentioned its use on roll-feed blanking presses or four-slide wire formers.

On a blanking press the stop is mounted on the foot-treadle rod, a latch on the stop engaging a notch in this rod. When the stop operates, the latch is disengaged from the notch and the rod is forced forward by the spring. A small spring-lever is also arranged to bear on the blanked scrap as the latter is fed from the die. When the scrap has been fed the desired amount, the lever rests on the metal between the blanked holes, and while thus positioned, the circuit is open. However, if the scrap is over-fed or under-fed, the lever will extend into one of the blanked holes and the circuit will be closed. This will cause the stop to actuate and halt the operation of the machine. In this way injury to a die as a result of punching the metal at a point where it has already been partially blanked out is avoided.



"Simplex" Automatic Safety Stop manufactured by the Atlantic Co.

Wires may be run from the stop to contact points located on a machine wherever trouble is likely to happen. The pressure of the clutch or belt-shifter rod against the stop latch is reduced by means of two unequal levers. A spring for exerting pressure up to 75 pounds may be used in connection with the stop, and such a spring is ample for shifting a 6-inch belt. A hand-trip enables the stop to be operated at any time. The device may be so arranged that it will not interfere with the ordinary method of starting and stopping a machine.

DIAMOND SPROCKET-TOOTH HOBS

On page 592 of March MACHINERY, attention was called to hobs for cutting sprocket teeth to the "American Standard" form. These hobs are not manufactured by the Diamond Chain & Mfg. Co., Indianapolis, Ind., although they were developed by this concern. They are supplied by the Brown & Sharpe Mfg. Co., Providence, R. I., Illinois Tool Works Co., Chicago, Ill., and Union Twist Drill Co., Athol, Mass.

* * *

Reports from Germany indicate that a great development has taken place in recent years in the utilization of compressed air locomotives in mines. In a group of mines at Dortmund, for example, in the year 1919, the number of locomotives in operation was nearly 2300, of which 624 were propelled by compressed air.

NEW MACHINERY AND TOOLS NOTES

Pressed-steel Hanger: Dodge Sales & Engineering Co., Mishawaka, Ind. A pressed-steel lineshaft hanger suitable for use under conditions where excessive vibration is not encountered. The bearing floats in the hanger so as to align itself with the shaft. Set-screws equipped with lock-nuts permit bringing the bearing to the proper height and lateral position.

Bench Lathe: A. V. Carroll Machine Tool Co., Norwood, Cincinnati, Ohio. A bench lathe driven by motor through a countershaft supported by an extension cast on the bed. The swing over the bed is 10 inches, and the distance between centers 24 inches. The carriage is fed by means of a long screw at the front of the machine which is turned by a crank-handle at the right-hand end.

Heavy-lift Portable Crane: Elwell-Parker Electric Co., 4223 St. Clair Ave., Cleveland, Ohio. A heavy-lift portable crane which is similar in general design to a crane brought out by the same concern about a year ago. The new crane has a capacity for lifting loads of 3000 pounds at a six-foot reach and 1000-pound loads at an eight-foot reach. The boom is 12 feet long, but it may be quickly lowered to permit the crane to enter buildings.

Electric Grinder and Buffer: Columbia Mfg. Co., Belleville, Ill. A motor-driven buffer and grinder, which, when used as a grinder, is intended for sharpening tools and performing general light grinding. The motor is of 1/3 horsepower and operates at a speed of 1800 revolutions per minute. The machine is equipped with adjustable tool-rests and guards for the wheels, and wheels 8 inches in diameter, either 1- or 1¼-inches thick, are used. When the machine is employed for buffing purposes, the guards and other fittings are removed.

Metal-parts Washing Machine: Colts Patent Firearms Mfg. Co., Hartford, Conn. An automatic metal-parts washing machine consisting essentially of an endless belt conveyor combined with a washing apparatus. As the work travels on the conveyor it passes through two sets of sprays which operate on both sides and on the top and bottom of the work. The fluid is circulated by means of a pump. All parts which can be handled on racks are put through the machine in that manner, but comparatively large castings may be placed directly on the conveyor.

Automotive-parts Grinding Machine: Cincinnati Grinder Co., Cincinnati, Ohio. A grinding machine particularly designed for operation on crankshaft bearings, valve seats and stems, piston-rings, pins, and push-rods. The machine is made in two styles, one for power feed and the other for hand feed. The power-feed machine provides power traverse and automatic reverse for the table and an automatic in-feed for the grinding wheel. Two back-rests with wooden shoes and two crank-heads are furnished, while adapters provide for holding flanged end cranks.

Portable Power Hacksaw: Edlund Machinery Co., Inc., Cortland, N. Y. A portable power hacksaw for cutting both machine and tool steel. The saw is driven from a small motor, direct-connected through cut gears, current being obtained through an electric light socket. The cutting is done on the back stroke, the saw blade being automatically relieved on the forward stroke to reduce the wear and prolong the life of the blade. The feed is regulated by a weight which can be quickly adjusted to suit the work. When the saw arm is raised to enable work to be put in place, it is automatically held in position until released by the operator. The machine stops automatically when a cut is finished, and can be stopped and started at any time during a cut. Any standard 8-inch blade can be used.

* * *

NEW BOOK ON JIGS AND FIXTURES

JIG AND FIXTURE DESIGN. Edited by Franklin D. Jones. 325 pages, 6 by 9 inches; 297 illustrations. Published by THE INDUSTRIAL PRESS, 140-148 Lafayette St., New York City. Price, $3.

The development of machine tools has been accompanied by a corresponding development of auxiliary equipment for increasing the quantity and improving the quality of the products of these machines. Whenever duplicate parts require some operation such as drilling, planing, or milling, the selection of a suitable type of machine is often followed by the design of whatever special tools or attachments are needed to adapt the machine to the operation required. The tool-guiding and work-holding jigs and fixtures which are now used in practically all machine shops represent the most important class of special equipment, and this book deals exclusively with their design and construction.

As most jigs are used for drilling operations, a book was previously published by MACHINERY entitled "Drilling Practice and Jig Design," covering different types of drilling machines and their use, the design of drill jigs, and, to some extent, the design of fixtures such, for example, as are used on milling machines. While the subjects of drilling and jig design are closely allied, it is no longer possible to cover them both in a single volume, owing to the extensive changes in drilling practice and the increasing use of jigs and fixtures of various types on different classes of machine tools. Therefore, the book referred to has been replaced by two volumes, of which this is one. The other book, "Modern Drilling Practice," is already well known to those interested in the latest types of drilling machines.

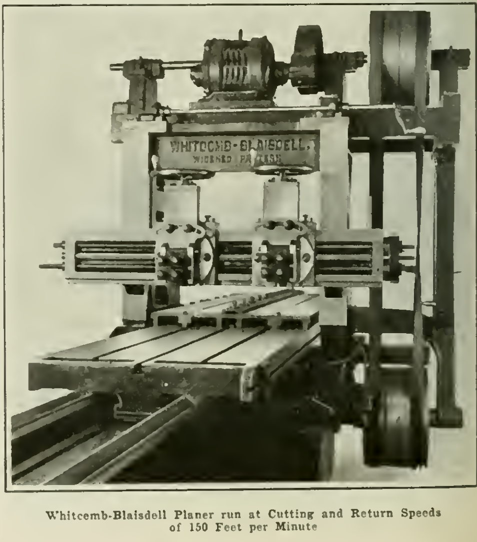
This new book, "Jig and Fixture Design," contains that part of the volume on "Drilling Practice and Jig Design" which dealt with jigs and fixtures. This material was used because it is a treatise on the principles of jig and fixture design which contains information that is indispensable in a book of this kind. These original chapters which explain the general procedure in designing jigs and fixtures and how work should be located, clamped, etc., have been supplemented by a large amount of new matter, thus making the present book a complete treatment of the subject. A great variety of jig and fixture designs have been described and illustrated in order to show just how the principles are applied under many different conditions.

* * *

PLANER OPERATED AT HIGH CUTTING AND RETURN SPEEDS

Brass screen plates are used extensively by paper mills in the manufacture of high-grade paper. In order to machine these screen plates at high rates of production the Whitcomb-Blaisdell Machine Tool Co., 677 Cambridge St., Worcester, Mass., has modified its 26-inch planer to operate at the high cutting and return speeds of 150 feet per minute. The machine is widened to 30 inches so as to permit the holding of work two abreast in a quick-acting fixture. The screen plates are 13 inches wide and 30 inches long. Two standard heads are supplied on the cross-rail, the minimum distance between the heads being 12 inches.

The driving mechanism of the machine is that supplied regularly on the 30-inch planer of this concern. Wider belts, heavier shafts, and larger gears are thus used. Excessive belt speeds and the momentum of the driving pulleys are reduced by increasing the diameter of one pinion and decreasing the diameter of its mating gear so as to lower the ratio. The satisfactory operation of this machine at the higher speeds, however, is mainly attributed to the second-belt drive employed on Whitcomb-Blaisdell planers.



Whitcomb-Blaisdell Planer run at Cutting and Return Speeds of 150 Feet per Minute

MACHINE TOOL MERGER UNCERTAIN

The proposed merger of a number of prominent machine tool manufacturers and one of the well-known dealers in machine tools, for which plans have been under way for several months, had not been effected when this form of MACHINERY went to press (March 27), and we were informed by one of the largest companies affected that there was still considerable uncertainty as to the outcome. The companies included in the list that has been published are: Lodge & Shipley Machine Tool Co., Cincinnati, Ohio; Newton Machine Tool Works, Inc., Philadelphia, Pa.; Hilles & Jones, Wilmington, Del.; Betts Machine Co., Rochester, N. Y.; Colburn Machine Tool Co., Cleveland, Ohio; Modern Tool Co., Erie, Pa.; Carlton Machine Tool Co., Cincinnati, Ohio; and Dale Machinery Co., Inc., New York City and Chicago.

The men who are expected to control the new combination, in case it is effected, are Waldo H. Marshall, formerly president, and C. K. Lassiter, vice-president of the American Locomotive Co.; J. Wallace Carrel, vice-president and general manager of the Lodge & Shipley Machine Tool Co.; Henry J. Bailey, president and general manager of Hilles & Jones; H. W. Champion, president and general manager of the Newton Machine Tool Works; H. W. Breckenridge, general manager and treasurer of the Colburn Machine Tool Co.; J. J. Dale, president, and Robert R. Lassiter, vice-president and secretary, of the Dale Machinery Co., Inc.; A. H. Ingle, president of the Betts Machine Co.; J. C. Carlton, president and general manager of the Carlton Machine Tool Co.

If the new corporation is formed, it will be one of the largest organizations in the machine tool field, manufacturing a comprehensive line for practically all purposes. It will be particularly strong in equipment for locomotive and railroad shops and shipyards.

* * *

GEAR MANUFACTURERS' MEETING

The sixth annual meeting of the American Gear Manufacturers' Association will be held April 20 to 22 at the Lafayette Hotel, Buffalo, N. Y. This association, through a sectional committee, closely cooperates with the American Engineering Standards Committee, and the report of this and other committees on standardization promises to be of unusual interest. Special emphasis will be given to business conditions in the gear industry and the outlook for the immediate future.

Among the subjects to be discussed are "Good Hob Practice," by H. E. Harris of the H. E. Harris Engineering Co., Bridgeport, Conn.; "The Use of the Projector Comparator in Testing Gear Teeth," by Ralph E. Flanders of the Jones & Lamson Machine Co., Springfield, Vt.; "Proportions of Industrial Gears," by G. E. Katzenmeyer, of the R. D. Nuttall Co., Pittsburg, Pa.; "The Grinding of Gear Teeth and its Future in the Industry," by R. S. Drummond, of the Gear Grinding Machine Co., Detroit, Mich.; "The Gleason Works System of Bevel Gears," by F. E. McMullen and T. M. Durkan of the Gleason Works, Rochester, N. Y.; and "Conditions in the Industry," discussed from the standpoint of the member companies under the leadership of George L. Markland, Jr., of the Philadelphia Gear Works, Philadelphia, Pa., and from the automotive standpoint with R. P. Johnson of the Warner Gear Co., Muncie, Ind., presiding. An informal banquet for representatives and guests will be held on Friday evening, April 21, at which the principal speaker will be John C. Bradley of the Pratt & Letchworth Co., Buffalo, N. Y., who will take as his subject "What's Ahead."

* * *

THE POETRY OF THE MACHINE SHOP

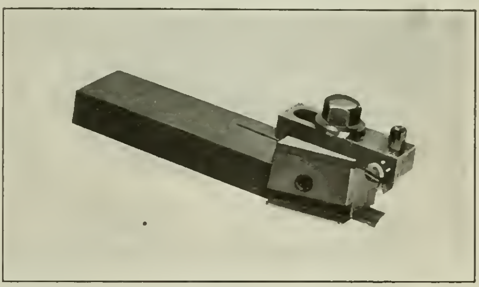
A collection of verse, the subject matter of which relates to science and engineering, is being compiled by Dr. C. E. Ruby, Box 130, Massachusetts Institute of Technology, Cambridge, Mass., who is desirous of obtaining copies or information relating to anything along these lines that has been published.

SCREW MACHINE CUTTING-OFF TOOL

By W. F. HONER

It occasionally happens that the limits on the over-all length of parts intended to be finished on automatic screw machines are much closer than is reasonably expected in the common run of commercial work. Of course, limits as close as plus or minus 0.001 inch can be maintained on such work in the ordinary manner if constant attention is given to the machines, but the improvised tool shown in the accompanying illustration will make the problem of handling this class of work much easier.

This tool was developed from a regular cutting-off toolholder with the cutting-off blade inserted. In making the holder, a hole is first drilled and tapped to receive an ordinary cap-screw, by means of which a suitable tool-holder is clamped to the upper surface of the cutting-off toolholder. The attached holder has a longitudinal slot in it to permit adjustment, and near its extreme outer end a lateral hole is bored to receive the cutting tool, which is held in place by the slotted set-screw. The slotted set-screw permits adjusting the tool so that the part to be operated upon will be cut off to the correct length.



Tool for cutting off Parts to Exact Length

As the cutting-off blade advances to the work, the newly attached facing tool, which is set to give the required overall length, trims or shaves off the outside face of the piece. No trouble was experienced by the operator of an Acme multiple-spindle automatic screw machine, in keeping the over-all length to within 0.001 inch on all work when this tool was used. The tool has proved very handy and practical.

* * *

OUTPUT OF AUTOMOBILE PLANTS

The seasonal demand is keeping many of the automobile plants well occupied. The March schedule of the Ford Motor Co. called for between 60,000 and 65,000 cars. The new Wills Sainte Claire Co. is said to have increased its output to 20 cars a day, while the Chandler shipments for March are expected to exceed 1000. The General Motors Corporation shipped twice as many cars in January and February as in the corresponding months a year ago. The Dodge plant is reported to be turning out between 2000 and 3000 cars a week, and Buick almost as many, while the Overland plant in Toledo is making between 200 and 300 cars a day. The Chevrolet plants are operating at 100 per cent capacity.

The Studebaker plants in South Bend and Detroit are working at full or nearly full capacity, the production schedule for the first three months of the year calling for 25,000 cars. The Hudson plant is also well occupied. Altogether, the General Motors Corporation is expected to turn out 60,000 cars during the first three months of 1922, compared with 24,000 for the same period last year. The leading automobile companies are unquestionably in a stronger position today than they have been at any time during the last eighteen months, but probably many of the smaller automobile organizations will pass out of existence.

PERSONALS

George J. Keller, formerly sales manager of the Frontier Chuck & Tool Co., Inc., Buffalo, N. Y., has joined the sales force of the Hannifin Mfg. Co., Chicago, Ill.

Ralph M. Sitterley has opened an office at 149 Broadway, New York City, to serve as foreign sales manager of American manufacturers of electrical specialties, marine supplies, automotive products and equipment.

J. Harvey Williams, president of J. H. Williams & Co., Brooklyn, N. Y., manufacturers of drop-forgings and drop-forged tools, has been elected president of the American Drop Forging Institute, and has been re-elected president of the Brooklyn Chamber of Commerce.

Charles B. Wilson, formerly vice-president in charge of operations of the Willys-Overland Co., Toledo, Ohio, has been made general manager of the Willys-Overland and associate companies. The executive offices in New York City are to be closed so that the entire time can be devoted to the Willys-Overland interests in Toledo.

E. M. Griffiths, the founder of Burton, Griffiths & Co., Ltd., of London, England, has resigned his position as managing director and chairman of that company, and has also retired from the board of directors of the Birmingham Small Arms Co., Ltd., so that he is no longer associated with the control of either company. His address is now 30-32 Ludgate Hill, London, E.C., England.

J. T. Slocomb, formerly with the J. T. Slocomb Co., of Providence, R. I., manufacturers of machinists' tools, who sold out his interest in that company and resigned his position as manager a year ago last June, has been devoting much of his time since then to the development of a steam pressure cooker for family use, which is made of monel metal and manufactured by the Economy Cooker Co., Providence, R. I.

Harry Fowler has been appointed district sales manager of the Cincinnati territory of the Carborundum Co., Niagara Falls, N. Y., succeeding Charles R. Cox. Mr. Fowler will take charge of the Cincinnati branch of the company, and will direct the sales force handling carborundum products throughout the Cincinnati district. Mr. Cox will be transferred to the main office at Niagara Falls, where he will take up his new duties on sales statistics.

W. C. Allen, formerly manager of the Philadelphia branch of the Black & Decker Mfg. Co., Towson Heights, Baltimore, Md., and subsequently special representative, has been made branch manager of the Chicago territory of the concern, which includes the states of Wisconsin, Illinois, Missouri, Iowa, Minnesota, and North Dakota. Mr. Allen has been connected with the company for about three years, and previous to that was assistant sales manager of the Manley Mfg. Co.

Julius S. Holl of the Link-Belt Co. was elected president of the Engineering Advertisers' Association at the annual meeting held at the Great Northern Hotel, Chicago, on March 14. The other officers elected at the meeting were as follows: Vice-president, J. B. Patterson, of the P. H. & F. M. Roots Co.; treasurer, C. H. Connell, Weller Mfg. Co.; and secretary, H. N. Baum, Celite Products Co. The members of the board of directors are E. W. Clark of the Clark Equipment Co.; A. K. Birch, Allis-Chalmers Mfg. Co.; Morris W. Lee, of Frank D. Chase, Inc.; and W. F. Leggett of the Chemical Engineering Catalogue Co., Inc.

Henry Harnischfeger and his wife are taking a combined business and pleasure trip around the world. Mr. Harnischfeger is one of the founders and the president of the Pawling & Harnischfeger Co., Milwaukee, Wis., manufacturer of cranes, hoists, monorail systems, horizontal drills, milling machines and all classes of gasoline-driven excavating machinery. They expect to go to Japan, the Philippines, China, Burma, Ceylon, India, and Europe. They will visit the various branch offices of the Associated Machinery Corporation, of which Mr. Harnischfeger is also president, with a view to looking over general business conditions and possibilities in the Far East, and also to determine upon the opening of new offices.

John McConnell has become affiliated with the United Alloy Steel Corporation of Canton, Ohio, in the capacity of vice-president in charge of operation. Mr. McConnell was previously associated with the company, in the early period of its existence, and contributed greatly to its success. He is an alloy steel expert, having been connected for ten years with the Carnegie Steel Co., for three years with the Bethlehem Steel Co. and for eleven years with the United Steel Co. (now the United Alloy Steel Corporation). He was also associated with the Central Steel Co. for one year as consulting metallurgist, and was vice-president in charge of alloy steel production with the Interstate Iron & Steel Co. for three years.

OBITUARIES

Joseph H. Shepherd, formerly mechanical engineer with the Blanchard Machine Co., Cambridge, Mass., died March 2 at his home in Needham Highlands, Mass.

John Lambert, first president of the American Steel & Wire Co., died at Pasadena, Cal., March 6, aged seventy-five years. Mr. Lambert was one of the organizers of the United States Steel Corporation.

Frank E. Cable, one of the organizers of the Porter-Cable Machine Co., Syracuse, N. Y., died in Newton Centre, Mass., on March 7. Mr. Cable was treasurer of this company until about two years ago, when he retired, moving to Nantucket, Mass., and later going to Newton Centre, where he made his home until his death.

Edward M. Barr, manager of the Chicago office of the Chisholm-Moore Mfg. Co., Cleveland, Ohio, died suddenly on March 15. Mr. Barr was born in Milwaukee, and lived there until he went into business about twenty years ago. He was the son of J. M. Barr, one of the pioneer railroad men in the West. His connection with the Chicago office of the Chisholm-Moore Mfg. Co. covered a period of eleven years, and he had a wide acquaintance among the trade in that district. His untimely death comes as a great shock, and his loss will be keenly felt by all those who knew him. He leaves a wife and one son.

James E. Greensmith, president of the Boston Scale & Machine Co. of Boston, Mass., died on March 8. He was born in Burton-on-Trent, England, where he was educated as a mechanical engineer. His early business experience was obtained in India, and he later came to this country to take charge of the Pond Machine Tool Co., which at that time was constructing a new factory in Plainfield, N. J. Mr. Greensmith supervised the construction and equipment of the plant, as well as the design and development of a new type of heavy gun turning and boring lathe which was later installed in the Watervliet Arsenal. Upon leaving the employ of the Pond Machine Tool Co. he became associated with the Portland Co. of Portland, Me., as superintendent, and later became superintendent of the Mason Machine Works, Taunton, Mass., which position he held for many years. For the last six years he has been president and general manager of the Boston Scale & Machine Co., manufacturer of electric weighing and recording scales, rotary grinders and special machinery. He was a member of the American Society of Mechanical Engineers and also of the Engineers Club of Boston.

* * *

WARNING AGAINST IMPOSTOR

The National Machine Tool Builders' Association has distributed the following letter throughout the machine tool industry in order to protect it from similar fraud. A New England member of the association wrote as follows:

On February 8, we were visited by a man who presented a card bearing the following inscription:

Member A. S. M. E.
Plant Engineer R. C. Cannon, M. E.
Pawling & Harnischfeger Co. Milwaukee, Wis.

As we have had business in the past with the above company, the bearer of the card was duly received as an accredited representative of Pawling & Harnischfeger. He claimed to be interested in behalf of his company in investigating other of our machines, and spent the entire day with us.

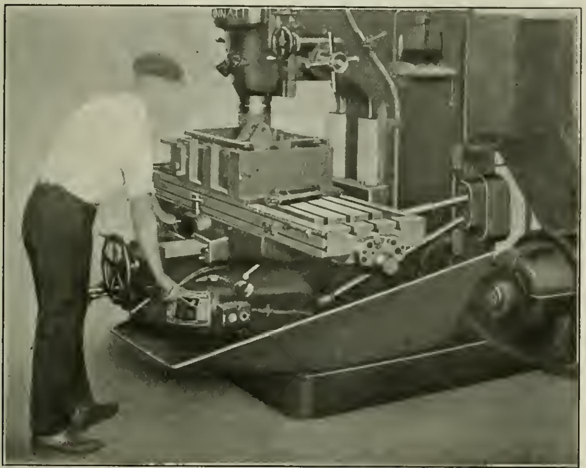
On his arrival, he informed us he had left a package of blueprints he had brought for our consideration on the train and in addition a wallet containing the most of his money, also important papers. He had, however, a certified check drawn on the West Allis Bank, West Allis, Wis., which we agreed to cash for him.

After his departure and at his request, we forwarded in his name to Pawling & Harnischfeger Co., circulars and other data relating to the matters he discussed with us. We have just received a letter from Pawling & Harnischfeger acknowledging receipt of the circulars and our letter addressed to R. C. Cannon, care of Pawling & Harnischfeger, from which it is evident that the man is an impostor. In addition, the certified check which we cashed is declared a forgery by the West Allis Bank and returned to us through our bank.

We thought it advisable to inform you at once regarding this matter, as you might, under the circumstances, wish to take some action in regard to placing other members on their guard against this party.

The same fraud has been heard of in Cincinnati, and members of the machine tool industry throughout the country should take warning.

PUT YOURSELF IN HIS PLACE! Wouldn't *you* be willing to hasten this job by changing the table direction 20 times—if you could do it by *merely moving a lever?*



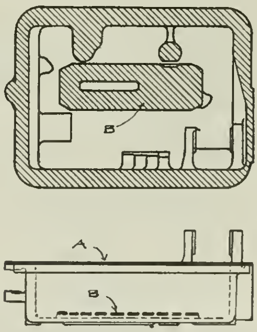
The No. 4 Cincinnati Vertical

The operator's hands are on the table quick traverse lever and the feed change lever. He uses the other two levers for cross and vertical feeds.

The operator on the No. 4 Cincinnati Vertical doesn't *have* to make all these changes. He *can* do the work with much less.

But he *does* make them because it is easy. He merely moves a lever. He doesn't change his position.

It requires very little effort and he saves time. Therefore he does it because it means more money for him. And for you it means greater production. He uses the table quick traverse (100 in. per minute) 3 times and changes feed 3 times, with the same ease and for the same reason.



The width of the flange varies end there are bosses. Time is saved by using a small mill and changing direction many times, because it is easy to change direction.

Are you missing all this by using old-fashioned Millers?

Tell us about your work and we will show what you can save.

The Cincinnati Milling Machine Co.

CINCINNATI, OHIO, U. S. A.

COMING EVENTS

April 7—Meeting of the New York Section of the American Society of Mechanical Inspectors at 29 W. 39th St., New York City. Secretary, H. M. Spitzenberg, 29 W. 39th St., New York City.

April 19-20—Annual meeting of the National Metal Trades Association in New York City; headquarters, Hotel Astor. Secretary, Homer D. Sayre, Peoples' Gas Bldg., Chicago, Ill.

April 20-22—Sixth annual convention of the American Gear Manufacturers' Association in Buffalo, N. Y.; headquarters, Lafayette Hotel. Secretary, F. D. Hamlin, 4401 Germantown Ave., Philadelphia, Pa.

April 21—Joint meeting of the Metropolitan Section of the Society of Automotive Engineers with the New England Section in New Haven, Conn. Secretary, C. F. Clarkson, 29 W. 39th St., New York City.

April 22-May 2—Sixth annual Swiss sample fair at Basle, Switzerland, in the Great Exhibition Bldg. For further information apply to F. Dossenbach, Director of the Official Information Bureau of Switzerland, 241 Fifth Ave., New York City.

April 24-26—Joint meeting of the American Supply and Machinery Manufacturers' Association and the Southern Supply and Machinery Dealers' Association at Birmingham, Ala.; headquarters, Tutweiler Hotel. Secretary, American Supply & Machinery Manufacturers' Association, F. D. Mitchell, 4106 Woolworth Bldg., New York City.

April 25-26—Spring convention of the National Machine Tool Builders' Association in Atlantic City, N. J.; headquarters, Hotel Traymore. General Manager, E. F. DuBrul, 817 Provident Bank Bldg., Cincinnati, Ohio.

April 26-28—Spring convention of the Society of Industrial Engineers in Detroit, Mich.; headquarters, Hotel Statler. Business Manager, George C. Dent, 327 S. La Salle St., Chicago, Ill.

May 8-10—Annual convention of the National Supply & Machinery Dealers' Association in Atlantic City, N. J.; headquarters, Marlborough-Blenheim Hotel. Secretary, Thomas A. Fernley, 505 Arch St., Philadelphia, Pa.

May 8-10—Twenty-seventh annual convention of the National Association of Manufacturers in New York City; headquarters, Waldorf-Astoria Hotel. General offices of the association, 50 Church St., New York City.

May 8-11—Spring meeting of the American Society of Mechanical Engineers in Atlanta, Ga. Assistant Secretary (Meetings), C. E. Davies, 29 W. 39th St., New York City.

May 10-12—Ninth National Foreign Trade Convention in Philadelphia, Pa. Secretary, O. K. Davis, 1 Hanover Square, New York City.

May 18-20—Annual conference of the National Association of Office Managers in Washington, D. C. Secretary, F. L. Rowland, Gilbert & Barker Mfg. Co., Springfield, Mass. Guests are invited to attend.

June 5-9—Annual convention and exhibit of the American Foundrymen's Association and allied societies in Rochester, N. Y. Secretary, C. E. Hoyt, Marquette Bldg., 140 S. Dearborn St., Chicago, Ill.

June 14-21—Annual meeting of the Mechanical Division of the American Railway Association in Atlantic City, N. J. Secretary, V. R. Hawthorne, 431 S. Dearborn St., Chicago, Ill.

June 15-24—International exhibition of foundry equipment and materials in Birmingham, England, in connection with the annual convention of the Institution of British Foundrymen.

June 20-24—Summer meeting of the Society of Automotive Engineers at White Sulphur Springs, W. Va. Chairman of Meetings Committee, C. F. Scott, 29 W. 39th St., New York City.

June 28-July 1—Twenty-fifth annual meeting of the American Society for Testing Materials in Atlantic City, N. J.; headquarters, Chalfonte-Haddon Hall Hotel. Secretary, C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

August 28-September 2—Annual Safety Congress of the National Safety Council in Detroit, Mich. Secretary, S. J. Williams, 168 N. Michigan Ave., Chicago, Ill.

The sectional meetings of the American Society of Mechanical Engineers for April are as follows: April 1—Oregon Section at the Oregon State Agricultural College, Corvallis, Ore. April 3—Syracuse Section at the Onondaga Hotel, Syracuse, N. Y. April 4—Eastern New York Section at Edison Hall, Schenectady, N. Y.

SOCIETIES, SCHOOLS AND COLLEGES

Melbourne Technical School, Melbourne, Australia. Prospectus of the Workingmen's College of the school for the year 1922, covering courses of study, tuition, and other related matters.

NEW BOOKS AND PAMPHLETS

Iowa Women in Industry. 73 pages, 6 by 9 inches. Published by the United States Department of Labor, Washington, D. C., as Bulletin No. 19 of the Women's Bureau.

Perpetual Inventory or Stores Control. 30 pages, 6 by 9 inches. Published by the Fabricated Production Department of the Chamber of Commerce of the United States, Mills Bldg., Washington, D. C.

The Production of Liquid Air on a Laboratory Scale. By J. W. Cook. 10 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Scientific Paper No. 419 of the Bureau of Standards. Price, 5 cents.

Method for Precision Test of Large-capacity Scales. By C. A. Briggs and E. D. Gordon. 16 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Technologic Paper No. 199 of the Bureau of Standards. Price, 5 cents.

Thermal Expansion of Nickel, Monel Metal, Stellite, Stainless Steel, and Aluminum. By Wilmer H. Souder and Peter Hidnert. 23 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Scientific Paper No. 426 of the Bureau of Standards. Price, 10 cents.

Effect of Heat-treatment on the Mechanical Properties of One Per Cent Carbon Steel. By H. J. French and W. George Johnson. 121 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Technologic Paper No. 206 of the Bureau of Standards. Price, 15 cents.

Weights and Measures. 132 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Miscellaneous Publication No. 48 of the Bureau of Standards. Price, 20 cents.

This pamphlet contains a report of the fourteenth annual conference on weights and measures of representatives from various states held at the Bureau of Standards in Washington, May 23 to 26, 1921.

Manual for Engineers. Compiled by Charles E. Ferris, Professor of Mechanical Engineering, University of Tennessee. 230 pages, 2¾ by 5¾ inches. Published by the University of Tennessee, Knoxville, Tenn. Price, 75 cents.

This little vest-pocket handbook for engineers and business men has reached its twenty-fourth edition. It contains about fifty tables considered to be of the greatest general use, including tables of areas and circumferences of circles; squares, cubes, square roots and cube roots; logarithms; sines, tangents, and secants; decimal conversion tables; weights of square and round bars; earthwork tables; wiring tables; interest tables, etc. The small size of this book makes it convenient to carry about for constant reference, but it has the disadvantage of making it necessary to use such small type that the figures in some cases are not very clear.

Mechanical World Electrical Pocket Book. 393 pages, 5 by 6¼ inches. Published by Emmott & Co., 65 King St., Manchester, England. Price, 2 s., net.

The 1922 edition of this little reference book has been enlarged considerably, and its scope has been extended to include a section on power station construction and operation. This contains considerable information of interest to those concerned with electric generating equipment. Another new section dealing with electric hoists contains much information on the construction and installation of such equipment. For the benefit of those not familiar with this book it may be stated that it represents a collection of electrical engineering notes and rules, as well as considerable tabular material, covering dynamos and motors, transmission conductors and cables, wiring systems and methods, lighting circuits and switching, electrical measurements and testing, electric lamps, telephones, small electric tools, electric welding, electric heating and cooking, etc.

Milling Cutters and Milling. 60 pages, 5 by 7½ inches. Published by the National Twist Drill & Tool Co., Detroit, Mich. Price, $1.

The purpose of this book is to present to those interested in the art of milling, data gathered by this company during a long period of intimate contact with milling work in its various branches, together with the results of extensive research work carried on at the University of Michigan within the last two years. The material should be of benefit to makers and users of milling cutters alike. The book contains fifteen chapters under the following headings: The Process of Milling; Milling Compared with Turning and Planing; Research Equipment; Rake; Clearance and Spiral; Shape of Teeth; Chip Space; Number of Teeth; Cutter Design and its Effect on Power Requirements; Feeds; Cutter Speeds; Lubrication and Cooling; the Milling Machine; its Relation to the Cutter; the Care of Milling Cutters; and Various Types of Milling Cutters and their Uses.

Burning Liquid Fuel. By William N. Best. 341 pages, 6 by 9 inches. Published by the U. P. C. Book Co., Inc., 243 W. 39th St., New York City. Price, $5, net.

It is generally recognized that the burning of liquid fuel is a science and that successful results can be obtained only by burning it scientifically. The information contained in this book is based on a study of over 42,000 burner installations, and the results should eliminate guesswork, and enable power plant owners to reduce their power costs considerably. The book gives comparative fuel costs, installation methods, ways of burning liquid fuel economically, and presents the results of a great number of tests and installations. The subject matter covers all forms of equipment for burning liquid fuels, giving information on the design and proper installation in each case. The equipment used in foundry practice, heat-treating furnace practice, forge-shop practice, and many diversified fields, is dealt with. Simple language is used so that the book will be readily understood by all.

Mechanical World Year Book. 348 pages, 4 by 6¼ inches. Published by Emmott & Co., Ltd., 65 King St., Manchester, England. Price 2s. 6d., net.

This well-known reference book is now in its thirty-fifth edition, and has been enlarged by the addition of twenty pages. The section on boiler construction has been largely rewritten, and a considerable amount of new matter has been added. A new section on pipes and tubes contains a concise collection of data on pipes of cast iron, wrought iron, steel, and copper, with many tables of dimensions, and particulars of flanged bends and tees, expansion bends, etc. The tables on the thermal properties of solids, liquids, and gases which appeared in a former issue have been restored by request, as have also the tables of weights of hexagonal and octagonal bars. A table giving the weights of fillets is also included. Many other sections of the book have been revised, and a number of new illustrations have been introduced. One of the valuable regular features of the book is the classified buyers' directory which is published in four languages—English, French, Russian, and Spanish.

Jigs and Fixtures. By Albert A. Dowd and Frank W. Curtis. 293 pages, 6 by 9 inches; 232 illustrations. Published by the McGraw-Hill Book Co., Inc., New York City. Price, $3.

This is the first of a series of three books covering the subject of tool engineering. This volume deals with the design of jigs and fixtures. It covers the important points connected with the design, compares different methods, and takes up principles of design and their application. A large number of diagrams are included to illustrate the principles involved. In this book the aim has been to deal chiefly with fundamental principles, rather than with specific designs, so that the designer can analyze his own peculiar problems and apply the principles set forth to the case under consideration. The subject matter is divided into eleven chapters under the following headings: Outline of Tool Engineering; Fundamental Points in Drill Jig Design; Details of Drill Jig Construction; Open and Closed Jigs; Indexing and Trunnion Jigs; Details of Milling Fixture Construction; Design of Milling Fixtures; Design of Profiling Fixtures; Vise Jaws and Vise Fixtures; Broaches and Broaching Fixtures; and Design of Riveting Fixtures.

Electric Arc Welding. By E. Wanamaker and H. R. Pennington. 254 pages, 6 by 9 inches. Published by the Simmons-Boardman Publishing Co., Woolworth Bldg., New York City. Price, $4.

The authors of this work have not attempted to cover the electric welding art in its broadest sense, but have confined the treatment exclusively to autogenous electric arc welding. The phenomena of the welding arc and the metallurgy of welding are in such a state of development that the authors' information has been limited to the research which has come under their observation. The effort has been made to present information that is most in demand for practical purposes. The material is conveniently arranged for ready reference. The book treats of many phases of the application of the art and covers descriptions of welding systems and their installation, phenomena of the metallic and carbon welding arc, training of operators, sequence of metal disposition for various types of joints and building up operations, electrode materials used, weldability of various metals, weld composition, thermal disturbances of parts affected by the welding process, physical properties of completed welds, efficiency of welding equipments expressed in pounds of metal used or deposited per kilowatt hour, welding cost, etc.

Materials of Construction. By the late Adelbert P. Mills. Second edition, edited by Harrison W. Hayward, Professor of Materials of Engineering, Massachusetts Institute of Technology. 476 pages, 6 by 9 inches. Published by John Wiley & Sons, Inc., 432 Fourth Ave., New York City. Price, $4.

This is the second edition of an original work prepared by the late Professor Mills of Cornell University. No attempt has been made to change the original fundamentally, but in the new edition certain chapters have been condensed, parts of others have been rewritten, and several new chapters have been added. The book has also been divided into sections. The original work was prepared to meet the need for a general textbook covering the manufacture, properties, and uses of the more common materials of engineering construction. The treatment of the various classes of materials considered follows a general systematic form which has been made uniform throughout as far as practicable. The consideration of each material or class of materials is prefaced by a discussion of its ordinary applications in engineering construction, followed by a study of its manufacture or natural occurrence, and concluded by a discussion of physical and mechanical properties in their relation to its uses. Whenever possible the data has been presented

Two handles may be better than one on a wash tub or a trunk, but not on a machine tool when one handle will do as well.

And when one handle will do BETTER than two or more, the advantage is great; on the

"PRECISION"

BORING, DRILLING AND MILLING MACHINE

one handle starts *any* feed previously selected and arranged for, so that the operator *cannot* inadvertently start a feed that is not wanted

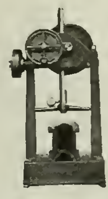
AND THAT IS NOT ALL!

The *same* handle throws in the *constant speed quick return* motion to whichever feed is in use, and

FURTHER;

The quick return is *always* in the *opposite direction,* so that the cutting tool *cannot* be thoughtlessly jammed into the work, giving *increased efficiency* from the *simplicity.*

The accuracy of the "Precision" has been well known for 20 years and certainly will not be neglected now or ever.



WE ALSO MAKE THE

LUCAS POWER

Forcing Press

LUCAS MACHINE TOOL CO. NOW AND ALWAYS OF **CLEVELAND, OHIO, U.S.A.**

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry. Societe Anonyme Belge, Alfred Herbert, Brussels. Aux Forges de Vulcain, Paris. Allied Machinery Co., Turin, Barcelona, Zurich. Benson Bros., Sydney, Melbourne. V. Lowener, Copenhagen, Christiania, Stockholm. R. S. Stokvis & Zonen, Rotterdam. Andrews & George Co., Tokyo, Japan.

graphically by curves or diagrams. The materials covered are as follows: Plaster, lime, natural cement; Portland cement and concrete; stone; bricks and other clay products; ferrous metals; non-ferrous metals and alloys; timber; rope; and mechanical fabrics.

NEW CATALOGUES AND CIRCULARS

Electric Controller & Mfg. Co., Cleveland, Ohio. Bulletin 1031-A, descriptive of E. C. & M., Type DR drum controllers for direct-current and alternating-current motors.

H. Gerstner & Sons, 53-63 Columbia St., Dayton, Ohio. Catalogue 22, containing specifications for the different sizes and styles of tool cases and chests made by this concern.

Kales Stamping Co., 1659 W. Lafayette Blvd., Detroit, Mich. Circular containing a list of sizes of special washers, of any gage or any material, for which the company has dies.

Wagner Electric Mfg. Co., St. Louis, Mo. Circulars outlining the main features of the Wagner "Pow-R-full" polyphase motor. Attention is called especially to the rigidity of construction.

New Departure Mfg. Co., Bristol, Conn. Loose-leaf sheets 143 FE and 144 FE, illustrating the application of New Departure single- and double-row ball bearings in metal spraying pistols and in mixing machine heads.

Deschanel Engineering Corporation, 90 West St., New York City. Bulletin descriptive of the Deschanel single-line cableway for handling coal and other materials, when unloading from railroad cars or barges into storage.

Surface Combustion Co., 362 Gerard Ave., Bronx, New York City, announces that it now has ready for distribution Bulletin 3D on Surface Combustion low-pressure air-gas inspirators, which are so designed that they may be readily applied to any make of gas furnace.

John Steptoe Co., Cincinnati, Ohio. Catalogue covering the Steptoe line of shapers, milling machines, and engine lathes. Specifications are given for the 14-, 16-, 20-, and 24-inch crank shapers, the No. 0 hand and power feed milling machines, and the 14-, 16-, 18-, and 20-inch lathes.

Technical Advisory Corporation, 132 Nassau St., New York City. Pamphlet outlining the activities of the concern, which cover service to manufacturers, bankers, and public utilities, research and development work, appraisals, the development of foreign trade, and industrial surveys.

Hamblin Tool Mfg. Co., Inc., 42 Mechanic St., Newark, N. J. Circular entitled "The Wrench that Grips and Never Slips," illustrating the use of the Hamblin reversible chain pipe wrench, which has a cam action permitting it to be reversed instantly without detaching the chain.

Black & Decker Mfg. Co., Towson Heights, Baltimore, Md. Miniature catalogue containing illustrations, specifications, and prices of Black & Decker portable electric drills, electric screw-drivers and socket wrenches, electric grinders, safety cleaning machines, and electric valve grinders.

Oliver Machinery Co., Grand Rapids, Mich. Bulletin 5, containing information on the care of circular sawing machines of the type used in woodworking plants and pattern shops. The catalogue illustrates a number of different styles and sizes of these machines. Copies will be sent to those interested upon request.

Whiting Corporation, Harvey, Ill. Circular illustrating the equipment made by this concern, which includes cranes, foundry equipment, trolley systems, hoists, transfer tables, etc. This company is also issuing to the trade a desk calendar card covering the last three months of 1921, the year 1922, and the first three months of 1923.

Foxboro Co., Inc., Foxboro, Mass. Pamphlet entitled "How Far Can You Read It?" devoted to Foxboro dial type thermometers, which are designed to give a maximum degree of visibility, the indicator having a dull black ground and white figures. These thermometers are made entirely of metal, there being no glass tubes to break.

Air Reduction Sales Co., 342 Madison Ave., New York City. Leaflet descriptive of the "Airco" D cutting torch, covering the features of design and construction, and containing tables showing the thicknesses of metals that can be cut, pressures of oxygen and acetylene necessary, and the gas consumption in cubic feet per hour when using tips adapted to the cutting of steel, cast iron, or rivets.

Wodack Electric Tool Corporation, 23-27 S. Jefferson St., Chicago, Ill. Bulletin 908, describing the Wodack combination portable electric drill and grinder, which is designed to fill the needs of shops and factories where drilling and grinding operations are performed but where there is not enough work of this kind to warrant the purchase of two separate machines. Complete specifications are given, including price.

Madison Mfg. Co., Spring and Elton Sts., Muskegon, Mich. Circular illustrating and describing Madison adjustable boring heads for rough- or finish-boring, made in sizes from 2¼ to 8 inches in diameter; adjustable boring cutters and bars for finish-boring; and counterbores equipped with cutters that are made to work both ways, so they can be used for front or back facing. In addition to the general description, complete price lists are given for the various sizes.

Ingersoll Milling Machine Co., Rockford, Ill. Circular illustrating Ingersoll milling machines, equipped with Ingersoll fixtures and cutters, for use in railway shop work and ordinary production work. The fixtures are shown applied to continuous rotary milling machines, heavy-duty adjustable-rail milling machines, fixed-rail reciprocating machines, horizontal-spindle milling machines, drum-type continuous milling machines, reciprocating continuous milling machines and multiple-spindle fixed-rail milling machines.

American Machine Products Co., Detroit, Mich. Circular illustrating "Ampco" Critchley improved adjustable reamers and Simplex gages for adjusting these reamers to the correct size for reaming the different sizes of bushings in Ford automobiles. In applying the gages, it is merely necessary to select a gage of the same size as the bushing to be reamed, place the reamer in a vise, and put the ring, or gage, over the reamer, after which the blades are adjusted until the ring is a snug fit on the tool. The adjustment by this method is said to require only five minutes, as compared with thirty minutes when adjusting with a micrometer. The reamers and gages are supplied in sets of different sizes. They are marked with corresponding letters, so that the gage to use with a reamer for a certain size bushing can be readily determined. The circular gives full particulars, including dimensions, prices, etc., for the sets, as well as for single tools.

TRADE NOTES

Gropler Bros., representatives of manufacturers of metal-cutting tools, are now located at 16-22 Hudson St., New York City.

Monarch Machine Tool Co., 209 Oak St., Sidney, Ohio, announces that it has made a reduction of 10 per cent in the price of Monarch lathes.

G. A. Ball Bearing Mfg. Co. has moved into a new factory at 3305-3335 W. Harrison St., Chicago, Ill. The building is of one-story, saw tooth construction.

Taft-Peirce Mfg. Co., Woonsocket, R. I., has moved its Detroit office from 1311 Majestic Bldg. to 2230 First National Bank Bldg. William Fairhurst is manager of the Detroit office.

Toledo Tap & Die Co., Toledo, Ohio, manufacturer of taps and dies, announces that it has opened a Cleveland office at 716 Superior Ave., N. W., and a Pittsburg office at 631 Fulton Bldg.

Chicago Flexible Shaft Co., 1154 S. Central Ave., Chicago, Ill., has moved its St. Louis office, which handles the sale of Stewart industrial furnaces, from the Railway Exchange Bldg. to 420 Wainwright Bldg.

Seneca Falls Mfg. Co., Inc., Seneca Falls, N. Y., at its annual meeting of stockholders in February re-elected Ogden R. Adams, president and general manager of the company. An entirely new board of directors was also elected.

Black & Decker Mfg. Co., Towson Heights, Baltimore, Md., has moved its Cleveland office from 6225 Carnegie Ave., to 2030 E. 22nd St. This office is in charge of Dan Paul, former manager of the Pittsburg office of the company.

Massachusetts Gear & Tool Co., 30 Nashua St., Woburn, Mass., has purchased the business of the Woburn Gear Works. The company will specialize in accurately cut small and medium size gears and sprockets of all types and of all materials.

Russell Mfg. Co., Greenfield, Mass., has appointed the **A. Z. Boyd Co.**, 126 Chambers St., New York City, as the New York agent for the sale of the Russell line of screw plates. The A. Z. Boyd Co. has had wide experience in the past in selling tools of this kind.

Tool Sales Co. announces that it is now located in the Hudson-Reade Building, New York City. This company sells tools and specialties to the hardware and automobile supply trade, and is in a position to render sales service in the Metropolitan District to manufacturers who are in need of such services.

Williams, White & Co., Moline, Ill., have taken over the Osterholm automatic surface grinding machine formerly made by the Osterholm Automatic Machine Co. of Chicago. In the future this machine will be manufactured in the Williams, White & Co.'s plant in Moline. This machine was described in the technical press about six months ago.

Colonial Steel Co., Pittsburg, Pa., has purchased a lot in Cleveland, Ohio, at 2121 St. Clair Ave., and is now having plans drawn and will begin at once the erection of a brick warehouse to be used for the storage and sale of Colonial steel. This warehouse will also be equipped with furnaces for heat-treating steel with a view to assisting customers in working out problems of this kind.

Eastern Machine Screw Corporation, 23-43 Barclay St., New Haven, Conn., manufacturer of H & G automatic die-heads, collapsible taps, and screw machine products, announces that its die-head works are now operating five days a week and ten hours a day. The business of the company has shown a decided improvement during the months of January and February.

Diamant Tool & Mfg. Co., Inc., 95 Runyon St., Newark, N. J., has appointed the **McMullen Machinery Co.**, 64-66 Ionia Ave., Grand Rapids, Mich., its exclusive representative in connection with the sale of Diamant standard punch and die sets in the territory covered by the northern and the southern peninsulas of Michigan, west of the counties of Bay, Saginaw, Shiawassee, Ingham, Jackson, and Hillsdale.

Shepard Electric Crane & Hoist Co., Montour Falls, N. Y., announces that its New York and Philadelphia territories have been consolidated under the management of Mr. Gledhill, with headquarters at the New York office, 30 Church St. Although the Philadelphia office has been closed, the number of sales engineers in that territory, as well as in the New York territory, has been increased so that closer personal contact can be maintained with concerns in these sections.

Kendell Engineering Co., 12 North American Bldg., Fort Wayne, Ind., manufacturer of Kendell piston-rings, announces that it has made definite plans for expansion, having incorporated under the state laws of Indiana and now being known as the Kendell Engineering Corporation. The construction of a new plant is to begin at once. The officers of the company remain the same as before, namely, C. A. Kendell, president; Robert L. Kendell, vice-president and sales director; and M. W. Cartwright, secretary and treasurer.

C. H. Wood Co., 214 W. Jefferson St., Syracuse N. Y., wholesale dealer in machinery, tools, factory supplies and equipment, has changed ownership, the interest of Charles H. Wood having been purchased by Wilton R. Olds, George E. Ingraham and A. J. Littlejohn. Mr. Olds has been elected president and general manager of the company; Mr. Littlejohn, vice-president, and Mr. Ingraham, secretary and treasurer. Mr. Littlejohn is also secretary of the Meldrum-Gabrielson Corporation, and will continue his activities with that firm.

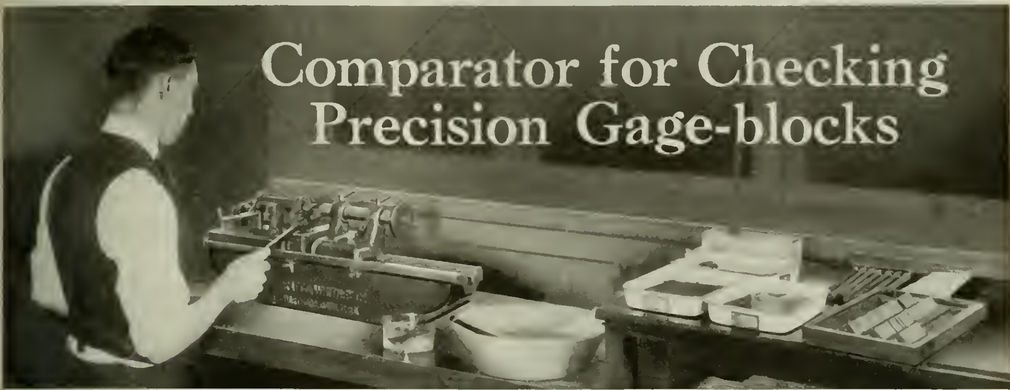
Medart Patent Pulley Co., St. Louis, Mo., manufacturer of power transmission machinery, has changed its name to the **Medart Co.** The change was made because of the fact that the former name gave an erroneous idea of the extent of the line carried by the company, which includes, besides cast-iron and wood-pulleys, friction clutches, rope drives, gears, sprockets, hangers and bearings of all kinds, turned and polished steel shafting, as well as machines for turning, polishing, and straightening shafting, and other special machinery and equipment.

Air Reduction Sales Co., 342 Madison Ave., New York City, and the Davis-Bournonville Co., Jersey City, N. J., have been amalgamated. The arrangement will make the combined sales and service facilities of both companies available to users of oxy-acetylene equipment. The firm will continue to make the "Airco" products, which include oxygen, acetylene, welding and cutting apparatus and supplies, acetylene generators, carbide, nitrogen, and argon, as well as the Davis-Bournonville welding and cutting apparatus, including the oxygraph, radiagraph, tube-welding equipment and other special devices.

Greenfield Tap & Die Corporation, Greenfield, Mass., has compiled a comprehensive telegraph and cable code for the benefit of its customers. The code was originally intended for overseas customers, but it is equally suitable for domestic concerns, and will enable cable and telegraph expense to be materially reduced. The technical nature of the company's products, which include screw plates, taps and dies, drills, reamers, gages, and machine tools makes it difficult to describe them by any standard code, and the five-letter code compiled by the company enables these products to be ordered by wire at the minimum of expense. The code is included in the new 46-A catalogue which has just been issued by the company. Copies will be sent upon request.

Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., has made a number of changes in personnel. The new appointments are as follows: R. L. Rathbone, branch manager of the Cleveland office, will take up special duties in connection with merchandising matters, with headquarters in Cleveland; J. Andrews, Jr., manager of the industrial division of the Pittsburg office, has been appointed manager of the Cleveland office, and will be succeeded by C. D. Taylor in the Pittsburg office; W. R. Keagy has been appointed office manager of the Cincinnati office; J. R. Deering has been made office manager of the Los Angeles office; and R. Seybold has been appointed manager of price statistics, and will also act as secretary of the domestic sales committee.

Whiting Corporation, Harvey, Ill., manufacturer of electric traveling cranes and foundry equipment, has established a branch sales office in New York City at 130 Liberty St., having discontinued its agency agreement with the Wonham, Bates & Goode Trading Corporation, who formerly represented the company in the East. J. Ross Bates, one of the vice-presidents of the Whiting Corporation, is in charge of the new office. He will be assisted in the New York territory by D. Polderman, Jr., and in the New England states by R. O. Maley, who will open an office at Springfield, Mass. A branch office has also been opened in Indianapolis, Ind., at 305 Merchants Bank Bldg., in charge of S. E. Stout, who was formerly located at the main office in Harvey. Mr. Stout will cover southern Indiana and adjoining cities in Ohio and Kentucky. The Detroit office of the company has been moved from Penobscot Bldg. to 206 Stahelin Bldg., 3000 Grand River Ave.



Comparator for Checking Precision Gage-blocks

An Extremely Sensitive Mechanical Apparatus, which has Proved Very Effective at the Plant of the Pratt & Whitney Co., for Testing the Accuracy of Precision Gage-blocks

By FRANKLIN D. JONES

CHECKING the sizes of precision gage-blocks in connection with their manufacture must necessarily be by comparison with a master block or standard of known accuracy, because a comparative test can be made quickly and is entirely reliable when all necessary precautions are taken. At the plant of the Pratt & Whitney Co., Hartford, Conn., the accuracy of the precision gage-blocks manufactured and of the working and primary standards is maintained by three different methods of testing, which are so related as to insure a uniform degree of precision, approaching very close to absolute perfection.

First, there is the well-known optical test employed to check the sizes in connection with the mechanical lapping of the commercial gage-blocks. This simple test, which requires the use of optical flats, or exceedingly accurate glass planes, has already been described in MACHINERY, and will not be considered further (see April, 1920, MACHINERY, page 705). This optical test, which is relatively accurate and quickly made, serves to compare the commercial gage-block with a working master.

The optical test has these disadvantages: (1) Its accuracy is plus or minus three-millionths inch, and a whole interferometer band may easily be missed, introducing an additional error of ten-millionths inch. (2) The gage-blocks must be handled in wringing, so that the operator may not have the block at temperature when the reading is taken. (3) It is an optical and not a contact measurement, and the condition of the block surface as regards polish may give an incorrect reading. This reading will be correct optically for the block, and yet it will not be correct for its contact value when the gage is placed in a stack with other blocks.

Making precision gage-blocks on a commercial basis requires an extremely accurate, dependable, and fairly rapid method of checking the truth of gage surfaces and their dimensions. The "millionth comparator" here described meets these exacting requirements by providing a mechanical test, which follows the well-known optical test and serves as an additional safeguard against errors. The master gages or primary standards used for this comparative test, are measured by means of an interferometer in which light waves are utilized as the ultimate standard either for originating or checking dimensions with the greatest possible degree of accuracy.

To safeguard against the probabilities referred to, a "millionth comparator" is used to check against masters. This comparator has no intrinsic temperature or band errors. The masters are not checked in the comparator except when a block gives two plausible readings in the interferometer described later. Then the masters are stacked against others which have given no trouble, and one of the two readings is selected, which checks with the observation in the comparator. The comparator is used to check every commercial block which will pass the optical test. This check can be further augmented by a test made at the Bureau of Standards, if it is desired.

Measurement of the Primary Standards

Now all blocks tested by the comparator are compared directly with primary standards, measured by the most precise method known. A bare outline of this method, which is too complex to be described fully here, will be given before considering the comparator.

While master gages or standards for checking other gages by direct comparison may also have been subjected to some purely comparative test, it is evident that there must be a fundamental method of measuring the primary standard. There is no intermediate master between the super-master and the commercial block. Every batch of blocks made is measured against a master which has been read in the interferometer just previous to the beginning of the job; thus a master may be read many times in its life. Such refinement is unnecessary in most

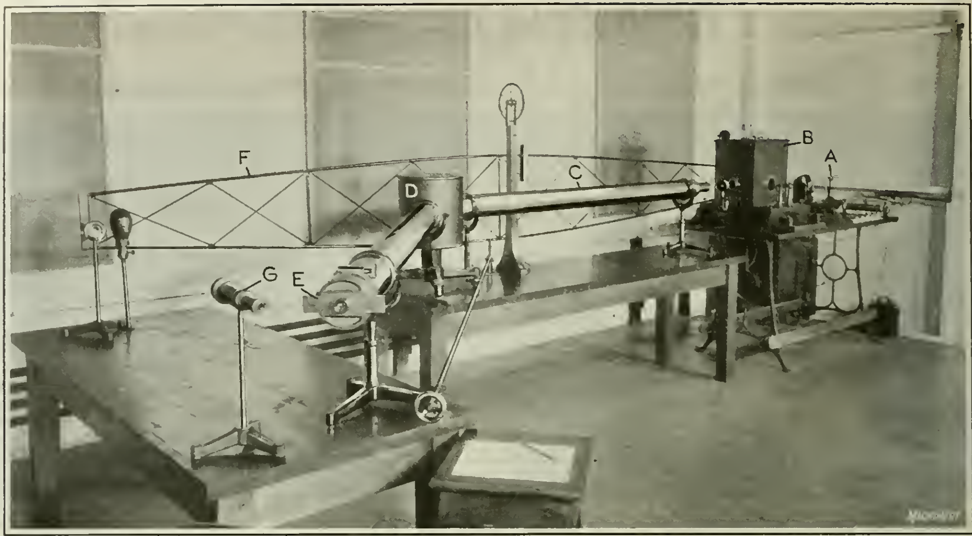


Fig. 1. Fabry & Perot Interferometer used by the Pratt & Whitney Co., for calibrating or measuring Primary Standards

cases, since successive readings check, but it is worth while because the method is absolutely safe. When one of these primary standards requires measuring either to determine the dimension of a new one or to check the size of an old one, this fundamental measurement is made by the interferometer. The use of this optical apparatus is a scientific undertaking, requiring considerable time and involving complex calculations. For this reason all commercial methods of checking accuracy must be comparative, and the taking of fundamental measurements is necessarily confined to the basic or primary standards, such as are used to a very limited extent for checking working masters, where the greatest possible degree of accuracy is required.

Use of the Interferometer

The interferometer used by the Pratt & Whitney Co. is shown in Figs. 1 and 2. This apparatus, which is one of the few in existence, is used to assist in determining the number of light waves of known wave length (or color) which at a given instant are between two planes coinciding with the opposite faces of a gage-block or whatever part is to be measured. When this number is known, the thickness can be computed because the lengths of the light waves used have been determined with almost absolute precision. The light, therefore, becomes a scale with divisions—approximately two hundred-thousandths inch apart.

The block to be measured is placed between two glass planes of great accuracy, which have previously been wrung into perfect contact, so that each plane extends beyond the block on one side. Thus the block is measured optically by contact and not by reflection from the gage surface itself. The character of the surface is likely to affect the latter reading, and the degree of polish cannot affect the first method, since the light does not strike the surface. The projecting ends of the glass planes are covered by an exceedingly thin transparent film of gold about one-half millionth inch thick, to increase the reflecting power. The planes with the block between them are secured to a suitable holder, which

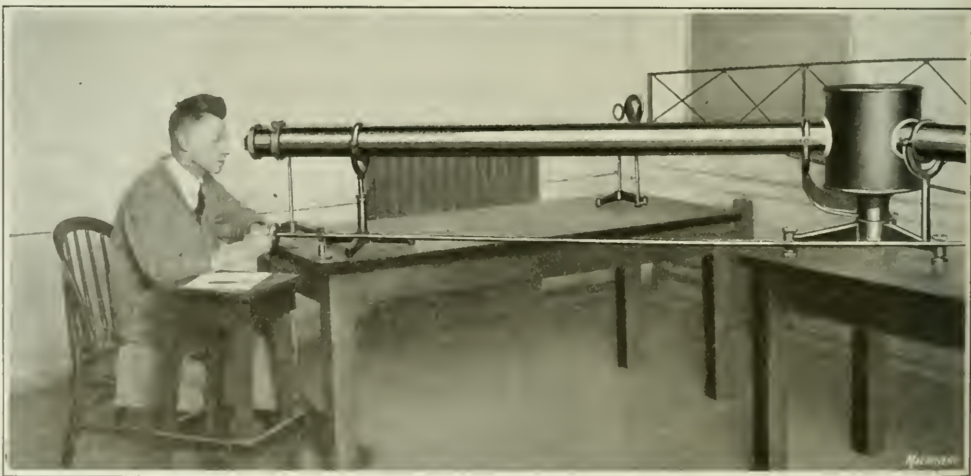


Fig. 2. Taking a Reading with the Interferometer which makes it Possible to use Light as a Scale, with Divisions approximately Two Hundred-thousandths Inch Apart, for measuring Reference Standards

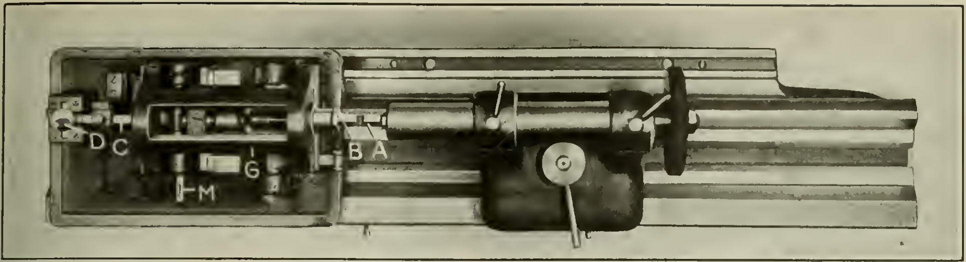


Fig. 3. Plan View of Comparator used for checking Precision Gage-blocks

is inserted in box *B*, Fig. 1, through an opening in the side. A constant temperature is maintained inside of this box by circulating oil through a series of coils and by means of a thermostat in conjunction with an electrical heating unit which serves automatically to maintain the temperature within very close limits.

The standard wave lengths used are those emitted by glowing Neon gas under electric discharge. These wave lengths have been calibrated against the Michelson-Benoit standard by Meggers and Peters of the Bureau of Standards to an accuracy of one part in four millions. It has been found to be a satisfactory and constant reference standard under easily reproducible physical conditions. The Neon light is located at *A*. Light waves from this source enter through a lens and suitable opening into box *B*, pass through the projecting ends of the glass planes referred to, and then through another lens and tube *C* to a prism or spectroscope located within the cylindrical box *D*. The light is refracted, and the rays of different lengths separated by this prism so that they can be observed through the telescope at *E*. The holder carrying the glass planes and block to be measured is attached to and turns with a long protractor arm *F* of light tubular construction. At the outer end of this arm there is a scale indicating angular movements, and this is enlarged by the telescope *G* at the observing end of the apparatus. The angular position of the protractor arm and of the glass planes is regulated by turning a handwheel (see Fig. 2) which transmits motion to the arm through suitable shafting and gearing.

Now at certain angular positions of the glass planes the phenomenon of light interference occurs. These angles, which vary for different light rays, are noted by taking readings on the scale seen through telescope *G*. When several of these angular values are known, in addition to the lengths of the different light waves, the required distance between the two planes is determined mathematically by a process of elimination carried on until the true value is obtained, as proved by the fact that it is the only value that satisfies an equation containing the other known values. When the number of waves is found (within a small fraction of a wave) it is multiplied by the known wave length, and the product is the absolute length of the block. This gage is now a master, or primary standard, and may be confidently used to calibrate commercial gage-blocks.

Before a measurement can be taken, the block must be left in box *B* until it has acquired the same temperature. Also, considerable time is needed for the various adjustments, readings, and calculations, so that the measurement of four blocks would require ordinarily an entire day. The extreme degree of precision which it is possible to attain by the interferometer method is indicated by the fact that measurements by Mr. Mueller of the Pratt & Whitney Co., have checked within one-millionth inch with measurements of the same gage-blocks made by Mr. Peters at the Bureau of Standards, each measurement being made independently on different types of interferometers.

General Arrangement of Comparator and Method of Using

When the comparator is used to compare the accuracy of a gage-block with a primary standard, the latter is first placed between the parallel surfaces of the fixed anvil *A*, Figs. 3 and 4, and the movable anvil *B*. The apparatus is then adjusted until a zero reading is obtained. The block to be checked is next placed between the gaging ends and any difference in reading is noted. The slightest change in the position of the movable spindle is transmitted through the multiplying lever *C* to a small and slightly concave mirror *D*. When this mirror is tilted, a V-shaped shadow obtained from light *E*, Fig. 5, which passes through a lens at *H* partly obstructed by a V-shaped projection, is reflected from *D* (Fig. 4) up to mirror *F* and then down to a scale located on the wooden case which encloses the comparator as shown in Fig. 6. The slightest movement of mirror *D* causes the image of the V-shaped projection to move rela-

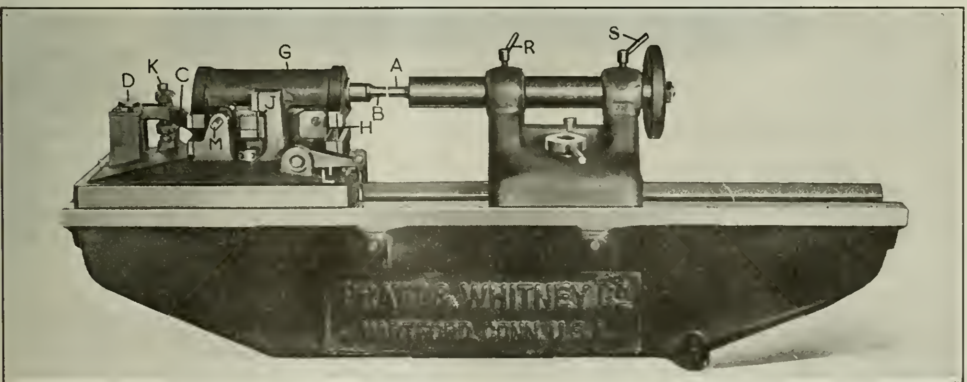


Fig. 4. Side View of Comparator which by using a Light Beam as a Lever multiplies the Movements of its Anvil 20,000 Times

tive to the zero position on the scale, thus indicating the error.

The comparator is so sensitive that a variation of even one-millionth inch causes a perceptible movement of the reflected shadow, and this sensitiveness can be increased readily by simply elevating the upper reflecting mirror and refocusing. With the two mirrors 2½ meters apart, the movements of the gaging anvil are multiplied 20,000 times, and because of this extreme sensitiveness the mechanical part of the apparatus must be enclosed when in use, since the temperature of the body causes changes that interfere with the accuracy of the test. While this comparator was built by the Pratt & Whitney Co., it is based upon a design furnished by the National Physical Laboratory of England and is one more indication of the value of this scientific organization which, like our own Bureau of Standards, has contributed so much toward scientific research and the development of apparatus for industrial uses.

One of the remarkable features of the comparator is its "dead-beat" action. There are no perceptible oscillations of the indicating shadow relative to the scale, or movements which must be allowed to die out before a reading can be taken. If the shadow is suddenly deflected from the zero position, as by lightly striking the table supporting the mechanism, the movement back to the zero point is instantaneous and without repeated vibrations. This dead-beat quality is due to the unusual method of providing for the necessary movements of the spindle frame and multiplying lever, without introducing the slightest radial or other play, such as would occur in some degree in any ordinary form of bearing.

The head or frame G (see Figs. 3 and 4) carrying the movable anvil is supported at each end by steel ribbons or thin plates about 0.003 inch thick. There is one ribbon H extending across the front, and two ribbons at the opposite end with a space between, through which multiplying lever C passes. These ribbons allow a slight lengthwise movement, but anvil B always occupies parallel positions. Any movement of the frame carrying B is transmitted to lever C, which has as the axis of its fulcrum the intersection of vertical ribbons J (located at each side of the lever) with horizontal ribbons adjacent to the vertical ribbons. These ribbons, which are about 0.004 inch thick, provide an exceedingly accurate fulcrum, and eliminate all radial, lateral, or angular play, because they form a cross and permit a turning movement about the intersection of the horizontal and vertical ribbons, but are sufficiently rigid to resist any movement except a turning of lever C about this axis of intersection.

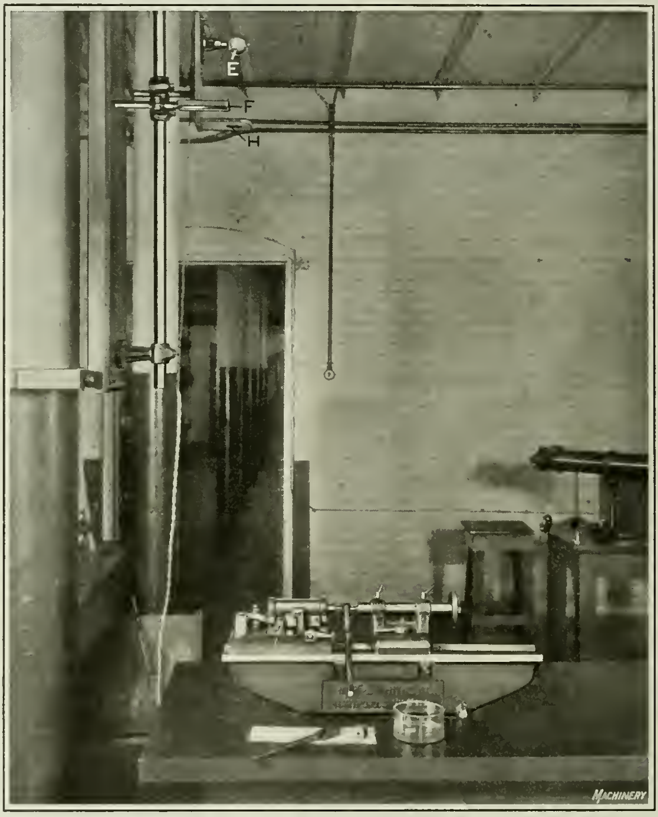


Fig. 5. Comparator with Upper Light and Mirror which reflects a Shadow upon a Scale indicating the Error

This multiplying lever C is carefully counterbalanced, and there is a point of contact between the lever and the frame through a ball located in a pocket at the upper end of the lever. The ball bears against the flat end of an adjustable plug carried by frame G. On the mirror end of lever C there are two small and very accurate plugs placed parallel to each other with a small space between. Similar pairs of fixed parallel plugs are located on each side of the lever and at right angles to those on the lever itself. These three pairs of plugs form the bearing surfaces for three very small balls which are attached to the under side of the reflecting mirror D. One ball which rests on the plugs at the end of the lever is offset relative to the other two balls, so that a 10 to 1 leverage back to this point is increased 2000 to 1, as the shadow is reflected to the upper mirror and back to the scale. The lens and circular opening, which is partly obstructed by the V-shaped projection, forms a shadow in such a way that the scale where the readings are taken is illuminated so that any movement of the shadow is readily seen. This scale has plus and minus graduations on each side of the zero position, with graduations indicating five-millionths inch and spaces between them which are sufficiently large to enable millionths of an inch to be estimated readily.

A uniform contact pressure between spindle B and the gage-block being tested is obtained by means of a weight suspended from a bellcrank L, Fig. 4, which connects with frame G through a spherical ended pin, resting in V-shaped pockets formed in the bellcrank lever and also in the frame. The frame and anvil B are withdrawn slightly for inserting or removing a gage-block, by turning shaft M which has eccentric surfaces in contact with the frame.

Adjusting and Using the Comparator

Before the comparator is used, it is adjusted so that the indicating shadow is in the zero position when the primary standard to be used is between the contact points. In setting up the comparator, the following procedure must be observed strictly or imperfect readings will result.

A weight attached to the bellcrank L is removed so that the recording anvil and its carriage assume an unstrained position. The tilting mirror and lever C are adjusted so that the mirror D is approximately horizontal. The remainder of the optical system is then adjusted until the image falls on the center of the scale and is in focus. A small block on the anvil carriage is now brought up against the ball on lever C until it is just in contact. This will insure that when the indicating shadow is on the scale, the two parallel springs supporting the anvil carriage and the cross-springs on lever C are all in mid position and unstrained. It is essential also that the machine be built with sufficient accuracy so that, in clamping the battens that bind down these springs, no warp or twist will be introduced into the springs which will not come out by taking off the bellcrank weight. The bellcrank weight is now replaced, which pulls the anvil into a strained position and tilts the mirror forward. Now the anvil may be retracted by the eccentric cams on the operating shaft M.

The whole purpose of this proceeding is simply to get the flexible springs in an unstrained condition near the point of measurement. From now on when successive blocks are placed between anvils for measurement, we can be sure that if the light remains on the scale, these springs have not been flexed a sufficient amount beyond their neutral position to affect the accuracy of the measurement.

The fixed anvil A is adjusted so that the space between the two contact points is slightly less than the width of the block to be checked. A primary standard is then placed between the contact surfaces, anvil B being withdrawn by turning eccentric or camshaft M. The spindle holding anvil A has a very accurate wringing fit in its two bearings and is next moved forward by simply turning and pushing it along until the indicating shadow is in the zero position. As a movement of a few millionths inch will cause a decided movement of the shadow, it is evident that a very sensitive adjustment for anvil A is necessary, and the degree of sensitiveness obtained simply by turning and at the same time gently pushing the spindle is an interesting feature of this part of the construction.

Fig. 8. View showing Case in which Comparator is enclosed when in Use to prevent Errors due to Temperature of the Observer's Body

When the shadow is at the zero position, the spindle holding anvil A is locked by two screws R and S, which act against bronze shoes bearing on the top of the spindle. The apparatus is so sensitive that clamping one of these screws even lightly deflects the shadow from the zero position decidedly, but it may be brought back readily by first tightening one screw and then the other until their effect on the spindle is neutralized. The rear anvil is lapped square with its axis in the bar and the sensitive anvil is then finished as nearly parallel as possible with the rear anvil when neither of the binding screws is tightened. When setting up for a block, the rear anvil is brought up against the block resting on the sensitive anvil, and since neither of the binding screws is down, it can be assumed that the two anvils are as parallel as when they were lapped. When one binding screw is put down, the flexure out of parallelism of the two faces is immediately made known by the movement of the indicating shadow. If this is brought back to its original position by tightening the other screw, it can be assumed that the anvils have again been brought parallel. This process is repeated alternately on each of the screws until they have both become tight.

It has been found that gage-blocks having dry surfaces cannot be tested satisfactorily because of minute dust particles which adhere to the surfaces and affect the reliability of the readings. This difficulty was overcome by a very simple method. The surfaces of the primary standards and the gage-blocks to be compared with them are first cleaned chemically by using ether; then, all of the blocks are immersed in highly refined and filtered kerosene mixed with a small amount of sperm oil, so that the surfaces are covered by an oil film when they are placed between the anvils of the comparator.

The block to be tested is held by pincers made of a non-conducting material (see Fig. 5), since the temperature of the hands would make it impossible to obtain accurate tests. When the block is first placed between the anvils, the end of the holder is moved up and down and tapped lightly, thus turning the block somewhat. This is necessary in order to reduce the oil film to a final thickness. This reduction, which is a very interesting phenomenon, is indicated by decided jumps in the position of the shadow relative to the scale. When the shadow settles to a point where there is no further movement as a result of the tapping on the holder, the very slight oil film remaining can be relied upon, as it is absolutely uniform for a given oil, as far as can be determined by repeated tests. To safeguard against any changes in the zero position, the primary standard is frequently inserted, assuming that a number of other standards or gage-blocks are being compared with it. This comparator has proved to be of great value, as it provides an exceedingly accurate, dependable, and comparatively rapid method of checking the accuracy of precision gage-blocks.

* * *

The Bureau of Standards has recently conducted an investigation of the operation, efficiency, and safety of oxy-acetylene welding and cutting blow-pipes. Apparatus from fourteen different makers was submitted to tests, developed jointly by the bureau in cooperation with makers. The blow-pipes were tested in a standard manner to minimize the personal equation. It developed that the principles upon which the design of such blow-pipes should be based were not well understood, and the conclusions reached should be useful to the industry. The results of the tests have been published in Technologic Paper No. 200 of the Bureau of Standards.

A Shuttle-type Drill Jig

A DRILL jig of unusual and interesting design is used for boring and drilling holes in rotary pump cases and covers in the plant of the Goulds Mfg. Co., Seneca Falls, N. Y. The jig is of a shuttle type. The chucking carriages or shuttles are started at one end of a box and pass the work through to successive spindle centers for machining, until they emerge at the opposite end with the work finished. This long shuttle box is fastened to the table of a four-spindle Barnes multiple drilling machine, as illustrated in Fig. 1. A track is provided for the shuttles, on which they slide as they are advanced from station to station.

Three views of the shuttle are shown in Fig. 2, as well as detailed views of the pump case. The shuttle is made of cast iron, open at the ends, and has a steel rack attached to the bottom so that it may be advanced by pinions, operated by handwheels at the front of the shuttle box. A sufficient number of these shuttles is provided so that the four spindles can be kept constantly in operation, and an extra shuttle permits work to be loaded in readiness to be advanced into the first spindle position as soon as this is free. The pump cases are loaded in the shuttles on a bench, and are located by four 5/16-inch pins in the top plate, as indicated in Fig. 2. They are then secured against the top plate by four jack-screws carried in bosses in the baseplate of the shuttle. Two steel-bushed tapered index-holes are located to correspond with the pitch centers of the rotary pump gears, so that by the use of a spring index-pin at the front of the shuttle box opposite each spindle, the shuttle may be correctly located while the two holes in the casting are machined. The same type of jig is used for machining the covers, the holes in which must correspond and align with those in the case, the only difference being that longer jack-screws are used.

When the loaded shuttle is placed on the extending track at the left-hand end of the shuttle box, the rack on the under side is engaged by the pinion on the first handwheel and the shuttle is advanced until the index-pin engages the first bushed hole in the shuttle box. At this station a four-lipped combination drill and countersink is employed to rough-bore one of the 1 1/16-inch holes and relieve the edge of the hole slightly with the countersink. The index-pin is then removed and the shuttle advanced to the second hole, where the operation is repeated. The work on each spindle is so timed that there is no delay in the advance of the shuttle from spindle to spindle. At the second spindle station these holes are finish-reamed, and at the third station the 4 3/16-inch holes are rough-bored with a boring-bar having a long pilot which extends into the previously finished holes. There are two of these large holes in which the rotary pump gears operate, and as they overlap, the use of a pilot for the boring-bars is essential in order to overcome the tendency of the tools to run out. At the fourth spindle station these two holes are finish-bored with a tool of the same type as that employed in the third spindle.

All drill, reamer, and boring-bar holes in the box are bronze-bushed, and the last bushing plate has four knurled feeler screws which are screwed down on the top of the shuttle to steady it and remove all likelihood of its moving while the hole is being finish-bored. Stop-collars are provided on the boring-bars to obtain the correct depth, which is held to gage limits. A plug gage, such as is shown resting on the top of the shuttle box, is also employed to check the diameters of these holes.

Jigs of this type are used for machining cases of various sizes, and when a different depth of bore is required, separate collars are used on the boring-bars under the regular stop-collars. It was stated that the shuttles are open at both ends, which makes them easily accessible for loading. It will also be noticed that the tracks on which the shuttles rest are high so that a pan can be placed between them to catch the chips from the tools and prevent the passageway of the shuttles from being clogged up. At the right in Fig. 1 may be seen another machine equipped similarly to the one

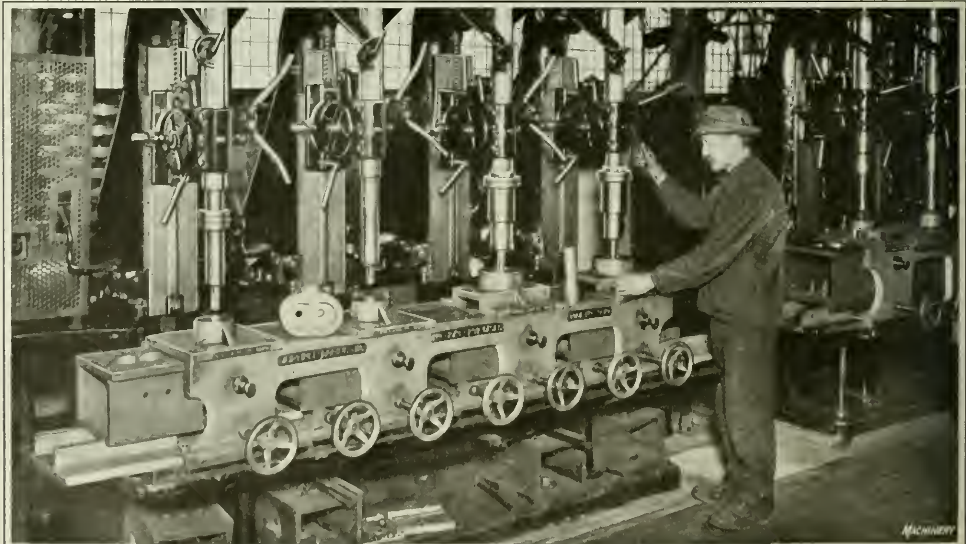


Fig. 1. Four-spindle Gang Drilling Machine with Box Jig and Work-holding Shuttles which travel from Station to Station

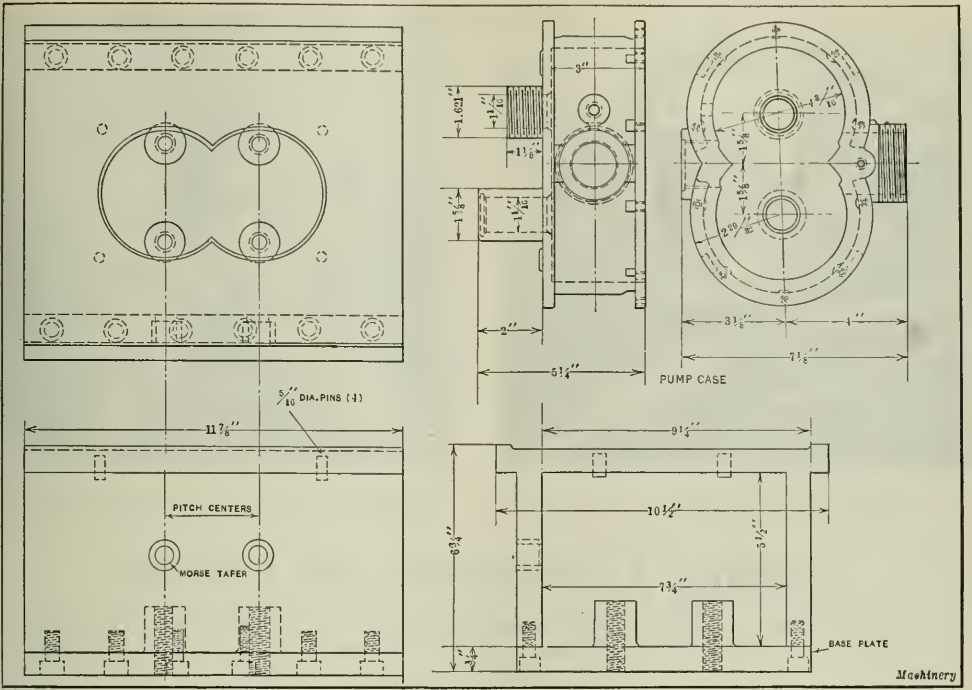


Fig. 2. Rotary Pump Case and Shuttle Jig in which it is bored

to which reference has been made, and here the covers for the cases are machined. Both machines are attended by one operator who thus produces one complete case and cover when the last shuttle is unloaded from each machine.

* * *

WORK OF THE AMERICAN ENGINEERING STANDARDS COMMITTEE

The American Engineering Standards Committee, which consists of representatives from five departments of the Federal Government, nine national engineering societies and fourteen national industrial associations, has recently issued a report which sets forth in detail the activities of the committee during 1921 in national standardization in the engineering field. This committee, which was organized January 17, 1917, at a meeting of a special committee appointed jointly by the American Society of Mechanical Engineers, the American Institute of Mining Engineers, the American Society of Civil Engineers, the American Institute of Electrical Engineers, and the American Society for Testing Materials, now has the cooperation of one hundred and sixty bodies of national importance. These cooperative bodies have designated more than five hundred persons as official representatives to serve on sectional committees working under the auspices of the American Engineering Standards Committee.

The object of the American Engineering Standards Committee is primarily to serve as a national clearing house for engineering and industrial standardization, to act as the official channel of cooperation in international standardization, and to provide an information service on engineering and industrial standardization matters. Since the committee functions as a clearing house rather than as a creator of standards, its work necessarily centers in bringing about systematic cooperation of the organized bodies—technical, industrial and governmental—which speak for industry.

During the past year a good foundation has been laid for a really effective information service on standardization. It is planned that a complete file of all American and foreign standards of significance shall be maintained for the free use, not only of the committees working under the auspices of the American Engineering Standards Committee, but of all American industries generally. The file now includes complete sets of standards approved by all national standardizing bodies, and a majority of the standards issued by the important organizations in this country.

During the year, seventeen standards have been approved by the committee, while seventy-nine projects have reached an official status. In the mechanical division specifications for pipe threads have been approved. In the metal divisions, specifications for Bessemer and open-hearth steel for cold-drawn automatic screw stock have also been approved. Of more general interest is the substantial progress reported on safety codes. The safety code program now includes twenty-nine codes for which definite arrangements have been made. The three following codes have been approved: the national electric code, the safety code for industrial lighting, and the code for the protection of the heads and eyes of industrial workers. The National Safety Code Committee serves as a committee for the general program, delimiting specific projects to be advantageously handled as distinct codes, recommending sponsors, assisting in caring for overlaps, and reporting on the progress of the program.

A general scheme for the plan and arrangement for safety codes has been developed and published for the guidance of those interested in the formulation of such codes, in order that there may be as great a degree of uniformity between the various codes as possible.

Copies of the national standards that have been approved by the committee as well as copies of foreign specifications and standards are available to American industries through the headquarters of the committee at 29 West 39th St., New York City.

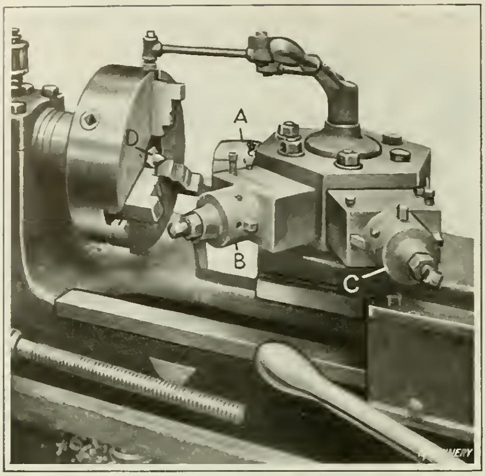


Fig. 1. Turret Lathe on which the Open End of the Piston Casting is bored, faced, and chamfered, and the Boss is centered

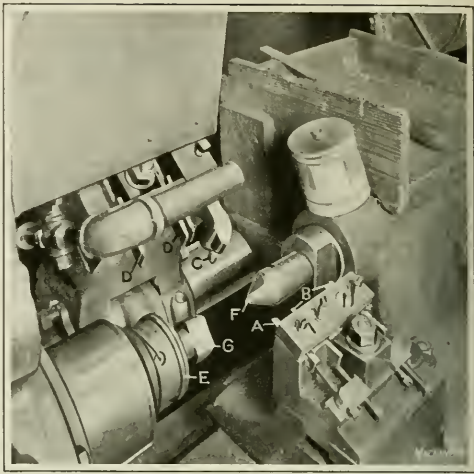


Fig. 2. Automatic Lathe tooled up for facing Closed End, turning Outside Diameter, and roughing and finishing Piston-ring Grooves

Tooling Equipments for Pistons

Use of Automatic Machines and Special Equipment for Machining Lynite Pistons at a High Rate of Production

By EDWARD K. HAMMOND

THERE are few industries in which production methods are more carefully scrutinized than in the manufacture of automobiles. In this industry the methods are constantly being checked over and improved, with the result that standards of efficiency and rates of production are steadily being brought closer to the maximum. The use of automatic lathes and turret lathes provided with special tooling equipments for machining pistons in a large automobile factory offers an interesting example of high-production methods. The pistons are made from lynite die-castings, and the high cutting speeds employed are possible because of the use of this material. This article explains, step by step, the procedure in manufacturing these parts, and the accompanying table gives the cutting speed and production for each operation.

As the castings are delivered to the piston department, the first step is to subject them to a visual inspection, after which the work is transferred to a Warner & Swasey turret lathe equipped as shown in Fig. 1. This machine bores, faces and chamfers the open end *a* of the piston casting, Fig. 4, and centers the opposite end at *b*. It will be seen in Fig. 1 that there is a block *A* on the turret at the first station, which pushes the work back into the chuck while it is being clamped in place. On the second face of the turret there is a combination rough-boring and rough-facing tool *B*; and on the third face there is a combination finish-boring, finish-facing, and chamfering tool *C*. The center drill *D*, which produces a hole in the boss *b* cast at the closed end of the piston for that purpose, is mounted on a spindle extending through the hollow main spindle and connected to the bar feed mechanism. The spindle on which drill *D* is mounted rotates in the opposite direction from the main spindle. As the work is rotated by the chuck, the drill can be fed through the spindle into contact with the boss.

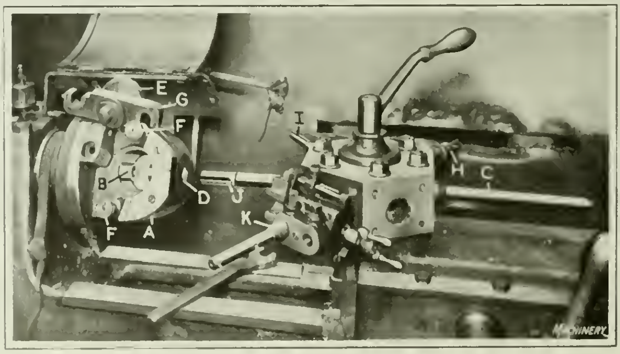


Fig. 3. Turret Lathe equipped for drilling, boring and reaming the Wrist-pin Holes and cutting the Locking Ring Grooves

Finish-facing the Closed End, Turning the Outside Diameter, and Roughing and Finishing the Ring Grooves

Next, the piston castings are sent to a Fay automatic lathe which is tooled up for finish-facing the top end *c*, Fig. 4, turning the outside diameter *d*, and roughing and finishing the piston ring grooves *e*. The front slide feeds from right to left, for turning the outside diameter with tool *A*, Fig. 2, and then moves inward to rough out the piston ring grooves with the three tools *B*. Meanwhile, the rear head swings down to face the top end of the piston with tool *C* and to finish-turn the grooves with the three tools *D*. The work is held between a center *E*, which enters the chamfered open end of the piston and another center *F*, which enters the hole drilled in the boss at the closed end. Driving is accomplished by means of a plug *G* on the spindle, which fits into the space in the piston between the inner ends of the wrist-pin bosses.

OPERATIONS ON PISTONS AND PRODUCTION TIME

Oper. No.	Operation	Type of Equipment	Cutting Speed, Feet per Minute	Prod. Time, Minute	Hourly Prod.
1	Inspect	Bench	......	......	.....
2	Bore, face, and chamfer skirt a and center boss h*	Warner & Swasey turret lathe	815	1.05	57.0
3	Face closed end c, turn outside diameter d, and rough and finish ring grooves a	Fay automatic	360	1.23	49.0
4	Drill, bore, and ream wrist-pin holes f and cut locking ring grooves	Warner & Swasey turret lathe	150	1.60	37.5
5	Mill faces g	Briggs milling machine	245	0.30	200.0
6	Chamfer faces h	Burke milling machine	120	0.42	143.0
7	Drill two oil-holes in faces h	Leland-Gifford drilling machine	60	0.63	95.0
8	Chamfer wrist-pin holes at i	Sipp drilling machine	200	0 22	273.0
9	Drill four oil-holes j	Sipp drilling machine	40	0.27	222.0
10	Mill oil-grooves in wrist-pin holes f	Sipp drilling machine	160	0.34	176.0
11	Grind clearance k	Landis grinding machine	5700	0.56	107.0
12	Center open end a	Special machine	750	0.185	325.0
13	Rough- and finish-grind outside diameter d and clearance on lands l and m	Special grinding machine	5700	1.34	44.8
14	Remove center boss b	Sipp drilling machine	275	0.28	214.0
15	Finish-ream wrist-pin hole f	Special machine	160	0.63	95.0
16	Mark center lines on face c	Bench and gage	......	0.15	400.0
17	Wash and dry	Tank and cloths	......	0.10	600.0
18	Final inspection	Bench	......	......	.....

Machinery

*For notation see Fig. 4.

Machining the Wrist-pin Holes

After the Fay automatic has completed its work, the piston castings are transferred to a Warner & Swasey No. 4 turret lathe to have the wrist-pin holes *f*, Fig. 4, drilled, bored and reamed, and to cut the locking ring grooves in these holes. A machine tooled up for this work is shown in Fig. 3. A pot fixture *A* is carried on the spindle nose. Into this fixture the piston casting *B* is inserted, being located by means of a pilot bar *C* on the first turret face, which extends through bushing *D* in the fixture and through the wrist-pin hole in the work. The work is then clamped in place by means of a plug *E*, which enters the chamfered open end of the casting and is secured by means of bolts. The ends of strap *G* are slotted to slip under the heads of two bolts *F* after they have been loosened slightly.

Having secured the casting in place, the wrist-pin hole is first roughed out with a core-drill *H*, on the second turret face, and then bored and reamed with the usual types of boring-bar *I* and reamer *J* on the third and fourth turret faces. The locking ring grooves are next cut in the wrist-pin hole by a tool *K* on the fifth face of the turret. This tool is mounted on a cross-slide, which is fed transversely to sink the two grooving tools into the work to the required depth. It is known as a cross-slide under-cutting tool, and is made by the Warner & Swasey Co. for use on turret lathes of its manufacture. To maintain the required accuracy of alignment, bushings are provided in the pot fixture *A* at each side of the work, to receive guiding pilots on the tools.

Facing the Wrist-pin Bosses

The next step in machining these pistons is to face the ends *g*, Fig. 4, of the wrist-pin bosses perpendicular to the finished holes *f*. This is done on a Gooley & Edlund, Briggs type of milling machine, which is shown in Fig. 5 equipped with a work-holding fixture *A* and a special offset cutter-head *B*. The piston casting *C* is slipped into the split cylindrical fixture and located by a plug *D* which enters the wrist-pin hole. The work is clamped by tightening a screw *E*, which passes through threaded bosses at each side of the split top of the fixture. By traversing the table, the work is fed up to the offset milling cutter *B*, which is held in such a way that it can enter the open end of the piston. The cutter is driven by gears to which motion is transmitted by a gear *F* carried on an arbor held in the milling machine spindle. The entire fixture is suspended from the over-arm.

Milling Chamfers on the Middle Piston-ring Groove

It is necessary to mill a chamfer *h*, Fig. 4, on the lower side of the middle piston-ring groove, directly above each end of the wrist-pin holes *f*. This is done on a Burke hand milling machine, equipped with a fixture, as shown in Fig. 6. The piston is located on a pilot *A* carried by the bed of the fixture, and is held down by a clamp *B* having a hand-lever *C*, by means of which the necessary pressure is exerted. Very little time is required to set up the job in this way. The work is traversed past an end-mill *D*, which cuts the chamfer on the middle piston-ring groove.

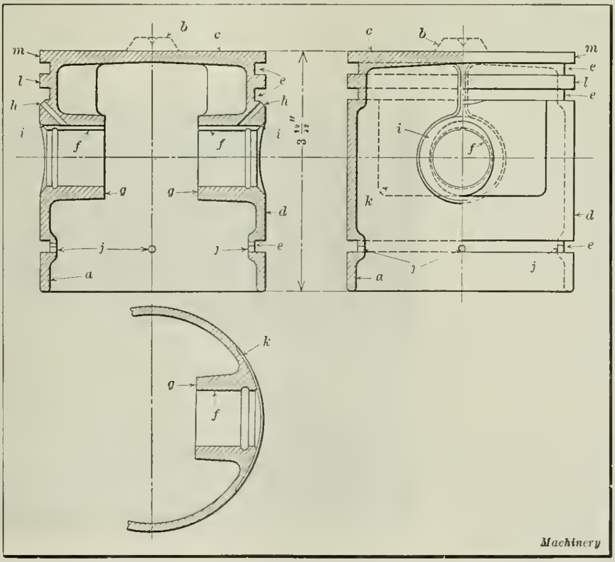


Fig 4. Piston on which Machining Operations listed in Accompanying Table are performed

Drilling Oil-holes

Next in the order of machining operations comes the drilling of two oil-holes *h*, Fig. 4, which extend diagonally from the middle piston-ring groove in to bearing holes *f* for the wrist-pin. Fig. 7 shows a Leland-Gifford sensitive drilling machine, equipped for this operation. A pilot extension on disk *A* fits into the bored skirt, and a smaller pilot extends up into the piston, which has a hole in it through which pin *B* can be slipped. This pin also extends through the wrist-pin holes in the piston and provides for clamping the work by tightening screw *C*,

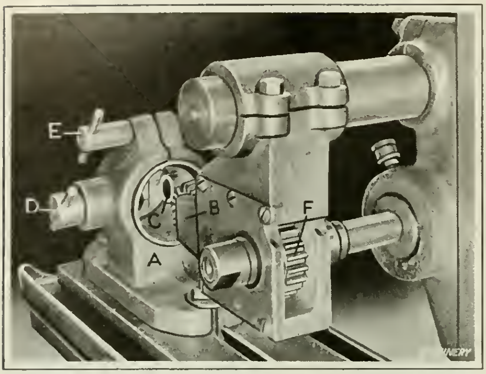


Fig. 5. Milling Machine equipped for facing Inner Ends of Wrist-pin Bearing Bosses

which draws the small pilot and pin *B* in toward the base of the fixture. The pilot is splined so that it cannot turn, and pin *B* serves the additional purpose of locating the oil-

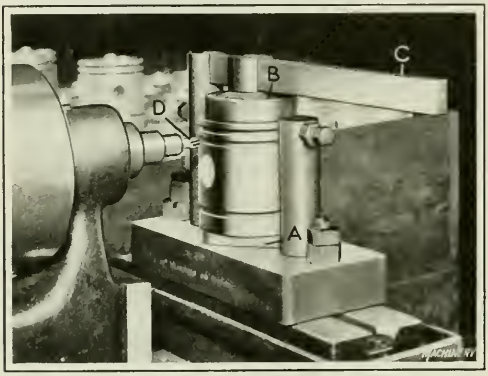


Fig. 6. Hand Milling Machine equipped for chamfering the Lower Side of the Middle Piston-ring Groove

holes in the proper relation to the wrist-pin bearings. The drill bushing is located at *D*, and after one of the two holes *h*, Fig. 4, has been drilled, the work is released from the fixture and reset 180 degrees from its first position. for drilling the second hole.

Next, the outer ends *i*, Fig. 4, of the wrist-pin holes *f*, are chamfered with a cutter *A* on a Sipp upright drilling machine, the work being held in a V-block *B* as shown at the left-hand side of Fig. 8. Then the casting is transferred to a similar fixture shown at the right-hand side of the illustration. The spindle in this machine carries a twist drill *C*, which is used to drill four oil-holes *j*, Fig. 4, in the lower piston-ring groove, distributed equally around the circumference of the work. Oil-grooves are then milled in the wrist-pin holes with a cutter carried in the spindle of a Sipp drilling machine.

Grinding Clearance at Ends of Wrist-pin Holes

It is required to grind a clearance of from 0.010 to 0.015 inch under the sliding surface of the piston over an area adjacent to each end of the wrist-pin bearings, and for this operation a Landis cylindrical grinding machine is used. The form of the clearance to be ground is clearly indicated at *k* in Fig. 4. The work is held at one end by an ordinary center *G*, Fig. 9, while a special center *F* at the other end enters the finished opening *a*, Fig. 4, at the base of the skirt. The Landis grinder is equipped with a fixture shown on the machine at *A* in Fig. 10, and details of its design are more clearly illustrated in Fig. 9.

The piston is rotated in unison with a cam *B* (see Fig. 9), which is finished to the shape and size of a cross-section of the finished piston, through the centers of the wrist-pin holes *f*, Fig. 4. This cam runs in contact with a fixed roller *C*, and as the entire work-holding fixture is pivoted on the grinding machine, the cam carried by the fixture and the

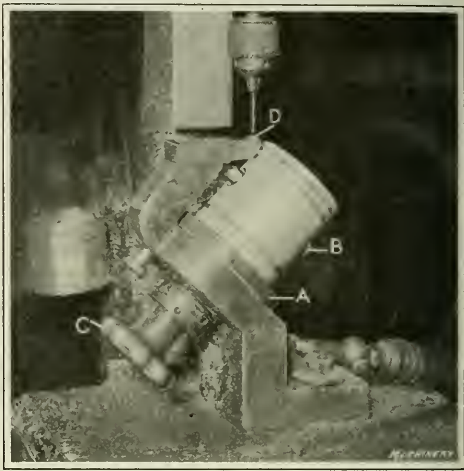


Fig. 7. Jig for drilling Two Inclined Oil-holes leading to Wrist-pin Bearings

roller secured to the frame of the machine oscillate the fixture on its pivotal support *D*, in such a way that the work is swung in contact with the grinding wheel and is ground to the same form as the cam.

The method of operation of the fixture is as follows: The piston *E* is carried between centers *F* and *G*, and a plug *H* extends inward, engaging the ends of the wrist-pin bosses, and thus affording a convenient method of driving. The live center *F* and the cam *B*, which controls the form of clearance ground on the work, are both carried by a spindle which

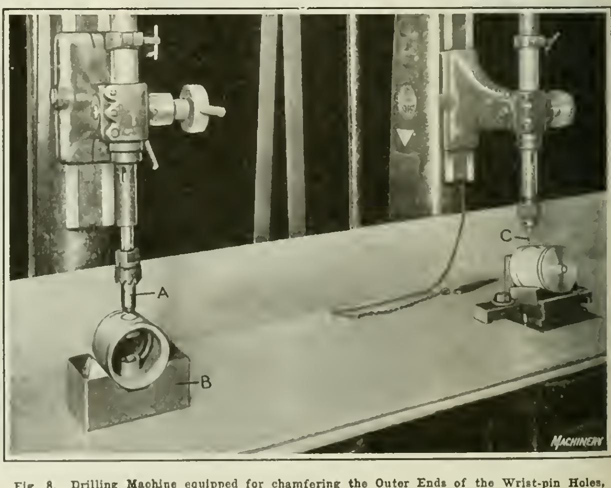


Fig. 8. Drilling Machine equipped for chamfering the Outer Ends of the Wrist-pin Holes, and for drilling Four Oil-holes in the Lower Ring Groove

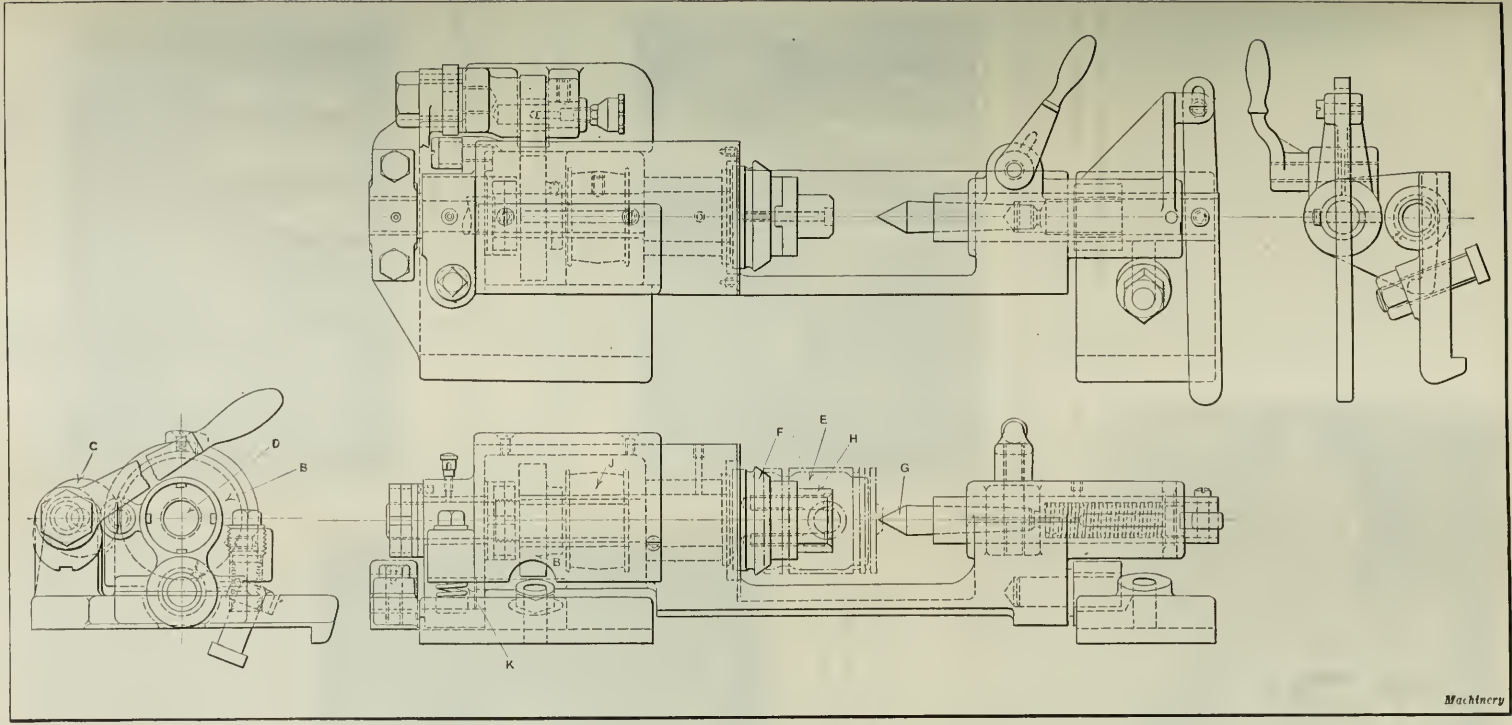


Fig. 9. Details of Design of the Grinding Machine Attachment shown in Operation in Fig. 10

is positively driven from below by means of a Morse silent chain *I*, Fig. 10, running over sprocket *J*, Fig. 9. Uniform contact is maintained between cam *B* and roller *C* by means of two springs *K*, and the action of these springs is supplemented by two additional springs *L*, Fig. 10.

Centering the Open End and Grinding Outside of Piston

After the clearance *k* has been ground, it is necessary to recenter the open end of the piston, as the chamfer formerly machined is not accurate enough to be depended upon for locating the work for rough- and finish-grinding the outside diameter *d*, Fig. 4. For this purpose the pistons are centered on a special machine, after which they are set up on a special cylindrical grinding machine on which the outside diameter *d*, of the work is rough- and finish-ground. Provision is also made at this setting of the work for grinding the clearance on lands *l* and *m* at the top of the piston. The work is shown in Fig. 11 set up for this operation. It is held by a center *A* entering a hole in the closed end of the piston, and a center *B* entering the open end of the work.

Removing the Center Boss at Top of Piston

After the pistons have been rough- and finish-ground, the center boss is no longer needed, and so it is removed by a Sipp drilling machine equipped with a work-holding fixture *A* and end-milling cutter *B* of the type shown in Fig. 12. The piston is located in the fixture by means of a pilot *C* which enters the finished wrist-pin hole, after which handle *D* is turned to raise the supporting table *E* into contact with the bottom of the work. Then the end-mill comes down through a guide bushing *F* at the top of the fixture, and cuts off the boss so that it is flush with the top of the piston.

Next the wrist-pin holes *f*, Fig. 4, are finish-reamed on a special machine. Finally, two lines are scribed across the top of the piston as shown in Fig. 13. The piston is located in a fixture *A* by a pin *B* passing through the finished

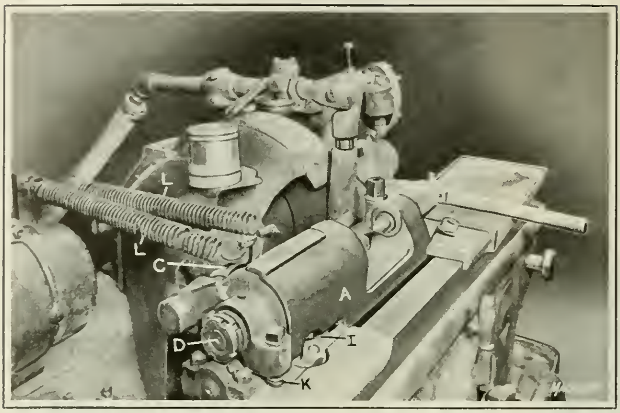


Fig. 10. Special Attachment for grinding Clearance Space at the Outer End of each Wrist-pin Hole

wrist-pin hole, and by a sliding block *C* on the surface plate, on which the work-holding fixture is carried. Block *C* carries two cutting points *D* and *E* which scribe the required lines across the work. The pistons are then washed, wiped, and inspected, and marked for size and weight, after which they are ready to be assembled.

* * *

INDUSTRIAL MACHINERY IN EGYPT

The imports of industrial machinery into Egypt have increased greatly during the last three years. In 1919 the total imports of this class of machinery into Egypt from

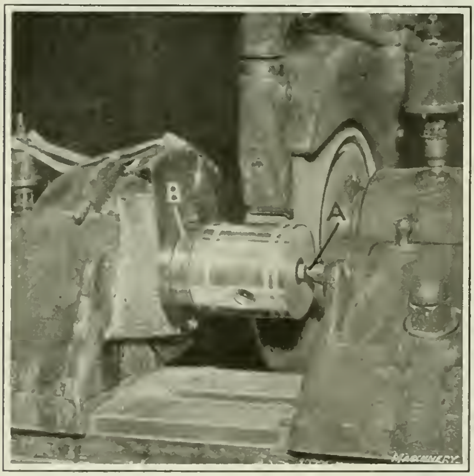


Fig. 11. Cylindrical Grinding Machine equipped for grinding the Outside Diameter and the Clearance on the Two Upper Lands

all countries amounted to about $2,100,000, rising in 1920 to $6,750,000, and in 1921 to nearly $10,000,000. Of these imports 12.3 per cent were from the United States in 1920, and 29.6 per cent in 1921. The imports in the latter year included 49 locomotives built by American firms for the Egyptian state railways. The market for industrial machinery in Egypt is not large, and the largest single item in 1921, outside of locomotives, was stationary internal combustion engines. The countries that contributed to the imports of industrial machinery into Egypt in 1921 in the order of their importance in this trade were: the United Kingdom, France, Germany, the United States, and Switzerland.

MOTOR TRUCK TRANSPORTATION

Although the motor truck is gaining in importance daily as a means of transportation, both for local purposes and in interurban service, there is no danger that it will ever replace the railroads for long distance hauls. An investigation has shown that compared with the tonnage moved by the railroads, the work done by trucks in interurban service is quite small. Between New York and Philadelphia, for example, where there is a highly developed truck service, the trucks do not carry more than one-half per cent of the total amount of freight transported. In the great majority of cases, the trucks handle small package business—a business which at best is not very profitable to the railroads, and which is sometimes even carried at a loss. The transfer of this business to the commercial truck is a logical development of our transportation system. It is economical from every point of view, and it causes no loss to the railroads. The motor truck fills a definite place of great value in the transportation system, and it will undoubtedly be

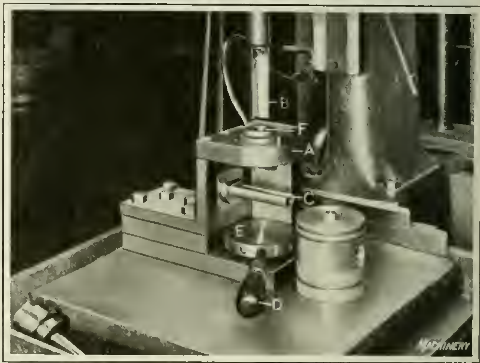


Fig. 12. Drilling Machine equipped with Special Milling Cutter for facing off the Boss on the Closed End of the Piston

used increasingly in certain classes of work, but it will never replace the railroad as the chief hauler of freight.

* * *

There are more than a million wireless receiving sets in use in this country at present, contrasted with 30,000 a year ago, and the number is growing at a rapid rate.

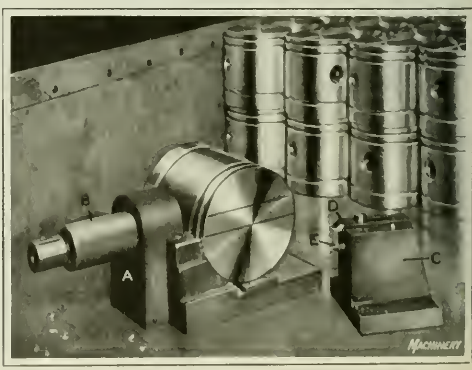


Fig. 13. Tools used for scribing Two Reference Lines across the Closed End of Each Piston for Guidance in assembling

DRIVING CHUCK FOR AUTOMATIC LATHE

By E. M. BIDWELL

Among the various types of lathe drivers or dogs designed for the automatic chucking of cylindrical work, the writer could not find any which seemed to be suitable for the conditions encountered in chucking the automobile clutch or main drive gear illustrated in Fig. 1. Consequently, a special driving chuck was designed, which is quick-operating and which furnishes a positive drive when machining the

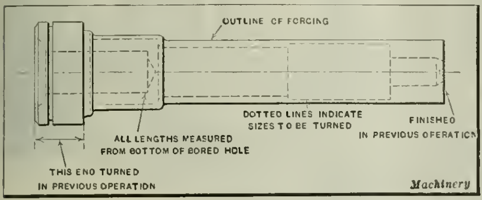


Fig. 1. Automobile Clutch Gear Forging for which Chuck shown in Fig. 2 was designed

forgings in a Fay automatic lathe. This clutch gear is turned down from the rough-forging size to the finished shape shown in dotted lines. Six turning and four facing tools are used in machining this forging, and consequently a very strong and positive drive is required. For this reason it was not thought advisable to use the ordinary set-screw lathe dog. Those familiar with the operation of the Fay automatic lathe know that a large amount of lost time and production will result if a driving dog that slips is used.

Features of Construction

Before the forging goes to the automatic lathe to be turned, the hole in the gear end is bored and the outside diameter of the gear rough-turned, so it is only necessary to provide for a variation of 1/16 inch on the diameter, in designing the driver. This special tool (see Fig. 2) consists of a body *A* which is recessed on one side to fit over the regular faceplate of the lathe, in place of the floating faceplate provided on the machine, and is attached by four fillister-head screws, using the same key as is used in attaching the floating plate. The body is made of machine steel, and is cut out to accommodate the ring *E*, a 1/8-inch floating movement being allowed for the ring. The ring is held in place by a retaining plate *C*, fastened to the body by screws and dowel-pins. The floating ring carries two hardened steels jaws *G*, which are dovetailed and located in the plate in the position indicated.

The top part of the floating ring is cut out on both sides, as is also a section from ring *C*, so that the driving pawl *F* can be assembled by straddling the section in ring *E*, in which position it is held in place by a 7/8-inch nickel-steel pin *D*. The shoulder against which the floating ring bears in the body is also cut away to correspond with the section that is removed from ring *C*, this being necessary on account of the design of the pawl *F*. The sections cut out for the accommodation of the upper end of the pawl are indicated at *K*, these surfaces being those against which the ears of the pawl contact when gripping and releasing the work, as will be explained later. The gripping end of the pawl contains serrated teeth and is hardened, and the surface in which these teeth are cut is eccentric with regard to the center of stud *D* on which the pawl swings when in operation.

The outside of the body of the chuck carries a handwheel which is corrugated to make it easy to grasp by the operator when it is covered with oil. When in operation, the weight of the handwheel rim acts as a flywheel, and its momentum aids in the operation of the chuck. The handwheel carries a finger *H* which is fitted into it and which extends through the body of the chuck and into a slot cut in floating ring *E*; this slot provides sufficient clearance so that the finger does not interfere with the floating movement of the ring. A section of the body of the chuck is also cut out as indicated at *J*, for approximately 90 degrees, which permits the handwheel to revolve nearly a quarter of a turn before its movement is arrested by the finger *H* on the handwheel coming into contact with the surfaces *J*.

Operation of the Driving Chuck

The live stub center of the lathe is made a sliding fit in the end of the clutch gear, and this stub center extends beyond the driver a short distance so that when the work is placed in the machine it is simply necessary to slip the gear over this center and bring the tail-center into engagement with the opposite end of the gear. The work is advanced on the plug center by pushing up the tailstock until the stub center bottoms in the hole in the gear. Jaws *G* are beveled on their inner edge, so that when the work is centered in the position described the floating ring *E* will be moved sufficiently to admit the work readily. The machine is then started, revolving the body *A* and retaining ring *C*, and bringing surface *K* into contact with the pawl, which causes it to swing on pin *D* until the serrated teeth grip the work. The continued rotation of the chuck transmits a rotary movement to the work which is thus positively driven, and any resistance to rotation produced by the cutting action of the tools only tends to tighten the grip of the chuck on the work.

In releasing the work after the machine has stopped, the operator grasps the handwheel and gives it a slight turn, just enough to bring the pawl *F* into contact with the surface *K* at the opposite end of the cut-out section, and thus swing the pawl in the opposite direction. This requires but little effort on the part of the operator on account of the flywheel effect of the handwheel, the momentum of which greatly aids in the disengagement of the pawl. For example, when a finishing cut is taken on this forging, the driver automatically releases itself, due to the momentum of the handwheel, by disengaging the pawl, when the machine comes to a quick stop, as it does when the brake attachment provided on the Fay lathe is used. When the machine comes to a stop, the pawl is swung so as to permit plenty of space for convenience in chucking another forging, so that after each piece is put between centers, all that is necessary is to start the machine.

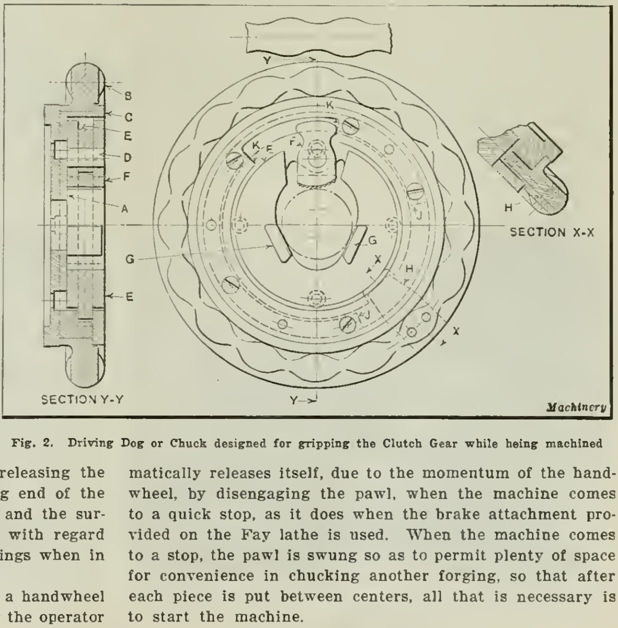
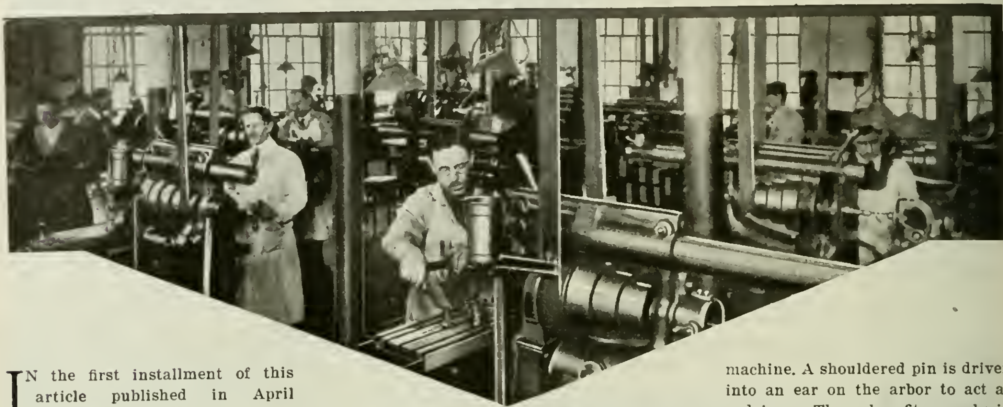


Fig. 2. Driving Dog or Chuck designed for gripping the Clutch Gear while being machined

Production Work in a Contract Shop



Manufacturing Methods Employed in the Plant of the Taft-Peirce Mfg. Co. Woonsocket, R. I., in Machining Automobile Parts—Second of Two Articles

IN the first installment of this article published in April MACHINERY, the equipment used by the Taft-Peirce Mfg. Co. for grinding, drilling, reaming, and inspecting the valve followers of the Wills Sainte Claire engine, and methods used in the production of the camshaft drive pinion floating washer were described. The present article deals with operations on the camshaft drive shaft bearing retainer, the motor fan, and the intermediate and fan shafts.

Camshaft Drive Shaft Bearing Retainer

The camshaft drive shaft bearing retainer consists of an upper and a lower member, both iron castings, on which probably the most interesting operation is that of facing one end and the under side of the flange, as shown in Fig. 10. This illustration also gives a good idea of the design of these castings. The two tools are carried in the back-facing attachment of a Porter-Cable lathe. A tolerance of 0.002 inch on the distance from the small end of the casting to the inside wall, through which eight holes are drilled, is allowed, this distance being nearly 3 inches. For finish-facing the flange, a limit of 0.0005 inch is specified between this face and the small end of the casting. Limit length gages are provided to check these distances. The work is mounted on a special arbor, which is shown lying on the carriage of the machine. A shouldered pin is driven into an ear on the arbor to act as a driver. The arbor fits snugly in a brass bushing previously assembled in the casting, with the small end of the pin fitting into one of the previously drilled holes in the flange. The back-facing attachment employs the cam-feed mechanism regularly furnished with this type of lathe.

Fig. 11 shows a special gaging device used for inspecting the concentricity of the two finished diameters of the retainer castings. This consists of a large surface plate to which a stand is bolted. The stand furnishes a bearing for the long bar and centers shown, these being regular Springfield straightening-press equipment applied to this inspecting device. One center has been changed to include a heavy expansion spring and a hand-lever *A* for withdrawing the center against the pressure exerted by this spring. Thus it is possible to center the arbor, over which the work is slipped for inspecting, by simply depressing this lever to withdraw the spring center before locating the arbor in the center at the opposite end of the bar. The lever is then released and the spring center advances into contact with the arbor. This holds the arbor with just enough tension to permit the inspector to revolve the work freely. A dial indicator is used, as shown in the illustration, for determining the amount of error in concentricity of the two diameters.

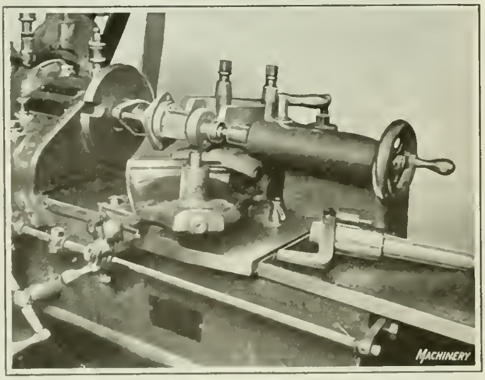


Fig. 10. Multiple Facing Operation on the Drive Shaft Bearing Retainer Casting

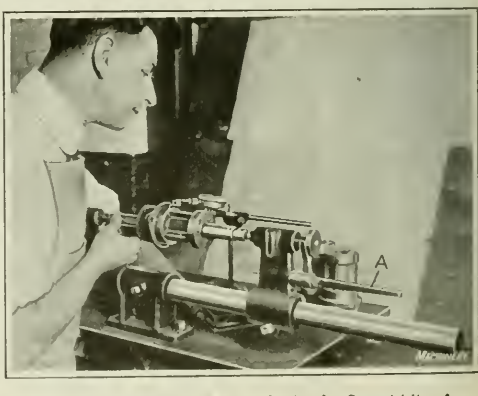


Fig. 11. Inspecting the Retainer Casting for Concentricity of Diameters

Machining the Motor Fan

The motor fan is an aluminum casting, and because of its peculiar shape some interesting machining equipment is employed. A detailed view of the fan is shown in Fig. 12. The first operation to which attention is called is that of chucking, boring, and reaming the hub, squaring face *A*, grooving and chamfering. This work is performed in a 24-inch Gisholt turret lathe equipped with regular Gisholt tools and a facing tool in the cross-slide, which may be seen at *A*, Fig. 13. This view is primarily intended to show the method of chucking the fan rather than the tooling set-up.

so that the blades are gripped at one spot, thus preventing them from being distorted when the nuts are tightened to clamp the straps. The fact that three segment arm studs are provided as fulcrums for operating the chucking mechanism makes it unnecessary to revolve the faceplate when chucking or releasing the work.

Both holes in the fan hub are hand-reamed, using the locating fixture shown in Fig. 15, and a double-expanding Martell reamer. A steel bushing is provided in the fixture as a bearing for the locating plug which is used to locate the fan concentrically when it is first placed in position.

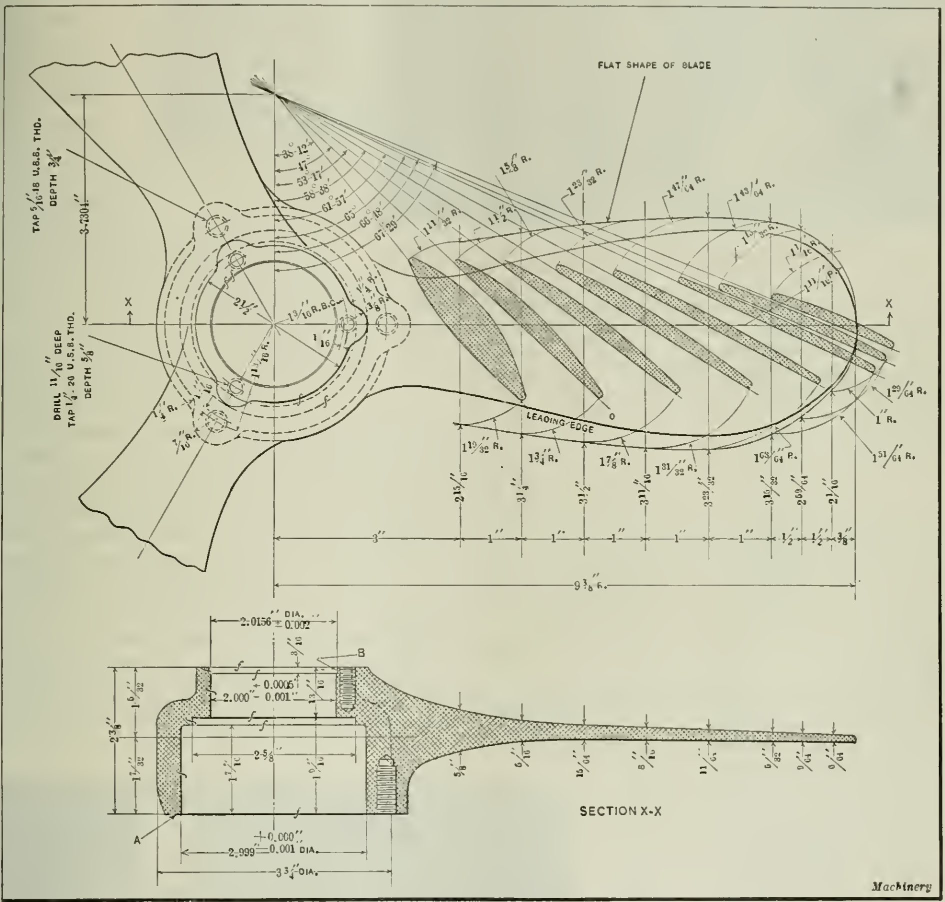


Fig. 12. Detail Views of the Aluminum Motor Fan of a Wills Sainte Claire Engine

A special fixture is bolted to the faceplate of the lathe, having a steel bushing to receive the pilots of the boring-bars and reamers employed in finishing the hole. The front plate of the fixture carries a gear of large diameter, in one side of which there is a cam groove, so that as the gear is turned in chucking the work, three pins are moved axially through the front plate, into engagement with the three bellcrank levers *B*, which causes the levers to swivel and grip the work on the hub between the blades of the fan. The fixture gear is operated by a segment arm *C*, in which there is a hole that fits over one of the three studs *D* extending from the inside of the front plate. The segment teeth engage the gear teeth and rock the bellcrank levers.

The fan is first placed in position for chucking, and given a slight turn forward until the blades enter between blocks *E* and the straps which they carry and are located against stops *F*. The blocks and the straps each carry a steel button,

When the fan has been properly located, a floating clamp at the rear of the fixture is swung around until its end engages a stud in the main casting of the fixture. The illustration shows a fan in this position with the locating plug removed. The body of the Martell reamer is accurately ground to the same diameter as the locating plug, so that when the reamer is placed in the steel bushing, there is absolute assurance of the concentricity of the two holes. At the left of the vise in which this fixture is held, are shown two Taft-Peirce plug gages by means of which the limits on these holes are gaged. Fig. 12 shows that the tolerance on the diameter of the large hole is 0.001 inch, and on the small hole 0.004 inch.

Squaring the Hub, Balancing, etc.

The operation of squaring the hub and counterboring at *B*, Fig. 12, is performed in a Lodge & Shipley lathe, on the faceplate of which the special fixture shown in Fig. 14 is attached.

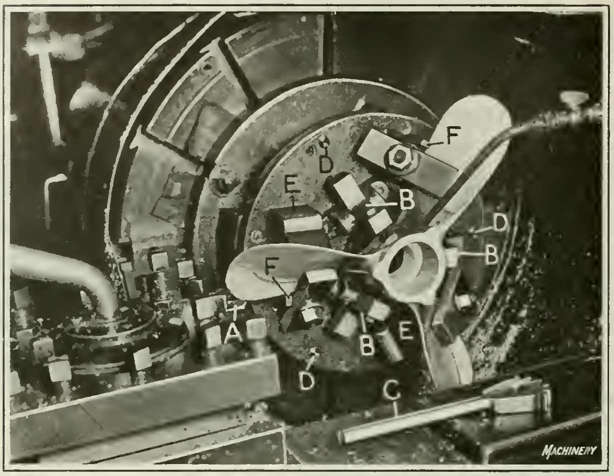


Fig. 13. Turret Lathe equipped with Special Fixture for chucking Motor Fan

This fixture is of the expanding type. Sleeve *A* is made of tool steel, spring-tempered, and has six slots so that when the expanding plug *B* is drawn in against the tapered hole, the fan will be located against shoulder *C* and securely chucked in this position. The end of the shank on plug *B* extends through the opening in arch bracket *D*, and carries a nut which is operated to draw in the plug. The angle of taper for this member is 15 degrees, this having been found a most efficient taper for rapid chucking. Only about one-fifteenth revolution of the nut on plug *B* is required in order to chuck the work securely.

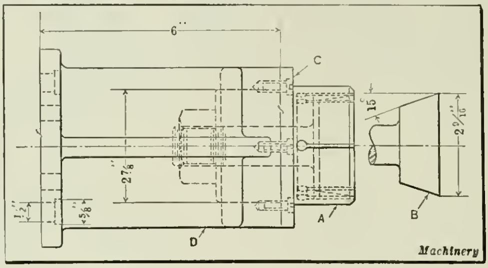


Fig. 14. Draw-in Expanding Fixture for chucking the Fan when squaring the Hub Face

After the fan has been completely machined, it must be balanced, and this is done with the aid of the Rockford balancing machine shown in Fig. 16. The tapered bushing assembled in the fan is engaged by a special tapered arbor, and the fan is placed in suspension between the disks of the balancing machine in the position illustrated. One of the arbors used is shown on the bench. After it has been determined which blade is too heavy to maintain static balance, the fan is clamped on another arbor and held in a bench vise while the metal at the edge of the heavy blade is scraped down or rasped with the square tool shown on the bench at the left of the vise. As in all specialized jobs of this kind, the workman must have a great deal of experience to do this work satisfactorily.

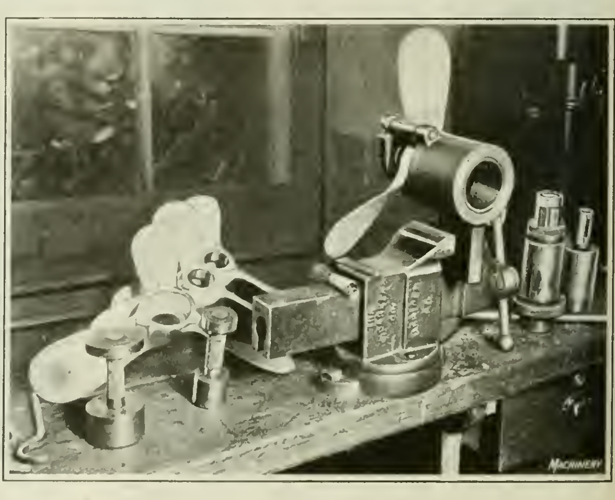


Fig. 15. Equipment used in hand-reaming the Central Holes in the Fan

The bronze bushing previously assembled in the tapered hole of the fan receives a final finish-boring operation; this procedure differs from the usual practice of producing a highly finished surface. The method of finishing consists of using a diamond tool, and this has been found to give the most satisfactory results. Grinding could not be resorted to on account of the possibility of charging the bronze bushing with abrasive. The use of the diamond eliminates all such work as broaching or burnishing for producing the final finish. The fan is chucked against a special base clamped to the lathe faceplate by means of a large-headed bolt which screws into the base and seats against the inner shoulder of the fan. This job is set up in a Lodge & Shipley lathe, the faceplate of which revolves at a rate which gives a cutting speed of 180 feet per minute.

Intermediate and Fan Shafts

All shafts and other steel parts that are subjected to wear and strain are made of a special analysis molybdenum steel, which, on account of its satisfactory service where strength, toughness, and resistance to wear are prime requisites, is admirably adapted for use in automobile construction. The intermediate shaft shown in detail in the upper part of Fig. 17 is forged from this steel and finished in the following manner: After inspecting the forgings and testing them for hardness by the Brinell method, the shafts are straddle-milled to length on a No. 4 Brown & Sharpe milling machine, the length being checked with a limit gage. A Cadillac centering machine is then employed to center both ends, gaging from the opposite side of the large flange in each case.

The next three operations are rough-turning the two sections *A* and *B* at the right of the small flange; rough-turning section *C* and squaring the small flange; and rough-turning end *D*. Each of these operations is performed in a Prentice automatic lathe, a model shaft being used for setting the tools. In machining section *D*. the shaft is not turned down for threading, this end being left one diameter temporarily.

The shafts are then recentered to a uniform depth at each end in a speed lathe, gages being used to check the depth. A Prentice automatic lathe and a model shaft are again used for setting the tools for the next four operations, in which sections *A*, *B*, *E*, *F*, *D*,

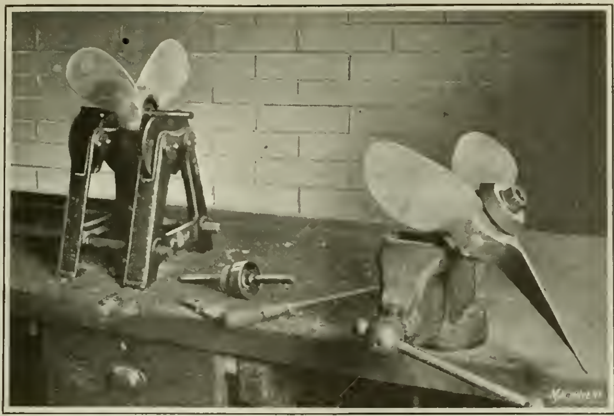


Fig. 16. Bench and Equipment used in producing Static Balance in the Fans

and the small flange are finish-turned. In finish-turning section *D*, 7/64 inch of stock is left at the end where the one-inch thread is later cut, so that the stock will remain soft after hardening. Both flanges are next underscored in a lathe, the shafts are straightened if necessary, and the keyway is cut for the Woodruff key. The latter operation is performed on a Brown & Sharpe milling machine, a gage being provided for checking the central location. The various holes are then drilled, reamed, countersunk, and tapped as indicated in the illustration, after which the threads in sections *B* and *E* are cut on a Pratt & Whitney thread miller, using 18-pitch hobs and limit thread gages.

Before heat-treating, the shafts are copper-plated heavily all over, after which the copper is removed from all surfaces except section *A* and the length on section *C* designated by dimension 7.4687 inches—the two surfaces which are not to be hardened. The shafts are then packed in Houghton's "Pearlite" carburizing material at a temperature of from 1650 to 1700 degrees F., which produces a carbon penetration of about 1/32 inch. The shafts are quenched in oil from a temperature of 1580 degrees, and are then reheated to from 1375 to 1385 degrees and quenched in brine. The higher quenching temperature refines the core and the second heat hardens the carburized exterior. The casehardened shafts are next drawn in oil at a temperature of from 350 to 400 degrees F., for a period of from one to one and one-half hours, and are then permitted to cool in the atmosphere.

There are a number of incidental operations performed before grinding, such as cleaning the centers, straightening, wire-brushing section *C*, cleaning the threads and inspecting. The threaded end of section *D* is then ground, underscored, and chamfered, after which it is ready to have the thread cut. The threading operation is performed on a Pratt & Whitney thread miller by hobbing, holding the threads to gage limits. Sections *A*, *F*, and *G*, diameters *B* and *E*, and the inside of the large flange are then rough- and finish-ground. The final operations are grinding the small shoulder to the 3.0625-inch dimension, grinding the shoulder at the small end of the shaft to the specified length, and grinding surface *H* of the large flange to thickness. The dimensions showing the limits to which the various surfaces are machined are given in the illustration.

The fan shaft shown in the lower part of this illustration is finished in much the same manner and with practically the same equipment as the intermediate shaft. The heat-treating is also substantially the same. There is only one operation of which mention need be made, and that is the cutting of the six-threaded left-hand spiral gear, which is done on a No. 3 Barber-Colman hobbing machine having standard equipment.

* * *

A device developed by the Société Anonyme Adolphe Saurer of Arbon, Switzerland, for the purpose of testing the piston-rings of automobiles, was described in detail in a recent number of *Engineering*. The object of this device is to determine whether the pressure exerted on the walls of the cylinder, when the spring is compressed to its working diameter, is within the allowable limits. The device is actually a comparator, as it indicates whether the ring being tested has the same characteristics of stiffness as some standard ring which is known to be satisfactory.

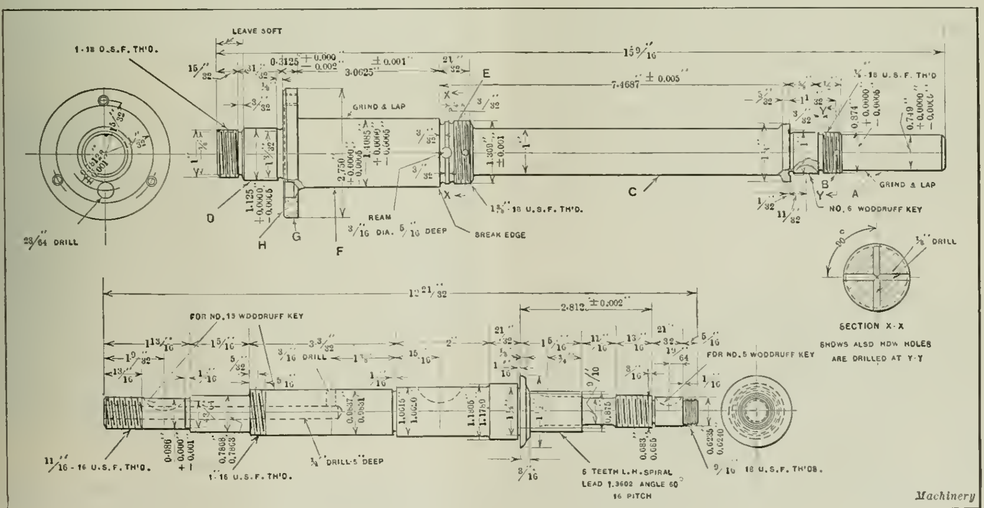


Fig. 17. (Top View) Intermediate Shaft; (Bottom View) Fan Shaft

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THE VALUE OF TRADE STATISTICS

A contributing cause of serious business depressions following periods of great prosperity is the lack of complete and accurate trade statistics which would enable manufacturers to form opinions of the industrial future. If such statistics had been available in 1920 our machine tool manufacturers would have been able to anticipate and prepare for the depression, months earlier than was possible when each had to rely on the information he could obtain individually. Signs of a coming depression in the industry were apparent in the spring of 1920, but most factories were then running full on unfinished orders which assured many that the future was secure; consequently large stocks of material were laid in at high prices and more contracted for. When the depression became a certainty many manufacturers continued to produce for stock, expecting it to be of comparatively short duration. Accurate statistics showing the machine tool production in pre-war years, compared with the production in 1917, 1918 and 1919, would have shown that the industry had produced at such a rapid rate as to make a prolonged falling off in demand inevitable. Apart from their value as records and as a guide to production, trade statistics are helpful to manufacturers in kindred industries whose relation is that of a buyer or seller.

Statistics reveal many surprising and encouraging facts bearing on current conditions. For instance, 85 per cent of the working men and women in the United States are employed today and at higher average wages, when compared with the cost of living, than at any time in the past twenty-five years. Savings bank deposits are increasing today more rapidly than at any time in the history of the nation. These are sure indications of returning prosperity, because apparently we have passed the era of reckless spending and entered upon an era of thrift, which is a necessary adjunct of normal industrial conditions.

Sometime there surely will be available complete trade statistics covering all the important industries, which will make the future safer for manufacturers and investors than it has been. Such statistics must be available to both seller and buyer, so that no unfair advantage can be taken of them for the purpose of limiting production or raising prices. Every industry will be benefited thereby, more stable industrial conditions will be made possible, judgment based on accurate facts will replace guesswork, and manufacturers' associations will exercise their highest functions for the benefit, not of one, but of all the industries of the country. It is becoming more clearly understood that no industry can prosper and profit alone. These conditions in any industry will be possible only when all, or nearly all, are prosperous.

* * *

REPAIR SHOPS NEED BETTER METHODS

In most shops where automobile repairing is done there is no uniformity in methods, and consequently the cost of the work varies greatly. In refinishing cylinders, for example, some shops grind, others ream, others simply bore. If the equipment used for making the same repairs on the same type of engine in a dozen shops could be gathered together, it would make a truly miscellaneous collection. When we consider how highly developed and standardized are the methods of manufacturing automobiles, the crude and inefficient practice in repair shops on the same class of machinery is striking. There are a few well equipped repair shops where the equipment has been selected with a view to efficiency and service and where modern methods are applied; but these are the exception.

Even the service stations maintained by the automobile companies themselves frequently are not equipped or organized to produce the most work for the least outlay, and both equipment and methods seldom compare favorably with those employed in the manufacturing plants where the cars are made. The management apparently does not consider that if the equipment and methods are deficient the service cannot do justice to their cars. The reputation of a high-class car may be lost or impaired through the inefficient service stations maintained by the manufacturers, who should devote the same attention to their service stations as to their manufacturing plants. If the former were brought up to the standard of the factory, automobile repair shops generally would be forced to adopt a higher standard, with resulting benefits to all who use them.

During the past two years considerable new equipment has been installed in repair shops which has not always been bought with the best judgment. Machine tool manufacturers can help this branch of the industry generally by educating small repair shop owners in the selection and operation of the best equipment for their purposes, and all concerned will profit thereby.

* * *

STANDARDIZATION SURELY PAYS

According to the statistics furnished by manufacturers and other authorities in the automotive industry, the annual savings resulting from the standardization effected by the Society of Automotive Engineers amount to 15 per cent of the annual turnover in the industry. This turnover is about $5,000,000,000, and the estimated saving therefrom amounts to $750,000,000 a year. No other society or association that we know of has made such great progress in the practical application of standardization. Hundreds of items have been made the subject of investigation and study, and many of the component parts used in automobile construction are now made by all manufacturers according to definite specifications. The marked improvements made in automobiles, without a proportionate increase in price, have been due in large measure to this work.

Other associations and societies that can do so profitably, should follow the example set by the automotive engineers. What has been accomplished by them can be accomplished in other industries, provided there exists the will to cooperate. This is the most important factor; for the success of standardization work in any industry depends upon the extent to which the cooperative spirit is developed and flourishes. In spite of the strenuous competition between automobile manufacturers there has always been a marked cooperative spirit among them. Individual manufacturers always have given freely their figures on production and turnover to their associations—technical and commercial—and as a result there is more information available relating to the automotive industry than to any other industry except iron and steel. This cooperative spirit is extended to the automobile engineering departments, and through them has come about the standardization work which serves as a bright and shining example to other industries.

Very large savings will result to both manufacturers and users of machine shop equipment and appliances, if through cooperation, manufacturers will agree upon certain standards for such parts of their product as need not differ.

National Machine Tool Builders' Convention

THE spring convention of the National Machine Tool Builders' Association was held at the Hotel Traymore, Atlantic City, April 25 and 26. The main business of the meeting was the revision of the constitution and by-laws of the association, and considerable time was devoted to this question. The remainder of the time was devoted mainly to committee meetings. In addition, reports on standardization were presented and such questions were dealt with as various members themselves chose to bring before the meeting in order to have the present problems of the industry discussed.

Address of the President

In his opening address, the president of the association, August H. Tuechter, of the Cincinnati-Bickford Tool Co., Cincinnati, Ohio, called attention to the solid constructive work that has been done in the face of discouraging conditions, and to the wide recognition that this work has received. Some of the vital problems now confronting the machine tool builders were also reviewed. "When the world again needs new machine tools," said Mr. Tuechter, "we will be there with tools so good that the world will have to throw its old ones on the scrap heap. Perseverance and courage have always marked this industry in every depression, and they mark it now as always before."

One of the important points mentioned was the value of reliable forecasts of fluctuations in demand. "With such forecasts, managers in our industry will be able to avoid disaster by learning to keep their finances sound, by learning when to stock and when not to stock, by learning when to run ahead of demands and when to hold operations close to demand. . . . The industry would also be benefited by having reliable forecasts of revival of demand, so that after costs are reduced through the operation of cyclical forces, the industry can again put men to work in advance of the next rise in demand. All equipment cannot be made for stock, and the builder of non-stock machinery always faces the difficulty of building his forces when the labor market is short of men."

It was pointed out that the work of the association and its cost to members should always be regarded strictly as a business proposition. In this connection, the valuable service rendered by the association when its facilities are utilized was emphasized, and some of the important activities were referred to, such as supplying information on business conditions, taxation, etc., and the issuing of special and periodical bulletins in addition to the monthly survey of economic conditions.

Standardization and statistical work covering every branch of the industry were cited as the two big tasks ahead. The importance of standardization and the backwardness of the machine tool industry in this respect, as compared with the automotive industry, was referred to, as well as the increasing demand for the standardization of those elements that are common to all machine tools. The standardization of T-slots was referred to as the first project to be considered, since these slots are found on practically all machine tools. Reference was made to the work of standardization done by the Machine Tool Builders' Association in England in arriving at a standard for milling machine spindles so that in the future face mills, arbors, etc., can be applied interchangeably to English milling machines.

The General Manager's Report

The customary report by the general manager of the association, Ernest F. DuBrul, contained many matters of great importance to the machine tool builders of the country. Mr. DuBrul particularly emphasized the value of an association as an information bureau, when there is the proper spirit of cooperation and the willingness to spend whatever money is required to get results. Attention was called to the fact that information about an industry must come from the industry, and must then be applied by the individual in his own business. By way of illustrating one of the activities along this line, reference was made to the model contracts covering the taking of patents by employes that were procured and distributed as a safeguard against expensive and unnecessary litigation.

That part of the report covering business conditions referred to the gradual increase in shipments and orders for machine tools since July, and also to the encouraging sign that business policies in the industry are being based, on an increasing scale, upon an intelligent study of the necessary cycles that are characteristic of the machine tool industry.

Another timely subject covered by the report pertained to the valuable service of the association in connection with amortization claims. The claims filed as a result of this campaign are claims for money which the law allows a machine tool builder to deduct or to have refunded, if paid. According to Mr. DuBrul, "The total amount of claims that will be presented and allowed as a result of the association's interest in the matter will far exceed the total cost of the association for the last twenty years and for the coming ten years. This is a direct money benefit that the association has returned to some members."

Interesting features of Secretary Hoover's conference of trade association representatives held on April 12 were summarized, and also such important subjects as the study of unemployment and business cycles, the value of adequate cost systems, and the necessity of improving the statistics of the association, especially those needed for a first-class business barometer.

In connection with cost systems, reference was made to the work started last year and carried to the point of establishing a set of uniform principles which association members may use as a basis for cost-finding systems. "It is very desirable," said Mr. DuBrul, "that those who can possibly afford it, revamp their cost systems to bring them in accord with these principles, and this is the best time to make changes. If members wait until faced with a rush of business, they will be unable to do good revision work on cost systems. Now is the time when members should be using the over-earned and unearned burden accounts that were recommended in our cost plan. The man who divides his total expenditures for a month by the number of hours, or other divisor used to arrive at a burden rate, now gets a ridiculously high figure. Such a method has been described as giving merely an exercise in long division, but not giving costs. If, on the other hand, a concern has established a normal burden rate, its costs continue to be comparable during this sort of period. The difference between a normal rate and the actual expenditure is taken into the unearned burden account."

The proposed business barometer merely deals with orders and shipments and not with production and stocks, as do the various group reports. The sole requisite is that the members furnish the information. The fact was emphasized that in order to get a barometer that is worth while, it is necessary to classify orders and shipments in groups covering all classes of machines according to their prices. Six classes were suggested ranging from $250 and less up to and including $4000. The idea is that such a tabulation of orders monthly, covering all kinds of machines within the given classes, would give the entire industry a valuable index of the progress of demand.

The Trade Association Conference

ANOTHER step was taken toward more complete cooperation between industry and the Department of Commerce at the meeting in Washington, April 12, between Secretary Hoover and the executives and secretaries of trade associations. The meeting had been called to consider ways and means of obtaining closer cooperation between the Department and the industries represented by the trade associations, to plan the organization of a comprehensive statistical service, and to arrange for giving publicity to statistics in such a manner as to meet the requirements of the Department of Justice. The meeting was attended by representatives of several hundred trade associations and by the editors of the leading industrial and trade journals. The opening address by Mr. Hoover defined very clearly the status of trade organizations, the possibilities for cooperation with the Department of Commerce, and the service that trade associations can and should render to their members. A clear indication was also given of the practices of trade associations that are not approved by the Government.

Need for Trade Associations

In his opening remarks, Mr. Hoover emphasized the fact that while the efficiency of individual business men engaged in industry and trade is high, there are many questions of general interest that require common action. This was the reason for the organization of trade and industrial associations. Results valuable to the community have been obtained through this cooperation, but one of our national problems is how to obtain the beneficent results of such cooperation without creating influences that will stifle equality of opportunity. Competition among individuals must be maintained as the main impulse toward progress. The legitimate associations in industry and commerce have proved to be in the public interest; one needs only to examine the many functions of the existing 2000 organizations to demonstrate this.

Valuable Activities of the Trade Associations

Among the activities undertaken by trade associations which have been valuable to the country at large, Mr. Hoover mentioned the promotion of foreign trade, with better preparation of goods to meet the necessities of different markets; the securing of credit information in foreign markets; the collection of information relating to demand and supply of goods from competitive countries, custom regulations, transportation of goods, port and warehouse conditions; and the creation of a merchant marine. In the domestic field they have collected domestic credit information, handled insurance in different forms for their members, and standardized qualities and grades of commodities and products so that the public may obtain reliable grades at predetermined specifications.

They have simplified trade terms, eliminated unnecessary varieties, engaged in joint advertising, acted jointly to prevent infringement in trade marks and designs, promoted welfare work among employes, aided employment insurance, created apprenticeship systems, developed trade education, and acted in common for the prevention of industrial accidents. They have also represented the industries and trades in legislation relating to tariff, taxes, and transportation, and have concerned themselves with freight rates, overseas transportation charges, uniform bills of lading, statistics as to production and stocks of goods, rational cost accounting, etc. All these activities, it would be possible to demonstrate, have resulted in great savings in cost of production and distribution for the benefit of both producer and consumer.

General Membership of Trade Associations

There is one generalization in connection with this movement, Mr. Hoover pointed out, that has been mostly overlooked. The membership of the trade association is predominantly made up of the smaller establishments. Big business can employ its own agents in all these matters. It can establish its grades and standards; it can employ its own research laboratories. Little business can hope only to be equally informed and make equal efforts to promote its welfare through trade associations.

The law provides that the Secretary of Commerce shall promote trade, industry, and transportation. In the reorganization of the Department of Commerce that it might become of far greater real service to our whole public, an effort has been made to cooperate with industrial and commercial organizations in the promotion of marketing abroad, in transportation, in elimination of waste, and in the improvement of our industrial technology, statistical services and information, and in many other directions.

These problems must become practical problems of day-to-day contact with commerce and industry, if the Department is to learn the direction in which real service can be accomplished. Such contact can be secured only through trade and industrial organizations, for without organization there can be no representation. Legitimate trade association work, therefore, Mr. Hoover said, is vital and should be encouraged.

Objectionable Activities of Trade Associations

Mr. Hoover made it very clear that trade associations, in order to obtain the cooperation of the Department of Commerce, must conform with the requirements of the law for maintaining our industries on a competitive basis. Certain doubts have been created as to the right purpose of all trade associations during the past year by the exposure of a few groups that have used the benevolent purposes of trade association work as a cloak to create combinations which restrained trade and became centers of corruption. A canvass of nearly two thousand trade associations has showed that only a small number were engaged in those functions that lay the foundations upon which a restraint of trade is suspected.

It is obvious that the Department of Commerce cannot establish cooperative relations with associations who follow practices that have been condemned by the courts. Again there are some two or three activities carried on by a small number of trade associations, the legality of which has been questioned but not yet determined. These are in the main the so-called "open-price associations," which are collecting data on prices and sales of their individual members, and circulating such individual data again to their members, together with certain other information.

"I wish to state frankly and at once that the officers of the Government do not believe that these functions are in the public interest," said Mr. Hoover "whether they are in violation of the law or not. The Department laid down the rule nearly a year ago that it could not cooperate with associations subject to such criticisms and sees no reason to change it."

Cooperation with the Department of Commerce

In regard to cooperation between trade organizations and the Department of Commerce, Secretary Hoover emphasized that all the services of the Department are offered for voluntary acceptance by the trade associations. They are not imposed upon anyone. The Department wishes no arrangement to be established which is not based on the expressed wish of the industry for such cooperation, with a view to aiding the trade associations in their legitimate intentions to serve the industry.

Many of these cooperative services have been developed by the Department of Commerce during the past year. The foreign trade division of the Department has been divided into specialized branches which work in intimate contact with the men in the different industries, and cooperation has already been established with several trade associations who have appointed special committees to advise and direct the Department's agencies abroad on behalf of the whole industry. This has resulted in placing these energies in the channels where the sale of actual goods has been promoted; in dictating the character of information needed for special trades; and in promoting the economic handling and reduction of risks in foreign business.

This cooperation has been very successful. The growth of inquiries from the industries to this division has increased from a few hundred to several thousand daily. Those industries that have not yet taken advantage of this cooperative effort on the part of the Department are invited to make use of the Department's facilities.

Cooperation with the Bureau of Standards

Another field in which the Department has worked jointly with various trade associations is in the advancement of their efforts at simplification of trade terms, in the simplification of general specifications, and in the simplification of dimensions of many and varied products—all of which make for cheaper production and cheaper distribution, which ultimately benefits the consumer as well as the producer.

The Department of Commerce has cooperated with many different industries in carrying out investigations into the technical processes of manufacture, thus taking advantage of the practical experience of men from the trade associations cooperating with the Department's scientific staff. This work of elimination of waste is of the greatest importance to our commercial and industrial development, and can be accomplished only by cooperative effort on scientific lines.

Value and Need of Statistics

The third field in which the Department of Commerce has had much cooperation has been in the development of the government service devoted to publication of statistics on production and distribution of commodities. These services had existed in the Government for many years and the problem was to make the material of greater value to the commerce of the country. In these matters the Department has had the cooperation of many trade associations. These services need further development in the interest of the whole community.

Statistical information as to productivity and national stocks is needed not only by the men in a particular industry, but by men in other industries as well. A study of the trend of production and consumption does not imply restraint of trade. If it does, then the whole statistical basis of commerce that fills one-third of our newspaper space would need to be abolished, and if it were abolished, we would be bankrupt in ten years. "The matter that I am principally interested in" concluded Mr. Hoover, "is that this information should be available to the whole public. It is the old question as to whether a community will succeed better if it acts in ignorance or if it acts in knowledge."

* * *

A general investigation of scrap losses in aluminum alloy foundry practice made by the Pittsburg Experiment Station of the United States Bureau of Mines showed that the annual losses in the United States amount to about $1,200,000, and that universal adoption of methods recommended by the bureau would probably result in a saving of about $600,000 a year. The complete results of the investigation will be published in bulletin form.

INDUSTRIAL CONDITIONS IN FRANCE

By MACHINERY'S Special Correspondent

Paris, April 13

Industrial conditions in France remain unsettled. Considerable variation from day to day in the exchange rates tends to keep manufacturers from undertaking any contracts covering a lengthy period. The only manufacturing plants operating steadily at the present time are those producing woodworking machinery, or machines and materials to be used in developing the water-power resources in the French mountainous regions. Sales are rare in the machine tool field, except by dealers handling machinery of German manufacture. In the northern part of France manufacturers are entirely replacing the equipment destroyed during the war with machinery imported from Germany. However, certain machines of well-known American make are being purchased by French manufacturers in spite of the high prices. Machinery of English manufacture also has a slight but steady sale.

The Wiesbaden agreement, which at first created considerable adverse criticism among French manufacturers, has now been accepted more or less graciously. At one of its meetings the Federation des Industriels et des Commercants Francais recognized the agreement, holding that the payment by Germany of her indebtedness with manufactured goods was in accordance with the terms of the treaty of Versailles and that it facilitates the actual delivery of the material.

Most of the orders which French manufacturers counted on receiving in connection with the reconstruction of the devastated sections will be placed in Germany. As a result, German industries will occupy an important and definite position in France. The introduction of German goods into France is one of the surest ways of obtaining the proper reparation, if precautions are taken to see that Germany does not send materials that French manufacturers produce in sufficient quantities to meet the needs of the country. It seems that this attitude of mind toward the arrangement is being generally adopted.

During the month of January there was a reduction in the imports of raw materials and manufactured articles which amounted to 836,067,000 francs (about $77,503,400, present exchange) and a reduction in the exports of such merchandise of 127,877,000 francs (about $11,854,200). Present imports are now lower than exports.

A great number of the articles included in the recent tariff laws are insufficiently protected. Since the end of the war a general revision of the tariff rates has been contemplated, but such a revision could not actually be undertaken so long as exchange rates remain unstable and business unsteady. It was, therefore, decided that until such a revision could be made, rates would be based on a system of coefficients. The coefficients established were often arbitrary. Besides being complicated, this system cannot take into consideration the fluctuation and prices of materials. Various propositions on the tariff, including the tariff on machine tools, are now before the Chamber of Deputies.

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TERMS USED FOR CASTINGS

At the American Gear Manufacturers' Association's annual meeting in Buffalo, the metallurgical committee proposed that, in designating castings made from steel, the expression "steel casting" always be used instead of the term "cast steel," in order to prevent confusion with the many so-called cast-steel tool steels on the market. It was also recommended that the term "cast iron" be dropped for the more explicit terms "gray iron" or "white iron" as the case may be, and that the term "semi-steel" be dropped in favor of the more specific term "gray iron with a certain percentage of steel scrap." The association accepted the recommendations with regard to steel castings and gray iron and white iron, but deferred action in regard to semi-steel.

THE RADIO EQUIPMENT INDUSTRY

"Broadcasting" has caused a phenomenal growth of the wireless industry. There are hundreds, if not thousands, of newly formed organizations in the radio field, and many others are constantly being formed to meet the abnormal demand. Most of these concerns, however, are producers in name only. The majority of the so-called manufacturers of radio equipment are little more than assemblers who have no manufacturing facilities. They purchase their metal parts from outside manufacturers, most of whom are unable to fill promptly the orders which are flooding their shops.

The contract shops that are actually doing the manufacturing are not rated as radio equipment manufacturers, while, on the other hand, those assemblers who are so rated often have no factories, or at least none that contain machinery. The entire production facilities in such shops often consist, perhaps, of a bench or two, with a few girls to assemble the units. One electrical engineer who has been connected with radio development since 1905 and is the originator of a certain type of wireless apparatus states that there are not more than twenty actual manufacturers of radio equipment in the United States, who have facilities for producing radio apparatus complete from start to finish. It is the parts manufacturing business that has assumed such large proportions.

Screw machine products molded into some insulating material, or otherwise attached, and sheet-metal stampings constitute the greater part of the metal units that enter into the construction of radio receiving sets. The flood of orders for these metal parts has surpassed the production facilities of shops regularly engaged in the manufacture of this class of work. The overflow will be taken care of by those machine shops that are properly equipped and in a position to handle additional orders. There is an opportunity for metal-working plants having small screw machine and power press equipment available to handle some of the present overflow. The radio industry promises to be active for a considerable period, as there are at present but a comparatively small number of receiving sets in use. It has been recently estimated that about 600,000 receiving sets have been distributed.

Classification of Manufacturers of Radio Equipment

In the early development of any industry there is lack of standardization and efficiency in manufacturing methods. An analysis of the present manufacturing conditions in the radio industry places the manufacturers in three groups: The first class is made up of operating plants that have previously been engaged exclusively in the manufacture of telephone and telegraph equipment. These manufacturers are well equipped for turning out radio apparatus in large quantities, and the methods found in these shops are well systematized. The second class consists of manufacturers who, through a lack of activity in their own industry and because they possess suitable machining equipment, have undertaken to manufacture wireless apparatus and furnish the parts to others engaged in the assembling of the units; manufacturers in this class sometimes build some of the more simple equipment completely. The third group comprises assemblers, who turn out receiving sets, trademark them and place them on the market. It is probable that at present more radio equipment is produced by this means than the combined products of the other two classes.

Machine Tool Equipment Used in Making Radio Apparatus

Molded insulator parts of bakelite, condensite, formica, and other compositions are largely used in radio receiving sets, and glass parts for vacuum tubes and lightning arresters are also extensively used; but neither of these products would be manufactured in a shop primarily engaged in metal-working. For that reason nearly all the molded composition articles are obtained from companies specializing in molded insulator materials; similarly, the glass detector and amplifying tubes and the lightning arresters are generally furnished by manufacturers specializing in those lines.

Comparatively few types of machine tools are employed for making the metal-working parts of radio equipment, fully 75 per cent of the parts being produced on screw machines and power presses. There is considerable use for certain light bench equipment such as bench lathes, and drilling and tapping machines are, of course, required. The hand screw machine or turret lathe also finds considerable use. Although a comparatively large amount of wire is used, most of the winding is done by means of special attachments either on a bench lathe or a speed lathe, so that single-purpose machines are rarely needed.

In the regenerative type of receiving set, the rotor and stator of the variometer are usually made of wood (although these parts are sometimes molded from bakelite), consequently woodworking machines are required for this work. The sets are usually furnished in a wooden cabinet with a suitable panel, made either of wood or of some molded material, on which the controls, dials and connection sockets are arranged. It is not the usual practice, however, for the instrument manufacturers to build their own cabinets, but they often finish the panels, and this requires certain woodworking machines. If the panels are to be grained, a sanding belt is usually employed.

An engraving machine is necessary for cutting the manufacturer's name and all notations pertaining to switches, capacity, and certain other specifications on the panels. A great many of the metal parts are made of nickel-plated brass; therefore plating equipment and polishing machines are in common use. Among the other machine tools that find varied application may be mentioned hand milling machines, nut tappers, arbor and foot presses, power saws, and riveting machines.

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PRODUCTION OF MILLING MACHINES IN 1919

On page 467 of February MACHINERY a table was published giving the production of machine tools in the United States as compiled by the Bureau of Census for 1919. The figures covering milling machines have been corrected by the Bureau because of an error that appeared in the returns given by one of the manufacturers. The corrected figures, as sent by the manufacturer to the Bureau in a revised return, are given in the accompanying table.

MILLING MACHINES MANUFACTURED IN THE UNITED STATES IN 1919

	Number of Establishments	Number of Machines	Value
Milling Machines			
Plain	34	7433	7,088,120
Ohio	10	3246	2,979,301
Wisconsin	3	924	1,536,666
New York	4	646	479,937
Connecticut	3	274	176,986
All other states	14	2343	1,915,230
Universal	17	3201	5,635,758
Wisconsin	4	914	1,710,317
Ohio	4	1155	1,860,215
All other states	9	1132	2,065,226
Vertical	14	1316	2,761,737
Automatic	12	822	1,232,048
Other Types	22	1760	3,000,593

Machinery

* * *

The Soviet Government, about a year ago, placed an order for 1000 locomotives with the Trollhättan Locomotive Works in Sweden, with the stipulation that deliveries be made during a period of five years. The locomotives are of the improved type based on a model developed at one of the leading Russian locomotive works in 1912. During 1921, 50 locomotives were delivered and 200 are scheduled for shipment this year, while during the next three years 250 locomotives will be completed annually until the entire order is filled.

Gear Manufacturers' Annual Meeting

THE sixth annual meeting of the American Gear Manufacturers' Association, held in Buffalo, April 20 to 22, was characterized by the activity always displayed by the association. Many reports on standardization were presented at the meeting, some of which were acted upon and adopted either as standards or as recommended practices. Progress reports were also presented by several committees, although final action was not taken at this meeting. A number of addresses on subjects closely allied to practice in the gear-cutting field were read, the meetings occupying the entire time of the three days set aside for the convention.

The President's Address

In his address at the first general session, F. W. Sinram, president of the association, referred to the present trend in the industry and to some of the important activities of the association. These activities were classified as twofold—commercial and technical. It was pointed out that commercial matters should receive greater consideration, especially as regards concerted constructive effort, and that, regardless of initiative, progress in any direction can be achieved only when a fair proportion of the industry is receptive and ready to cooperate. The discussion of commercial subjects in connection with the association meetings was advocated because "the present demands constructive effort that we may stabilize our industry and do our part in giving stability to business in general." In connection with this topic, the attention of the members was directed to the two group meetings for considering industrial conditions. In view of the fact that there are problems peculiar to each of the main groups comprising the gear industry as a whole, separate meetings for each were arranged to facilitate the deliberations, and in order to accomplish as much as possible. In commenting briefly on the technical side of the association's work, what has been accomplished, especially toward standardization, was referred to as a decided step forward, and as a phase of the work that has attracted the attention of the entire mechanical world.

Papers Read before the Meeting

The papers read before the convention covered a wide range of subjects. H. E. Harris of the Harris Engineering Co., Bridgeport, Conn., read a paper on "Good Practice for Cutting the Faces and Clearance of the Teeth of Hobs, Gear Cutters, and Form Cutters." In this paper Mr. Harris emphasized the necessity for proper rake of hob and gear cutter teeth. Ralph E. Flanders of the Jones & Lamson Machine Co., Springfield, Vt., read a paper on "The Use of the Projection Comparator in Testing Gear and Gear Cutter Teeth," in which he pointed out the advantages of the Hartness comparator for the visual inspection of tooth profiles. G. E. Katzenmeyer, of the R. D. Nuttall Co., Pittsburg, Pa., presented a paper on "The Proportions of Industrial Gears," containing valuable formulas and charts which enable the designer to readily proportion gears according to requirements and to place this work upon a standardized basis. R. S. Drummond of the Gear Grinding Machine Co., Detroit, Mich., dealt with the subject "The Grinding of Gear Teeth and its Future in the Industry." F. E. McMullen and T. M. Durkan presented a paper on "The Gleason Works System of Bevel Gears" in which the principles underlying the system were thoroughly explained.

Hartness Comparator Applied to Gear Testing

The application of the Hartness comparator as a thread-testing apparatus is dealt with in the first part of Mr. Flanders' paper, and then the use of this apparatus for the inspection of gears and gear-cutters is considered. For gear work the comparator is entirely rearranged. The microscope must have a large aperture to take in a whole tooth, and in order to get the required degree of magnification at a distance of five feet (so that the operator can readily observe and manipulate the work) the image is reflected against a mirror, because the angle of projection is so wide that no lens system can be devised to prevent distortion and interference from color bands. The accuracy of the results may be judged from the fact that with a magnification of 100 times, differences of 0.0001 inch can be detected.

As applied to a form cutter, the apparatus is applicable for testing the regularity of the teeth one with another; the tooth of a cutter giving satisfactory results may be compared with one which is not satisfactory and the reasons for the unsatisfactory results determined. The projection of cutter outlines is a comparatively simple problem, owing to the sharp, definite character of the cutting edges. In the case of gears, however, the problem is complicated because of the lack of clearly defined lines both at the entering side of the cut and at the opposite side. Furthermore, many gears used in the automotive field have the teeth chamfered.

An ingenious and interesting part of the apparatus is that used for projecting and tracing a tooth outline representing any section throughout the length of the tooth. This is done accurately and simply, by using a needle that is mounted and focused in the plane of the tooth to be inspected. The tooth outline is traced by this point, the junction of the point and its reflection providing a location for the surface which is measurably accurate within 0.0001 inch; it is also possible to draw the outline rapidly with nearly this degree of accuracy.

Gleason Bevel Gear System

The bevel gear system developed at the Gleason Works, as explained in the paper by McMullen and Durkan, is the result of a need for a definite system of designing bevel gear teeth based on the most desirable tooth form for use under average conditions. It has been common practice in the past to use spur gear formulas, such as those of Brown & Sharpe and Fellows, in figuring bevel gears. These formulas were worked out for an interchangeable spur gear system, which necessarily required some compromise, so that when they are applied to bevel gears, where interchangeability is not a factor, the possibilities of the involute curve are not fully utilized. The Gleason 0.3 and 0.7 long and short addendum tooth was brought out to improve this condition, and various other alterations of the standard spur gear design have been used, but for the most part these can be applied to certain combinations only, and therefore, are not universal. Recent applications of bevel gearing covering a wide range of ratios have made it imperative that a progressive system, embracing all ratios and any number of teeth in common use, be worked out.

An investigation has been conducted by the Gleason Works with the idea of developing a practical system of designing the quietest form of tooth consistent with strength and wear considerations, and the results of this research have been incorporated in a simple table. This system applies to any pair of generated spiral or straight-tooth bevel gears, operating at right angles, where the pinion is the driver and has ten or more teeth. Bevel gears cut on planers of the former type are the subject of a special study, as certain practical limitations prevent the application of the system to this class of gearing without modification.

The principal qualities considered in arriving at this system, arranged in the order of their importance, are quietness, strength, and durability. In regard to quietness, experience shows that bevel gears cut with a lower pressure angle will operate more quietly than those with a higher one, other conditions being equal. There are several reasons for this: With the lower pressure angle, a greater arc of action is obtained, any eccentricity has less effect, and the radial component of the tooth load is minimized. Thrust forces also make it desirable to avoid the higher angle, not only because of the introduction of an axial or cone thrust not present in spur gears, but also because the majority of bevel gears are overhung from their supports so that the total load should be kept as low as possible. For these reasons the basis of the system is the use of the lowest pressure angle that can be employed without sacrificing strength by introducing excessive under-cut.

The limitation of under-cut has been fixed by a study of successful automobile practice where both strength and silence are paramount. Strength, as governed by the pressure angle, is not sacrificed to any great extent when a low pressure angle is selected in the interests of quietness, because the stronger tooth section of a higher angle is nearly offset by the greater arc of action of the lower angle. The effect of this increased arc of action is to keep the load nearer the pitch line when only one tooth is in contact. Durability has been taken account of in the system by proportioning the teeth so that the sliding action, which is always present in gears, is approximately balanced between approach and recess. The various factors that go to make up the system have been arrived at by an examination of the considerations already outlined, and have been arranged in a simple practical form. The Gleason Works system will be fully described in June MACHINERY.

Reports of Committees

Among the committees that presented reports were the Sectional Committee of the association working in conjunction with the American Engineering Standards Committee; the General Standardization Committee; and the Spur Gear, Bevel Gear, Spiral Gear, Herringbone Gear, Electric Railway and Mine Gear and Pinion, Nomenclature, Worm Gear, Inspection, Composition Gearing, Keyway, Sprocket, Metallurgical, Transmission, Differential Gearing, Tooth Form, Uniform Cost Accounting, and Library Committees.

Companies Elected to Membership

The convention also included two special group meetings, one of the Industrial Gearing Group and one of the Automotive Gearing Group to consider the conditions in the industry. The American Gear Manufacturers Association now has 94 member companies, 110 executive members, and 55 associate members. The Automotive Gear Works, Atlanta, Ga., was elected to membership at this meeting, with C. G. Hamilton as executive member. The Willys-Morrow Co., Elmira, N. Y., was also elected to membership, with F. H. Higgins and T. W. Tidd as executive members. E. H. Ott of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., and D. L. Boyle of the General Electric Co., Schenectady, N. Y., were elected associate members.

Executive Committee and Officers

The following members were elected to serve on the executive committee of the association: E. J. Frost, Frost Gear & Forge Co., Jackson, Mich.; J. B. Foote, Foote Bros. Gear & Machine Co., Chicago, Ill.; C. F. Goedke, William Ganschow Co., Chicago, Ill.; W. H. Phillips, R. D. Nuttall Co., Pittsburg, Pa.

The officers were all re-elected to serve for the coming year and are: President, F. W. Sinram, Van Dorn & Dutton Co., Cleveland, Ohio; first vice-president, R. Johnson, Warner Gear Co., Muncie, Ind.; second vice-president, B. F. Waterman, Brown & Sharpe Mfg. Co., Providence, R. I.; secretary and treasurer, F. D. Hamlin, Earle Gear & Machine Co., Philadelphia, Pa.

CONVENTION OF THE NATIONAL METAL TRADES ASSOCIATION

The twenty-fourth annual convention of the National Metal Trades Association was held at the Hotel Astor, New York City, April 19 and 20. The first session, in addition to the usual preliminaries, included the appointment of convention committees and the reports of W. W. Coleman, president; Frank C. Caldwell, treasurer; Homer D. Sayre, commissioner; and L. W. Fischer, secretary. During the sessions following, many subjects of vital importance to the metal trades were presented by prominent speakers. Professor Harold G. Moulton of the University of Chicago spoke on "American Industry and the Stabilization of Europe." A clear analysis of the factors affecting business conditions both here and abroad was presented, as well as the important points to be considered in building up export trade. "Facts and Fancies about Wages in Basic American Industries" was the subject of an address by Magnus W. Alexander, managing director of the National Industrial Conference Board, New York City. A. M. Loomis, from the Washington office of the National Grange, spoke on "The Farmer as a Balance Wheel"; and James A. Emery, counsel for the National Association of Manufacturers, spoke on "Industrial Courts." E. L. Greever, whose subject was "West Virginia Fights for Freedom" gave first-hand information on this critical situation, Mr. Greever having been counsel for the non-union mine operators.

Report of Apprenticeship Committee

Another subject of vital importance to the metal trades, which was discussed at the convention, was that of training apprentices to be skilled all-around workmen. The committee on apprenticeship examined various apprenticeship systems in order to incorporate their virtues and eliminate their defects in the training course advocated. The report which the committee presented laid down courses of shop work of the apprentice and included suggestions for a standard diploma, for an interchange of apprentices among the smaller or specialty shops, and dealt with other aspects of the apprenticeship problem on the basis of the best American practice. Harold C. Smith, chairman of the Industrial Training Committee is president of the Illinois Tool Works and also of the Chicago branch of the National Metal Trades Association. The other members of the committee are William Taylor, president of the Chandler & Taylor Co., of Indianapolis, and John C. Spence, works manager of the Grinding Machine Division of the Norton Co.

The officers of the association for the coming year are as follows: President, W. W. Coleman, Bucyrus Co., South Milwaukee, Wis.; first vice-president, J. B. Doan, American Tool Works Co., Cincinnati; second vice-president, Paul C. DeWolf, Brown & Sharpe Mfg. Co., Providence; treasurer, J. W. O'Leary, Arthur J. O'Leary & Son Co., Chicago; commissioner, Homer D. Sayre; and secretary, L. W. Fischer.

* * *

MEETING OF AMERICAN WELDING SOCIETY

The American Welding Society held its annual meeting in the Engineering Societies Bldg., New York, on April 26 to 29. At the morning session on April 26 there was a conference, at which a number of tank manufacturers were present, for the purpose of considering the subject of the welding of unfired pressure vessels. At the technical session, held on the evening of April 27, a number of interesting papers were presented, among which were "Welding of Heavy Copper Plate," by A. S. Kinsey; "Electric Welding of Dredge Pipes," by J. H. Nead and R. L. Kenyon; and "Thermit Welding," by J. H. Deppeler. The reports of the various committees were presented at the different sessions, covering welding wire specifications, resistance welding, specifications for steel to be welded, electric arc welding, gas welding, training of operators, and welding of storage tanks.

Tool Design Standards

Development of Standard Instruction Sheets for the Use of Tool Designers

By H. P. LOSELY, Industrial Engineer, Detroit, Mich.

ANYONE who has worked in different tool designing offices must have noticed the large amount of time usually spent in looking up machine dimensions, how other jigs or fixtures are made, and other miscellaneous information. Somewhat less obvious, but none the less substantial, is the amount of time spent in designing certain elements of tools again and again which could be worked out carefully once, and after that simply copied when required. In addition, extra time is taken in checking the drawings each time to see that all parts of the design are correct. It is the purpose of this article to show how the principle of permanent standard practice instructions may be profitably applied to tool designing.

Developing Standard Practice Instructions

The first thing to be considered in developing such standard instructions is what shall be covered by them. No hard-and-fast rule can be laid down to cover all cases, but the following will serve as a general guide:

1. General instructions should be issued on office practice, covering every phase of the work, including the organization of the office and its relation to other departments, and the methods to be followed in ordering and routing work. The practice to be followed in making designs and drawings should also be written down. When a new man comes into the organization, he can read over these instructions and readily acquaint himself with customs, so that he can work in harmony with the organization.

2. Data should be accumulated of all machines on which jigs and fixtures are employed.

3. All elements of construction which recur with great frequency in jigs and fixtures, such as spring plungers, U-lugs, eyebolts, etc., should be carefully studied, and standard practice instructions issued concerning them. In many cases it will be found practical to draw up the element in question to scale, and dimension it so that when it is required in a design it can be readily copied. Not only does this save time otherwise spent in designing that element, but it also enables the designer, in making the first lay-out, to know how much space he will need for the element. Furthermore, the completed design will be known to be correct.

4. Certain detail parts can be so drawn on standard instruction sheets that special drawings will be unnecessary in the making of tooling equipment. This does not mean that the parts must be carried in stock; they may be catalogued by a classification number and ordered by that number when required. Examples of detail parts that can be handled in this way are as follows: Drill bushings, tool bits, locating keys and pins, jig feet, adapter plugs, and gage handles.

5. There are many details such as hand-knobs, hand-wheels, stops for jig lids, baseplates, angle-plates, and handles, which vary in the dimensions required on an individual tool, but which can readily be made from a standard pattern. This method reduces pattern costs as well as the time required to obtain the casting. In many cases it may be feasible to keep rough castings in stock, thus still further reducing costs.

In making up standard practice instructions, the neatest and handlest arrangement is to use one size of sheet. A size that has given satisfaction is 8½ by 11 inches, leaving at least a ¾-inch margin at the left side so that holes may be punched for placing the sheets in a three-ring loose-leaf binder or so that they may be bound together. When only a few copies of the instructions are required, they may be typed with a black ribbon on a good bond paper, preferably without a watermark. Black carbon paper should be placed with the carbon side to the back of the sheet thus producing a negative from which blueprints may be made. If many copies of the instructions are needed, some manifolding process may be employed. In larger offices it is worth while to have blank sheets printed and carried in stock ready for use.

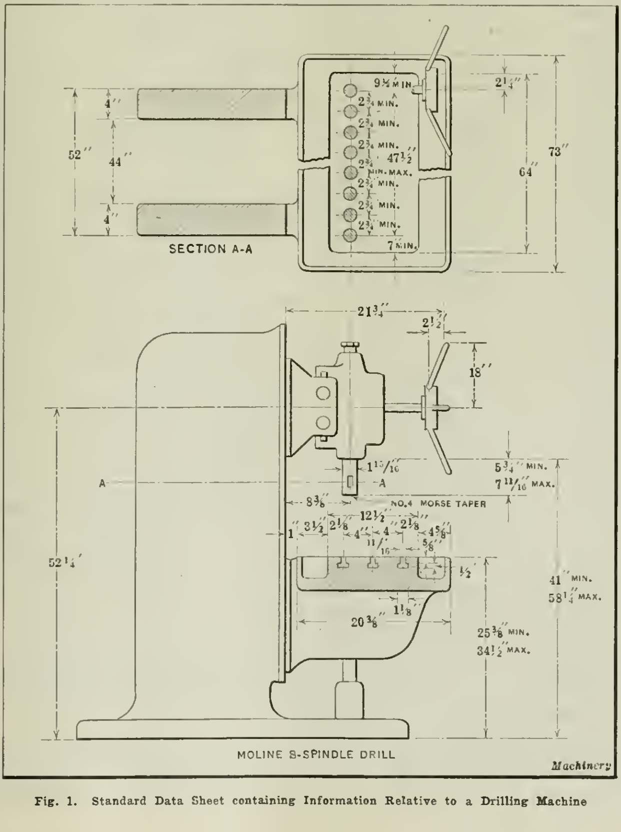


Fig. 1. Standard Data Sheet containing Information Relative to a Drilling Machine

Collection of Machine Data

The subject of machine data is somewhat controversial. In the opinion of the writer it is not worth while, as a rule, to make elaborate drawings of each machine; whenever data is required it should be obtained and arranged conveniently for reference. This end may be attained by not allowing any draftsman to go into the shop to sketch a machine without permisson from the chief draftsman who has charge of the standards. This scheme makes the men use the sheets in existence, and whenever any material is at fault or missing, they must bring the matter to the attention of the chief draftsman. The latter can keep notes of such work and see that data obtained are turned in to him. A sketch can then be drawn on a standard sheet, and the latter can then be indexed and placed in the file.

When work is slack and it is desirable to keep the force together, it may be a good thing to have sketches of all machines drawn up. The data for a machine much used may, of course, be worked up elaborately, and an ink tracing made. In any case, all dimensions should be checked by a second man before a sheet is put in the reference file. Fig. 1 gives an idea of the manner in which useful data of a machine may be arranged. In drawing up standards for units, parts, or patterns, there will be a choice between tabulating and showing each size drawn to scale. If the space is limited so that tabulation is necessary, care should be taken to do this with due regard to proportion. In fact, it is generally advisable to sketch each size roughly to scale before tabulating dimensions in order to be sure that no errors are made. It is preferable to draw each size separately on data sheets, as it eliminates referring to a tabulation for dimensions and in many cases allows a designer to make a direct comparison between sizes, enabling him to decide readily which size is best for the work in hand.

TABLE I. INDEX TO MACHINE TOOL DATA SHEETS

General Classification

Group No.	Type of Machine
1- 9	Drilling and tapping machines
10-19	Milling machines
20-29	Lathes and screw machines
30-39	Grinders
40-49	Shapers, planers, and slotters
50-59	Boring machines
60-69	Punching machines
70-79	Gear-cutting, thread-milling, profiling and broaching machines
80-89	Bench equipment
90-99	Miscellaneous

Note: For automatic and semi-automatic machines, see Section A

Detailed Classification

Group No.	Type of Machine
1	Upright drilling machines
2	Radial drilling machines
3	Multiple - spindle drilling machines
4	Bench drilling machines
5	Electric drills (hand)
6	Gun drills
7	Tapping machines
10	Plain milling machines
11	Universal milling machines
12	Hand milling machines
13	Vertical milling machines
14	Multiple - head milling machines
15	Lincoln milling machines
16	Briggs milling machines
17	Automatic milling machines
18	Keyway milling machines
20	Engine lathes
21	Turret lathes
22	Bench lathes
23	Centering machines
30	Plain cylindrical grinders
31	Universal grinders
32	Surface grinders
33	Internal grinders
34	Cylindrical grinders
35	Disk grinders
36	Cutter grinders
37	Portable grinders
40	Shapers
41	Planers
42	Slotting machines
50	Vertical boring mills
51	Horizontal boring mills
60	Plain power presses
61	Back-geared presses
62	Toggle presses
63	Foot presses
70	Gear-cutting machines
71	Thread milling machines
72	Profiling machines
73	Broaching machines
80	Arbor presses
81	Bench straighteners
82	Vises
90	Shears
91	Saws
92	Furnaces
99	Special machines

Machinery

Indexing and Cataloguing Instruction Sheets

It is most important that a proper indexing and cataloguing system be used in connection with instruction sheets. One of the chief reasons that unsatisfactory results are sometimes obtained in making up standards is that they are incompletely indexed and badly kept so that when information is wanted it cannot be found. Considerable forethought is necessary in deciding upon any numbering system, since if it is done haphazardly, a renumbering may soon be required, causing great annoyance and some expense. Before deciding on a system, it is advisable to ascertain what other numbering systems are being used by the concern so that the one used for standard sheets and parts will not be confused with others. The writer uses a symbol consisting of a letter indicating the class of data, a prefix number indicating a group in that class, and a suffix number for each sheet of the group.

Suppose, for instance, a sketch is made of a Whitney No. 6 hand milling machine. The letter "M" may be used for all machine tool data, and upon referring to the classification list in Table 1, it will be seen that 12 is the group number. Looking under the detailed list of sheets it might be found that two other hand milling machine sheets had been previously issued so the number assigned to the new sheet would be 12-M-3. Then, if a draftsman requires data on this machine he can find it on the list of hand milling machines and get the sheet from the supply room.

In numbering special tools the part number method may be used, in which a symbol is added to the part number consisting of a letter which designates the kind of tool and a distinguishing number. Then when two fixtures are required for part No. 529, for example, they are numbered 529-F-1 and 529-F-2.

Various letters may also be used for identifying the standard sheets. The letters used for these purposes must receive consideration when making the standard sheets, and the following arrangement is suggested:

SPECIAL TOOLS

(B) Boring and reamer bars
(C) Cutters
(D) Punches and dies
(F) Fixtures
(G) Gages (special)
(H) Multiple heads
(K) Tool-blocks
(L) Arbors
(R) Reamers
(T) Tool bits
(Y) Special machines
(Z) Form tools

STANDARD SHEETS

(A) Automatic lathe data
(E) Construction elements for general use
(M) Machine tool data
(N) Small tool and equipment data
(O) Organization and office system
(P) Pattern drawings
(Q) Gages (standard)
(S) Stock lists
(V) Thread gages (s't'd.)

The reason for subdividing the standard data sheets into nine classes is that this allows the group numbers generally to be kept down to two digits, and should a renumbering of any class become necessary, probably only that one class would be affected. Table 1, to which reference has previously been made, shows an index for data on machines generally used in a large shop, and indicates how the various groups may be arranged.

Accessibility and Maintenance of Data

In the distribution of standard data, the two main requirements are to make the information accessible and to keep it up to date. The following suggestions may be of value in securing these ends:

1. Place the responsibility of upkeep on the chief draftsman who can appoint an assistant if necessary.
2. File all original data sheets in the supply-room drawing files.
3. Keep a visible card index of all data sheets in an accessible place so that anyone can find the number of any required sheet.
4. Have the supply clerk maintain a separate file of blueprints of the standard sheets. The number of copies in existence should be recorded on the left-hand margin of the original, or in a large establishment, a separate card index may be kept for this purpose.
5. Require a receipt for each blueprint lent, this receipt to be given back only when the blueprint is returned to the file.
6. When changes or additions are made, require the chief draftsman to obtain the original and all blueprints from the supply clerk and have them all changed together, or the old prints destroyed and replaced by new ones.
7. Select sheets which are frequently required, and make up special standard books. These books should be firmly bound, properly recorded, and charged to the men receiving the books; loose-leaf binders should not be used.
8. Keep complete sets of prints for open reference, in small shops; where more than four men use a set, it is difficult to maintain them in this way, and it is better to keep them in a file room.

Standard Feet for Jigs and Fixtures

As a rule, it is preferable to make a jig or fixture with feet, rather than to have the under side of the base machined all over. This is particularly so when a jig is to be slid around and turned on the machine table, as it lessens the chance of chips getting between the jig and table contact surfaces. Incidentally, the cost of machining and scraping the feet is less than when a solid base is used. If a fixture is clamped to the table or not pushed around much, the most economical design is to make the feet integral with the fixture casting. The feet should be located in such a way as to prevent distortion of the casting by clamping or cutting strains, and they must be far enough apart to prevent rocking or upsetting of the fixture. Fig. 2 shows a fixture used in drilling a hole in a long bar; the bar is supported by a button *A* close to the drilling point, and an extra foot *B* is placed beneath this point of pressure to prevent the whole casting from sagging. This makes it possible to use a lighter design than could otherwise be employed.

Where cast feet are in the form of pads, they should be 1-inch square, and when finished there should be a 1/4-inch

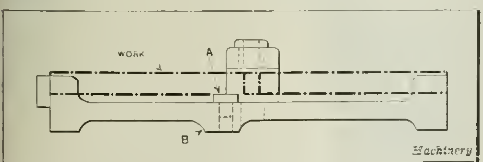


Fig. 2. Drill Jig with Extra Foot located close to Drilling Point to prevent Distortion

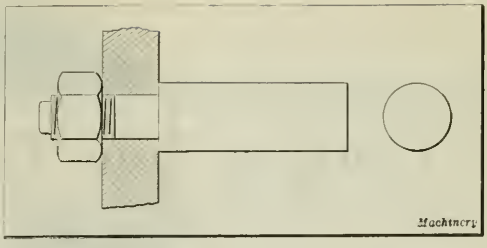
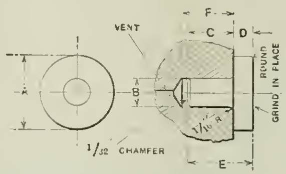


Fig. 3. Type of Foot commonly used on Reversible Jigs

clearance between the table and the rough surface of the base. If the feet are formed by an extension of a wall, they will naturally be made the same thickness as the wall and should generally be not less than 1½ inches long. The practice with milling machine fixtures is usually to make a solid base; however, if the base is over 8 by 10 inches, it is advisable to relieve it, but care must be taken to see that all pressures are transmitted directly to the machine table.

TABLE 2. DIMENSIONS OF STANDARD INSERTED JIG AND FIXTURE FEET



All dimensions in inches

A	B	C	D	E	F
¾	0.3758 0.3755	⅝	¼	⅞	¾
1	0.3758 0.3755	⅝	¼	⅞	¾
1¼	0.5010 0.5005	¾	5/16	1 1/16	⅞

Machinery

When a jig is to be slid around, or if great accuracy is required, it is best to use inserted hardened tool-steel feet. These can be carried in stock by the tool-room in sizes such as shown in Table 2, of which the 1-inch size is best adapted for general use. These stock feet are pressed fits in standard reamed holes, and the working surface of each foot is ground after all the feet of a jig have been assembled. As with any pressed-fit plug, an air vent must be provided and provision made for removal. If the air vent is so placed that a pin cannot be used to drive out a foot, then the pad supplied for the foot on the casting should be smaller in diameter than the large diameter of the foot, so that the latter may be pried out. Fig. 3 illustrates the type of foot construction commonly used on reversible fixtures, both ends of the plug being ground.

* * *

COMPENSATION FOR SKILLED WORK

By CHARLES W. LEE

The kind of encouragement often accorded skilled mechanics, especially in small towns, is well illustrated by the following incident. A hurry call on the 'phone was received recently from a neighboring manufacturer requesting the writer to come and see if he could tell what was the matter with one of the machines. The writer, not wishing to be unneighborly, left what eventually proved to be far more important business to comply with the request. On arriving at the plant a whole group of machines was found idle. Something had gone wrong with one of the machines, causing the production of the entire group to be suspended. In spite of all efforts, no one had been able to locate the trouble.

The matter was soon straightened out however, and production resumed. The writer began mentally to convert about $24.99 into terms of gasoline, supposing of course, that the manufacturer would at least suggest that a bill be sent in for the service rendered. But instead, he looked at his watch, and said: "Now let's see—you've been here about half an hour, would fifty cents be about right?"

Cutting Spur Gears by Hobbing

Setting up Gear-hobbing Machines—Examples from Practice—Application of Multiple-threaded Hobs—Cutting Small Pinions

Fourth Article of a Series on the Use of Different Types of Gear-cutting Machines for Cutting Various Classes of Gearing

GEAR teeth cut by the hobbing process are given the required shape or curvature by a generating action resulting from the rotation of the gear blank relative to a cutter of the hob form. Gear-hobbing machines are commonly applied to the cutting of spur, helical, and worm gearing, and hobbing is the most rapid method of cutting gears by a generating process. This article will be confined to spur gears.

In the practical application of the generating principle to gear-hobbing machines, the hob used has cutting teeth of the same cross-sectional shape as teeth of a rack of corresponding pitch, except for minor variations such, for example, as increasing the length of the hob teeth to provide for clearance at the bottom of the tooth spaces. As the hob teeth lie along a helical path (like a screw thread) the hob is set at an angle to align the teeth on the cutting side with the axis of the gear blank. When the hob is inclined an amount depending upon the helix angle of its teeth, the latter represent a rack on the cutting side.

When a hobbing machine is in operation, the gear blank and hob revolve together, the ratio depending upon the number of teeth in the gear and the number of threads on the hob—that is, whether the hob has a single or a multiple thread. This rotation of the hob causes successive teeth to occupy positions corresponding to the teeth of a rack, assuming that the latter were in mesh with the revolving gear and moving tangentially. In conjunction with the rotary movement of the hob, the slide on which it is carried is given a feeding movement parallel to the axis of the gear blank. As this feeding movement continues across the gear blank (or blanks when several are cut together) all of the gear teeth are completely formed. In other words, hobbing is a continuous operation, since the teeth around the entire circumference of the gear are finished together (instead of one tooth being cut at a time) and ordinarily by one passage of the hob.

A front view of an Adams-Farwell gear hobber, built by the Adams Co., Dubuque, Iowa, is shown in Fig. 1. The slide carrying the hob-spindle feeds downward or vertically as on most gear-hobbing machines. As the illustration shows, the gear on this machine is about half finished. It is made of cast iron, has 90 teeth of 3 diametral pitch, and a 3¼-inch face width. A particularly smooth finish was obtained by using a feed of 0.050 inch per gear revolution, and a hob speed of 80 revolutions per minute. This gear was completed in one hour and twenty minutes.

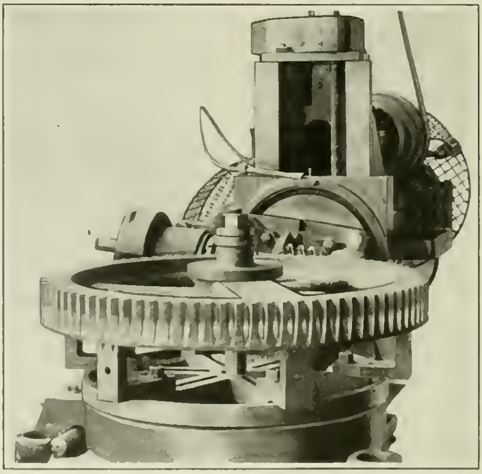


Fig. 1. Hobbing a 90-tooth Spur Gear of 3 Diametral Pitch

Another Adams-Farwell machine is shown in Fig. 2. In this instance five gears were clamped in a stack on the work-table, and were cut at one passage of the hob. This is common practice when the shape of the gear blanks will permit placing one on the other. The operation is roughing differential ring gears for a tractor. These gears have 100 teeth of 4 diametral pitch, and a 2¼-inch face width.

The hobbing machine or generator shown in Fig. 3 differs entirely in its design from the vertical-cutting type of machine. The head or slide which supports the hob is adjusted along the bed to suit the diameters of the gears to be cut, but remains in one position when the machine is in operation. The feeding movement is in a horizontal direction and is applied to the slide carrying the work. This illustration shows a 19-inch generator, made by the Lees-Bradner Co., Cleveland, Ohio, arranged for cutting tractor gears.

The gear-hobbing machine shown in Fig. 4 is so designed that the slide carrying the hob is mounted on the horizontal ways of the machine bed, and the horizontal work-spindle is supported by a slide adjustable along the vertical face of the column, to suit the diameter of the work. This machine is made by the Barber-Colman Co., Rockford, Ill., and in the illustration it is shown cutting a stack of six gears, having 37 teeth of 5–7 pitch.

The hobbing process is used extensively for cutting helical as well as spur gears, and its application to the former will be considered in a succeeding article. Hobbing machines are also used for cutting worm-gears and even for cutting worm threads.

Setting up Machine for Hobbing Spur Gears

While the exact method of adjusting or setting up a gear-hobbing machine varies somewhat with different designs and makes, there are certain general adjustments common to different machines.

No attempt will be made to cover the details of various designs, the idea being to deal with the more important general features.

In arranging a machine for cutting spur gears, there are several important adjustments to be made. The hob must be set to the correct angle, and an axial adjustment for centering a tooth relative to the gear blank may be considered desirable. The machine must be so geared that the hob and work revolve at the proper speed ratio. This is taken care of by means of change-gears.

The rate at which the hob feeds across the gear blank must be varied to suit the quality of finish required on the teeth and the cutting qualities of the material. Change-gears in some form, are also used for this purpose. This feeding movement, as previously mentioned, is parallel to the axis of the gear being cut, and the amount per revolution of the gear blank or work-table may vary from 0.015 to 0.030 inch on some jobs and from 0.100 to 0.200 on others.

The method of holding or chucking the gear blank (or blanks) is very important, and there are two essential points to consider: First, the blanks must be supported rigidly to prevent any decided springing action when the hob is at work; second, the gear blanks must be concentric with the axis of the work-spindle or table and not be sprung out of shape by clamping. It is well to test the concentricity of the blanks after they are placed on the machine and before cutting, by the use of a dial indicator.

The next step is to adjust the blank relative to the cutter, or vice versa, so that gear teeth of the correct depth will be cut. This may be done on most machines, by adjusting the cutter-slide until the hob is opposite the uncut blank; then the work-table is moved until the teeth of the hob, which should be revolving, just graze the blank. The hob is next moved far enough to clear the rim of the blank, and the work-slide is adjusted toward the hob an amount equal to the whole depth of the tooth. Gear hobbers have graduated dials on the feed-screws or special gaging devices to facilitate making these adjustments. When the hob is set for the depth of cut, as just described, the teeth should be correct provided the outside diameter of the gear blank is the right size.

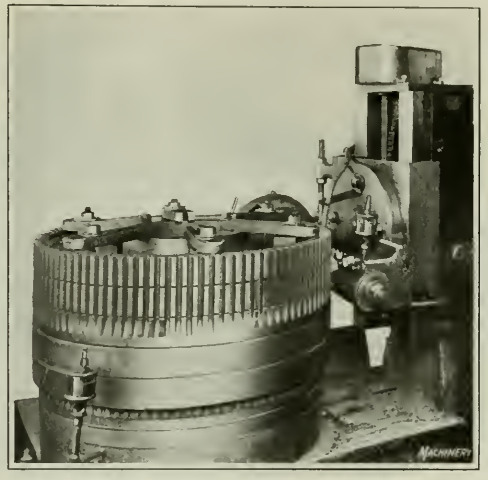


Fig. 2. Hobbing a Stack of Five Spur Gears

A reliable method of checking the accuracy of the teeth is to measure the chordal thickness, using a vernier gear tooth caliper. This chordal thickness should be checked just as soon as the hob has been fed into the gear blank far enough to produce completely formed teeth. Before the cut is started, the work-holding table or slide should be secured rigidly to the ways on which it is mounted, by means of clamping screws provided for this purpose.

The stop which serves either to automatically disengage the feed or stop the entire machine after the gear teeth are cut, is set before starting the machine, so that it will come into action after the center of the hob clears the edge of the gear blank. Spur gears are usually finished at one passage of the hob, although sometimes a roughing cut is taken with the hob set slightly less than full depth, and this is followed by a finishing cut in order to obtain greater refinement. According to one rule, two cuts should be taken when cutting gears of 3 diametral pitch and coarser, assuming that gears of the best grade are required. The important adjustments referred to briefly in the foregoing will now be dealt with more completely.

Determining Angular Position of Hob when Cutting Spur Gears

Although a hob must conform to the diametral pitch and pressure angle of the gear to be cut (the pitch being stamped on the hob), it is not necessary to consider the number of teeth in the gear, as when using formed cutters. In other words, a hob of given pitch is applicable to gears having any number of teeth, and this is also true of cutters used on any machine of the molding-generating type.

The angle at which the hob-spindle or swivel slide is set depends upon the lead of the hob thread and its diameter, since the object of inclining the hob is to bring the teeth on the cutting side into alignment with the axis of the gear blank. This angle is equal to the helix angle of the hob thread at the pitch line, measured from a plane perpendicular to the hob axis, and is often called the "end angle." To avoid the necessity of making calculations, this angle is usually stamped on the hob. If the angle is not known, its tangent may be determined simply by dividing the lead of the hob thread by the pitch circumference.

Gears may be cut with left-hand hobs, although hobs threaded right-hand are used ordinarily. The hob is inclined from the horizontal position in one direction when it is right-hand, and in the opposite direction when it is left-hand. The proper direction may be determined readily by simply considering which way it is necessary to turn the swivel slide, to bring the teeth on the cutting side parallel with the work-spindle.

Centering the Hob

In many shops it is the general practice to locate one tooth of the hob central in relation to the gear blank before setting the hob at the required angle; that is, the hob is adjusted in a lengthwise direction until the center of one tooth lies in the same plane as the axis of the gear blank. The object of centering a tooth is to avoid slight errors which are sometimes caused by using a hob that is not centered, and to insure that the teeth will be cut the full depth.

The effect of hob-centering was analyzed in an article by John Edgar, published in June, 1914, MACHINERY, page 862. It was pointed out that there are hob defects that cannot be compensated for by centering, such as distortion due to hardening and unequal tooth thickness due to springing of the tool when forming. The defect that centering favors is that of any slight eccentricity which causes the teeth to run out of true, as when the arbor is not concentric with the spindle; the inaccuracy resulting from the use of an untrue arbor when backing off the teeth may be another cause of eccentricity.

The three conditions considered included (1) a hob with the low tooth and high space centered; (2) a hob with the high tooth and low space centered; (3) a hob not centered but half way between the conditions represented by the two preceding cases. Mr. Edgar's general conclusions are as follows: With an unground hob in which the eccentricity is an unknown quantity, but may be taken as sure to be existent, it is well to center the high tooth; and with an accurate hob, such as would be obtained by an accurate method of grinding, it is unnecessary to center the hob, if the hob has been carefully sharpened and the hob arbor runs true on its axis.

According to Gould & Eberhardt, it is important to center a hob tooth when cutting gears having less than thirty teeth. The centering gage on the Gould & Eberhardt machines is permanently attached to the slide at the rear of the hob. The hob is adjusted until the gage, which may be moved forward by turning a small knurled knob, coincides with a tooth space on the rear side; then a tooth at the front side is in a central position, as the hobs have an even number of flutes. The hob is adjusted lengthwise for centering by loosening nuts on the spindle bearings, which permits adjusting the bearings in a lengthwise direction by means of a small screw. When a tooth space matches the gage, the spindle bearing bolts are tightened and the gage withdrawn.

According to the Newark Gear Cutting Machine Co., the subject of hob-centering may be summarized as follows:

1. For roughing operations, where the prime object is the removal of metal, without especial regard to the accuracy of the tooth contour, the centering of a hob tooth is not necessary.

2. The best gear shops today commonly use ground hobs for finishing the better grades of gears, so they are not concerned with the errors due to distortion in hardening. It is not possible to get the best production if the hob arbor runs out of true or if the hob has a high tooth, as either of these conditions causes a few teeth to do all the work, which makes them become dull very rapidly.

3. If hobs were made with a vast number of teeth, centering a tooth would be unnecessary. Since hobs are made with from about four to twenty flutes, or rows of cutting teeth, it will be seen that the gear tooth contour is composed of a large number of small flats produced by the hob teeth. To illustrate, if a gear tooth were found with a contour made up of only six flats which did not match each other on the two sides of the tooth, the tooth would be unsymmetrical. This would be an extreme case, as a gear tooth contour should be composed of from fourteen to twenty flats or more.

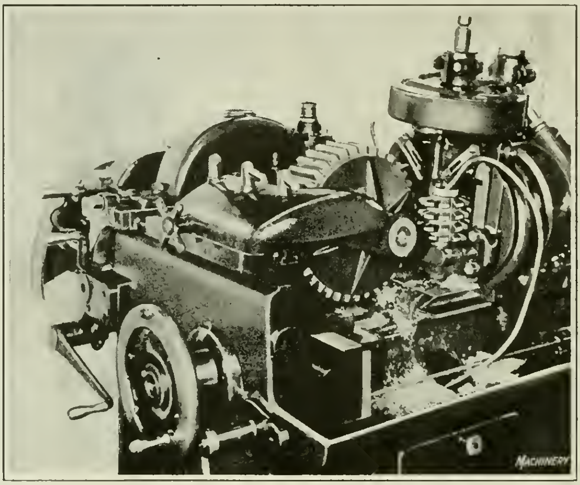


Fig. 3. Cutting Tractor Gears on Hobbing Machine having Horizontal Work-spindle

4. A hob should be centered when it is found that unsymmetrical gear teeth are being cut. If centering does not correct this fault, the trouble is in the hob teeth or the machine itself. To prevent unsymmetrical tooth contours, a hob tooth should be centered if the hob has less than twelve flutes, especially when hobbing gears of less than thirty teeth, for extra fine work, or eighteen teeth for ordinary work.

Adjustment of Hob to Distribute Wear

In order to distribute wear, it is good practice to set different teeth in the central position when resetting the hob. A hobbing machine has been designed to give the hob an axial movement in conjunction with the required feeding movement, the idea being to insure a more uniform distribution of wear. To compensate for this lengthwise motion of the hob, the rotary speed of the gear blank differs from the normal speed required when a hob remains in the same axial position. This change in the rotation of the work is just enough to compensate for the lengthwise motion of the hob. This refinement makes the machine more complicated, and such a design is not likely to supersede a simpler one, especially in view of the fact that wear on the hob teeth can be distributed satisfactorily if care is taken to set the hob each time so that different parts are in the cutting position.

Rotating Hob and Gear Blank at Correct Speed Ratio

When cutting spur gears with a single-threaded hob, which is the kind generally used, the number of revolutions made by the hob per revolution of the gear is equal to the number of teeth to be cut. For example, if a gear is to have forty teeth, the machine would be geared to revolve the hob forty times during one revolution of the gear or work-table. The combination of gears required for cutting any gear would ordinarily be determined simply by referring to a table or chart accompanying the machine.

When calculating these gears, it is necessary to consider the fact that in all gear-hobbing machines there are certain gears that form a permanent part of the machine and serve to transmit motion from the main driving shaft to the hob-spindle and to the work-table. Since the ratios of these permanent gears vary in machines of different makes, these ratios enter into change-gear calculations: In the equation given below, which may be used to calculate change-gears on machines of different makes, there is a constant or fixed value for each machine. These fixed numbers are based on the ratio of the permanent gearing in each machine, and serve to allow for this ratio. In the equation n equals the number of threads on hob (that is, n equals 1 for a single-threaded hob, 2 for a double-threaded hob, etc.), N equals number of teeth to be cut in gear, and the constants for different machines are: Adams-Farwell, 30; Barber-Colman, 30; Gould & Eberhardt, 60; Lees-Bradner, 24 on some machines, 32 on others; Newark Gear Cutting Machine Co., 16, except for special machines.

$$\frac{\text{Product of No. of Teeth in Driving Gears}}{\text{Product of No. of Teeth in Driven Gears}} = \frac{\text{Constant} \times n}{N}$$

To illustrate how change-gears are calculated, assume as an example that the gears to be hobbed have 45 teeth, a single-threaded hob is to be used, and the constant of the machine is 60.

Then

$$\frac{\text{Product of Driving Gears}}{\text{Product of Driven Gears}} = \frac{60 \times 1}{45} = \frac{5 \times 12}{5 \times 9}$$

The numbers in this expression are now raised to higher values by multiplying with trial numbers in the usual manner, thus obtaining larger numbers corresponding to the numbers of teeth in available change-gears. Thus,

$$\frac{5 \times 12}{5 \times 9} \quad \frac{(5 \times 16) \times (12 \times 5)}{(5 \times 16) \times (9 \times 5)} = \frac{80 \times 60}{80 \times 45}$$

The numbers above the line represent the driving gears which have 80 and 60 teeth, respectively, and the numbers below the line the driven gears, with 80 and 45 teeth, respectively. Of course there are other combinations that would give the same ratio, and it might be necessary to calculate them by selecting other trial numbers, assuming, for example, that it were not possible to find change-gears corresponding to one or more of the numbers obtained by the calculation.

Hobs Used for Spur Gears

Hobs for spur gears are made by cutter manufacturers for cutting gears of various diametral pitches, the pitch being stamped on the end of the hob. The normal pitch of the hob should be the same as the circular pitch of the gear. The "normal pitch" is the shortest distance from one thread to the next, the pitch being measured at right angles to the thread. If the pitch of the hob, as measured parallel to its axis, were made equal to the circular pitch of the gear, an error would be introduced owing to the fact that the hob must be inclined to locate it in the working position. However, the difference between the normal pitch and the pitch measured parallel with the axis may be so small as to be negligible when there is little inclination of the hob teeth relative to the axis.

While ordinary hobs must be inclined to align the teeth with the gear on the cutting side, some hobs are so made that they can be set at right angles to the axis of the gear. The included tooth angle on these hobs is reduced in order to obtain the effect of a rack-shaped cutter when the hob is in the right-angle position.

Using Multiple-threaded Hobs

While hobs that have a single thread or row of teeth are generally used for cutting spur gears, multiple-threaded hobs are sometimes employed. An example of spur gear cutting on a Lees-Bradner generator, equipped with a triple-threaded hob is shown in Fig. 5. The operation is that of cutting teeth on the rims of automobile flywheels. A number of these flywheels may be seen at the right-hand side of the illustration. There are 128 teeth of 8-10 pitch. The face width is 1 inch, and the rate of production 125 gears in nine hours, or nearly 14 per hour.

When using a multiple-threaded hob, it is necessary, of course, to change the ratio of the gearing controlling the relative speeds of the hob and the work, in proportion to the number of threads in the hob. For instance, when using the machine shown in Fig. 5, driving and driven change-gears of 3 to 4 ratio are used for a triple-threaded hob, whereas for a single-threaded hob the ratio is 1 to 4. In view of the fact that a single-threaded hob must revolve 128 times to one revolution of the gear for the particular operation referred to, whereas a triple-threaded hob revolves only one-third that number of times, it is evident that much greater production is obtained with multiple-threaded hobs, assuming that the same rate of feed is maintained.

To illustrate, suppose that a single-threaded hob is used for cutting a gear having 128 teeth; the hob diameter is 3 inches, and the speed 80 revolutions per minute, thus giving a cutting speed of about 63 feet per minute. Now, assuming that the feeding movement of the hob per revolution of the gear is 0.160 inch, and that the hob has to travel 2 inches for cutting the teeth, then the gear will make 12.5 revolutions while the teeth are being milled ($2 \div 0.160 = 12.5$), and the total number of hob revolutions will equal $12.5 \times 128 = 1600$, since the hob makes 128 revolutions to one of the gear. Hence, the actual cutting time will equal $1600 \div 80 = 20$ minutes when using a single-threaded hob.

Now suppose that the same gear is cut with a triple-threaded hob having the same diameter as in the preceding case and that the same cutting speed and feed per revolution of the gear are employed. Since the triple-threaded hob makes 42 2/3 revolutions to one of the gear, the total number of hob revolutions during 12.5 revolutions of the gear will equal $42\ 2/3 \times 12\frac{1}{2} = 533\ 1/3$. Therefore, the cutting time equals $533\ 1/3 \div 80 = 6\ 2/3$ minutes, or one-third of the time required when using a single-threaded hob for the same work.

Notwithstanding the relatively high production obtained with multiple-threaded hobs, the single-threaded type is preferable for hobbing spur gears, as a general rule, because it generates more accurate teeth. This is due to the fact that a multiple-threaded hob has a larger helix angle than one with a single thread, unless the diameter of the multiple-threaded hob is increased in proportion to the number of threads. Because of this difference in the angle of the helix along which the teeth are located, the cutting action and the form produced are different, assuming that the teeth are the straight-sided rack-shaped form commonly used. The general practice of the Lees-Bradner Co. is to use triple-threaded hobs for cutting cast-iron gears, which need not be very accurate. The use of the multiple-threaded hob for cutting steel gears is usually limited to the double-threaded form, and this is only applied to work that does not require the same degree of accuracy that is possible with a single-threaded hob.

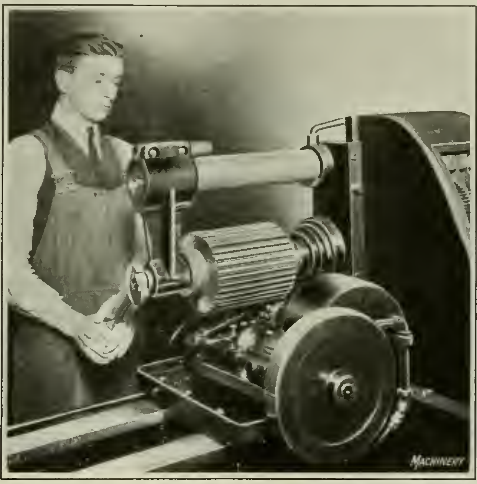


Fig. 4. Another Horizontal Type of Hobbing Machine

It has been shown that a multiple-threaded hob of given size will reduce the actual cutting time in direct proportion to its number of threads, as compared with a single-threaded hob of the same size rotating at equal speed and having an equal amount of feed per gear revolution. The metal is removed at a faster rate by the multiple-threaded hob, because it has, in effect, two or more tools or hob threads working instead of one. Now each tooth of a multiple-threaded hob has to remove more metal per hob revolution than a single-threaded hob, unless the hob diameter and number of flutes are increased in proportion to the number of threads on the hob. This is due to the fact that a single-threaded hob, because of its smaller helix angle, has more turns or thread convolutions, and, consequently, more teeth in contact with the gear being cut or a larger number of cutting edges working constantly, than a multiple-threaded hob of the same size. This point is brought out in connection with the following comment on the use of multiple-threaded hobs by Fred Ross Eberhardt, of the Newark Gear Cutting Machine Co., Newark, N. J.

When using a hob, the amount of feed possible per revolution of the work depends upon (1) the hardness of the material; (2) the revolutions per minute of the hob; (3) the degree of finish desired. The number of revolutions per minute of the hob depends upon the hardness of the material and the feed, which, to be exact, means the thickness of chip for each hob tooth actually working. With a certain hardness of material and a finish requirement permitting only 0.125 inch feed per revolution of the work, the following examples will be considered:

A gear having 90 teeth of 12 diametral pitch and a pressure angle of 14½ degrees was cut with a single-threaded hob, 2¾ inches outside diameter, having 14 flutes. The hob speed was 100 revolutions per minute, and the feed 0.125 inch per gear revolution. In this instance, about four convolutions of the hob teeth were cutting, and each tooth of the hob removed about 0.002 inch of metal per hob revolution. The finish requirements would not permit a greater feed. If the hob were run at a higher speed (revolutions per minute) it would have dulled too quickly. The limit of production, therefore, seems to have been reached with this hob.

With all other conditions the same as in the preceding example, but using a triple-threaded hob, only about one and one-third convolutions of the hob teeth were cutting in each tooth space. Therefore, each hob tooth removed about 0.006 inch of metal per hob revolution. The feed per revolution of the work remaining the same, this triple-threaded hob would leave feed marks of the same appearance as the single-threaded hob previously referred to, but the cutting time would be one-third that of the single-threaded hob.

While these are actual examples of work done in the Newark Gear Cutting Machine Co.'s shop, there might be different cases. Each tooth of a multiple-threaded hob does so much more work than each tooth of a single-threaded hob of the same diameter, using the same feed, that the hardness of the material might necessitate reducing the feed per revolution of the work to reduce the chip thickness per hob tooth; however, according to the experience of the company just referred to it is seldom possible to feed single-threaded hobs as much as the teeth will stand, because such coarse feeds would cause unsightly feed marks. As the appearance of the cut usually determines the maximum feed, the use of a multiple-threaded hob makes it possible for each hob tooth to take as large a chip as it can efficiently. It is assumed that the hob has a sufficient number of flutes to give the required generating action. Another point worthy of consideration is that when the number of teeth to be cut is prime to the number of hob threads, the generating flats are the same as for a single-threaded hob of the same diameter, although usually the flats are not noticeable.

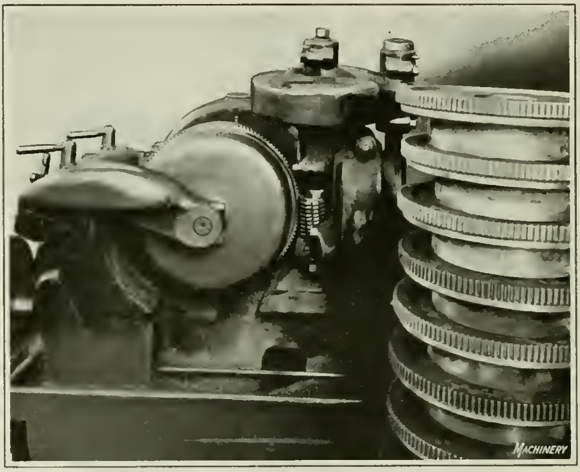


Fig. 5. Cutting Spur Gears with a Multiple-threaded Hob

Hobbing Pinions Having a Small Number of Teeth

Sometimes it is desirable to use pinions having a very small number of teeth in order to obtain a certain velocity ratio and at the same time a relatively small center distance between pinion and gear. When an ordinary pinion is used (having a pressure angle of 14½ degrees) 12 teeth is generally considered the minimum number. Even with a pinion of this size, the flanks of the teeth must be under-cut somewhat to avoid interference, provided the mating gear has more than twelve teeth, and this interference and the need for under-cutting increases if the pinion is to run with larger gears.

A method of improving the shape of the pinion tooth that has long been employed consists in enlarging the pinion blank and reducing the gear blank a corresponding amount. Another method is to increase the pressure angle of the gearing, and a third method consists in modifying both the pressure angle and the blank diameters in order to obtain a tooth shape giving the best results.

Enlarging the pinion blank and decreasing the gear blank a corresponding amount is applied not only to spur gears but also to bevel gears, worm-gearing and herringbone gears. When cutting an enlarged pinion or a reduced gear (whether by hobbing or on a generating shaper or planer) the procedure is the same as when cutting standard gear teeth, and any generating type of machine may be used. The teeth are cut to the full depth on both pinion and gear, and in the usual manner, but if the position of the cutter relative to the gear blank is checked by measuring the tooth thickness, then the change in the height of the pinion and gear addendum must be taken into account, the tooth thickness being measured where the pitch circle crosses the tooth in each case.

For instance, when using a gear tooth caliper for measuring the tooth thickness of the pinion at the pitch line, it must be set with reference to the long addendum. This tooth thickness will exceed one-half the circular pitch, because the same number of teeth have been formed on a blank of larger circumference than standard for that pitch. On the contrary, when measuring the mating gear, the caliper should be set with reference to the short addendum to check the thickness at the pitch line, and the gear teeth are thinner than one-half the circular pitch, because the blank diameter has been decreased.

On account of these changes, the formulas used for determining the chordal thickness and corrected addendum of standard spur gears must be modified. When the blank diameter is changed, the following formulas may be used, in which T = chordal thickness at pitch circle; D = pitch diameter; X = circular thickness of tooth on pitch circle; R = pitch radius; and H = height of tooth arc or amount to add to long or short addendum to obtain corrected addendum.

$$T = D \times \sin \frac{90\,X}{R \times 3.1416}$$

$$H = R\left(1 - \cos \frac{90\,X}{R \times 3.1416}\right)$$

To obtain the value of X, first find the difference between the normal and the modified addenda and multiply this difference by the tangent of the pressure angle of the gear. For a pinion *add* twice this product to one-half the circular pitch to find the value of X; for a gear, *subtract* twice the product instead of adding.

When the pinion blank is enlarged and the gear blank reduced, as described, without changing the pressure angle, the practical effect is to move the pinion teeth outward radially and the gear teeth inward a corresponding amount relative to the pitch circles as well as to the base circles from which the tooth curves are derived. In order to understand why the shape of the pinion teeth is improved by enlarging the blank, it must be remembered that the base circle of the pinion is much closer to the pitch circle than the base circle of a comparatively large gear. This is due to the fact that the diameters of the base circles for the gear and pinion must be in the same ratio as the diameters of the pitch circles or as the numbers of teeth. For instance, if the gear is four times as large as the pinion, the base circle of the gear must also be four times as large as that of the pinion, and the pinion base circle will be proportionately closer to its pitch circle.

In this connection it is important to note that an involute curve cannot extend below the base circle from which it is derived. Now, unless prevented in some way, the part of the tooth below the base circle of a small pinion of standard proportions will be under-cut if generated in the usual manner, thus showing that the teeth of a gear, and especially the teeth of a straight-sided involute rack, would interfere unless this under-cutting had taken place. This explains why standard 14½-degree pinions in small sizes are not recommended.

When the pinion blank is enlarged, as described, the base circle diameters remain the same and the pitch circle and base circle of the pinion cross the tooth near the root; consequently, the involute curve extends over a larger part of the tooth since the latter has been moved outward, thus increasing the amount extending beyond the base circle. As the length of the involute is increased, that part below the base circle where under-cutting occurs, is correspondingly decreased. It should be remembered, however, that this improvement in the shape of the pinion tooth is at the expense of the gear tooth, which is moved inward relative to its pitch circle and base circle. The extent to which the shape of the gear teeth is sacrificed decreases as the size of the gear increases and is considered negligible for gears having, say, 40 teeth or more.

Changing the blank diameters as described does not affect the velocity ratio of the gearing, since this depends upon the relative diameters of the pitch circles, or the number of teeth in the gear and pinion. The center distance also remains the same, provided the gear is reduced an amount equal to the pinion enlargement. An enlarged pinion does not necessarily have to be used with a gear of reduced size, as it will mesh with any gear in an interchangeable series, but if the mating gear is standard, the center distance will be increased an amount equal to one-half the increase in the pinion blank diameter.

Determining Diameter of Enlarged Pinion Blank

When a pinion blank is enlarged to avoid under-cutting, the increase of diameter may be determined by the following formula, in which O = outside diameter of blank; B = pressure angle; D = pitch diameter; and W = working depth.

$$O = \cos^2 BD + 2W$$

To maintain the same center distance between the gear and the pinion, the gear is reduced by the same amount that the pinion blank is increased.

* * *

HOSPITAL FOR INDUSTRIAL INJURIES

The first hospital intended specifically for industrial workers who have been injured in the course of their employment, is the Reconstruction Hospital at 100th St. and Central Park West, New York City. Here patients have been treated from every industrial state east of the Mississippi, and a new eleven-story addition is now under way, to provide room for additional patients who have been injured or contracted diseases as a direct result of their industrial employment. The aim of those in charge of the Reconstruction Hospital is to make it an institution upon which hospitals all over the country can be modeled, and to give instruction to medical students and post-graduates in the modern science of industrial medicine and surgery, as well as to train nurses in industrial plants.

CHECKING DIAMETER OF TAPER PLUG GAGE

By W. G. HOLMES

In checking the diameter at the small end of a taper plug gage, the gage is first mounted on a sine-bar as indicated in Fig. 1 so that the top of the gage is parallel with the surface plate. A disk of known radius r is then placed in the corner formed by the end of the plug gage and the top side of the sine-bar. Now by determining the difference in height between the top of the gage and the top edge of the disk, the accuracy of the diameter B can be readily checked.

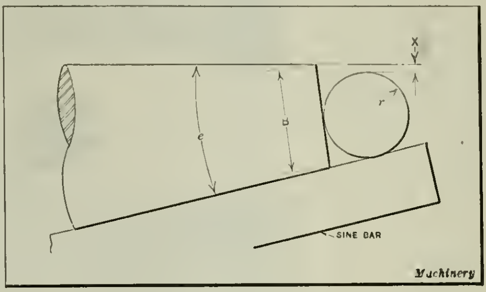


Fig. 1. Gage in Position for checking Diameter B

The known dimensions are:

e = angle of taper;

r = radius of disk; and

B = required diameter at end of plug gage.

With the dimensions given, it is required to find the difference X between the height of the top of the gage and the upper edge of the disk. Referring to Fig. 2 we have,

$$g = 90 \text{ degrees} - \tfrac{1}{2} e \quad \text{and} \quad k = \tfrac{1}{2} g$$

By trigonometry,

$$F = \frac{r}{\tan k}; \; E = B - F; \text{ and } \tan m = \frac{r}{E}$$

Also

$$P = \frac{r}{\sin m}; \; n = g - m; \text{ and } H = P \sin n$$

Therefore, $X = H - r$ or $r - H$, depending on whether or not the top edge of the disk is above or below the top of

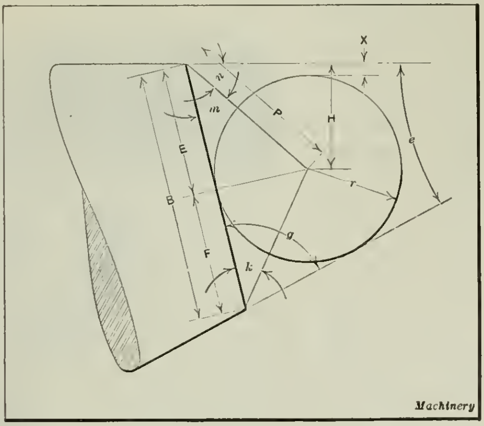


Fig. 2. Diagram used in calculating Dimension X

the plug gage. In the illustration the top of the disk is below the top surface of the plug gage so that it is evident that $X = H - r$.

Sine-bar Fixture for Accurately Checking Thread Angles

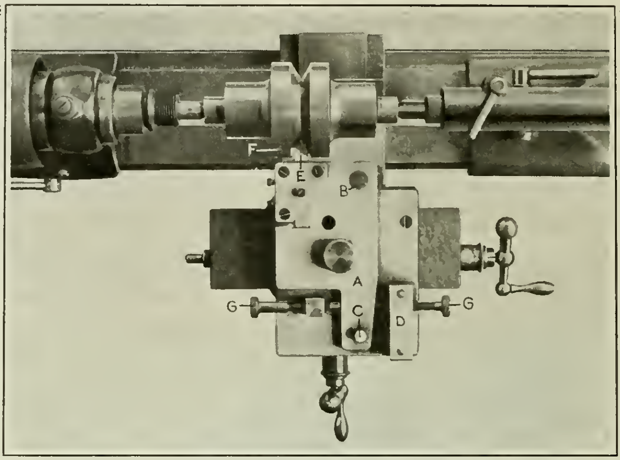


Fig. 1. Adjusting Sine-bar Fixture by Means of a Master Plug

In making screw thread plug gages, hobs, taps, etc., the thread or tooth angles may be tested by means of the sine-bar fixture described in the following. This fixture is simple in design, but very accurate as a means of checking angles, and is used by the Pratt & Whitney Co. whenever such a test is required in connection with work of the classes referred to. The fixture is used in conjunction with a bench lathe. It is held on the tool-slide, and the gage or other piece to be tested is placed between the lathe centers. If the angle is not standard, the error may be readily determined.

This fixture has a plate *A*, Fig. 1, which is free to swivel about pivot *B*. This plate, which is used like a sine bar, has a projecting plug at *C*, opposite block *D*, from which measurements are taken with an ordinary micrometer. A gaging or contact point *E*, having an accurately ground V-shaped end, is secured to the sine-bar plate by the set-screw and holder shown. Before using the fixture, one side of this V-shaped end is set in alignment with the conical surface of master gage *F*, which has the standard angle required. In making this adjustment, screws *G* are used for shifting the sine-bar plate as required.

The master gage is next replaced by whatever gage, hob, or tap is to be tested. When the V-shaped gaging point *E* is brought into contact with the side of the thread or tooth, even a slight lack of alignment may be detected without the aid of a magnifying glass. Assuming that there is an error in the angle, a measurement is first taken, in the manner illustrated in Fig. 2; the sine-bar plate is then adjusted as shown in Fig. 3 until the gaging point is in perfect contact, as nearly as can be observed. The magnitude of the error is indicated by the difference between these two micrometer readings. The length of the sine bar or the distance between the centers of pivot *B* and plug *C* is such that a difference of 0.0001 inch in the micrometer readings is equivalent to an angular error of 5 seconds. This general rule, which makes it very convenient to determine errors without calculation, is accurate enough for practical purposes unless the errors are larger than those ordinarily encountered. If the bar were moved more than, say, 2 degrees, because of angular error, it would be advisable to calculate the error instead of using the rule referred to.

There are two general methods of using this fixture. One is to test one side of a thread at a time, the work being reversed between the centers for testing the opposite side. The other method is to test both sides at the same time by adjusting the V-shaped point until it makes contact with both sides instead of one side only. The second method is sufficiently accurate for most work, because the V-shaped points are carefully ground to standard angles, and they have clearance like a thread tool, so that the lines of contact are along the upper edges only.

Accuracy of Readings Obtained with the Sine-bar Fixture

It might be supposed that accurate results would be impossible with this fixture, inasmuch as its use depends entirely on the alignment of the V-shaped point, which, in turn, is a matter of judgment and vision. In this connection it is interesting to know that three men not particularly skilled in using such a device, each tested a thread of ⅛-inch pitch, and all came within 10 seconds of the same reading. A fourth man varied by 20 seconds. A skilled inspector is able to repeat readings within 5 seconds on plugs having eight threads per inch, and within 15 seconds when the threads are as fine as twenty per inch.

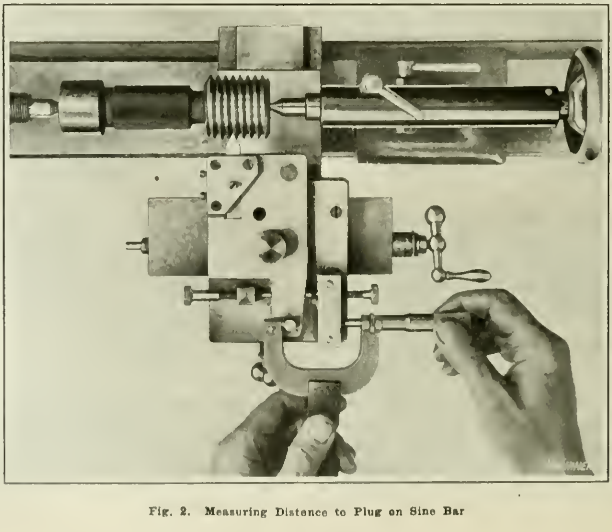


Fig. 2. Measuring Distance to Plug on Sine Bar

EQUIPMENT OF UNIVERSITY SHOPS

By WARREN ICHLER

The aim of any technical school is to furnish the broadest possible instruction along engineering lines. In spite of this, however, we find numbers of universities and technical schools equipped with, say, fifteen or twenty engine lathes of one make which are all exactly alike; two or three milling machines from one manufacturer that differ in general features only in that some are plain millers and some universal machines, and so on down through the list, except, of course, for the more bulky and special machines where one unit is sufficient for instruction purposes and where, perforce, there can be no duplication.

Possibly a laudable desire for standardization—that is, laudable in nearly every business except that of instructing engineering students—has led to this standardization of equipment, but it will be plain to anyone familiar with machinery that any school shop so equipped can give only limited instruction in the use and care of machine tools. Lest this be considered as merely destructive criticism, the writer ventures a few suggestions as to how he endeavored to broaden his courses while a machine shop instructor at a state university.

The first and most important step toward overcoming the disadvantages of a limited tool equipment was taken when inspection trips to nearby shops and factories were substituted for one shop or laboratory instruction period each month. Instead of making these trips general in their nature, an effort was made to confine the inspection to one particular machine or class of machine. For example, one trip to a large shop was made to study vertical boring mills since the vertical boring mill was not included in the university's equipment. Of course, this method of instruction is as old as the teaching profession, but too much emphasis cannot be laid upon it, as the students see work being performed under actual manufacturing conditions.

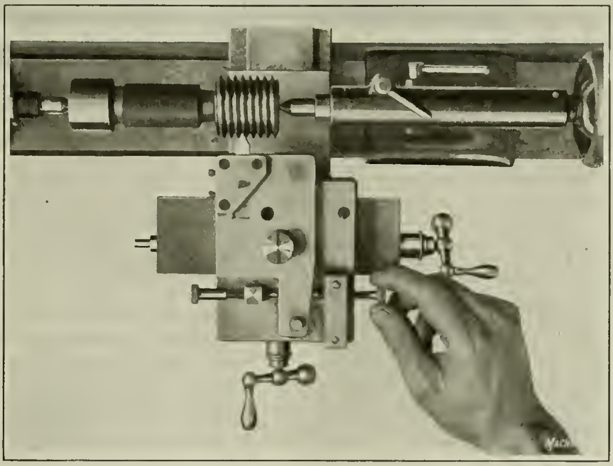


Fig. 3. Adjusting Sine Bar to align V-shaped Point with Gage Thread

Use of Pictures for Instruction Purposes

A second method of supplementing the regular university course was by the use of pictures of machine tools, and in this connection the writer would mention that the machine tool industry in general responded generously to requests for such pictures. Many instructors spend hours in producing fine blackboard lay-outs of novel or special machines, but it is a question whether these have any more value for instruction purposes than a large well posed picture of the same tool would have.

When not in use for instruction purposes the pictures of machine tools were employed to transform the shop into what may be termed a machinists' art gallery. This was valuable in making what would otherwise have been rather dingy surroundings more attractive. Catalogues, and descriptive matter were secured along with the pictures, and brought to the attention of the students, and finally a quiz on each particular machine that had been made the subject of a lecture was held. One gratifying result of such instruction was the fact that students were often able to explain, while on inspection trips, many novel features in machines that puzzled the mechanics operating the machines.

School Equipment Used for Actual Manufacturing

A third measure for broadening the course was the somewhat radical innovation of inviting the owners of certain small garages and machine shops to send to the university shop such work as could not be handled on their equipment, but was still within the capabilities of the university shop. It must be understood that this work was performed by the mechanics of the shop sending the work, and was paid for on a basis of hourly rental for machines and power, so that in no sense were the students used on contract labor, and the hourly rental basis was fixed at a figure that was attractive to the average manufacturer. In this way, students became familiar with the methods of setting up for more intricate work than that of their regular course and were able to see the little indefinable distinctions that differentiate the work of the skilled mechanic from that of the student. Of course, the methods of the skilled mechanic were studied on inspection trips as well, but of necessity, under less favorable conditions than in the school shops. The school was thus made of real benefit to the community and the money realized from the rental of its machines was available for new equipment. Another plan that was employed was that of asking certain large manufacturers to lend the services of their salesmen or service men for short talks to the classes.

The writer has noted one exception to the usual method of equipping an engineering school shop. In this school which is located in the Middle West, one can search the machine shop through and through without finding two machines that are duplicates of each other. This shop was fortunate in having for its founder a man of wide practical experience, as well as thorough technical training. In a conversation with the writer this man remarked: "Standardization is yet in its infancy, and the boys we are training will not be likely to secure employment in factories standardized as they should be, so why try to surround them with ideal conditions in that respect? Furthermore, no two students are reached by the same methods in the class or shop. We have built up quite a little healthy rivalry with our varied equipment by reason of this principle. That boy over there running that lathe is quite convinced that his is a better machine than the lathe next to it on which his chum is working, because his lathe has a little handier quick-change-gear mechanism than that provided on the other machine. Conversely, the boy on the other lathe is firmly convinced that he can secure a finer finish on his work, and at higher speeds, than his chum because the bed of his lathe is braced differently from that of the other machine and is a little deeper. Just as long as manufacturers strive to outdo each other in producing machines of the highest development, just so long should we strive to bring before engineering students, everywhere, the results of the manufacturers' experiments and experience."

Planning in Large Contract Plants

Problems Relative to the Installation of Planning Departments

By GEORGE H. SHEPARD, Professor of Industrial Engineering and Management, Purdue University

EFFICIENT planning means not only the giving of instructions for performing work in the most economical manner, but also the scheduling of the various jobs to insure their completion on the desired dates. In the machine shop using the cards and records shown in the previous article on this subject, which appeared in March MACHINERY, the percentage of jobs completed on time increased greatly immediately after the installation of the planning system. The chart in Fig. 1 illustrates diagrammatically the results obtained in this shop during a period of over six months. At the time the system was installed, only about 45 per cent of the jobs were completed according to schedule. The percentage line gradually rises until it reaches the 100 line one month from the installation date. From then on, the percentage of jobs completed on time is never less than 89.

In connection with planning, it may be found that some jobs run in a sufficient volume to warrant their segregation and a standardized manufacture. Such jobs should be placed on a manufacturing basis as soon as possible.

Personnel of a Planning Department

In building up a planning organization, care must be taken to select a competent personnel. This is especially important in contract or jobbing shops, because the continual variation in the work handled makes it necessary to rely on the skill and good judgment of the planners. Hence, only skilled mechanics with a good local knowledge of the shop should be employed. Planners should have an opportunity to advance. The departmental chief planner should have a foreman's rank, and the nature of his job makes him, provided he has executive ability, the logical understudy and prospective successor to the general foreman.

Some executives think that the work of the planning office is an addition to that of the shop and that the employment of mechanics as planners results in a corresponding reduction in productive capacity. But this is not the case. The purpose of a planning department is to increase production. Whether there is a planning department or not, it is necessary to determine the priority of jobs, to see that preparations are made for the work, to combine different jobs in order to obtain the most efficient use of machine set-ups, and to record the progress and completion of jobs. These things can be done more effectively by fewer persons in an office with a specialized organization and records, where there is an opportunity to develop special skill, than on the shop floor in the midst of the distractions of manufacturing. Shop men who are employed in the planning department, no matter how skilled they may be as mechanics, must be trained for the work and be guided until they have acquired the special skill necessary for planning.

Functionalizing Planning and Dispatching

Functionalizing planning and dispatching along the general lines of methods, materials, and progress, has been found advantageous. Another common method is to assign separate sections of a planning office to different work, such as customers' orders, stock, plant maintenance, repair, etc. The method followed must, of course, depend largely on local conditions, but the experience of the writer has been that functionalizing by methods, materials, and progress is preferable for the following reasons: (1) This is a definite classification of specially skilled men who can be used on any job on which their services would be of value. (2) Planners develop higher skill by specializing along these lines than they otherwise would, and a smaller personnel is capable of doing the work. (3) Better coordination of the work as a whole is obtained when all the jobs are handled by the personnel along the special lines outlined, than when the various jobs are handled independently by different people.

When planning and dispatching are first started, a daily priority list may be the only dated schedule for the guidance of the shop, but as the application of these principles proceeds, the amount of scheduled work increases rapidly. For example, soon after a planning organization is functioning, it may be necessary to repair part of the shop equipment. The method man of the planning office foresees the necessity of having this equipment ready for use on some order. The completion date of this order on the priority list establishes the date when the equipment will be needed and therefore determines the completion date for the repairs. Again, as planning and dispatching are installed in the stores department, the planning office begins to issue requisitions for the manufacture of stock parts with completion dates based on the date when the parts will be needed to keep the stock from falling below the minimum limit. In such ways as these the majority of the job orders will gradually come to have completion dates. In contract or jobbing plants usually from 70 to 75 per cent of the job orders finally are scheduled in this way.

Need for Filler Orders

The remaining 25 or 30 per cent of job orders have no definite priority, and this is of considerable advantage. Under contract or jobbing conditions it is impossible for a planning department to see ahead far enough always to provide a definite job for every machine or group of men. In order that supervisors on the shop floor may be able to fill such gaps, it is necessary for them to have some filler work, which can be run to suit conditions; jobs without a definite priority meet this need. A certain amount of filler work should be provided also to stabilize the load on the shops, so as to keep them busy when customers' orders are unavailable.

One means of providing filler work is to manufacture parts for stock when there is a large enough demand to warrant this. In such cases the overhead costs to be distributed over the parts, the cost of carrying the parts in stock, and the comparative cost of shop manufacture relative to tne market price of the article should be carefully considered. Parts for which there is a large and steady demand and which can be made profitably, instead of providing filler work, are suitable for production by manufacturing methods. Some stock orders, also, require a too definite and immediate completion date to allow them to be run as fillers.

Notwithstanding these facts, the manufacture of stock parts is the source of the largest volume of filler work in contract plants. Another convenient source of filler work is the maintenance of shop equipment. This should properly be the responsibility of a separate department, specially organized for the purpose, but the variety of such work in a contract plant makes the expense of a completely equipped maintenance department prohibitive. In order to use plant maintenance jobs as filler work, ample notice must be given of the needed repairs. This requires the installation of a system of constant and thorough inspection of equipment, which will make the need for repairs apparent well in advance of the time when immediate repairs are necessary.

Centralization and Decentralization of Planning

The question of centralization and decentralization comes up continually in the installation of planning systems. A correct balance must be maintained between the two if the work of the planning department is to be successful. While it has been found desirable to install a central planning office to deal with the plant as a whole, it has been found equally desirable to leave the details of departmental planning to the departmental offices. The function of the central planning office should be to make the first analysis of orders, determine in general the methods to be followed in filling the orders, decide what materials are to be used, order the stores department to provide and reserve these materials, place in general terms the orders on the shops for the work to be done, determine the final delivery date of a job and the completion date for every shop on all but filler work, follow up the progress of work from shop to shop, and settle questions of conflicting priorities referred to it by the shop or departmental planning offices.

Extent of Decentralization

A point requiring attention in the installation of a departmental planning office is the relation between the general foreman and the departmental chief planner. The former is likely to think that the latter is placed over him and to resent the whole planning scheme, considering it an attempt to undermine his authority. It should be made plain, therefore, at the beginning of a planning installation that the departmental chief planner is a subordinate of the general foreman and that his duty is simply to relieve the general foreman of details, in the same way that the other foremen do. The responsibility for meeting completion dates rests on the general foreman, and he has the authority to give the departmental chief planner whatever orders his judgment dictates. In fact, the general foreman and the chief planner should meet every day for that purpose.

After a departmental planning office has been installed, it is sometimes necessary to decentralize further by installing a sub-departmental office in some section. This second sub-division is likely to be needed in connection with a service section. For example, the tool section of a certain machine shop worked largely on orders from other sections of the shop. It was found impossible for the departmental planning office to foresee much of this work in connection with its analysis of orders, and so this section was finally given a small sub-planning office of its own. The foremen of other sections sent their orders directly to the tool foreman by means of the inter-shop order, described in the March article. These orders were handled by the tool foreman and his planning office without reference to higher authorities, except in case of conflicting priorities and similar questions.

One of the problems of a contract plant, as compared with a manufacturing plant, is the difficulty of assembling data into general summaries, which will give those in control an idea of the relative amount of work in the different departments, and other conditions. It is common for a jobbing plant to pass quickly from a greatly overloaded to an underloaded condition, notwithstanding the fact that the plant has plenty of filler work. This is due to a lack of planning. Some preparation is always necessary for filler work, and if the falling off in customers' orders is not foreseen, the plant will be without this class of work or will be unprepared to take up filler work. One of the main values of a daily prior-

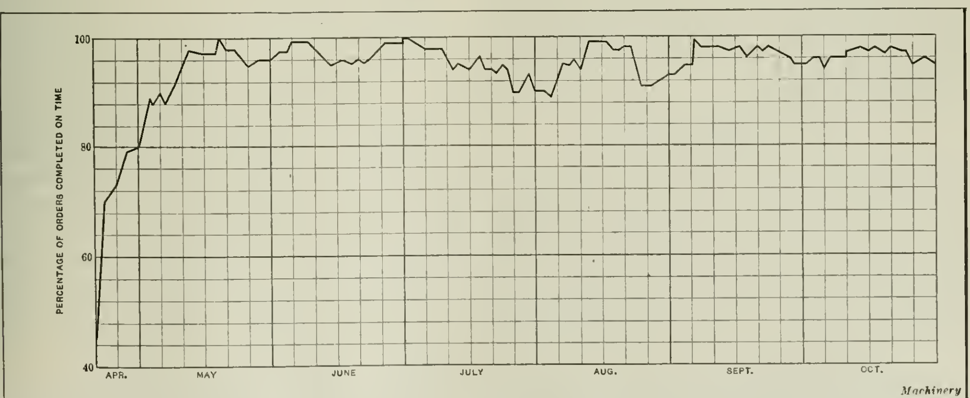


Fig. 1. Graphic Representation of Results obtained by the Installation of a Planning Department in a Contract Machine Shop

ity list is that its regular consideration can hardly fail to bring to the attention of the chief officers of the plant a prospective falling off in the amount of work on the main orders. Besides this, continual attention by planners and shop foremen to schedules and progress of jobs will cause them to notice a prospective falling off in the amount of work and indicate the necessity of looking for filler work and of preparing for it.

A good cost accounting system and frequent balance sheets are particularly necessary in a contract shop so that estimates and bids can be compared with actual costs. The industrial engineer should be continually on the watch for chances to install periodic summaries which will show to the officials the general tendency of matters under their control. Local conditions cause this matter to vary so much that it is useless to go into details; however, as an example, a summarized graphic record of tool loss and damage per man per day in a certain shop is shown in Fig. 2. As soon as general tool-room practice and records had been improved to the point where it became possible to obtain summarized records with substantial accuracy, this monthly summary was made. In the illustration, line *A* indicates the cost of wear; line *B* the cost of tools damaged; line *C*, the sum of the costs of tools worn and damaged; and line *D*, the average total cost. The results for the first three months showed the loss and damage to be going up at an alarming rate. Every month the summary was reported to the works manager, and every foreman concerned was informed of the loss and damage chargeable to his section. Beginning with the fourth month a gratifying reduction in waste was shown.

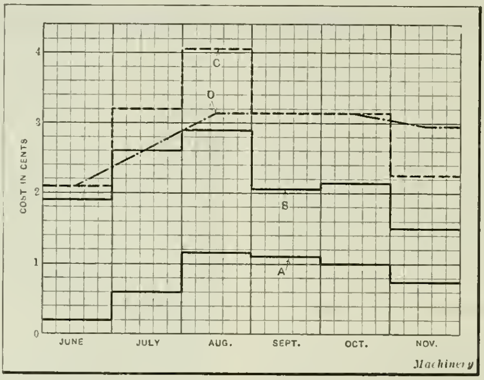


Fig. 2. Monthly Record showing Average Daily Cost of Tool Wear and Damage per Man

If teamwork is to be obtained under the unstandardizable conditions of a contract plant, all means of communication and transportation must be made as convenient as possible. The principal means of communication are the plant mail and the telephone. The former is generally used effectively, but often there is not an equal appreciation of the latter. Every plant official down to, and including the grade of foreman, and in special cases, the assistant foreman, should have a desk telephone. A planning office of any size should have several, and every shop shipping and receiving clerk should have one. These telephones should be connected to a private exchange, and the service should be the best obtainable. Anyone who has experienced the convenience of automatic service in private exchanges will prefer it to a manual exchange on account of the delays and errors customary with the latter system.

Transportation within the Plant

Transportation can be divided into two distinct classes inter-shop and intra-shop. In a large plant inter-shop transportation should be controlled by a separate department, under its own head, who should report directly to the works manager. The work of this department should be planned and dispatched in detail by its own departmental office. The question of equipment for transportation is important. For intra-shop transportation, the overhead traveling crane is in general use for heavy articles, and the elevating truck (propelled by storage batteries for long hauls) for light loads. For inter-shop transportation, the equipment should consist of a standard gage plant railway, locomotive traveling cranes, and automobile trucks. The latter should be provided with various auxiliary devices for hoisting and quick loading and unloading. During the last few years there has been a great development of conveyors; for the contract plant, the small portable types are the most promising. There seem to be considerable possibilities for effecting economy in the handling of materials by the judicious use of conveyor equipment.

Problems Connected with Transportation

Closely connected with transportation are the problems of locating responsibility for parts during their movement, of preserving their identity, and of securing a proper sorting of materials for convenient handling in the receiving shop. The plant delivery tag for inter-shop movement and the route tag for intra-shop movement are the means of locating responsibility and preserving identity. These tags were discussed in the article previously referred to. Preserving the identity of parts is no small problem when you have in process of manufacture, for example, hundreds of small valves, which are too nearly alike to be identified by casual inspection, but which are not interchangeable. The greatest trouble experienced in the use of tags is that they are likely to become detached.

This is especially true with castings and forgings, and for such parts, a satisfactory solution is to have an identifying symbol painted in black or colored shellac on each part by the shop which produces it. This method could not be followed, of course, if the parts were to be annealed. In such cases identification tags should be provided for all articles, all tags should be removed and kept during the annealing process, all work should be looked over just prior to being placed in the annealing oven, all articles should be re-identified after being annealed and, finally, all tags should be correctly re-affixed immediately after annealing. It is sometimes necessary to have special memoranda or sketches on the tags to insure correct identification. The work outlined may seem considerable, but anyone who has experienced the troubles incident to the loss of identity of steel castings, for example, in and after annealing, in a plant handling large numbers of such parts, will realize that the care necessary to prevent occurrences of this kind is the lesser by far of the two evils.

Storage of Equipment and Large Numbers of Parts

The delivering shop should be responsible for sending its product out properly sorted. If the shop is insufficiently supplied with containers, its shipping force will put the product into the containers on hand, which will result in mixing the orders and will cause confusion in the receiving shop. In order to insure a sufficient supply of containers, there should be a central place for their storage, manufacture, and repair. Then the general foremen may send to the central point all skids for elevating trucks, containers, and tote boxes for which there is no immediate use. This equipment can be looked over, repaired if necessary, inventoried, and stored. When the general foremen need these articles again, they can obtain them through a requisition on the central storage department. The storekeeper of the central storage department should be responsible for keeping a sufficient stock of skids, containers and tote boxes on hand to meet any demand that might arise.

Closely connected with the preservation of identity of parts and the placing of responsibility for them, is the problem of assembling and storing large numbers of parts, such as are often needed for construction or repair jobs. Failure to solve this problem is serious, because parts are likely to be lost, and even if they are only mislaid temporarily, considerable delay and expense result. On some large jobs, which were expected to require months of work, so that parts would need to be stored for a long time, it proved desirable to establish a complete storehouse with its own force of storekeepers, to receive and store such parts, and to issue them correctly on requisition as needed. The parts were sent to this storehouse at all stages of manufacture, whenever they were not actually being worked on in the shops.

Other troubles are those due to partial deliveries. For example, when a foundry delivers directly to a machine shop, it is almost impossible to keep up such a steady flow of castings that work in the machine shop will not be interrupted. The machines must then either stand idle, or their set-ups must be broken down and later remade. The use of a store-room enables the machine shop to accumulate castings, until it can start an order with a reasonable assurance that there will be a sufficient supply of work to insure that the operation will be continuous, thus eliminating costly delays.

Attention to the progress of jobs through the plant results in cleaning up dead jobs, in preventing their occurrence, and in improving the appearance of the shop. It is common to find a shop with a large accumulation of junk, a great number of dead orders, and tools stored at random. In one instance a clean-up revealed several tons of old tools, the purpose of which in many cases was unknown. In another instance, carloads of valuable scrap metal were unearthed and immediately sold at a good price.

* * *

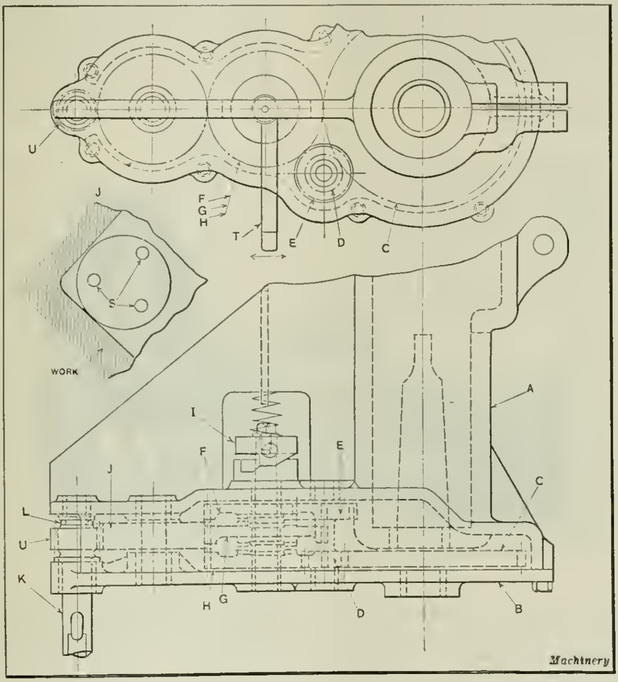
FOREIGN TRADE CONVENTION

The program for the ninth national foreign trade convention to be held in Philadelphia, May 10 to 12, includes a number of both general and group sessions devoted to important problems in the foreign trade field. Among the many questions that will be discussed are the following: "A Foreign Loan Policy that will Enable Idle Factories to get to Work"; "A Practical Method of Putting Our Surplus Gold to Work in Financing Foreign Trade"; "The Effect of High Taxation on the Exchanges"; "The Factor of Depreciated Currency in Competition"; "Protection Against Exchange Losses"; "Uniform Commercial Credit Instruments"; "The Merchant Marine—an International Problem"; "Inland Waterways as Developers of Traffic"; "Marine Insurance"; "Free Ports"; "Meeting Preferential Tariffs"; "Sales Promotion through Advertising"; and "The Essentials of a Market Survey." Further information may be obtained from the National Foreign Trade Council, New York City.

DRILLING AND TAPPING HEAD

By HAROLD A. PETERS

The drilling and tapping head illustrated was designed for use in drilling and tapping three small holes in an engine crankcase. The holes were located in a corner as indicated at *S* and could not be drilled satisfactorily in a regular drilling machine or with any of the small air or electrically driven portable drills available. The drilling head shown differs from the usual type in that it is adapted for tapping as well as drilling. The drilling and tapping head consists of two steel castings *A* and *B*, and a train of gears enclosed by the castings. The top casting *A* is designed to be clamped to the drilling machine spindle housing, and the lower casting serves as a cap to enclose the gear train. The gear train is so arranged that the small auxiliary tapping spindle *K* can be revolved in either direction, or stopped by simply manipulating lever *T*. Although the illustration is diagrammatic, it will serve to show the location of the various gears comprising the gear train and give a good idea of the general construction of the device.



Drilling and Tapping Head for Use in drilling Three Inaccessible Holes

A Morse taper shank, turned integral with gear *C*, fits into the drilling machine spindle after the head is clamped in place on the spindle housing. Gear *C* is always in mesh with gear *D*. Above gear *D* on the same shaft is a slightly larger gear *E*, which is in mesh with the upper clutch gear *F* while the taper shank gear *C* is in mesh with the lower clutch gear *H*. The center clutch gear *G* slides up and down on the shaft, but gears *F* and *H* are kept in the position shown by the stationary bushings on which they revolve.

Clutch gear *G* is raised until its clutch jaws grip those of gear *F*, or lowered until they grip those of gear *H*, by means of the clutch *I*, which can be rotated on its axis by lever *T*. Drill socket *K* can thus be revolved to the right or left, or stopped, by manipulating lever *T*, as previously mentioned. When lever *T* is in the position shown, gear *G* is held in a neutral position and no movement is imparted to socket *K*. Gear *G* is always in mesh with the idler gear *J* as shown, and gear *J* is constantly in mesh with the drill socket gear *U*. A small ball thrust bearing *L* takes the thrust of the drill or tap. The gears are all heat-treated to insure long wearing qualities. A drilling head of this type which has been in constant use for about eight months is giving excellent service, although it has been subjected to unusually severe service.

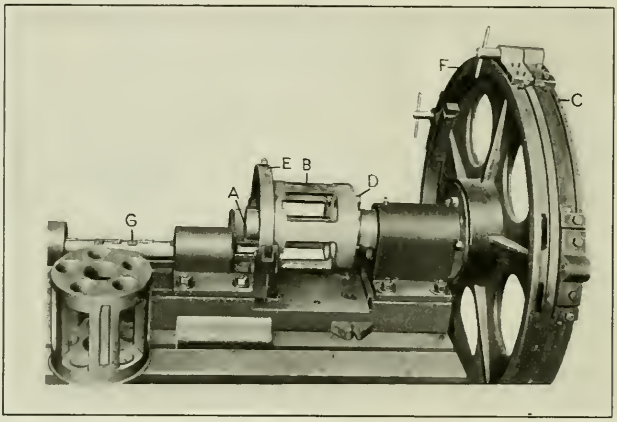
* * *

Exports of automobiles during 1921, according to the Department of Commerce, totaled 41,392 cars, of which approximately 14,000 cars went to Latin America and about 6000 cars to Canada.

BORING AND MILLING FIXTURE

Two drum-shaped cast-iron heads are provided on the Davenport multiple-spindle screw machine; one of these revolves and carries the five work-spindles, and the other is stationary and carries the tool-spindles. The revolving head has five longitudinal slots machined in it to receive the steel blocks by means of which it is indexed. The boring of the five holes in each of these cast-iron members, as well as the milling of the five index-block slots, is pérformed by the use of the special boring and milling fixture illustrated. Accuracy was the chief consideration in designing this fixture, as it is essential that all spindles be equally spaced, that they be parallel and that the radial distance from the center of the castings be the same for all holes. The milling of the slots in the revolving head must also be done with the same degree of accuracy.

For boring the holes, the fixture is placed on a Rockford horizontal boring and drilling machine. The fixture has a solid base machined for attaching three bearings, the foremost of which carries the spindle *A* on which the work *B* and the index-wheel *C* are mounted. The other two bearings, which are in line with the spindle bearing, carry the boring tool. All three bearings are bushed with steel. The work is driven by finger *D* which extends into a hole machined in the end of the casting, and is secured by a collar which screws on the end of the spindle. An outboard support is furnished in the form of a cradle having a hinged cover *E* which secures the work in position during a boring or milling operation and which must be released while indexing the work to the next position.



Boring and Milling Fixture of the Indexing Type

At the outer extremity of the spindle bearing is attached a flange to which a stationary wheel *F* is bolted. This wheel carries two locating plug blocks which are fitted to the periphery by means of a tongue and groove and which are located so that the plugs may be properly aligned with similar blocks attached to the periphery of the index-wheel. Five of these index plug blocks are attached to the periphery of the index-wheel, and they are set to the correct chordal distance by the use of plugs and verniers. These wheels are 40 inches in diameter, and the pitch circle on which the holes are bored in the work is 6 inches in diameter, so that an error of 0.001 inch in the setting of the plugs is reduced to less than 0.00015 inch in the spacing of the holes. After these locations have been accurately obtained, the two blocks on the stationary wheel are set by the use of the knurled handle plugs shown, and during the indexing of the work it is necessary that both of these plugs enter corresponding holes in the blocks on the revolving wheel. The plugs are made of hardened steel, and the blocks are furnished with steel bushings.

A special Kelly reamer *G* is used in boring the holes. This bar carries six blades, three for finishing the holes in the front wall of the castings and three for the holes in the rear wall. The first cutter-blade stocks out the holes, while the second is a fly cutter for finish-boring, and the third is a double blade for reaming. Corresponding cutters in each set of three feed through the work before the next cutter starts operating so that there is no tendency for the boring-bar to become cramped and cause inaccuracies or misalignment of the holes. The boring-bar is driven by a floating holder or chuck; thus it is free to adjust itself so as to maintain its parallelism with the work-carrying spindle, established by the alignment of the boring-bar bearings.

The revolving head is shown resting on the base of the fixture. The axial hole of this casting is larger in diameter than the hole in the stationary head, so that it is necessary to use a sleeve to fit in this hole in order that the same work-holding spindle can be used. For milling the parallel grooves in the revolving head the fixture is attached to a Milwaukee milling machine.

* * *

INSPECTING THERMIT WELDS

Progress in welding methods has been retarded by the fact that the actual strength of a weld cannot be determined without destroying the weld itself. An examination of the surface of a weld does not reveal its strength. For this reason, technical societies and associations accepting the responsibility of setting standards have naturally been severe in their restrictions regarding specifications for and the allowable application of welding. According to the Metal & Thermit Corporation, however, definite conclusions as to the strength of a thermit weld may be drawn from a careful interior inspection of the collar or reinforcement section of the weld.

In thermit welding, it is said to be impossible for defects such as lack of fusion or oxide inclusion to exist, if the proper amount of thermit is used and if instructions are carefully followed. Oxide inclusions (due, for example, to the failure to clean scale properly from wrought-iron sections before welding), if present at all, will always be in the thermit steel collars due to the natural tendency of the gases to rise in the molten mass. An examination of the interior of the collar can be made without materially affecting the strength of the weld. Thus unsound welds can be found and condemned.

In practice, this examination is made by gouging deep grooves in the thermit steel collars parallel with the axis of the piece. These grooves may reach almost to the original section itself. Two grooves on each of the four sides of a thermit weld have been found sufficient. If these grooves are observed to be clean and free from blow-hole defects, the inspector may be assured that the weld itself is sound.

* * *

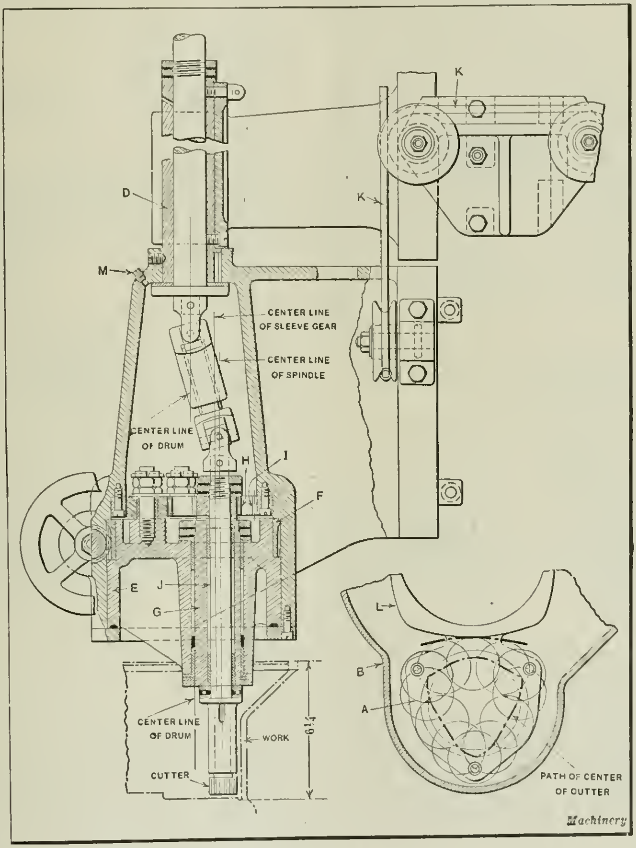
A new chromium-nickel steel is said to have been developed by the Armstrong-Whitworth Works in England, which, it is claimed, does not have the brittleness present in nickel-chromium steels when subjected to certain heat-treatments. The new steel is said to be highly resistant to torsion and shock, which makes it particularly adaptable for use in turbine rotors and for crankshafts and other shafts subject to high stresses when running at high speeds. It has been given the trade name "Vibrac," and is understood to be the result of researches carried on at the company's Openshaw Works in Manchester, England.

Geared Milling Head for Profile Work

By A. B. BASSOFF

THE special geared milling attachment here illustrated was designed for end-milling a flat pad in a transmission gear-case casting. This surface *A* is triangular in shape, and located within the casting 6¼ inches from the end. The circular wall *B* merges into the bell-shaped casting proper and produces a very restricted area within which to work, requiring the use of long slender spindles if the work is produced in a milling machine in conjunction with former plates. The use of former plates is usually objectionable, because they introduce the human element, and often result in rejected work due to the failure of the operator to follow the outline of the profile plate. There is a raised surface *L*, approximately rectangular in shape, which is adjacent to one side of this triangular pad, so that it was impossible to face the surface in a lathe. At the point where the rectangular boss joins the pad the casting has a draft, and it was necessary to cut into this metal along the contour shown by the heavy dot-and-dash line, in order to accommodate the plate which was to be attached to the finished surface of the pad.

The problem of machining the surface and of following the desired contour was solved by the use of a head which is shown in section in the illustration. This attachment was designed to be used on a 24-inch Cincinnati drilling machine, to which it was applied in place of the regular quill and spindle, the quill *D* of the attachment being inserted into the spindle bracket, in place of the regular construction. The milling head consists of a body casting or case which was designed to fit the regular slide on the column of the machine. This casting has attached to it, at the top, a quill *D* for accommodating the special spindle of the milling head. Within the lower end of the case a drum *E* is contained, and this drum has a spiral ring gear *F* keyed to it so that it may be revolved by means of the handwheel shown and a small spiral pinion meshing with the ring gear. The drum has an eccentrically located neck extending down through the retainer plate that holds the drum in position, and that carries within it a sleeve *G* in which there is cut a gear *H* at the upper end. This gear rotates the sleeve through the internal ring gear *I*, which is attached to the inside of the case, and a train of two gears. The spindle *J* that carries the cutter at the lower end is located eccentrically relative to the center line of the sleeve, and runs in bearings. It will be seen that the upper end of the spindle is connected, through universal joints and a telescopic sliding shaft, to the upper vertical spindle which has its bearings in the quill, and which is driven similarly to the regular drilling machine spindle.



Geared Cutter-head used for end-milling Inaccessible Flat Surface

Operation of the Head

With each half revolution of sleeve *G* the cutter-spindle *J* is alternately advanced toward the center of the drum and receded from it, due to the eccentricity of the spindle relative to the center of the sleeve gear *H*. The ratio between the sleeve gear and the large stationary ring gear *I* is 3 to 1, so that when the large drum has made one complete revolution, the cutter-spindle will have advanced and receded radially three times, and in so doing the path of the cutter will follow a regular figure having three high points and three low points midway between them, corresponding to the general triangular shape of the pad to be machined.

The partial view of the interior of the transmission case in the lower right-hand corner of the illustration indicates, by broken outline, the path that the center of the cutter-spindle takes during one revolution of the drum. From this view it will be seen that the course of the cutter corresponds very nearly to the contour of the pad. It will be noticed that the movement of the spindle is not an abrupt rise and drop, but a curve very nearly parallel to that of the outline of the surface to be milled.

The cutter is fed to the work in the same manner that a drill spindle is fed, the vertical location being established by the use of stop-collars such as are regularly furnished with the machine. After the head has been fed to the proper depth, it is clamped in place by two clamping bolts which bind the body casting to the column of the machine through the medium of the regular dovetailed slide construction. The operator then turns the handwheel until the drum *E* has made one complete revolution, and as has already been explained, this completes the cut. Only one cut is taken across the surface, the finish produced being sufficiently flat and free from chatter marks.

The position of the work is shown in broken outline in the illustration, with the cutter adjacent to the surface to be machined, and although no fixture is shown, it is understood that any suitable device for holding the work will be adequate. The entire mechanism runs in oil, the top of the case being provided with a filling plug *M* and also a drain plug at the bottom of the casting, thus permitting the oil to be renewed from time to time. Obviously the weight of an attachment of this kind is considerable, necessitating additional counterweights for returning the spindle to its upper position. These are provided at the rear, and a wire rope *K* is connected to them, passing through a series of pulleys in and around the head, so as to equalize the strain produced by the weight of the attachment on the dovetailed slide.

* * *

In "The Transactions" of the American Institute of Mining and Metallurgical Engineers, it is stated that an investigation of the so-called "fatigue of metals under stress," covering a period of a little over a year, has shown more conclusively than has been shown before that steel under repeated applications of stress, reversed from positive to negative, will not fall below some fairly clearly defined limiting stress which, however, so far as can be determined, does not bear any definite relation to the ordinary elastic limit, being as large as the elastic limit in some cases and about one-half the elastic limit in others.

SPRING PLUNGERS FOR FIXTURES

By H. P. LOSELY, Industrial Engineer, Detroit, Mich.

Three supporting points determine the plane in which a given piece of work will lie when clamped in a jig or fixture. However, it is sometimes necessary to provide more than three points of support in order to take up the thrust of the cut and prevent the piece from being distorted and machined out of alignment. When rough or unevenly machined surfaces are being dealt with, these extra supports must be adjustable. The piece may then be laid on the three fixed points and the adjustable supports brought in contact with the piece and locked, so that the work will be firmly held in position.

While there are various other types, the most economical adjustable support to use on a production job is the spring plunger, which consists of a cylindrical plunger pressed against the work by means of a spring. The plunger is held in place by a screw. The simplest way to make a plunger would be to mill a flat on the cylindrical surface and let the clamping screw bear directly on this flat; however, this is not good construction, because the vibration of the cut is likely to make the plunger slip so that it does not support the part properly.

To avoid this trouble, the plunger construction shown in Fig. 1 has been devised. This plunger has a flat milled on the cylindrical surface at an angle of 7 degrees with the axis, and the use of an intermediate plug between the screw and the plunger prevents the latter from being burred and locks it securely in position when the screw is tightened. Both the plug and plunger should be made of drill rod and hardened; the clamping screw may be made from cold-rolled stock, and cyanide-hardened. Either a plain hexagonal-head machine screw may be used or a pin may be driven through the head to assist in rotating the screw. This pin should be at least ¼ inch in diameter, so that it will be heavy enough to withstand hammer blows. The

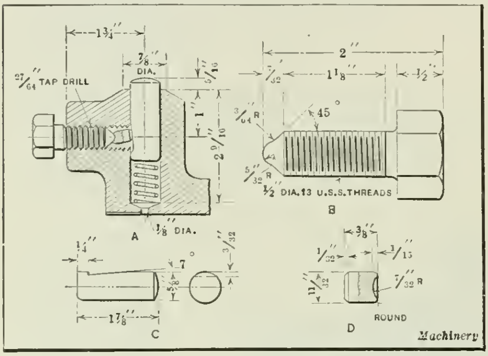


Fig. 1. Standard Design of Spring Plunger Construction for Jigs and Fixtures

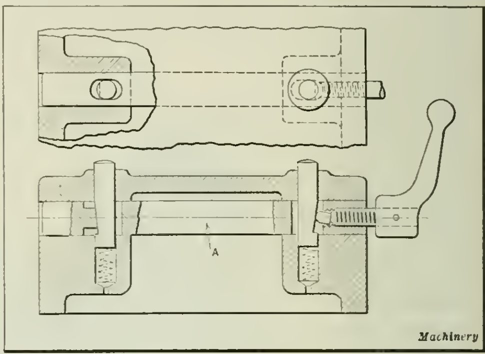


Fig. 2. Arrangement for operating Two Plungers by turning a Single Screw

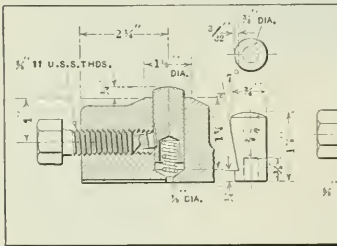


Fig. 3. Plunger with Spring placed in Hole at Lower End

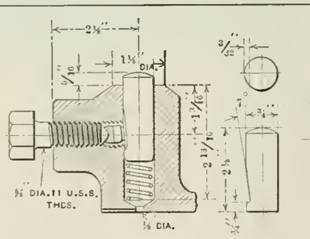


Fig. 4. Size which meets Average Requirements

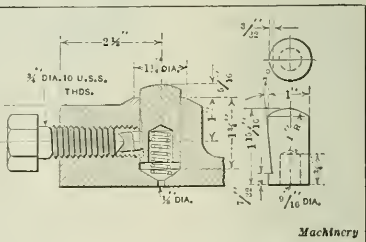


Fig. 5. Especially Heavy Construction for Large Work

plunger hole is reamed to a slip fit for the plunger. The coil spring is made of spring steel, 0.062 inch in diameter, and it has seven coils, an outside diameter of 19/32 inch, and a free length of 1⅜ inches. An air groove is provided from the ⅛-inch diameter vent at the lower end of the plunger hole to the outside of the fixture.

Fig. 3 shows a variant of the standard plunger construction, this being a heavier size, and in order to reduce the head room, the plunger is drilled at the lower end to accommodate the spring. The spring in this case is made of spring steel, 0.054 inch in diameter, and it has six coils, an outside diameter of 11/32 inch, and a free length of ⅞ inch. Fig. 4 shows a good size of plunger for average requirements, the spring being made of spring steel, 0.072 inch in diameter, and having seven coils, an outside diameter of 11/16 inch, and a free length of 1 5/16 inches. A specially heavy construction, intended for jigs and fixtures holding large pieces on which heavy cuts are to be taken, is shown in Fig. 5. The position of the spring here is the same as in Fig. 3. The spring is made of spring steel, 0.062 inch in diameter, and has seven coils, an outside diameter of 17/32 inch, and a free length of 1 5/16 inches.

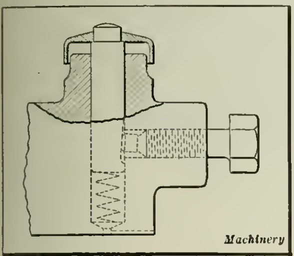


Fig. 6. Method of keeping Chips from Plunger Hole

An arrangement for clamping two plungers at one time is illustrated in Fig. 2. It will be seen that when the screw is first tightened, the clamping plug will be locked against the right-hand plunger; then, as the screw continues to be tightened, shaft *A* will be forced over, also locking the left hand plunger. Care must be taken to make the slots in the shaft of sufficient length to allow the necessary longitudinal movement. At the left-hand slot, enough stock must be milled away at the bottom of the shaft to provide clearance between the latter and the shoulder at the lower end of the flat on the plunger.

Usually the head of the plunger, on account of being under the work, is somewhat protected from chips, so that the provision of a boss, as shown in the various illustrations, is sufficient to prevent chips from working into the plunger hole. Sometimes, however, a condition will arise when chips will be thrown under the work by a cutter at some distance from the point of support, or a heavy stream of lubricant conveys the chips to the plunger. In such cases, additional protection is desirable, and the special design shown in Fig. 6 may be used. The cap on the plunger slides over the machined head of the boss, and if the fixture is so designed that the head of the boss is above the level of lubricant, the plunger cap will effectually keep out chips and prevent having the plunger jammed. If lubricant floods around the boss, its height from the base to the ridge or shoulder half way up on it should be at least ½ inch. In all cases of plunger construction, an air vent must be provided at the bottom of the plunger hole, so that the plunger can move freely. A plunger and spring must be of such dimensions that the plunger will have sufficient travel to meet variations in the work.

* * *

About forty airplane factories having a total production of 2500 machines a week were in operation in Germany at the close of the war. The majority of the firms operating these plants took up other work after the war, although three of the firms decided to manufacture airplanes for commercial use. These were the Sablatnig Co. of Berlin, the Junkers Co. of Dessau, and the Fokker factory of Schwerin.

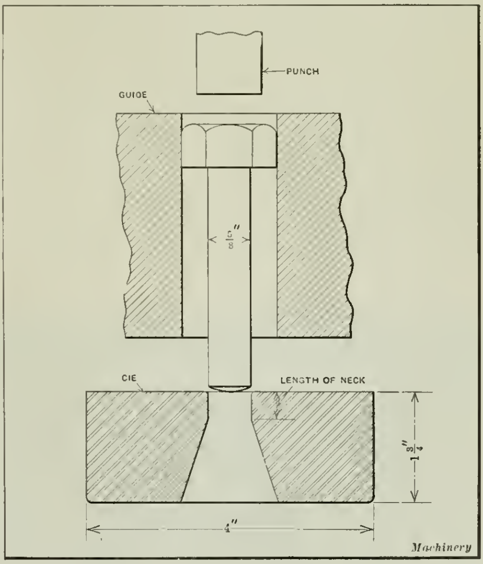
BURNISHING BOLTS IN QUANTITY

By D. C. OVIATT

A high rate of production can be obtained by finishing the bodies of bolts by burnishing instead of by grinding. As will be seen by referring to the accompanying illustration, the die employed is of simple design, as is also the guide by means of which the bolt is kept in alignment with the center of the opening in the die. The over-all dimensions of the die-block will be suitable for the size of bolt shown in the illustration, that is, ⅝ inch diameter. The length of die neck through which the bolts are forced by the punch should be equal to about half the diameter of the bolt, and should be finished by lapping and have about ⅛ inch radius at the top. Good results will be obtained from "Novo" steel, double heat-treated in the following manner: Pack-harden for three hours at 1700 degrees F., and allow to cool off in the pot; then reheat to 1300 degrees and quench in oil. The diameter of the die opening in this case is such as to reduce the diameter of the bolt 0.005 inch.

Comparison of Results Obtained by Burnishing and by Grinding

Whereas the production rate by grinding will average about 800 bolts per day, it is possible to burnish as many as 4000 bolts per day when a power press equipped with a die of the type described is employed. No trouble will be experienced in maintaining straightness of the bolts up to 4 inches long, and even then the bolts may be successfully finished in this manner. The degree of finish obtained is good, possibly superior to that obtained by grinding, and the structure of the surface, being subjected to the compressive action of the burnishing die, is harder and will wear longer than any surface which has not been treated in this way. The type of press on which this operation has been successfully performed is a No. 84 Bliss reducing press, equipped with a cam-actuated attachment for lifting the bolts out of the die after the operation has been completed. The bolts which were so finished were what is known as spring bolts and king-pin bolts, such as used on the front axles of automobiles, and they were made with an undercut under the head to take care of the metal that might accumulate on the die and prevent the bolts from seating properly.



Die used in burnishing the Bodies of Bolts

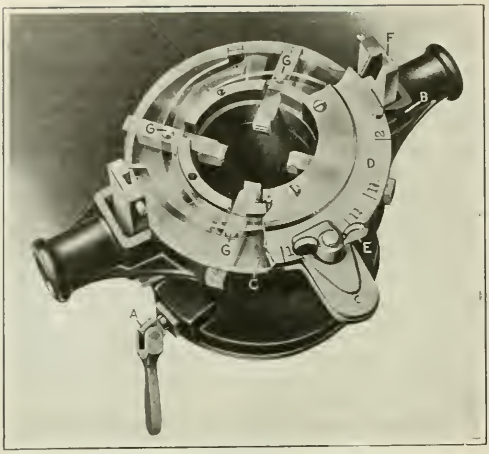


Fig. 1. Adjustable Die-stock for cutting Taper Threads on 1-, 1¼-, 1½-, and 2-inch Pipe

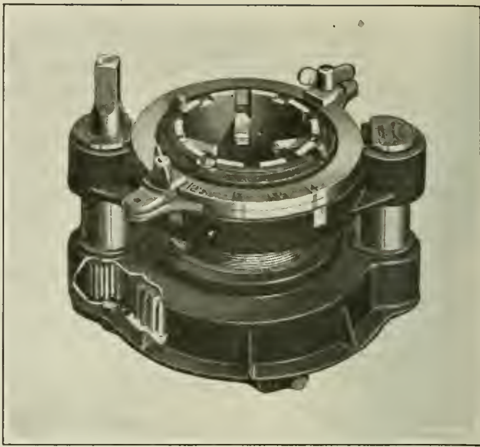


Fig. 2. Geared Die-stock for threading Pipe from 2½ Inches to 4 Inches in Diameter

Pipe Threading Tools and Their Manufacture

Methods Used in Making Beaver Die-stocks and Chasers—First of Two Articles

By FRED R. DANIELS

A MODERN type of pipe-threading die-stock is shown in Fig. 1. The die-stock is secured to the pipe by a universal chuck, tightened and released by the grip-screw *A*. The chuck-holder is threaded into die-head *B* so that as the latter is turned in cutting a thread, the chasers will be advanced at the same rate. This means that the threaded portion of the die-head must correspond in lead with that of the thread to be cut. Since the lead is the same for threads of more than one pipe diameter, it is obvious that by providing a means for opening the chasers independently to suit varying diameters, a number of pipe sizes can be threaded with the same die-stock. This is accomplished by a cam-plate *C*, in which there are slots which are engaged by pins *G* in the chasers, thus opening or closing the dies when plate *C* is turned. The dies are set to the desired pipe diameter, as determined by the graduated plate *D*, and the chasers locked in this position by wing-nut *E*. The chasers start cutting at full thread depth and travel at an angle with the center of the pipe in order to produce the standard taper pipe thread. This angular travel of the cutters is produced in the following way: On plate *D* is a lug which travels in an angular slot in post *F* as the die-head is turned in cutting a thread. The result is that the top plate advances with the die-stock, and being clamped to the cam-plate, turns that member and causes the chasers to travel at the correct angle to produce the desired taper thread, as previously mentioned. The taper-threaded chasers are not usually provided with more than two or three threads; in fact, a single chaser thread might cut a pipe thread satisfactorily under these conditions.

The die-stock shown in Fig. 1 will accommodate the four pipe diameters 1, 1¼, 1½ and 2 inches, these sizes having the same thread pitch. The use of a universal chuck for clamping the die-stock to the pipe does away with the neces-

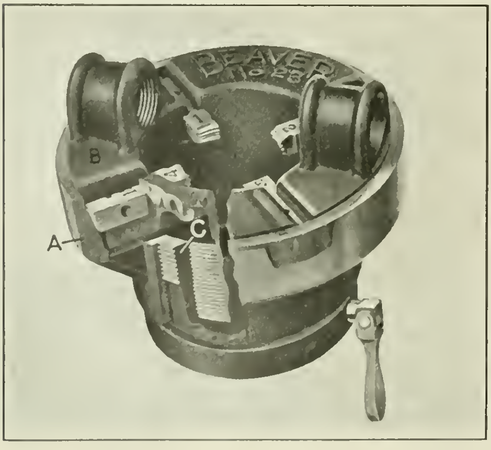


Fig. 3. Die-stock of the Non-adjustable Type

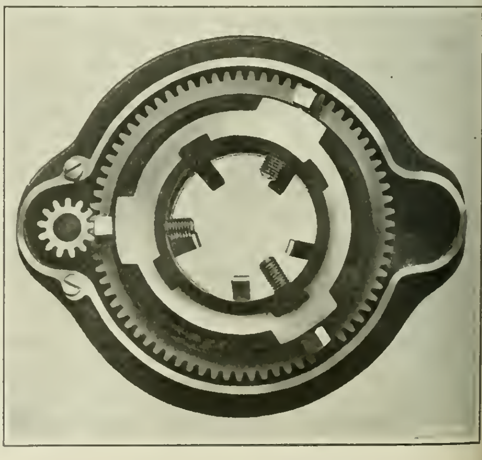


Fig. 4. Interior of Geared Die-stock shown in Fig. 2

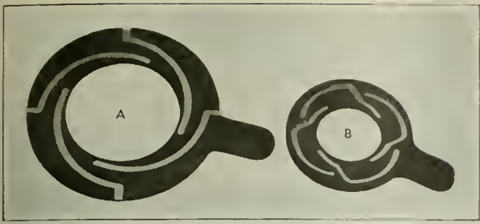


Fig. 5. Types of Chaser Cam-plates

sity of using a separate bushing for each of these sizes. The die-stocks that are described in this article are known as the "Beaver" type, and are manufactured by the Borden Co. of Warren, Ohio.

For pipe diameters of 2½ inches and larger, the die-stocks are operated by a gear and pinion, but the principle is identical with that already described. A tool of this construction that will handle pipe sizes up to 4 inches is illustrated in Fig. 2. Aside from the geared feature and the pillar arrangement for keeping the upper and lower main members in alignment, this die-stock is the same in principle as the one used for the medium sizes of pipe.

Die-stocks with Two Sets of Chasers

For the small sizes of pipe, when it is necessary to handle more than one diameter, the construction previously described must be modified. This is due to the fact that the pitch varies more in the smaller sizes than in the larger sizes. For example, a ¼-inch and a ⅜-inch standard pipe thread have eighteen threads per inch, and a ½ and a ¾ inch thread have fourteen threads per inch, whereas, the thread pitch on larger sizes of pipe would be the same for a number of consecutive sizes. By making provision for accommodating two sets of chasers, these four pipe diameters can be threaded with one tool. A die-stock of this type must be so designed that while one set of chasers is in use the other set can be withdrawn from contact with the pipe. The principal change in design made necessary by this requirement is in the slots of the cam-plates which control the radial adjustment of the chasers.

The difference in cam-slot arrangement is clearly shown in Fig. 5, the cam shown at *A* being the type used when one set of chasers is employed, and that at *B* the type used when more than one set is employed, and it is necessary alternately to advance and withdraw the sets of chasers, as when threading the smaller pipe sizes.

Non-adjustable Type of Die-stock

A die-stock which is not adjustable is illustrated in Fig. 3. This tool is of simpler construction than the cam-plate type, and consists of only three main parts in addition to the die chasers. In this case, the chasers are set to the required pipe diameter when the top edge of the outer housing *A* is flush with the upper surface of the die-head *B*. The barrel of the die-head is threaded externally, the threads having the same pitch as the thread to be cut. The threaded part of the head operates in the leader nut *C*, the outside of which has a coarser thread than that of the die-head barrel so that as the die-stock is turned, the outer housing will advance at a faster rate than the die-head. Consequently, the chasers will be traversed at the required thread angle due to the angularity of the inner wall of the outer housing against which the ends of the chasers bear. With a die-stock of this type it is necessary to use separate sets of chasers and bushings for each size of pipe that is threaded. The principal feature of this stock is its low cost due to the small number of parts entering into its construction.

Examples of Machining Operations

The housings for the operative parts and the slots in which the chasers are seated must be correctly machined, and the surfaces must be in a definite relation to each other if ease of operation and a high quality product is desired. The machining of the leader nut for the type of die-stock shown in Fig. 2 is of interest. This leader nut has gear teeth cut on its periphery, as shown in Fig. 4, which is a view of the bottom of the die-stock, showing the chasers and the construction of the pinion-shaft case in which the pinion and the gear end of the nut are housed. The machining operations to be described are performed on a Potter & Johnston turret lathe, Fig. 6. The work is held in a chuck provided with soft jaws. The tools carried in bar *A* rough-bore the two diameters *B* and *C* of the work. The bar is long enough to enter a guide bushing in the chuck and thus insure concentricity between the two bored diameters. While the second tool is at work, two tools in holder *D* rough-turn the flange of the work. This flange has two diameters separated by recess *E*. Before these two rough-turning operations are completed, tool *F* chamfers the inside of the hole.

The boring-bar used at the second station of the turret also comes into alignment with a bushing in the chuck and carries two finishing tools *G* and *H* for finish-boring the previously rough-machined holes while the shoulder is being squared up by tool *J*. At the same time the outside of the flange is beveled by means of tool *K*. Surfaces *L* and *M* are then rough-faced by a pair of tools mounted at the rear of the cross-slide and finish-faced by another pair of tools at the front of the cross-slide. Recess *E* is turned by tool *N* carried in a tool-block which is attached to the cross-slide in such a position as to turn the recess at the same time that surfaces *L* and *M* are being faced. The final machining operation consists of tapping the hole in the flange with a self-opening die-head *O*, which is mounted in the third station of the turret.

In finishing the outside diameter and the opposite side of the leader nut in another Potter and Johnston machine, the work is held by soft expanding jaws which grip it in the previously tapped hole. The chuck also has a pilot for locating the piece centrally with respect to the turret lathe spindle. The operations performed in this machine are rough- and finish-facing the opposite side of the nut and rough-turning the outside diameter. While these operations are in process, the rough edges are removed by auxiliary tools.

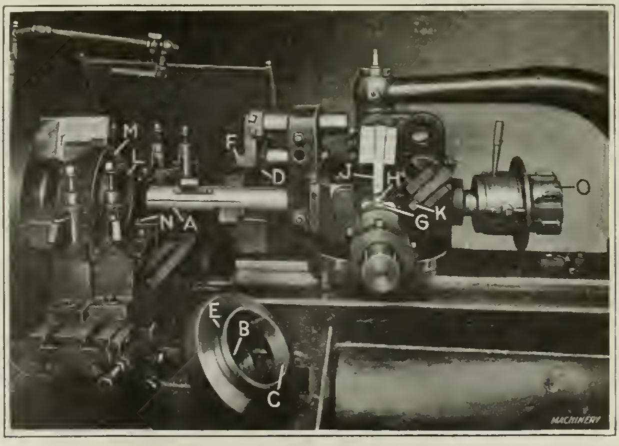


Fig. 6. Turret Lathe equipped with Tooling for machining Leader Nuts for Pipe Thread Chasers

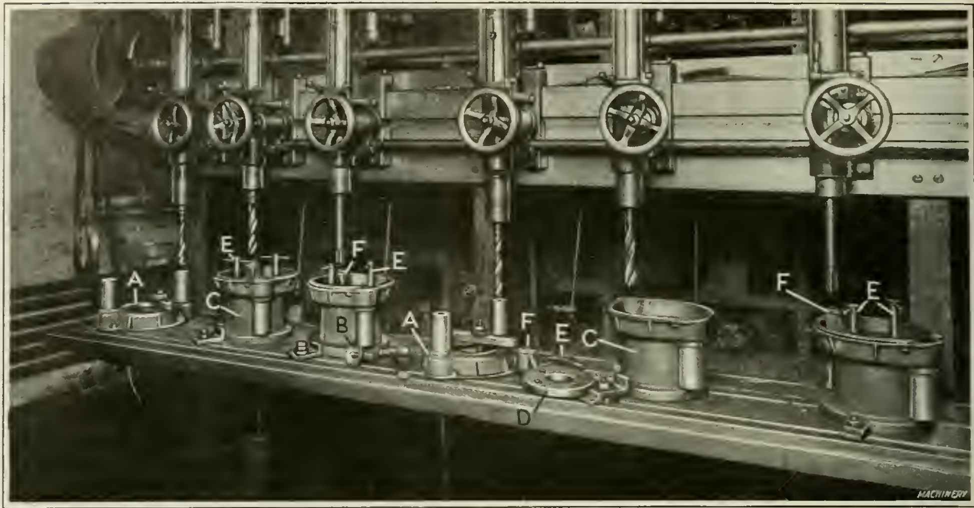


Fig. 7. Multiple-spindle Drilling Machine arranged for drilling Hole in the Pinion-shaft Case

The pinion-rod hole in the pinion-shaft case, Fig. 4, is machined on a Foote-Burt multiple drilling machine, as illustrated in Fig. 7. Two gangs of tools are used, each of which consists of two drills and a reamer, so that steady production can be maintained without undue loss of time by the operator. The work is shown strapped to the machine table at *A*. The outside diameter of the post through which this hole is drilled is previously machined, so that by using the prick-punch *B* for locating the center for the 7/8-inch drill which is used first, it is not necessary to use a fixture for this operation. As soon as this hole has been drilled, the operator unclamps the work and loads it into jig *C*. The jig is of the pot type, with a shoulder for receiving the work. The height of this shoulder is less than the thickness of the casting, leaving a pocket, 1/4 inch deep, in which the jig plate *D* fits, where it is located by dowels and secured by pilot-screws *E*. This brings the bushing *F* into correct relation with the center hole in the case.

The 1 7/32-inch drill used in the second spindle is fed at a higher rate than it would be if the preliminary drilling operation had not been resorted to. By this means it is possible to so regulate the feeds of the two drills that no idle time results. As soon as the drilled piece is removed from the second spindle position, it is located in a similar jig, and reamed by a 1 1/4-inch reamer in the third spindle. While the three tools are operating, the attendant is busy at the other three spindles of the machine, after which it is time to return to the opposite end and start over again. The jigs are not fastened to the machine table, but are located by straps attached to the table; one of these prevents the jig from turning by abutting against a foot projecting from the base of the jig, and the other acts as a locating point at the front of the jig.

Machining Chaser Slots in Die-stock Heads

It is very important to have the chasers accurately fitted in the die-heads, and great care must be exercised in laying out the slots in the cam-plate by means of which the chasers are opened and closed. The practice in machining the malleable iron die-head castings for the accommodation of the chasers, is to first rough-mill them and then to finish the slots by broaching. Broaching has been found to give the desired degree of accuracy. In Fig. 8 is shown the set-up of a Lapointe broaching machine for finishing the slots in the type of die-head illustrated in Fig. 3. The work *C* is located on a special fixture *D*, which is attached to the head of the machine. In the illustration broach *A* is shown located in guide *B*, as it would appear near the end of the broach travel.

Another type of broaching fixture which will accommodate four small die-head castings is illustrated in Fig. 9. In this case, broach *A* rides on its back on bar *B*. The work is

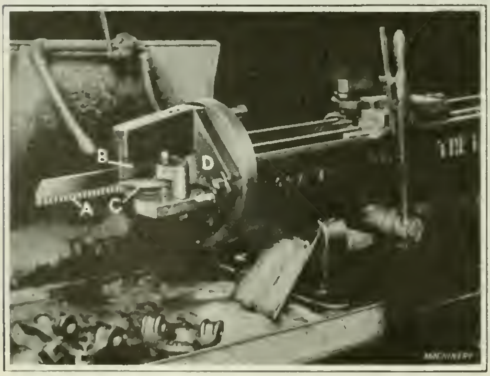


Fig. 8. Broaching Chaser Slots in Die-heads of the Type shown in Fig. 3

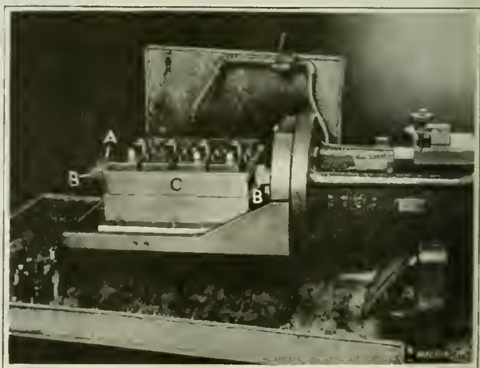


Fig. 9. Broaching Chaser Slots in the Smaller Die-heads, using a Gang Fixture

clamped in an inverted position in fixture C so that the cut is up. These die-heads are also milled previous to broaching, and the broaching fixture is arranged so that when it is clamped in position the milled slots align with the broach. Small die-heads like these are for use on die-stocks employed for threading the very smallest sizes of pipe. An unusual feature of the broaching fixture shown in Fig. 9 is its massive size for such a small piece of work. This heavy construction, however, provides the necessary support for the broach to maintain the required accuracy.

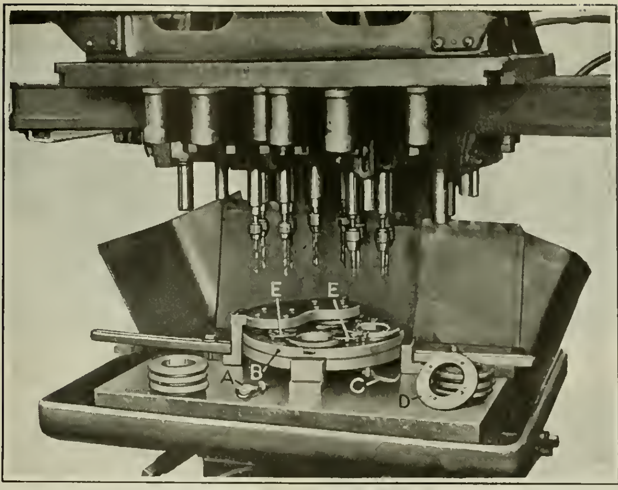


Fig. 10. Multiple-spindle Drilling Machine of the Cluster Type, and Indexing Jig used in drilling Chaser Cam-plates

Before the cam-plate slots, Fig. 5, can be milled, a preliminary drilling and counterboring operation is performed on the "Natco" multiple drilling machine illustrated in Fig. 10. The holes thus produced are for starting the end-mills used in cutting the slots. The indexing type of drill jig used for this work accommodates four chaser cam-plates, and can be indexed from station to station by inserting the removable handle A in hole B of the revolving jig plate after latch C has been depressed. There are three clusters of tools, two of four drills each, and one of four counterbores. These are all working at once while the operator is loading and unloading the fourth station. A number of the unmachined plates are shown lying on the machine table, and one which is partly drilled and counterbored may be seen at D. The work is held on the indexing jig plate by two flat springs E which are attached to the plate by a screw at the center so that they can easily be raised from the work and swung to one side when unloading. There is sufficient tension in these springs to prevent the work from changing position during the drilling operation.

Milling the Cam-plate Slots

In milling the pin slots in these chaser cam-plates a special duplex end-milling machine, designed and constructed by the Borden Co., is employed. This machine is illustrated in Fig. 11. The machine has an ordinary worm and worm-wheel feed mechanism on each end. The faceplates C on which the work is mounted are revolved by master cams A and B to produce the special form of cam slots. An end-mill D of the proper diameter is used in taking the cut. The procedure is as follows:

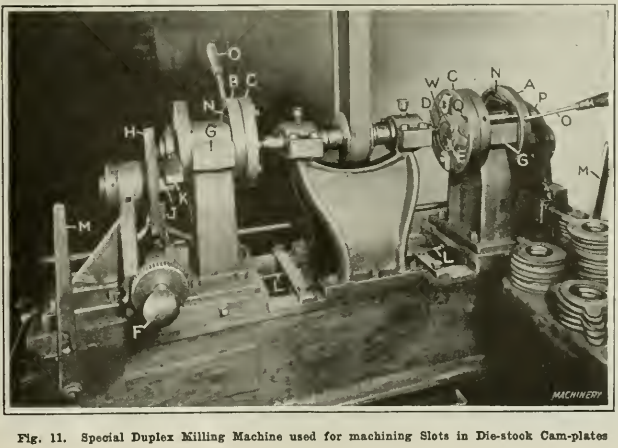


Fig. 11. Special Duplex Milling Machine used for machining Slots in Die-stock Cam-plates

After attaching the cam-plate W to the faceplate of the machine by the aid of a central locating stud E and suitable clamps, the operator advances each carriage against stops L until the end-mill enters one of the previously counterbored starting holes. The carriages are traversed by the hand-levers M to bring them against the stops. The feed is then engaged by raising the worm-handle F, and a combined radial and rotary movement of the faceplate is obtained by the engagement of a cam-roll in slot N of the master cam. This cam-roll is attached to the end of the bearings G, and always remains in engagement with the slot in the master cam.

Obtaining Variable Rotary Feed

A rather ingenious arrangement has been employed in this machine for obtaining a variable rotary speed in feeding the work past the end-mills. This variation in speed is necessary because of the design of the slot, it being evident that at the central section of the slot the direction changes from approximately a concentric path to an abrupt angle, which is almost radial in direction (see cam B, Fig. 5). The variation in rate of feed is accomplished by mounting the feed worm-wheel H eccentric relative to the center of the faceplate of the machine and below it. There is a dog J on the inside of the worm-wheel, by which the faceplate is driven through the medium of lever K, which is fixed to the faceplate shaft. The relative position of the centers of the worm-wheel and of the faceplate is such that when the abrupt change in direction of the path is reached, the driving dog J will travel toward the center of the faceplate on the lever K, and so the angular movement of the driver will transmit to the faceplate a greater rotary movement when driving from this position than when the lever arm from the center of the dog to the center of the faceplate is longer. To express it in another way, the lever arm of the driver is shortened, which results in a greater movement at the circumference of the faceplate. At the end of this abrupt change in path, it is necessary to resume a slower rate of feed, and the relation of the driving dog to the center of the faceplate permits this to be done by again increasing the length of the lever arm of the driver.

At the termination of one slot, the feed knocks off and the operator turns the master cam backward by means of handles O so that the cam-roll is again at the beginning of the slot. The two carriages are slid away from the end-mill sufficiently to enable the faceplate to be indexed through an arc of 90 degrees preparatory to starting the second slot. The index-pin and bushing are shown at P and Q, respectively.

On the types of cam-plates in which the slots follow a more uniform cam curve (as cam A, Fig. 5) machines of the same type are used, but in this case it is not necessary to employ a master cam, the cam-plates simply being mounted eccentrically relative to the center of rotation of the faceplate.

The second article on the manufacture of pipe threading dies, which will be published in June MACHINERY, will contain a detailed description of the operations employed in manufacturing the thread chasers, the heat-treating and inspection practices, and the device used in registering the amount of pull required in threading a pipe.

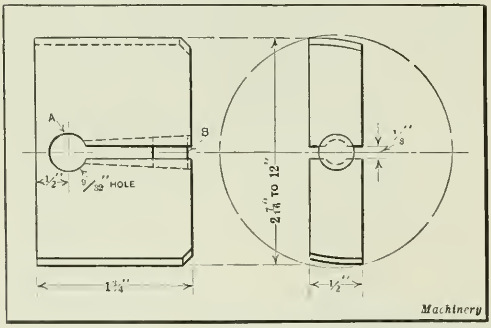
* * *

ADJUSTABLE REAMER BLADE

By LOUIS J. KESSLER

The writer read with interest the description of a new style of adjustable reamer blade, which appeared on page 231 of November, 1921, MACHINERY. Another adjustable reamer blade of somewhat different construction, which is used in the plant where the writer is employed, is described in the following. The cutters range in size from 2 7/16 inches up to the large blades used for reaming holes 12 inches in diameter. They are referred to in the shop as "floating double-end cutters" and all sizes are made adjustable within certain limits. Annealed flat high-speed steel stock ½ inch by 1¾ inches is standard for making all sizes.

The adjustable feature will be apparent from an inspection of the illustration. After the cutters have been turned about 0.015 inch over size, a 9/32-inch hole is drilled at A.



Floating Reamer Blade of Adjustable Type

A hole for a No. 5 taper pin is then drilled in the end of the cutter so that it will break into hole A. The ⅛-inch slot shown in the illustration is then cut in the blade.

After being hardened, a short taper pin B is driven into the tapered hole just tight enough to prevent it from falling out. The cutter is then placed on an arbor held between centers on a grinder and ground to size and relieved. The width of the cutter at the back end is made about 0.0015 inch less than the width at the front or cutting end. When worn so that it cuts under size, the cutter can be readily expanded by driving in tapered pin B.

This style of cutter has been in use for several years on boring mills, lathes, and drilling machines for reaming operations on all kinds of materials. The bars in which the cutters are held must always be properly centered or aligned with the holes being reamed. Not more than 0.005 inch on the side of a hole should be left for reaming. The maximum amount of expansion obtainable with this type of cutter is approximately 0.030 inch.

SIMPLIFIED FORMULA FOR STRENGTH OF GEAR TEETH

By DAVID T. MALPARTIDA

The formulas given in this article make it possible to determine directly the diametral or circular pitch for a gear when the horsepower to be transmitted and the velocity in feet per minute at the pitch diameter are known.

On page 595 of MACHINERY'S HANDBOOK this formula is given:

$$W = \frac{SAY}{P} \qquad (1)$$

in which

W = maximum safe tangential load in pounds at pitch diameter;
S = allowable unit stress for material at given velocity;
A = width of face in inches;
Y = outline factor for Lewis formula (as applied to diametral pitch); and
P = diametral pitch.

Let P_1 = circular pitch $= \frac{3.1416}{P}$, or $P = \frac{3.1416}{P_1}$

Inserting this value in Formula (1), we have:

$$W = \frac{P_1SAY}{3.1416}$$

But A (the width of face) is usually a certain number of times the circular pitch; so that we may write $A = kP_1$, where k generally is from 2 to 3 for cast teeth gears. Then

$$W = \frac{P_1SkP_1Y}{3.1416} = \frac{P_1^2SkY}{3.1416}$$

From this it follows that

$$P_1 = \sqrt{\frac{3.1416W}{SkY}}$$

But $W = \frac{33{,}000 \text{ H.P.}}{V}$ (see page 595, MACHINERY'S HANDBOOK) in which V = velocity in feet per minute at pitch diameter. Hence,

$$P_1 = \sqrt{\frac{3.1416 \times 33{,}000 \text{ H.P.}}{SkYV}} \qquad (2)$$

To obtain the diametral pitch P, substitute $\frac{3.1416}{P}$ for P_1 in Formula (2) and solve for P:

$$P = \sqrt{\frac{3.1416SkYV}{33{,}000 \text{ H.P.}}} \qquad (3)$$

For cut teeth gears, k is generally from 3 to 4.

For gears with cast teeth, the writer uses the following values for the static unit stress S_s:

Cast iron, 4000; phosphor-bronze, 6000; 0.30 carbon steel, 7500; 0.50 carbon steel, 12,500; steel (average) 10,000 (all in pounds per square inch).

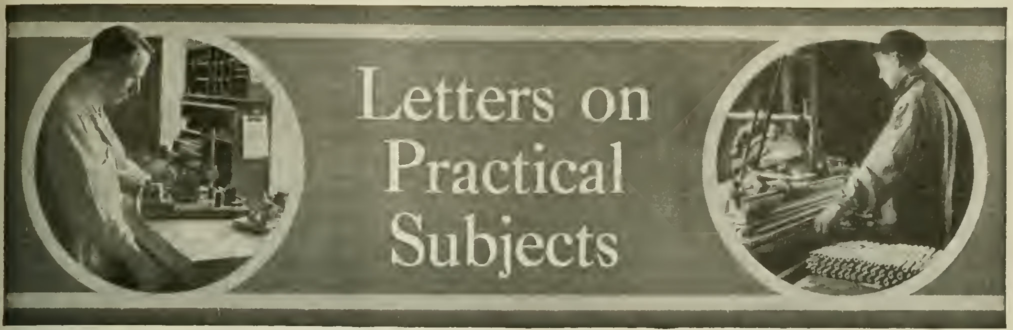
These values apply to steady load conditions; for intermittent service, use from 50 to 75 per cent of these values.

From these values S can be found as follows:

$$S = S_s \times \frac{600}{600 + V}$$

* * *

According to index figures of prices collected by Dwight P. Robinson & Co., engineers and constructors, New York City, if the price index for 1914 is assumed as 100, the index figure for January, 1922, for metals and metal products is 117. The average of all commodities is 148, showing that the metal-working industries have reduced their prices far below the average of the industries in general. Building materials have an index figure of 202, one of the highest on the list.

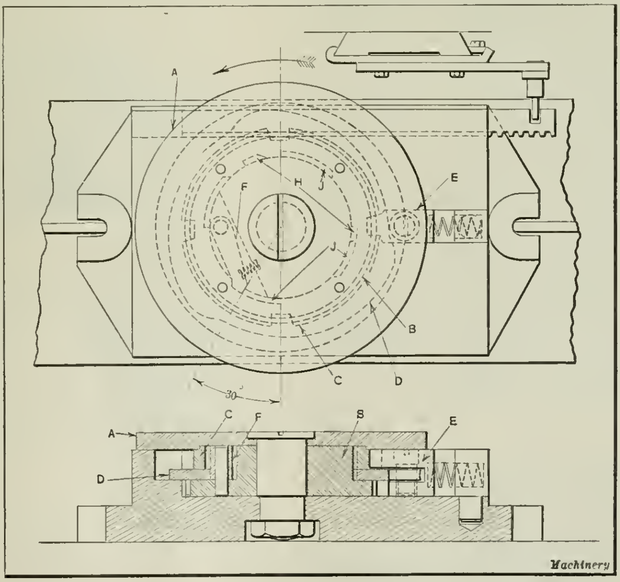


INDEX MILLING FIXTURE

An indexing milling fixture which may be used either on a hand- or a power-fed milling machine is shown in the accompanying illustration. This fixture is of simple design and positive operation. It lends itself to a rather broad application, although it is not recommended for an index movement of less than 45 degrees. The illustration shows the fixture as arranged for a 90-degree index movement. The special use for which an equipment of this kind is recommended is in the milling of a large number of small pieces, where a considerable amount of time may be saved by clamping four holding devices on the fixture plate *A*. By this means high production may be obtained, utilizing the fixture as in station milling, one side being loaded while the holding device at the opposite side is at work.

The construction and operation of the device are as follows: A stationary rack is connected to the column of the machine and is capable of adjustment for position relative to the machine spindle. The backward movement of the machine table causes the gear *B*, which is loose on a central stud, to rotate in the direction indicated by the arrow. The gear is cut out to accommodate a spring pawl *F*, by means of which movement is imparted to the index-plate *C* and thence to the fixture plate *A*. The index-plate is attached to the fixture plate, and in this case contains four notches *J*. The outer periphery of the plunger plate *D* is a three-lobe cam which operates the spring plunger *E*, and permits the indexing movement of the fixture to take place.

In the illustration the fixture is shown just prior to the backward movement of the table after the cut has been taken. Pawl *F* engages one of three notches *H* in the plunger plate, and as the gear is rotated this plate is moved through 30 degrees, withdrawing plunger *E* from the notch in the index-plate at which time the pawl also engages one of the four long notches *J* in the index-plate. Continued rotation of the gear from this point turns the index-plate 90 degrees, when the plate is again locked in place by the plunger. During the forward movement of the table and while the cut is being taken, the index-plate remains locked by the plunger. The 30-degree reverse table travel before the index movement occurs, is for the purpose of preventing pawl *F* from again coming into the indexing position until the table has carried the work backward for enough to clear the cutter.



Indexing Milling Fixture for Use in milling a Large Number of Small Pieces

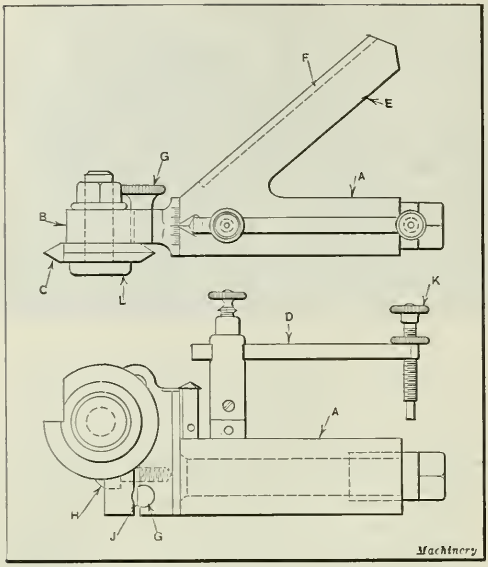
As previously mentioned, the design may be modified to suit different cases, but the main points in the construction are that the index-plate must be fastened to the fixture plate and that the plunger plate must have one less cam rise than there are index movements.

Fitchburg, Mass. E. E. Lakso

THREAD-CUTTING TOOL

In the following is described a thread-cutting tool designed by the writer with the object of combining some of the most desirable features found in different types of thread-cutting tools. Although this tool has now been in use for a number of years the writer has yet to find its equal for ease of manipulation or for accuracy. The tool is composed of the following parts: A block or holder *A* which fits the lathe toolpost; a swivel head *B* which holds the cutter *C* and allows it to be set at any angle within its range; and a swinging gage-bar *D* with an adjustable stop *K* which is used to set the cutter in its proper position after it has been ground.

The part *A* is a piece of machine steel finished accurately to the shape shown. A dovetail slot cut in the side of arm *E* holds a data plate *F* which can be made to suit the class of work for which the tool is generally used. The part *B* is made from tool steel, finished to size and graduated in degrees. This piece is hardened and drawn to a spring temper. The cutter *C* can be counter-



Thread-cutting Tool

sunk on one side to allow a countersunk head bolt to be employed, if desired, so that the tool can be used for cutting threads close to a shoulder. The cutters are hardened and drawn to a light straw color, after which the bolt holes are lapped to size. After the holes are lapped, the cutters are placed on an arbor and ground accurately to the correct form for thread-cutting.

By means of button *G* and adjusting screw *H* the holder can be adapted for use either as a spring or a solid tool. When used as a spring tool, the flat side on button *G* is brought parallel with the slot in part *B*, leaving an opening of about 1/16 inch at *J*, and thus allowing the spring in the upper part of *B* to act. When in use as a solid tool, the flat surface on button *G* is turned at right angles with the slot in part *B* and adjusting screw *H* tightened. Part *B* is graduated in degrees to read in both directions as shown, thus allowing the cutter to be set to correspond with the helix angle of either right- or left-hand threads.

The gage-bar *D* and adjusting screw *K* are of great assistance when the point of the tool breaks, as it is a simple matter to loosen the nut on screw *L*, remove the cutter and grind it, after which it can be set back in the same position without removing the work from the lathe. By swinging bar *D* around and using the lower end of screw *K* as a stop, the cutting point of tool *C* can be located at the proper height. The plate *F* is marked to give the diameter of screw, number of threads per inch, angle of thread, and also total depth of thread. This has proved a convenient method of presenting these data, and as many slides are made up as are required to cover the range of threads likely to be cut. When setting the tool in the lathe, a parallel is first placed between the faceplate and the side of the holder, after which the cutter is adjusted for height.

Chicago, Ill. A. H. Wilson

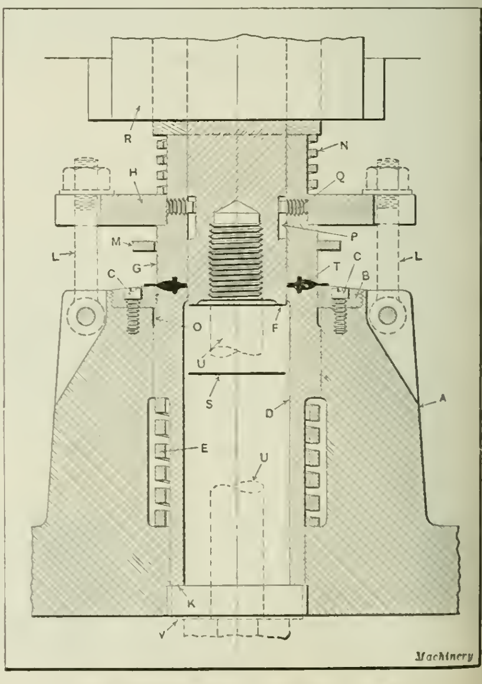
TRIMMING DIE FOR SMALL FORGINGS

The accompanying illustration shows a trimming die for removing the fin or flash from cycle free-wheel ring forgings in one operation. This die has a cast-steel bolster *A* into the top of which is screwed the hardened external trimming ring *B*. Two fillister-head screws *C* are inserted in ring *B* to prevent it from working loose. The punch *D*, which is made of special punch steel, serves as an extractor and also forms the ring for punching out the center part *S* of the forging.

On the up stroke the spring *E* actuates punch *D*, causing the forging *T* to be extracted from ring *B*. The center punch *F* is also made of special punch steel and is hardened and ground. This member forms a center which locates the sliding punch *G*. There is a shoulder on the outside diameter of punch *G*, on which flange *H* rests. It is necessary to provide a stripper *M* for the outer flash. Spring *N* acts on punch *G* through flange *H*.

The operation of the tool is very simple, and it is well adapted for use on a single-acting press. Referring to the illustration, it will be noted that the center of the forging has just been punched and that the fin is falling through the hole in punch *D*. As the ram of the press continues its downward stroke, punch *G* will clip the outer part of the forging. On the return of ram *R*, stripper *M* removes the fin from punch *G*. Punch *D*, actuated by spring *E*, follows the up stroke of the press until the shoulder at *O* strikes the bottom of the trimming ring *B*. Ram *R* continues its upward stroke carrying with it punch *F*.

Punch *G*, through the action of spring *N*, will remain down until punch *F* has moved upward a sufficient distance to bring the bottom of the slot *P* into contact with the screw *Q*. This enables ram *R* to open the dies so that the finished forging can be taken out. It should be noted that punch *G* and extractor *D* are both formed at the ends to fit the forging. This is necessary to prevent any distortion of the forging, which is of very light weight and is required to be kept within close limits of accuracy, only 1/32 inch being allowed for finishing. Center punch *F* is threaded for an extractor bolt *U* (shown in dotted lines) on which is placed a mild steel washer *V*, which rests on the end of punch *D* at point *K* when the bolt is employed to release the dies. It will be noticed in the illustration that two swinging bolts *L*, shown by dotted lines, are fitted into slots cast into bolster *A*. When the dies become worn, they occasionally stick in ring *B*. The extractor bolt is then screwed into the punch *F*



Die for trimming Flash from Small Forgings from beneath the press table. The bolt thus clamps the parts *R*, *F*, *G*, and *D* together as one piece. The dies are then released by turning the flywheel by hand. To release a forging in case it becomes stuck on punch *F*, it is only necessary to swing the bolts *L* into slots cut in flange *H* so that the punch can be readily withdrawn.

Cleveland, Ohio C. F. George

CONNECTING-ROD BORING AND REAMING FIXTURE

The fixture shown in Fig. 1 was designed to perform the finish-boring and final reaming operations on a connecting-rod crankshaft bearing. It insures a bearing of accurate size and one that is parallel and square with the wrist-pin bushing hole. The connecting-rod *A* is held on the wrist-pin end by means of a spring collet *B* actuated by the screw *C*. On the crankpin end it is held by the sliding arbor *D* which locates it, prior to clamping, by the forked clamp *E* actuated by the screw-operated tapered wedge *F*.

The arbor *D* is hollow and has a hole ground at the connecting-rod end to take the end of the reamer-bar *H*. It also has a stop-pin *G* at the other end so that there will be no chance for the workman to force the connecting-rod over the small shoulder on the arbor; this shoulder is necessary because the bushings in which the arbors *D* and *H* slide are made large enough to let the reamer and cutting tools through. The left-hand end of reamer-bar *H* is made to fit into a "Magic" chuck, and the right-hand end is provided with a pilot and a standard shell reamer taper to take the reamer shown in Fig. 2.

The reamer is composed of a shell carrying a single fly tool *K* on the front end, which bores the bearing to within 0.003 inch of the required size. At the back of this reamer are inserted eight duplex reamer blades, one of which is shown at *L*. Each of these blades is 1 inch long and set at a 5-degree angle with the axis to form a left-hand spiral reamer. This reamer produces a fine finish and a very accurate hole.

The body of the fixture is made of cast iron and is well ribbed. It can be set up in a lathe or on a horizontal boring machine. When in operation, the connecting-rod is inserted while the reamer is pulled back. After the rod is in place

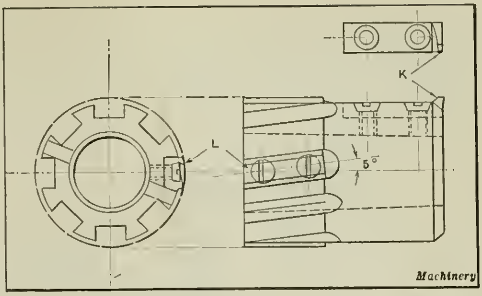


Fig. 2. Combination Boring and Reaming Cutter used in Fixture shown in Fig. 1

the reamer is fed up while being rotated at a very high speed. Compressed air is used to blow the chips away from the cutting edges of the tool.

Pittsburg, Pa. William Owen

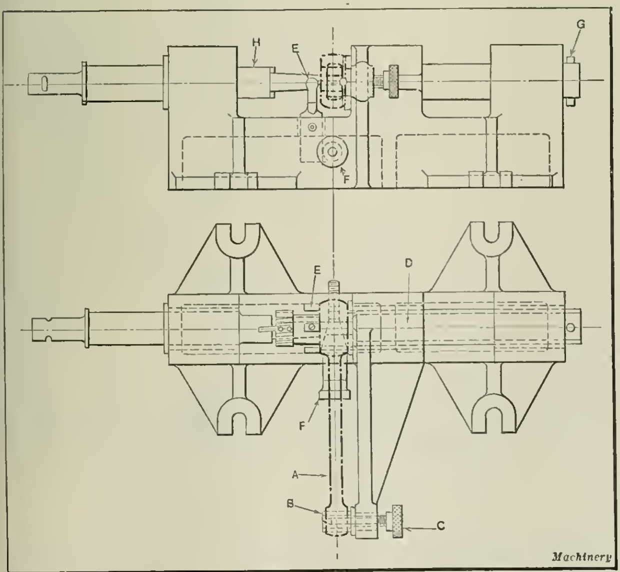


Fig. 1. Boring and Reaming Fixture for Connecting-rod Bearing

LISTS FOR CHECKING DRAWINGS

A list as an aid in checking drawings has been tried out at one time or another in nearly every drafting-room. Checking lists are very good in principle, but in practice it is usually found that the checkers lay them away as soon as the novelty has worn off. One firm has insured daily reference to its checking lists by providing blank spaces to the right of each item on the list. The drawing number is entered at the head of the column and as each item is checked, a mark is made in the proper space.

When the checking is completed, the check list and drawings are turned in to the chief draftsman. The improvement in the quality of checking which was noticeable when checking lists were first introduced in this drafting-room has been maintained, although the lists have been in use for more than eight months. The two check lists adopted (one for lay-out and one for detail drawings) were compiled after a study of several representative ones. The scope of the lists examined varied widely and none of them could be adopted outright. It seems to be necessary for each drafting-room to make its own checking list to suit local conditions.

The lists finally adopted, which proved satisfactory in this particular instance, are given here simply to illustrate the general nature of the checking system. After the lists were prepared, they were carefully traced and blueprint copies furnished to the checkers. At the head of the lists a space was left for the name of the checker and the date. It will be noted that the various items in the check list for lay-out drawings are arranged in groups; for instance, in the first group there are only two items, namely, the drawing number and the original data, while in the third group there are ten items, including the group heading and the subheadings.

The check list for lay-out drawings included the following items in the order given:

1. Drawing number; original data.

2. Design, including (a) rigidity; (b) strength; (c) formulas; and (d) numerical work.

3. Practice, including (A) finish, under which are given the items (a) limits of accuracy necessary, and (b) use of finish pads; (B) methods of fastening, with reference to bolts, studs, cap-screws, etc., and their (a)

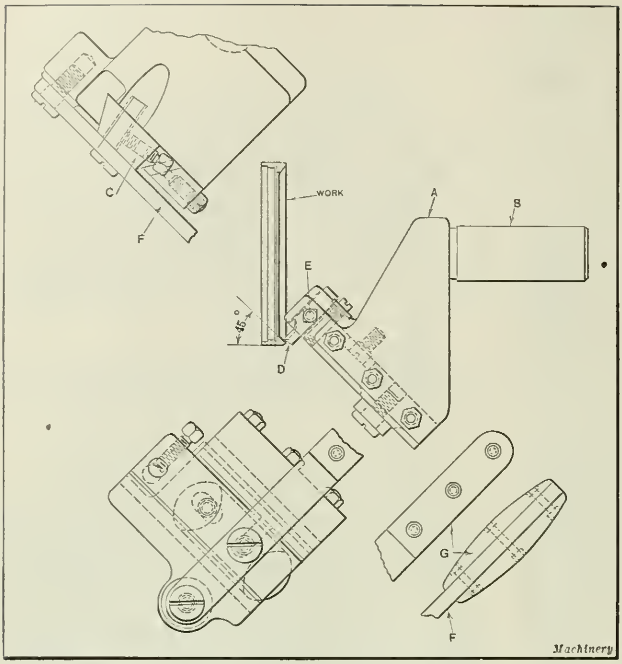


Fig. 1. Auxiliary Cross-slide designed for turning a 45-degree Taper

position; (b) size; (c) number; (d) removable with standard wrenches; and (e) clearance provided for bolt-heads and nuts.

4. Ease of manufacturing parts with reference to: (A) molding, including (a) fillets of sufficient size; (b) draft; and (c) cores; (B) forging, with reference to (a) machining, (b) use of jigs and fixtures, (c) use of standard sizes and standard parts, and (d) use of old parts, patterns, etc.

5. Interference, with reference to: (a) assembly checked with detailed drawings, and (b) operation of machine from checking assembly drawings.

6. Operation with regard to (a) simplicity, (b) ease of adjustment, (c) ease of repairing, and (d) provision for proper lubrication.

7. Check drawings with drafting-room standards.

The items to be checked as given on the check list for detail drawings, were as follows: Drawing number; neatness and clearness; crowding; lettering; center and section lines; projections correct; drawn in relative assembled position; drawn to scale; all necessary dimensions given; dimensions repeated; finish marks; limits; notes; name; number of pieces required; material specification and treatment; drawing, pattern and piece numbers; initials, date and scale; use of a part already made; standard parts and sizes; easily machined and molded; checks with component parts; how fastened in place; easily assembled; interference of moving parts; interference in assembly; lubrication; check with drafting-room standards; index card; drawing checked.

Spinner

AUXILIARY CROSS-SLIDES FOR TURRET LATHES

The special turret tools shown in Figs. 1, 2, and 3 were designed for the purpose of providing a more sensitive feed and stop than is possible with the standard style of box-tool, boring tool, or facing tool, and at the same time affording a means of obtaining greater production through the provision of a lighter and therefore faster means of feeding the cutter. Too often a large heavy turret is employed when taking a comparatively light cut, the work being placed on the large machine because of its size or the nature of other operations that are to be performed.

An example of this class of work is shown in Fig. 1. The large diameter of the work in this case made it necessary to use a machine as large as a No. 2 Brown & Sharpe or a No. 2 Warner & Swasey hand screw machine. The cast-iron holder *A*, with its shank *B* cast integral, is provided with a gibbed dovetail slide *C*. The cutter *D* is made from round tool steel, and is retained in the slide by a set-screw *E*. The slide is operated by the lever *F*, the handle of which is shown at *G*.

The accuracy obtained by the use of this tool in finishing the work to the required 45-degree angle was greater than that resulting from the use of a formed blade held in a regular box-tool holder. The expense for cutters was also considerably reduced by the use of the auxiliary slide. A tool of this design need never become obsolete, owing to the fact that it can be easily equipped for application to a large variety of work.

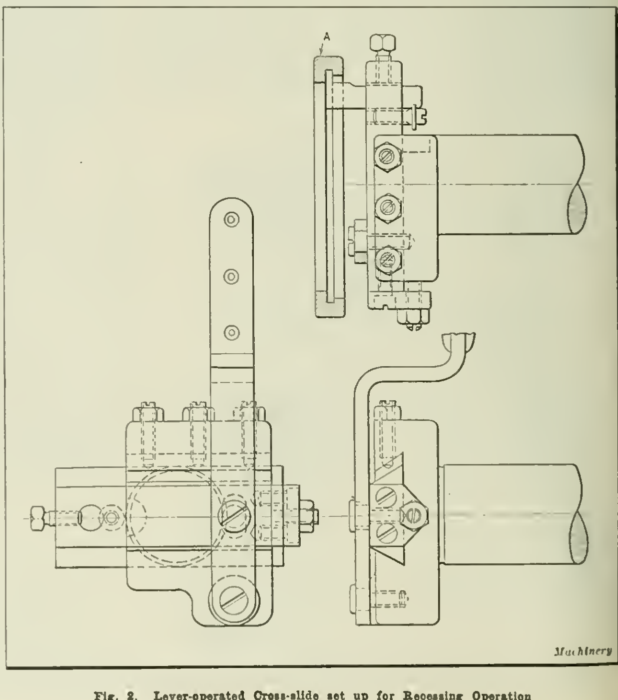


Fig. 2. Lever-operated Cross-slide set up for Recessing Operation

The tool shown in Fig. 2 is similar in design to that shown in Fig. 1. It was originally intended for performing a recessing operation on the part shown at *A*, but it could also be used without change for a variety of boring, facing, or forming operations by providing the necessary style of cutter. This type of tool provides a convenient means of finish-forming when the cross-slide toolposts are used for rough-forming and cutting off. Circular forming cutters for this kind of work should be made with stems to suit the holder. If the holder is intended to be used with a large variety of cutters, it should have a larger hole than otherwise and be provided with a set of bushings to correspond with the cutters.

A somewhat different style of holder is illustrated in Fig. 3, which was designed to accommodate three cutters, as shown. The question of using the regular feed of the hand screw machine or that of the auxiliary slide depends largely upon the class of work to be done, and whether a high production rate or extreme accuracy is more desirable. The use of auxiliary slides of the types described would greatly increase the accuracy obtainable on hand screw machines having worn cross-slides and turret-slides or turret tool-holes that have become battered and out of alignment.

In such cases it is possible to obtain quite accurate results if the work is chucked and has a hole in the center (as is usually the case) by aligning the turret tool with the spindle by means of a pilot on the tool and a bushing in the spindle. The slide on the tool would then take the place of the worn cross-slide for the finishing operation, with results equivalent to those obtained with a new machine. In Fig. 4 is shown an auxiliary tool-slide adapted for use on a bench lathe, bench mill, floor lathe, or hand screw machine. The work shown at *A* was more accurately machined by the use of the special tool-slide in this particular case than it could have been by using the regular cross-slide and a forming tool. This special tool also made it possible to increase production more than 100 per cent.

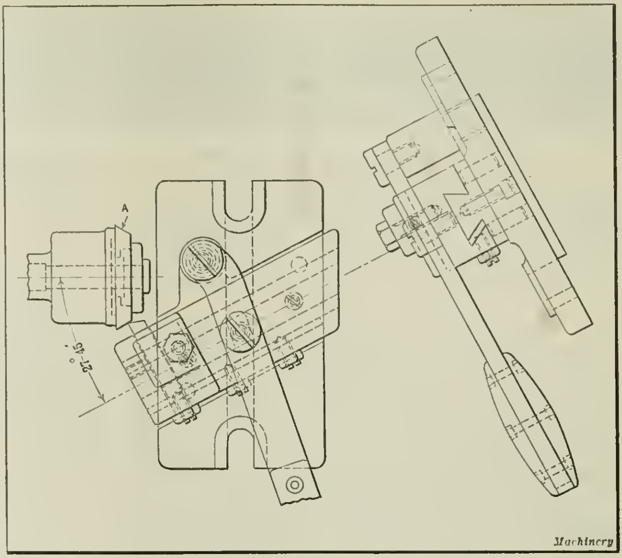


Fig. 4. Auxiliary Cross-slide for Bench Lathes, Bench Mills, etc.

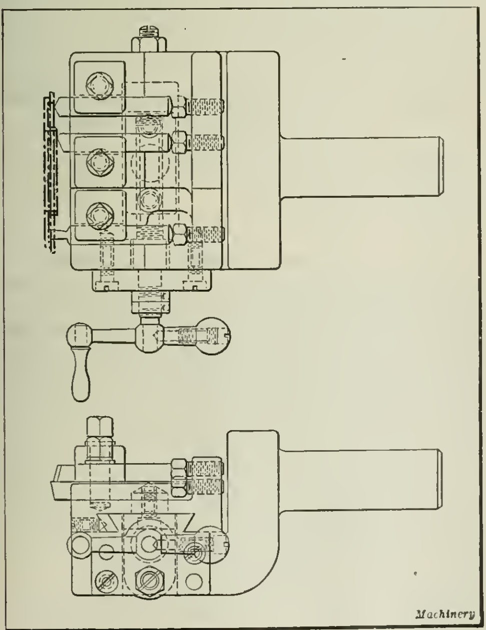


Fig. 3. Screw-fed Auxiliary Cross-slide for Turret Lathe

Waynesboro, Pa. D. A. NEVIN

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HENDEY MACHINE COMPANY 1870-1920

An anniversary volume entitled "Hendey 1870-1920" has been published by the Hendey Machine Co., Torrington, Conn., in which is recorded the history of the company from the time of its foundation in 1870 until the end of the first half century of its existence. This book contains an interesting account of the founder, Henry J. Hendey, of this well-known machine tool building enterprise, of whom it says that "confronted by adverse conditions, hampered by lack of money, but with a splendid faith in what the future held, his many fine qualities and sheer strength of character asserted themselves. An unshaken courage, a steadfast determination, decision; these were his outstanding characteristics."

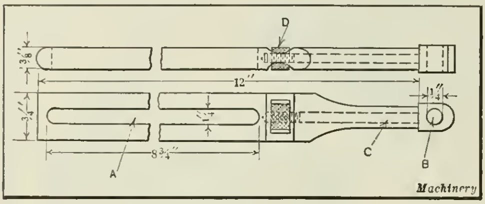
In 1870, Henry J. Hendey, a toolmaker of Torrington, Conn., and his younger brother Arthur Hendey, then a patternmaker in New Haven, associated themselves in the launching of a new enterprise with a very humble beginning. In referring to the starting of the business, the review states that "in the present period of business inactivity, there is a homely lesson in the courage and confidence of the founder of this enterprise, who, due to business depression, was at the time unemployed, but who did not hesitate to face forward, backed only by mentality and muscle and that invariable and constant asset, an unfaltering faith in America."

The motive power of the first shop was a three-horsepower rotary engine made by Henry Hendey at night after leaving his daily task. This engine has been preserved and is still to be seen on a table in the engine room of the present Hendey plant in Torrington. The gradual growth of the business from its small beginning to its present proportions is well illustrated by many interesting photographs showing the earlier shops and the present plant. The book also shows the development of the types of machines associated with the name Hendey, from the simple designs of 1870 to the high-production shapers, milling machines, and lathes of 1922. It is being distributed to the friends and customers of the company.

SHOP AND DRAFTING-ROOM KINKS

UNIVERSAL INDICATOR HOLDER

The device shown herewith was made by the writer for the purpose of holding an indicator in any desired position. The slot *A* permits the holder to be attached to a machine or fixture by means of a ¼-inch bolt or cap-screw. A ¼-inch hole *B* in the threaded member *C* provides a means of holding the indicator itself. Part *C* is a good fit in the shank of the holder, and is clamped in position by means of a knurled nut *D*. From the illustration it will be noted that slot *A* provides a means of adjusting the position of the indicator either outward or inward for a distance of approximately 8 inches, and that part *C* to which the indicator is directly attached can be revolved about its axis and locked in any desired position.

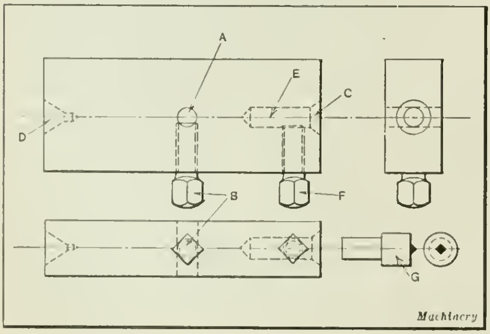


Adjustable Holder for Indicator

Rochester, N. Y. PHILIP A. HALL

HOLDER FOR TRUING DIAMOND

A convenient diamond-holder for tool-room work is shown in the accompanying illustration. It may be made from a piece of ½- by ¾-inch machine steel about 3½ inches long. It is finished all over and can be held on a magnetic chuck for truing surface-grinder wheels. For this work the flat side of the holder is placed on the magnetic chuck with the diamond held in hole *A*, where it is locked in place by set-screw *B*. It is understood, of course, that the diamond itself is mounted in a short round holder *G*. For truing a wheel on an electric toolpost grinder, the block is held by means of the centers *C* and *D*, the diamond being held in the same position as when used on a surface grinder. The machine centers should be screwed up tight to prevent the block from turning; excessive pressure, however, is not necessary if large centers are made in the block at *C* and *D*. The diamond-holder may also be held in a vise with the diamond clamped in hole *E* which is on the same center line as the countersunk center *C*. In this position, the diamond is locked in place by screw *F*.

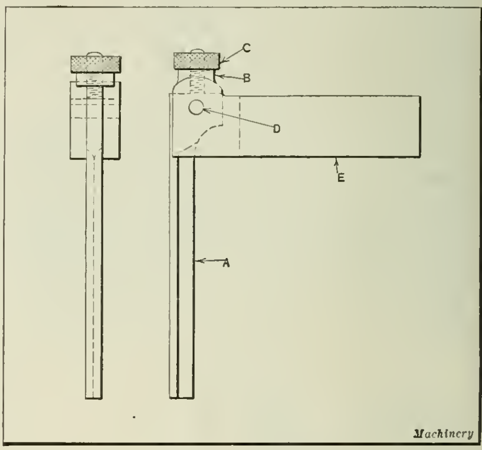


Holder for Grinding-wheel Truing Diamond

Ilion, N. Y. D. R. GALLAGHER

DIEMAKER'S SQUARE

The square shown in the accompanying illustration is of unusual design. It has the distinct advantage of being readily set to any angle within the narrow limits usually called for in diemaking. The body *E* is slotted at the front end to receive the blade *A*, and the latter is threaded at the top for nut *C*. Washer *B* is fitted to the radial part of body *E* and is a sliding fit on the screw. When nut *C* is tightened the blade will retain its exact setting, as washer *B* does not turn with the nut. The blade *A* is machined to a knife-edge on one side and swivels on a pin *D*. It can be assembled with the knife-edge down if desired.



Diemaker's Square

Rosemount, Montreal, Canada HARRY MOORE

* * *

WORK OF THE DEPARTMENT OF COMMERCE

The Bureau of Foreign and Domestic Commerce, the Bureau of Census, and the Bureau of Standards are at present the three chief points of contact between the Government and the commerce and industry of the country. These three bureaus receive annually about 300,000 inquiries. In a single day the Bureau of Foreign and Domestic Commerce received 514 inquiries from commercial concerns all over the country having to do with the promotion of foreign trade. The greatest difficulty under which the department labors is that the salary scale of the men and women employed in this important work dates back to 1914, and hence in many cases their compensation is about one-half that obtained for similar work in the general commercial field. The department is essentially in competition with business houses in finding men, and the economic pressure exerted on those employed by the department from the outside is constant and must be recognized. In the Bureau of Standards alone the turnover during the last five or six years has been about 50 per cent.

HOW AND WHY

QUESTIONS ON PRACTICAL SUBJECTS OF GENERAL INTEREST

LEATHER WASHERS FOR CLEANING SHAFTING

R. F. B.—How are leather washers applied to lineshafting to keep the shafting clean between the pulleys?

A.—The leather washers which are sometimes used for this purpose simply have holes that are considerably larger than the shaft, so that the washer may easily be turned or twisted to an inclined position relative to the shaft. As the shafting revolves, the washer travels from one pulley to another, and when it comes into contact with the hub of a pulley its angular position is changed, so that it begins to travel in the opposite direction. The backward and forward movement is continued automatically, and as the result the shaft is kept clean and bright.

ROLLER BEARING TANGENCY PROBLEM

L. W. C.—In making tapered roller bearing cones, it sometimes happens that the cone is required to be ground accurately to a given radius r, Fig. 1. AB represents the back face of the finished cone, CD the back face of the cone before grinding, EF the finished bore, and GH the bore before finishing. In cases of this kind it is obviously important that the proper allowance be made for finish-grinding. The destructive effect of a sharp point or edge of steel on the face of the grinding wheel makes it desirable to so proportion the cone that as little stock as possible will need to be removed at the point where the back face joins radius r. The problem of determining radius R occurs when it is planned to make the radius of the unfinished forging and the finished radius tangent to each other in order to eliminate as far as possible the use of the wheel where the destructive effect is greatest. The problem, therefore, consists in determining the radius R, of a circle which is tangent to a given smaller circle, and to two lines at right angles to each other at given unequal distances from tangents to the smaller circle, as indicated in Fig. 2. In the illustration, the dimensions a, b, and r are known. Please show how to find R.

A.—In solving this problem, we may start out with three equations, assuming three unknown quantities R, y, and z, Fig. 2. From these three equations we obtain by substitution the final equation in which R is the only unknown quantity. Note that $x = \sqrt{y^2 + z^2}$.

We then have the three equations:

$$R = x + r = \sqrt{y^2 + z^2} + r \qquad (1)$$
$$R = y + r + a \qquad (2)$$
$$R = z + r + b \qquad (3)$$

Transposing,

$$z = R - r - b$$

Then, from Equation (1),

$$R = \sqrt{y^2 + (R - r - b)^2} + r$$

Transposing terms in Equation (2) we have,

$$y = R - r - a$$

Therefore

$$R = \sqrt{(R - r - a)^2 + (R - r - b)^2} + r$$

It is, of course, possible to solve this equation for R by transposing r to the left-hand side of the equation and then squaring both sides, which will result in a quadratic equation. In a problem of this type, however, the trial method will be equally rapid—that is, a trial value may be substituted for R that is as nearly exact as it is possible to determine by measuring a scale drawing. The substituted value is then slightly adjusted until it satisfies the equation.

CALCULATING DIAMETER OF ROLL FOR ROLLER CLUTCH

W. A. Z.—In the accompanying diagram are shown the conditions encountered in the design of a roller clutch. From the dimensions given, please explain the method of finding the diameter of the roll.

ANSWERED BY LEWIS D. CASTOR

A.—Referring to the diagram, it will be evident that

$$OK = \sqrt{1.25^2 + 0.25^2} = 1.2747$$

$$\text{Sin } OKA = \frac{0.25}{1.2747} = 0.19612$$

Hence

$$OKA = 11 \text{ degrees } 19 \text{ minutes}$$

By construction, angle AKH = 60 degrees; therefore

$$OKH = 60 \text{ deg.} + 11 \text{ deg. } 19 \text{ min.} = 71 \text{ deg. } 19 \text{ min.}$$

and

$$HK = r \times \sec 30 \text{ degrees} = r \times 1.1547$$

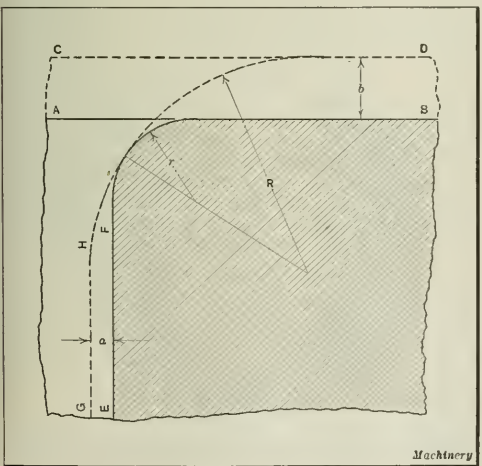


Fig. 1. Section of Roller Bearing Cone illustrating Tangency Problem

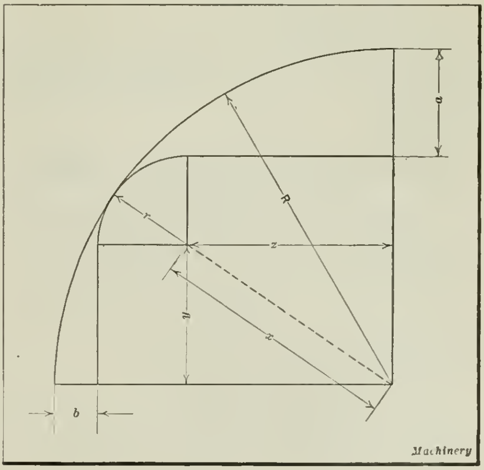


Fig. 2. Diagram used in the Solution of the Tangency Problem

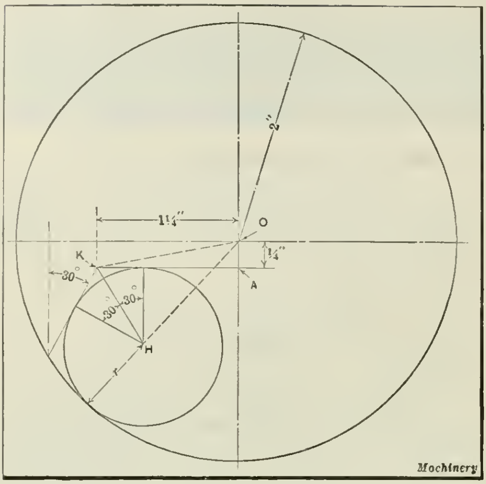


Diagram for finding Diameter of Roll for Roller Clutch

Also

$$OH = 2 - r$$

According to the equation given in MACHINERY'S HANDBOOK, page 152, for solving an obtuse-angled triangle, when two sides and the angle between them are known, we have:

OH or $2 - r = \sqrt{HK^2 + OK^2 - 2\,(HK \times OK \times \cos OKH)}$

Substituting the numerical values of the known quantities,

$$2 - r =$$

$$\sqrt{(1.1547r)^2 + 1.2747^2 - 2\,(1.1547r \times 1.2747 \times 0.32034)}$$

$$2 - r = \sqrt{1.3333r^2 + 1.6248 - 2\,(1.1547r \times 0.40833)}$$

$$= \sqrt{1.3333r^2 - 0.9430r + 1.6248}$$

Squaring the left-hand member, we have,

$$4 - 4r + r^2 = 1.333r^2 - 0.943r + 1.625$$

Transposing and uniting terms

$$0.333r^2 + 3.057r = 2.375$$

or

$$r^2 + 9.18r = 7.1321$$

Solving this quadratic equation according to the formula given in MACHINERY'S HANDBOOK, on page 100,

$$r = -\frac{9.18}{2} \pm \sqrt{\frac{9.18^2}{4} + 7.1321}$$

$$r = -4.59 \pm 5.3104$$

$$r = 0.7204 \text{ inch}$$

Hence the diameter of the roll is equal to $2r$ or 1.4408 inches. It will be noted that in the foregoing solution only such formulas as are to be found in MACHINERY'S HANDBOOK are employed.

REMOVING ONE-HALF THE VOLUME OF A SPHERE

F. D. K.—Please give a general method of determining the diameter of the hole that must be drilled through the center of a 3-inch sphere to remove one-half the contents.

ANSWERED BY W. W. JOHNSON, CLEVELAND, OHIO

From the diagram it will be seen that the material to be removed by drilling consists of two equal spherical segments and a cylinder.

Let R = the radius of the sphere, and
$2h$ = the altitude of the cylinder.

Then

$R - h$ = the altitude of the spherical segment

and

$\sqrt{R^2 - h^2}$ = the radius of the base of the segment and the radius of the cylinder.

The volume of the two spherical segments in terms of R and h is:

$$2[1/2\ \pi(R - h)\ (R^2 - h^2) + 1/6\ \pi(R - h)^3]$$

and the volume of the cylinder $= 2\pi h(R^2 - h^2)$

To remove $\frac{1}{n}$ of the sphere we have 2 times the volume of one segment plus the volume of the cylinder $= \frac{1}{n}$ the volume of the sphere.

Therefore,

$$\pi(R - h)\ (R^2 - h^2) + \frac{1}{3}\pi(R - h)^3 + 2\pi h(R^2 - h^2) = \frac{1}{n}\left(\frac{4}{3}\pi R^2\right)$$

Expanding and combining terms,

$$\frac{4}{3}\pi(R^3 - h^3) = \frac{1}{n}\left(\frac{4}{3}\pi R^2\right)$$

Removing the factor $\frac{4}{3}\pi$,

$$R^2 - h^3 = \frac{1}{n}R^3 \qquad (1)$$

Again, referring to the diagram, $h = R \cos \phi$. Substituting this value for h in Equation (1), and removing the factor R^3,

$$\text{Cos}^3\ \phi = 1 - \frac{1}{n} = \frac{n - 1}{n}$$

and

$$\text{Cos}\ \phi = \sqrt[3]{\frac{n - 1}{n}}$$

To remove one-half the volume of the sphere, let $n = 2$. Then

$$\text{Cos}\ \phi = \frac{1}{\sqrt[3]{2}},$$

and

$$\phi = 37 \text{ degrees } 28 \text{ minutes } 2 \text{ seconds}$$

Let D = diameter of sphere, and
d = diameter of hole.

Then,

$$d = D \sin \phi$$

For a 3-inch sphere this gives $d = 1.825$ inches.

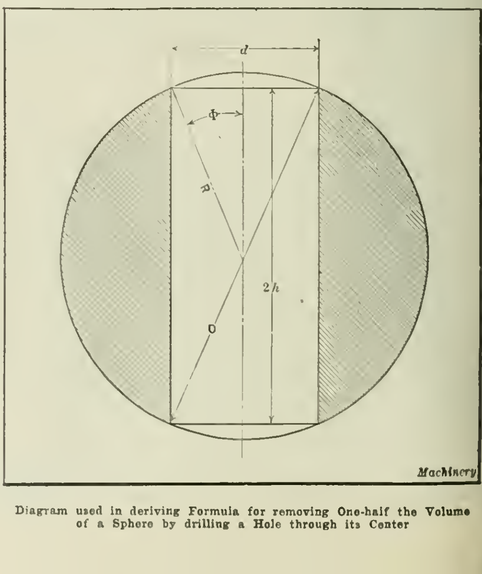


Diagram used in deriving Formula for removing One-half the Volume of a Sphere by drilling a Hole through its Center

The British Metal-working Industries

From MACHINERY'S Special Correspondent

London, April 14

AT the time of writing, the engineering dispute involving a lock-out of 250,000 men dominates all other conditions in the metal-working industries. The dispute hinges on the question of managerial rights, working conditions, and over-time. There is no evidence that a majority of the Amalgamated Engineering Union seriously challenges any fundamental rights of management, and it is expected in many quarters that the real bone of contention will ultimately be found to be a case of wage reduction.

That trade has dropped to a low ebb, due to the effect of the engineering dispute, cannot be denied, but this condition, it is thought, is only momentary. Indications of better conditions are too pronounced to admit of denial.

The Machine Tool Industry

Most of the firms engaged in the machine tool industry are members of the Engineers' Employers Federation, so that all the workers are locked out except apprentices. Prior to the lock-out the machine tool industry showed flickers of improvement, more particularly in connection with foreign business, which indicated an early revival.

A welcome piece of news was the statement made at the recent annual meeting of the Machine Tool Trades Association that 90 per cent of the government stock of surplus machine tools had been disposed of, and that only about 2500 machines remained to be sold. Altogether the Disposal Board has sold over 60,000 machines. Unfortunately government disposal does not represent the end of the matter, because it does not follow that the machines sold are actually in use; in fact, a considerable proportion of the machines are in the hands of dealers and will be certain to make their reappearance on the market as the demand increases.

A number of inquiries for machine tools has been received from abroad, but buyers are insistent on getting the lowest prices possible. As an indication of this, it might be mentioned that in some cases orders have been offered at 25 per cent less than the price quoted. This, of course, does not represent the average buyer's idea, but applies more to cases where machines can be used to advantage but are not urgently needed. Wage reductions in prospect always have two effects—either the buyer decides to wait until he can get the full benefit of reduced manufacturing costs, or if he does place an order, he expects the manufacturer to charge on the basis of the new wage rates.

One of the paramount troubles in the trade is the accumulation of stocks that can be replaced for less than the original cost of manufacture and that will still further depreciate in value as greater reductions are made in wages. Losses appear to be inevitable in the case of machines manufactured under the artificial conditions of a year ago. Activity is displayed in the small tool line, but orders are mostly for small quantities and quick delivery.

The Automobile Industry

In the automobile industry it is particularly unfortunate that the labor dispute should come along just at this time. During the last few weeks many promising inquiries from abroad have been reaching the manufacturers, and with the home season developing satisfactorily, factories have been actively preparing for increased output. Most firms are members of the Engineers' Employers Federation, and they have been forced to get along without toolmakers and fitters, who probably represent about 20 to 25 per cent of the total force. A number of machine operators and assemblers remain at work, but they cannot maintain production much longer alone.

The scarcity of stocks will bring deliveries to a standstill in many shops unless terms are speedily agreed upon. In certain departments there has been a considerable accumulation of finished parts for the completion of orders already started, but if production is interrupted in other allied branches these stocks will not help. Normally, manufacturers have plenty of materials and can go ahead safely in anticipation of the spring season, but there are various considerations which have deterred them from doing so this year. For instance, there is the lack of working capital and the restrictions on credit. Then there is the desire to get the utmost advantage from a falling market for raw materials. Most firms have, in fact, based their prices for this year's models on the assumption that materials would have reached a lower level. The light car makers are the busiest, but some of the commercial truck makers are working overtime.

Railway and Locomotive Engineering

Locomotive builders report conditions improving, especially inquiry from abroad, and will doubtless find an outlet for their product as soon as the present labor troubles are over. The Rumanian state railways, it is understood, contemplate placing a large order in which Glasgow manufacturers are expected to participate. Structural engineers have better prospects, perhaps, than any other branch, chiefly owing to railway developments in the Colonies and abroad. An important contract, involving a sum of £350,000, has been received by William Arrol & Co., Ltd., the well-known Glasgow engineers and bridge-builders. This is for the erection of work-shops for the Mexican State Railways at Enugo, and is the initial part of a big development scheme which includes the erection of a bridge over the river Benue.

The Iron and Steel Field

For the most part iron and steel users are buying only for immediate requirements, and in view of the uncertainty of the labor situation it is but natural that they should restrict their purchases at the present time. Even so, values remain steady. No inclination to delay deliveries of pig iron under existing contracts is noticeable, and some pressing inquiries have been received from Continental countries, including one of 1400 tons from Germany. Italy and Belgium are also in the market.

In the gray iron and malleable foundries, there is much more activity. One firm in Birmingham recently began a night shift and is making extensions to its plant that will double its output. This firm states that although the orders for castings are principally for the automobile industry, a good general trade has developed in the last few weeks.

The small concessions made by railway companies in the transit rates of fuel to steel works and blast furnaces have proved of little value, and the export trade is hampered by comparatively high freight rates.

Shipbuilding

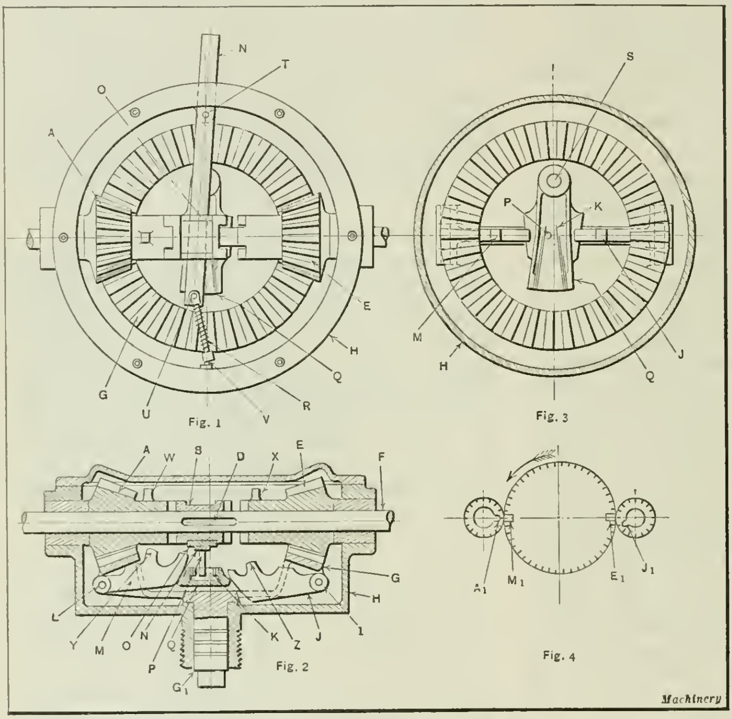
The shipbuilding industry, at the time of writing, is at a standstill owing to the cooperation with the engineers' union, but quite apart from that disturbing feature, it must be some time before orders will mature from this quarter. The machine tools in the shipyard engineering shops which, under normal conditions of night and day shifts last about two years, have not been worked under these conditions since the armistice, and consequently are still in good condition.

RECIPROCATING MOTION MECHANISM

By DAVID ERSSON

The reciprocating motion mechanism which is described in this article is one important unit in the construction of a washing machine. The principal driving members of the mechanism consist of the commonly employed gear and double pinions, the latter being located diametrically opposite each other. The reversing parts are of simple construction and are designed to eliminate wear and friction as far as possible. They have been found to work faultlessly and are positive in their action. In Figs. 1, 2, and 3 the same reference letters are used to denote the same parts.

The cast-iron housing H carries the vertical shaft G_1, which connects the main gear G with the drum on the washing machine. The two pinions A and E run on the horizontal shaft F which is connected with the motor or power source. This shaft is provided with a key-slot and key D upon which the double-ended clutch jaw B slides. The center of this clutch jaw is recessed to receive a semicircular bushing O. This bushing has a square section on its outer side which is in contact with the starting and stopping lever N. The bushing O is provided with flanges on both sides which keep lever N in its proper position.



Figs. 1 to 3. Reversing Mechanism used on Washing Machine. Fig. 4. Diagrammatical Lay-out showing Relative Positions of Reversing Lugs

Another lever Q swivels on a stud S driven into gear G. Movement is imparted from lever N to lever Q by a pin P which is driven into lever N. This pin extends down into a recess in lever Q and works against two shock-absorbing springs K, one spring being located on each side of the recess. Gear G carries, besides stud S and reversing lever Q, the two cams J and M located in slots which extend below the gear and toward the center. These cams are arranged diametrically opposite each other and are pivoted on their respective studs I and L.

The form of the cams is best seen by reference to Fig. 2. On the upper side of the cams are located lugs Y and Z which at intervals come in contact with lugs W and X, the latter being cast on the extensions of pinions A and E. The purpose of the cams is to push lever Q over the center, one cam coming into action when the main gear is revolving to the right and the other when it is revolving to the left. Thus when cam M is in the position shown with lever Q over to the left of the center, lug Y comes in line with lug W on pinion A at a certain moment. When this happens lug W pushes the cam down and this, in turn, forces lever Q over the center to a similar position on the right, carrying with it the other movable parts—pin P, lever N, bushing O. and clutch jaw B. The latter member is now disengaged from pinion A and engaged with pinion E, thus imparting the reciprocating or reversing motion to gear G.

When lever Q moves over to the right it also pushes cam J up into a new position, ready to act similarly to the other cam. To obtain a good working action, there must be a certain ratio between the gear and the mating pinions, and this ratio must be based on the number of revolutions which the washing machine barrel is required to make before reversing. In this case eight revolutions are chosen for half a period, or double that (sixteen revolutions) for one whole period. To obtain this, the ratio must be 8 to 23. The number of teeth in this case is 16 for the pinions and 46 for the gear. Another thing to be taken into consideration is the location of the lugs on the pinions. Fig. 4 shows a diagrammatical lay-out of the relative positions of these lugs in regard to each other and also to the cams. Assume that the barrel of the washing machine has completed one period of sixteen revolutions and is ready for the next period, and that the gear will now revolve in the direction indicated by the arrow for the next eight revolutions. After completing the eight revolutions, the direction of rotation is reversed by means of lug J_1, which comes in contact with cam E_1. To obtain this action, the gear and pinions must be so assembled that lug J_1 lacks just two tooth spaces of making contact with cam E_1, when lug A_1 is in contact with cam M_1, as illustrated.

When the required eight revolutions are completed, lug A_1 again comes in contact with cam M_1 and the motion is reversed again for the next eight revolutions. A coil spring R, Fig. 1, holds lever N in the required position on each side of the center. This spring is seated at point V on the housing, and is guided on the lever by means of a pin U. Lever N is mounted on a pin T located diametrically opposite point V on the housing. The lever is extended outside the casing so that the operator can get a good grip on it for starting and stopping the mechanism.

* * *

The installation of sixty-seven double-frame steam drop-hammers at the Highland Park plant of the Ford Motor Co., Detroit, now in process, is an important step by the Ford organization in its plan to do practically all of its own drop-forging work. The new hammers range in size from 800 to 5000 pounds' capacity and are being placed in operation immediately upon being set up.

STRIPPERS FOR DRAWING DIES

By N. T. THURSTON

The success of a drawing die or push-through die depends largely upon the efficiency of the stripper employed to strip the stock from the punch on the upward stroke of the press ram. Even with a properly designed stripper there is likely to be some spoilage, particularly when drawing light gage metal. This spoilage is increased, of course, when the stripper is not the correct type for the work. Each of the three styles of strippers described in the following has its distinct features, and it is the purpose of this article to make clear the class of work for which each has been found best adapted.

Stripper for Small Work

The die shown in Fig. 1 is equipped with a type of stripper which has proved satisfactory for small work. This stripper, however, will seldom be found suitable for shells over 1 inch in diameter. A shell of 22-gage brass stock, ½ inch in diameter and 2 inches long is representative of the class of work for which this type should be used. The stripper consists of a split ring of tool steel composed of four parts or segments. As shown in the illustration, the segments are grooved to receive a circular wire spring *A* which holds them in place. As the shell is pushed through the die and enters the stripper, the segments are forced back allowing the shell to pass through.

On the return stroke of the punch the segments grip the punch above the shell and thus serve to strip the shell from the punch. This stripper is the least positive of the three described in this article, and its success depends upon using it with shells of small diameter having thin walls. The stripper is held flat and in place by the tool steel forming plate *B*. This plate, in turn, is kept in position by the three clamps fastened to the top of the die, one of which is shown at *C*. By merely removing the clamps, the forming plate and the stripper are left free so that they can be lifted from the die.

Stripper for Thick-walled Shells

The die shown in Fig. 2 is equipped with spring-actuated strippers, and has been found to be best suited for use in dies employed for drawing thick-walled shells varying from 1½ to 5 inches in diameter that are less than 6 inches in length. This die is mounted on a machine steel base while the forming parts are of tool steel, hardened and ground. The strippers *A* are also of tool steel, hardened and ground, and are kept in constant contact with the shell by the compression springs *B* which force them outward into the die opening. These strippers are provided with a shoulder so that they can extend into the die opening only a certain distance, and they are made a good sliding fit in the slots in ring *C*.

As these strippers have only a small bearing surface on the shell, it is necessary to make them rather sharp on the edges which come in contact with the work. As will be noted by referring to the view in the upper right-hand corner of Fig. 2, the end of the stripper which bears on the work is not only rounded, but also beveled at an angle of 2 degrees. For this reason the stripping action is severe, and shells having thin walls are found to tear and wrinkle badly when this type of stripper is used. This type, however, is the most positive of the three types described in this article. It has proved most successful when used on shells having a wall thickness of not less than 20 gage. A shallow 8-gage steel shell, for instance, is well handled by this stripper, whereas a stripper of the type shown in Fig. 1 would be entirely unsuitable. The rate of production on work of the type shown in Fig. 2 can be very high, as a good operator, protected by safety devices, can keep the press running continuously, 5000 pieces in a ten-hour day being the average production.

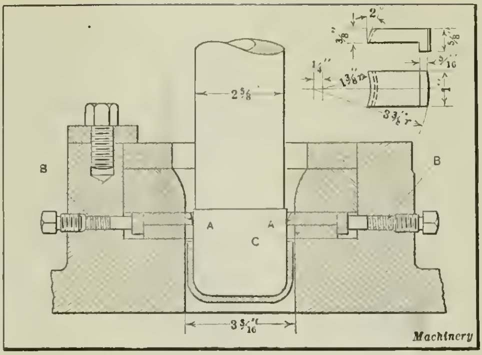


Fig. 1. Drawing Die equipped with Segment Type Stripper

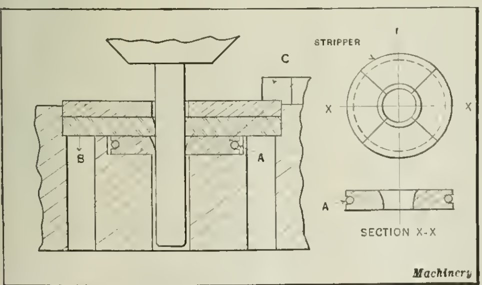


Fig. 2. Die equipped with Two Spring-actuated Strippers

Stripper for Large-diameter Thin-walled Shells

The die shown in Fig. 3 is equipped with a stripper constructed on an entirely different principle from that of the strippers previously described. In the types described, spring pressure is applied at right angles to the part of the shell being pushed through the die. In the type shown in Fig. 3, however, spring *A* applies pressure in a direction parallel to the path of the shell, and the gripping action of the jaws *B* is similar to that of a collet. This die is held in a cast-iron base, the forming ring being tool steel, hardened and ground, as are also the gripping jaws. The plate *C* held to the bottom of the die by four ½-inch screws (not shown) is machine steel and holds the six action-pin springs in place.

As the shell passes through the forming ring, it strikes the jaws of the collet and forces them down and outward. The ¼-inch clearance at *D* between the bottom of the jaws and the top of the machine-steel ring below them permits this downward movement. At the end of the downward stroke the top of the shell is still in contact with the base of the jaws, which, actuated by the constant spring pressure forcing them upward, grip the shell and hold it fast while the punch continues upward and thus strips the shell off so that it drops through the die at the next stroke.

The action-pins *F* are made from 1-inch cold-rolled stock machined to ½ inch at both ends. A clearance of ⅛ inch is provided in the holes in which the pins enter the jaws. Without this clearance the jaws would not be able to expand or contract. The pins extending into the base of the jaws for about ½ inch serve to keep the jaws from moving in a circular direction. The compression springs used on the pins have an inside diameter of ⅝ inch and a length of about 2½ inches. The gripping power of the stripper is adjusted by the machine-steel ring *E* which lies on the top of the jaws. By grinding off the under side of this ring against which the jaws are forced by the springs, a greater upward and inward movement of the jaws is permitted.

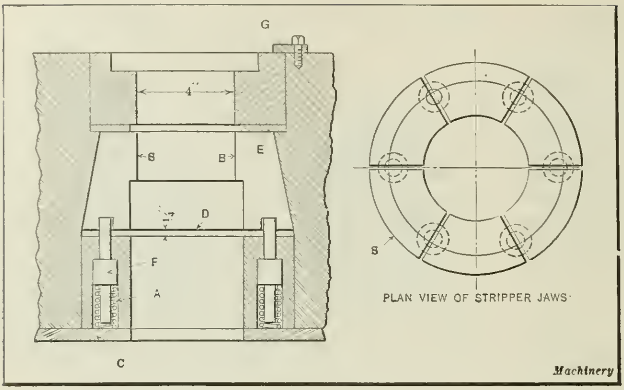


Fig. 3. Push-through Die fitted with Stripper adapted for Long Thin-shelled Work

This of course causes the shell to be more tightly gripped. To provide for an equal pressure on the jaw sections, the spring-actuated pins are placed under the separations in the jaws so that each pin bears on two sections of the stripper at the same time. The forming ring in the top of the die is left loose and can be lifted out of the die at any time by removing the three cleats *G* at the top.

This type of stripper was found to be the best for stripping shells about 4½ inches in diameter and about 12 inches long, which were being pushed through the die on a rack-and-pinion press. Inspection of the shells pressed through the die on which this stripper was employed, showed that less than 2 per cent failed to pass because of defects resulting from the stripping operation, whereas about 15 per cent were spoiled when a stripper of the type shown in Fig. 2 was employed. The stripper shown in Fig. 3 is best suited for stripping shells of rather large diameter having comparatively thin walls. The reason that it is useful on such work is that it has a large bearing surface which comes in contact with the work during the stripping operation.

* * *

REPAIRING CRANKSHAFT OF PUMP

By JAMES ELLIS

The writer recently had occasion to assist in repairing a hydraulic pump that had given considerable trouble. The pump was of the four-cylinder type having a crankshaft of the design shown at *A*. The break occurred at the point *B*, as indicated by the broken line. Several crankshafts had previously broken at this point and several sets of gears had also been worn out in an incredibly short time.

The difficulties encountered in replacing a pump crankshaft of this type will be readily understood by those experienced in the design of this kind of pump. The method of overcoming these difficulties in making the repair should therefore be of interest to designers as well as to those handling repair work. The chief difficulty in replacing the gears, pinions, pinion-shaft, or crankshaft of a pump of this type is in obtaining accurate alignment of the pinions *F* with respect to each other, and also with respect to their mating gears *G* which must also be properly aligned on the crankshaft.

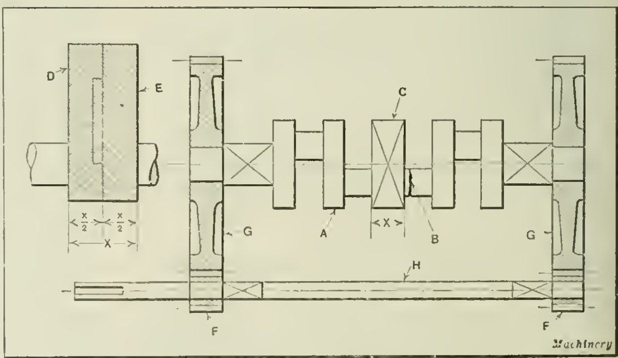
If any of these members are out of alignment, the torque produced in shaft *H* and in the crankshaft will cause unequal loads to be imposed on the gears, which will result in unequal wear on the gear teeth. As the wear increases, the difference in the load carried by each gear also increases until some one of the stressed members is broken.

In making the repair, the halves of two broken crankshafts were used. The bearing *C* of one broken crankshaft was machined as shown at *D* in the enlarged sectional view at the left, while the bearing of the other half was machined as shown at *E* to fit the recess in *D*. This allowed the load to be evenly distributed on the gears as was originally intended; that is, the gear at the right-hand end of the crankshaft and its mating pinion would carry one-half the load, while the gear and pinion at the other end of the shaft would carry the other half of the load. The full width of the original bearing surface at *C* was retained, and the shoulder (shown in the enlarged view at the left) allowed the thrust from the cylinders to be transmitted from one half of the bearing *C* to the other half, and at the same time it did not allow any of the turning force to be transmitted from one end of the crankshaft to the other.

At the time that this repair was made it was regarded as more or less of a makeshift, but after noting the satisfactory manner in which the pump operated, the writer has been led to believe that this construction would not be out of place in a new machine, provided that a large sized bearing is used at the center of the crankshaft. This construction would eliminate much of the tedious work of laying out keyways and the cost of production would be lowered. The pump repaired in the manner described has been in operation twenty-four hours a day for several months. A new shaft previously installed broke before it had been in operation for that length of time. The drive pinions are also resisting wear much better than they did when the one-piece crankshaft was used. The extra cost of making the shaft in two sections would probably be more than compensated for when building new machines, by the time saved in assembling.

* * *

Farmers of New York State, according to the *Review of Industry*, have taken a decided stand in favor of the repeal of the Full Crew Act, and a bill to abrogate the measure is to be submitted to the legislature. It is estimated that the waste resulting from this law has amounted in New York alone to from $2,000,000 to $3,000,000 since the law went into effect in 1913. In Pennsylvania the waste averaged $4,000,000 a year until the people of that state had the law repealed last year. Indiana has stricken a similar law from its statutes. Missouri voted against the measure in the proportion of 2 to 1. In Massachusetts, Oklahoma and Ohio, Full Crew Acts were vetoed by executive action.



Hydraulic Pump Crankshaft which broke at B

CALCULATING THE HORSEPOWER OF SPUR GEARS

By FRED ROSS EBERHARDT, Manager Gear Department
Newark Gear Cutting Machine Co., Newark, N. J.

As electric motors are used more widely for machine and mill drives, there is more frequent occasion to figure the size of gears required, and as motors are rated according to horsepower and speed in revolutions per minute, it is desirable to rate or calculate gears the same way, rather than to figure the breaking strength of the gears at loads in pounds.

The Lewis and Barth formulas are generally accepted as being the most satisfactory for industrial gearing where the pitch-line velocity is under 2000 feet per minute. In their usual forms, however, they are rather cumbersome to use, and it is very easy to make errors. Realizing the inadequacy of the ordinary formulas, a number of charts have been prepared by various engineers. It has been the writer's experience that these charts, as a rule, seem to be simple, but are even more complicated than the arithmetical process required to work out the Lewis formula, or else they are so abbreviated as to be inaccurate.

The following formula, which is based on the Lewis formula, has been arranged to simplify this work, especially for those who frequently have to calculate the power-transmitting capacity of gearing. In this formula

H = horsepower;
S = allowable static unit stress;
W = width of gear face in inches;
Y = outline factor for given number of teeth and pressure angle (see MACHINERY'S HANDBOOK, page 595, for table of factors);
V = velocity in feet per minute at pitch line of gear = 0.262 × pitch diameter in inches × R. P. M.; and
P = diametral pitch.

$$H = \frac{SWYV}{P\,55\,(600 + V)}$$

In using this formula, the values of S for accurately cut gears made of different materials are as follows: cast iron, 8000; semi-steel, 9000; U. S. Government bronze, 10,000; 0.30 per cent carbon steel, 15,000; 0.50 per cent carbon steel, 25,000; rawhide, 5000; bakelite, condensite, formica, textoil, etc., 5000.

Example—Find the horsepower that can be transmitted safely by a cast-iron spur gear which is to have 40 teeth of 4 diametral pitch, a 2-inch face width, and a speed of 80 R. P. M. It is assumed that the gear has accurately cut teeth, and the pressure angle is 14½ degrees. Then,

$$H = \frac{8000 \times 2 \times 0.34 \times 210}{4 \times 55 \times (600 + 210)}$$

$$= \frac{80 \times 2 \times 34 \times 210}{4 \times 55 \times 810} = 6.4 \text{ horsepower}$$

It will be noted that the arithmetical work is reduced somewhat simply by dropping the decimal point from the outline factor 0.34 and at the same time cancelling two ciphers from 8000 representing the static unit stress.

In determining the power-transmitting capacity of spur gears having cut teeth, the following general rules should be considered:

1. The horsepower a gear will transmit depends upon the quality of the material, accuracy of the teeth, rigidity of shafts, bearings, and housings, and the accuracy of the shaft alignment.

2. A gear supported on only one side should be made with a comparatively narrow face, a good rule being to make the face width in inches equal to 10 ÷ diametral pitch.

3. The gears should always be made *strong* enough; that is, they should be capable of transmitting at least 25 per cent more than the rated horsepower. The reason for this is that everything mechanical is subject to overload from one cause or another. If the drive is subject to a known overload, the gears should be made strong enough for the full overload, plus about 25 per cent for safety. Gears for crushers, rolls, and reciprocating pumps must often be made capable of carrying 250 per cent of the normal or rated load.

4. While it is possible to make spur gears with as few as three teeth, it is well known that small numbers of teeth are not satisfactory for high-speed or hard work. As a rule, it is not practical to use a pinion with less than 18 teeth, when the pitch line velocity exceeds 800 feet per minute.

5. When the gears are of rigid construction, mounted on rigid shafts supported on both sides of the gear face, and run in oil, a pitch-line velocity of 2000 feet per minute is permissible in some cases. Usually, however, it is well to keep below 800 feet per minute for metal gears to be used under ordinary conditions. Above 800 feet per minute it is well to use rawhide or bakelite for one of the gears, the other gear being made of metal. If noise is not objectionable, both gears may be made of metal. Strength and quietness can be obtained by making the pinion of laminated construction, using alternate plates of steel and bakelite, riveted together.

* * *

MACHINISTS AND TOOLMAKERS IN THE UNITED STATES

The Bureau of Census of the Department of Commerce has just completed a compilation of the number of machinists and toolmakers in the United States, classified according to states. From this compilation, as given in the accompanying table, it appears that in 1920 there were over 800,000 machinists and 55,000 toolmakers in the country, as compared with 461,300 machinists and 9240 toolmakers in 1910.

The twelve leading states as regards the number of machinists employed, in the order of their importance, are New York, Pennsylvania, Ohio, Illinois, Michigan, Massachusetts, New Jersey, California, Indiana, Wisconsin, Connecticut, and Missouri. The twelve leading states as regards the number of toolmakers employed are Michigan, New York, Ohio, Connecticut, Massachusetts, Illinois, New Jersey, Pennsylvania, Wisconsin, Rhode Island, Indiana and Missouri.

MACHINISTS AND TOOLMAKERS IN THE UNITED STATES ACCORDING TO 1920 CENSUS

State	Machinists	Toolmakers and Die-Sinkers	State	Machinists	Toolmakers and Die-Sinkers	State	Machinists	Toolmakers and Die-Sinkers	State	Machinists	Toolmakers and Die-Sinkers
United States	801,896	55,089	Illinois	63,889	4,098	Montana	2,142	5	Rhode Island	10,899	1,387
Alabama	6,821	29	Indiana	28,188	1,341	Nebraska	3,984	23	South Carolina	2,901	7
Arizona	1,599	8	Iowa	10,200	234	Nevada	634	7	South Dakota	1,154	......
Arkansas	2,200	10	Kansas	6,852	39	New Hampshire	4,047	96	Tennessee	6,483	31
California	32,465	350	Kentucky	7,509	144	New Jersey	40,729	3,733	Texas	11,342	49
Colorado	4,807	54	Louisiana	3,928	22	New Mexico	1,112	3	Utah	1,964	......
Connecticut	22,634	6,106	Maine	5,306	71	New York	100,565	7,831	Vermont	2,909	68
Delaware	2,772	39	Maryland	11,776	289	North Carolina	5,769	10	Virginia	10,313	83
District of			Massachusetts	55,128	4,702	North Dakota	945	2	Washington	9,288	124
Columbia	4,108	227	Michigan	60,878	11,794	Ohio	78,844	6,582	West Virginia	4,810	75
Florida	3,777	24	Minnesota	10,653	173	Oklahoma	3,818	10	Wisconsin	26,085	1,421
Georgia	6,804	30	Mississippi	2,066	9	Oregon	4,491	48	Wyoming	1,177	1
Idaho	1,345	3	Missouri	16,261	554	Pennsylvania	93,525	3,143	....	....	......

Machinery

The Machine-building Industries

THE gradual improvement in the machine tool business referred to in this review last month continues. In standard lines the improvement is very slow, and in some lines it is not perceptible; but there has been a fair demand for special machinery, and the automotive industries have either placed orders for, or are inquiring about, a fair amount of new equipment.

One of the most encouraging signs is the increased activity in the iron and steel field, which always, in due course, brings about a demand for machine tools and other shop equipment. About the middle of April the average operation in this industry was close to 75 per cent, the United States Steel Corporation in the Chicago district operating at 80 per cent of capacity, and the steel works in the Pittsburg district running close to 70 per cent. A very large part of the demand comes from the railroad field, hundreds of thousands of tons of steel being required for railroad cars and locomotives that have been ordered recently. Extensive repair work on the great number of freight cars out of commission also increases the demand for steel, and the building of new cars and locomotives and the repairing of old ones will naturally put into operation existing machine tool equipment and probably create some new demand.

Conditions in Different Branches of the Industry

The volume of business in the tool and contract field is increasing materially; but conditions are not satisfactory, because the prices quoted are too low and competition is not based on an accurate knowledge of costs. A number of the tool shops started during the war have gone out of business; but there are still a great many more shops of this type than present conditions warrant, and it is expected that there will be a further reduction in their number.

In the gear industry conditions are 'spotted.' This business has had its ups and downs during the entire depression. The makers of automobile gears are experiencing a steadier demand, and one of the largest gear manufacturers in this field is running over 50 per cent of the maximum capacity; this represents a business considerably in excess of the prewar output of this company.

In the die-casting field there has been a substantial improvement, especially in the demand for new dies. The diemaking departments of some of the die-casting plants are working overtime; others are occupied at about 100 per cent with regular time and force. The production of die-castings is not quite so active as die-making, but the improvement even in this field is noteworthy. Present activity in some plants is well over 50 per cent of capacity.

The ball-bearing industry shows signs of greater activity. One well-known maker states that while the present demand is only from 35 to 40 per cent of maximum capacity it is 50 per cent greater than the average demand for 1921. This statement is borne out by the conditions in the ball making factories, which have experienced a similar improvement.

The process of finding an outlet for the excess shop capacity in the machine tool and special tool field is making progress. In addition to the activities previously mentioned in past months in this review, some plants are turning to automobile accessories, watchmakers' machinery, truck parts, radio parts, etc., to keep their shops at least partly busy.

A constantly increasing interest in high-production and cost-reducing machinery and devices is being taken by manufacturers in general, particularly in the automobile field. The maker of a line of machine tools especially suitable for plants where high production counts, has for years tried to interest one of the largest and best-known automobile plants in his machines; but it was only recently that he was successful in gaining even an opportunity to demonstrate what his machines can do. The reduced prices on cars make it necessary for the builders to investigate every possible means of reducing manufacturing costs.

In the general machine-building field there has been a substantial demand for road-building and excavating machines, and some plants that ordinarily produce other equipment for which there is but a small demand at present, are keeping partially busy by diverting their organization and equipment to the building of such machinery. A large hydraulic pressed steel concern reports a definite business improvement in all of its plants.

The Automobile Industry

In the automobile industry there seems to be more confidence than there has been for the last eighteen months. It is true that automobile plants are now running at a higher rate than the average for the year, due to the seasonal demand, but the buying of dealers is said to be generally for actual sales rather than for stock.

The number of automobiles registered in the United States during the last twenty years, according to figures compiled by the Automobile Chamber of Commerce, are of considerable interest. In 1900 there were less than 14,000 automobiles registered. In 1905 this number had risen to 78,000, and in 1910 to 468,000. In 1915 there were close to 2,500,000 cars; in 1920, 9,211,000; and in 1921, 9,245,000. The schedule for the April production of Ford cars calls for over 90,000 automobiles. The total production of automobiles during February, according to the Department of Commerce statistics, was 109,005 passenger cars and 12,898 trucks.

The Truck and Tractor Industry

In the motor truck industry there has been an increase in the number of orders received, and an optimistic feeling prevails among truck manufacturers and dealers. The buying is more conservative than it was two years ago, and manufacturers have to make prompt shipments in order to close sales. There has also been a definite change for the better in the automobile parts business, but buying is largely for immediate requirements.

The tractor industry begins to show signs of improvement. One of the largest tractor builders in the Middle West reduced a stock of 5000 tractors to 400 during the fall and winter, and at that point began to operate on a manufacturing schedule of 75 tractors a day to replenish its stock. In the general farm machinery line, there has been but a slight change, but the Federal Reserve banks state that the reports from the agricultural sections are growing more favorable and that a spring demand is in evidence.

The Influence of the Radio Business

The demand for radio apparatus has created a considerable business for shops having suitable equipment for this kind of work. Small sizes of hand and automatic screw machines and power presses are needed chiefly for making the parts for receiving sets. Some of the machine tool builders have obtained business from this source, but much of the work is done by existing plants having the necessary equipment, a large part of which is idle on account of the general depression in the metal-working field. There will doubtless be a considerable volume of business in the radio field for some time to come, and if all the manufacturers of radio apparatus begin to make their own parts, instead of buying them from other concerns, there will be a demand for new machinery from this industry.

NEW MACHINERY AND TOOLS

THE COMPLETE MONTHLY RECORD OF NEW AMERICAN METAL-WORKING MACHINERY

The New Tool descriptions in MACHINERY are restricted to the special field the journal covers—machine tools and accessories and other machine shop equipment. The editorial policy is to describe the machine or accessory so as to give the technical reader a definite idea of the design, construction, and function of the machine, of the mechanical principles involved, and of its application.

Blanchard Vertical-Spindle Surface Grinding Machine

PROBABLY the heaviest and most powerful vertical-spindle surface grinding machine ever built has been developed by the Blanchard Machine Co., 64 State St., Cambridge, Mass. This machine weighs about 30,000 pounds, is 12 feet 6 inches long, 7 feet 6 inches wide, and 10 feet high. In general arrangement it is similar to the No. 16 Blanchard grinding machine. The work is carried on a rotary magnetic chuck, which is moved horizontally from the loading to the grinding position, and then rotates continuously while the grinding wheel is gradually being fed downward. The chuck and table of the machine are traversed by power.

The grinding wheel is held by sulphur in a cast-iron retaining ring attached to the faceplate by six screws, and is wire-banded. The wheel-head weighs three tons and has a sixty-horsepower induction motor built into it, which runs at a speed of 600 revolutions per minute. The rotor is mounted directly on the wheel-spindle, which is carried in two large radial-thrust ball bearings. A spring take-up at the upper end exerts an upward pull on the spindle that exceeds the weight of the rotating parts by about 1000 pounds. This initial load on the lower or main thrust bearing serves to eliminate all play or backlash. The main bearing has a rated thrust-load capacity of over 25,000 pounds. Fig. 3 shows the principal parts of the wheel-head, with a man of average height standing behind them to give an idea of their size. The main ball bearing is in the left foreground of the illustration.

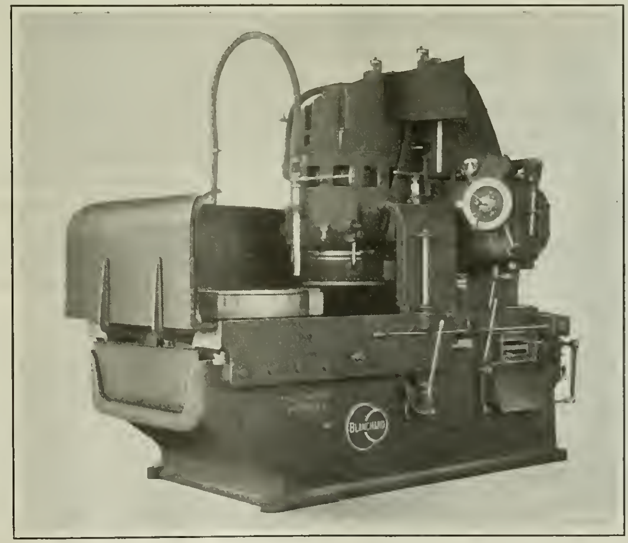


Fig. 1. No. 27-R High-power Vertical-spindle Surface Grinding Machine built by the Blanchard Machine Co.

The wheel-head slides vertically on the column, this movement being controlled by a feed-screw carried in ball bearings in the column. The feed-screw is driven through a gear-box, the mechanism of which is driven by the upper pulley at the right end of the machine. The latter may be clearly seen in Fig. 2. Double friction clutches provide for the rapid raising or lowering of the wheel-head. Both hand and power feeds are obtained by means of the box on the front of the column. The power feed has an automatic stop, and is supplied with a convenient adjustment which gives feeds of from 0.0005 to 0.005 inch per revolution of the chuck. One lever controls the engagement of the power feed and the raising and lowering clutches, the lever being so designed that these cannot be simultaneously engaged. The hand feed is 0.010 inch per crank revolution.

The wheel has a safety guard constructed of 5/16-inch steel plate which is supported on three steel rods, and it has a convenient rack-and-pinion mechanism for vertical adjustment. A dresser attached to the wheel-head provides for truing the wheel face while grinding. Water is supplied to the inside of the wheel through a 2-inch pipe and to the outside nozzle through a 1½-inch pipe. The column is fastened to the base by means of the usual Blanchard three-point support, which makes it easy to maintain proper alignment of the column.

The large pulley, seen in Fig. 2 near the base of the machine, transmits power for rotating the chuck, while the pulley to the right of it drives the water pump and the table-traversing mechanism. The chuck is driven through a four-speed gear-box having sliding gears and a friction clutch for starting and stopping. This clutch is interlocked with the gear-shifting mechanism. Power for all purposes, except driving the grinding wheel, is supplied by a 5-horsepower motor on the back of the column. The rotary magnetic chuck is of the one-piece steel type, and has closely spaced holes suitable for holding either small or large work. The face is made of brass and steel, and is waterproofed.

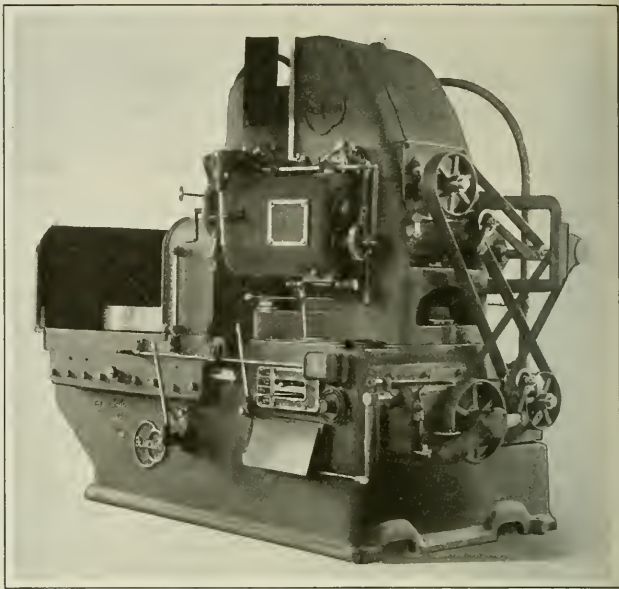


Fig. 2. Right-hand End of Blanchard Grinding Machine, showing Drive to Various Units

The chuck is caried on a table sliding on one flat way and one V-Way on the base. The table spans the base in such a way that all water and chips from the work fall directly into the first part of the water tank in the base. Here most of the solid material settles to the bottom, and the water overflows into the rear part of the tank where any remaining material settles. The water then flows under a skimmer which retains floating dirt and over another dam into the pump tank. The main tank is designed to facilitate cleaning. Both parts are so arranged that the entire bottom can be reached with the hoe provided, and an incline leading to an overhanging drip edge makes it easy to remove dirt into any receptacle. The pump tank holds 425 gallons.

Water guards made of ⅛-inch steel plate entirely surround the work and the grinding wheel. The section on the front of the machine was removed at the time the photographs were taken. The question of lubrication was carefully studied in the designing stage. Both main gear-boxes have pressure-feed lubrication from submerged gear pumps to every bearing. Other important units have a reservoir of oil with means for circulating or splashing to all bearings.

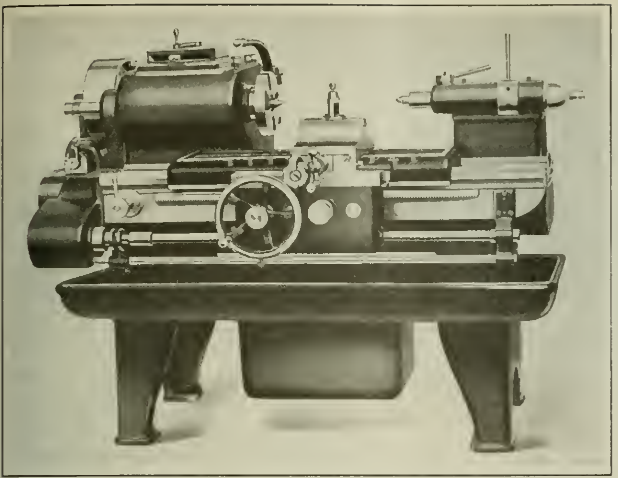
Some of the specifications of this machine are as follows: Range of work with a standard 42-inch chuck, 48 inches in diameter by 20 inches high; with an over-size 48-inch chuck, 48 inches in diameter and 16 inches high; maximum swing inside of water guards, 60 inches; wheel size, 27 inches in diameter by 7 inches thick and 2 or 3 inches width of rim; wheel speed, 580 revolutions per minute or 4100 feet per minute; and chuck speeds 3, 5, 8, and 13 revolutions per minute.

SUNDSTRAND HEAVY-DUTY MANUFACTURING LATHE

A 12-inch manufacturing lathe which is intended for specialized production but which is also suitable for handling a variety of work because of the incorporation of a cross-feed, quick-change feed and reverse to the carriage, is here illustrated. This machine can also be used for thread-cutting by substituting a lead-screw in place of the feed-rod. It has recently been added to the line of equipment built by the Rockford Tool Co., 2400 Eleventh St., Rockford, Ill. The bed is of the patented construction employed in Sundstrand lathes, having separate ways for the carriage, and the headstock and tailstock. This design allows the carriage to travel to the end of the bed in front of the tailstock and eliminates overhang of the tailstock spindle when short work is being supported.

The headstock is of the selective-speed type, and is driven by a single pulley furnished with a friction clutch. The clutch-operating lever is conveniently located, and the same movement that disengages the clutch automatically applies a brake which almost instantly stops the spindle. Nine spindle speeds are obtainable by means of two levers on top of the headstock, which operate sliding gears. The spindle can be locked by a plunger at the front end of the

Fig. 3. Principal Parts of the Wheel-head



Sundstrand Twelve-inch Manufacturing Lathe built by the Rockford Tool Co.

headstock, so that chucks and faceplates may be conveniently removed. The spindle has a hole running through its entire length, and the rear end is extended to permit the attachment of an air cylinder, draw-in attachments, expansion chucking device, etc.

The carriage has an exceptionally long bearing surface on the ways, and is arranged with a slide-block for a taper attachment. Provision is also made for mounting extra cross-slides, special tool-holder blocks, and similar attachments. A multiple stop collar furnishes a positive stop for the cross-slide when turning shafts with shoulders.

The apron is of the double-wall type, and so designed that a lead-screw can be substituted for the feed-rod. Practically all standard threads may be cut after such substitution, by the use of a few additional change-gears. The main feed-shaft or the lead-screw is connected to the feed-box shaft by means of a sliding clutch operated from a trip-rod on which collars can be placed at any point to stop the carriage movement automatically. The taper attachment is conveniently placed below the carriage, where it can easily be reached for adjustment.

A tool placed on the rear ways of the bed between the headstock and tailstock works simultaneously with the carriage, being driven by means of a rack fastened to the carriage. The tailstock is of a quick-acting design. The motor is attached to the rear of the bed, a silent chain transmitting power from the motor to the main driving shaft. An eccentric bushing provides for taking up slack of the chain.

Some of the specifications of this lathe are as follows: Swing over carriage, 12 inches; maximum distance between centers, 18 inches; diameter of hole through spindle, 1 11/32 inches; length of carriage on bed, 34 inches; number of feeds, 29; range of feeds, from 0.005 to 0.043 inch; range of spindle speeds, from 36 to 251 revolutions per minute; and weight of machine, 3130 pounds.

SENECA FALLS LATHES

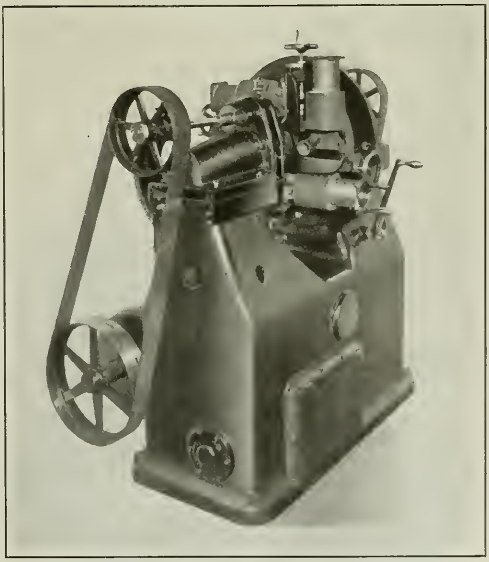
A line of engine lathes designed especially for the radio industry and automobile service stations is being made in various sizes ranging from 9 to 13 inches swing by the Seneca Falls Mfg. Co., 381 Fall St., Seneca Falls, N. Y. These machines are sold under the trade name of "Handy," and are similar in design to the gap-bed lathe described in February, 1920, MACHINERY, with the exception of the bed. The latter corresponds to the bed provided on the lathe described in April, 1919, MACHINERY. These lathes may be arranged for either belt or motor drive.

The same company is placing on the market a plain turning lathe, not provided with thread-cutting equipment. This machine will be of particular interest to the manufacturers of small electrical apparatus. It has a swing of 10⅛ inches, takes work up to 12 inches long between centers, and has feeds of from 0.002 to 0.040 inch per revolution of the spindle. It has a three-step cone pulley.

SEMI-AUTOMATIC TWO-WAY BORING MACHINE

A semi-automatic two-way boring machine designed primarily for boring, bottoming, and reaming the intake and exhaust ports of gas-engine cylinders, but which is also adaptable to similar operations on other work, is a product of the Manufacturers' Consulting Engineers, McCarthy Bldg., Syracuse, N. Y. An indexing fixture at the middle of the machine receives four pieces of work at one time. The work is clamped on the fixture in any of the four positions by tightening up a handwheel. The cutters are mounted in two multiple heads, which are placed on opposite sides of the fixture. Each head is supplied with three cutters. The two heads are fed simultaneously toward the work, and each time this movement is made, an operation is performed on three of the cylinders. At the same time the fourth is unloaded and a new one substituted. There is plenty of time between movements of the cutter-heads for reloading.

The feed of the cutter-heads is started by throwing in the clutch through the operation of a hand-lever at the front of the machine. One piece is completed every twenty seconds. The holes reamed in the work are 1 9/16 inches in diameter and 1 inch long. The motor for driving the machine is placed inside the base and drives a shaft running the length of the machine at the rear, which has a pulley on each end. Power is transmitted from the motor to this shaft through a chain and sprockets, and the pulleys on the ends of the shaft transmit the drive to the cutter-heads.



Motor-driven Semi-automatic Two-way Boring Machine brought out by the Manufacturers' Consulting Engineers

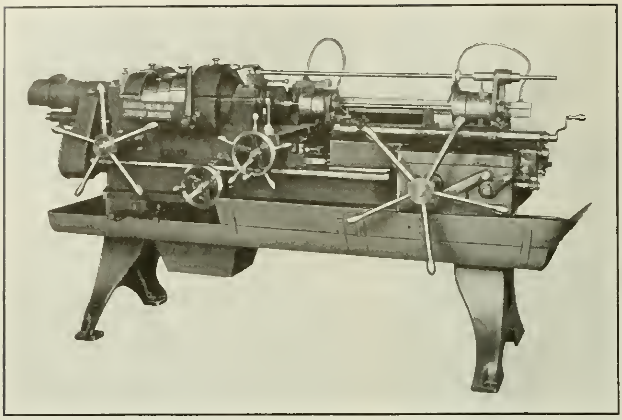


Fig. 1. Staybolt Machine built by the Millholland Machine Co.

The main driving shaft has a worm near the middle which drives a worm-wheel on a shaft having two cams. These cams actuate lever arms connecting with the cutter-heads and cause them to reciprocate to and from the work. A trip on the camshaft throws out the clutch at the completion of each cycle and stops the movement of the cutter-heads. The latter slide on ways similar to those of a shaper, and the work is positively held in alignment with the cutter-heads by the shaft on which the work-fixture is mounted. Each cutter has a multiplicity of cutting edges, which permits the use of a rapid feed per revolution.

LASSITER-MILLHOLLAND STAYBOLT MACHINE

Increased steam pressures in locomotive boilers have necessitated that the thread of staybolts used in their construction be uniform in pitch and that the lead of the threads on each end be continuous relative to each other. With the staybolt machine illustrated, a continuous lead is assured, as the machine slide is fed by a lead-screw in cutting the threads. This machine is built by the Millholland Machine Co., 1102 W. 23rd St., Indianapolis, Ind., and the Dale Machinery Co., Inc., 17 E. 42nd St., New York City, is the exclusive selling agent. The machine is built in two types, a Model A for rigid side staybolts, which have straight threads cut on both ends, and a Model B, for radial, flexible button-head, and crown staybolts, which have a straight thread on one end and a taper thread on the other or head end.

Fig. 2. Threading a Staybolt on the Lassiter-Millholland Model A Machine

Fig. 1 shows a Model B machine of the cone-pulley type; this machine is also furnished in a geared-head motor-driven design. The three-step cone and back-gears of the headstock give a range of nine spindle speeds. Changes in spindle speeds are made through friction clutches without stopping the spindle. The staybolt forgings are gripped by the square end in a special collet having an adjustable stop. The main slide has two "modern" die-heads, the forward one of which is mounted in a permanent position on the slide, while the rear die-head is adjustable longitudinally by means of a fine-pitch screw. This adjustment adapts the die-heads for cutting staybolts of various lengths. An accurate spacing bar facilitates the setting of the two heads to cut a continuous lead when changing the position of the heads to suit a new job. The die-heads open sufficiently to permit a button-head to be passed through them to the chuck. A V-block on the slide prevents a staybolt from dragging in the die-chasers when the heads are open.

The first operation on staybolts of this class is to turn the surfaces to be threaded. For this operation the die-heads are provided with solid cutters. The cutters of the front die-head are tapered, and this die-head is also equipped with a taper attachment which gives its cutters a slight opening movement as it is fed forward. Both die-heads are opened automatically at the proper instant, and are closed by adjustable cams on a bar at the rear of the machine. During this operation the slide is fed forward at a rapid rate by means of a rack and pinion mechanism, actuated by a long lever on the apron which operates a friction clutch.

For the threading operation on the staybolt ends, chasers may be substituted for the cutters in the die-heads, although in shops where large quantities of staybolts are produced, it is generally preferable to use a second machine for the threading operation. The front die-head is equipped with tapered chasers. The two die-heads are held in a constant relation on the slide, and the latter is fed forward by two half-nuts in the apron which engage the lead-screw. Feeding the slide by means of the lead-screw prevents the die-heads from lagging or creeping.

Because of the different lengths of the surfaces machined, the rear die-head, both in turning and threading, advances about 1½ inches along its corresponding surface before the cutters or chasers of the front die-head begin cutting. This makes it unnecessary to support the rear end of the bolt on a center. The cross-slide is intended for use in facing the under side of the button-head, and may or may not be furnished. Change-gears can be furnished for cutting threads of any standard pitch. This machine has a capacity for staybolts from ¾ to 1½ inches in diameter and 14 to 36 inches in length. The maximum turning length is 5 inches. The net weight of this machine is 3500 pounds.

The Model A machine is intended for producing staybolts from bar stock fed automatically through the headstock spindle. The main slide of this machine is equipped with a turret on which are mounted a stock stop, single-cutter roller box-mill, and a "Modern" automatic self-opening die-head as shown in Fig. 2. After the stock has been fed to the stop, the turret is indexed to bring the box-mill in line with the work. The turret-slide is then fed forward, and during the feeding movement, the portion of the bolt between the ends to be threaded is relieved by the box-mill. The feeding movement is accomplished by means of the rack and pinion mechanism mentioned in connection with the Model B machine.

After the turret-slide has been returned to its original position, the turret is again indexed to bring the die-head in line with the work. The die-head having been closed, the two apron half-nuts are engaged with the lead-screw. Then the slide is fed forward to enable the die-head to cut threads on both ends of the staybolt, during which operation the die-head cannot lag or creep. Fig. 2 shows this operation in process.

As the die-head completes the thread on the first end, the machine is speeded up instantly by means of a friction clutch in the headstock so as to feed the die-head quickly over the relieved portion of the staybolt. When the die-head approaches the opposite end of the staybolt, the machine is again slowed down before the chasers begin cutting the thread. The die-head is automatically opened when the thread is completed. The turret binding bolt has a hole which permits the staybolt to project through the turret. The finished staybolt is cut off from the stock by the tool on the cross-slide. This machine regularly has a capacity for staybolts up to 1⅝ inches in diameter, but it can be arranged for handling work up to 2¼ inches in diameter. The maximum over-all length of staybolts that can be machined is 12 inches. The net weight of this machine is 3000 pounds.

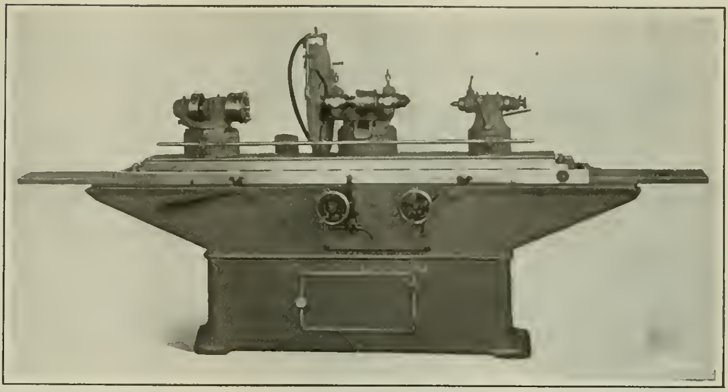


Fig. 1. Grinding Machine brought out by the Brown & Sharpe Mfg. Co. for Automotive Parts, in Addition to Regular Straight and Taper Work

BROWN & SHARPE UNIVERSAL AND CRANKSHAFT GRINDING MACHINE

Automotive crankshafts, pistons, wrist-pins, valve seats and stems, etc., in addition to the regular straight and taper work which a universal grinding machine is capable of handling, may be ground on the No. 4 universal and crankshaft grinding machine here illustrated. This machine has been recently brought out by the Brown & Sharpe Mfg. Co., Providence, R. I., to meet the requirements of motor service shops. Internal and face grinding can also be accomplished on such parts as individual cylinders, clutches, and transmission gears, by means of an internal grinding attachment and chuck. In fact, with the exception of cylinders cast en bloc, all ordinary parts of automobile engines can be ground. Furthermore, the machine can be employed for grinding line reamers, milling cutters, centers, boring-bars, and other tools.

Successful crankshaft grinding depends to a great extent upon the accuracy with which the throw-blocks are constructed. For this reason, the throw-blocks on this machine are made to tool-room accuracy. Their sides are finished relative to the center holes in the sliding blocks. This permits a crankshaft to be readily aligned by placing the blocks on their sides on a surface plate. The blocks are provided with adjustable clamp caps so that crankshafts of various diameters can be accommodated, three center holes for crankshafts of different throws, and an adjustable slide for obtaining a fine adjustment. The sliding block used on the headstock end of a crankshaft has a special extension which, with its recess, provides for grinding flanged crankshafts.

Another noteworthy feature of the machine is the piston arbor, by means of which a piston, in addition to being mounted on dead centers, is ground on its own centers. This method not only insures accuracy, but also enables a used piston to be trued up concentric with the axis on which it was first machined. For valve grinding, the wheel-slide is set at the desired angle, and the corner of the wheel moved across the valve seat. After the wheel-slide has been set, the table remains stationary, the wheel being traversed across the valve seat by the cross-feed.

Aside from the few special features necessary to fit the machine for its particular purpose, the construction is similar to that of the regular No. 4 Brown & Sharpe universal grinding machine. By removing the raising blocks from under the headstock and footstock, changing the size of the grinding wheel and its guard, and making slight additions to the equipment, the machine can be converted into the regular type.

The wheel-spindle is made of tool steel and runs in self-aligning phosphor-bronze boxes provided with means of compensating for wear. The spindle and its boxes can be easily removed to make room for the internal grinding attachment, as shown in Fig. 3. The automatic cross-feed moves the wheel from 0.00025 to 0.004 inch per reversal of the table. It is automatically disengaged when the work has been ground to size. The table travel is also automatic, being controlled by adjustable dogs. The speed and feed of the wheel, the speed of the work, and the table feed, are entirely independent of each other. A single lever is operated to start or stop the rotation of the work and the feed of the table. The table-reversing mechanism permits of grinding work close to shoulders.

The base of the machine rests on the floor at three points. This maintains the alignment of the table, even though the floor may not be absolutely level. Ample overhang at each end of the bed gives a firm support for the table, especially at the end of its traverses. Included in the equipment are back-rests for supporting slender work or splined shafts, as shown in Fig. 2. These rests are universal in all movements.

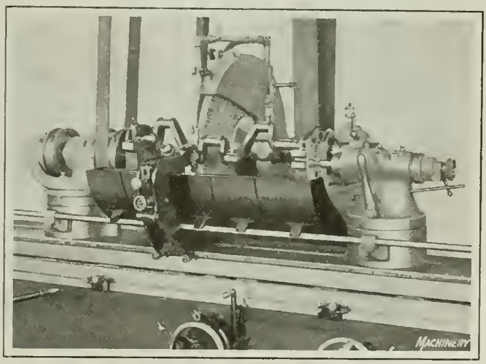


Fig. 2. Grinding a Crankshaft supported during the Operation by a Back-rest

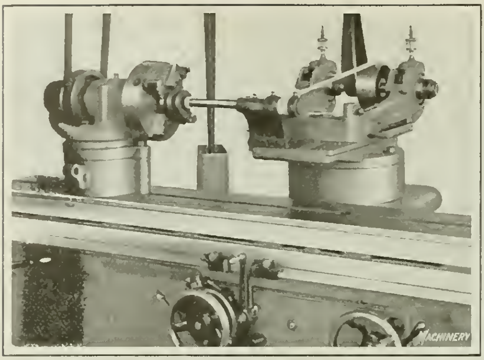


Fig. 3. Internal Grinding made Possible by substituting an Attachment for the Wheel-spindle and its Boxes

and have close adjustments. They automatically compensate for a decrease in diameter as work is ground to size.

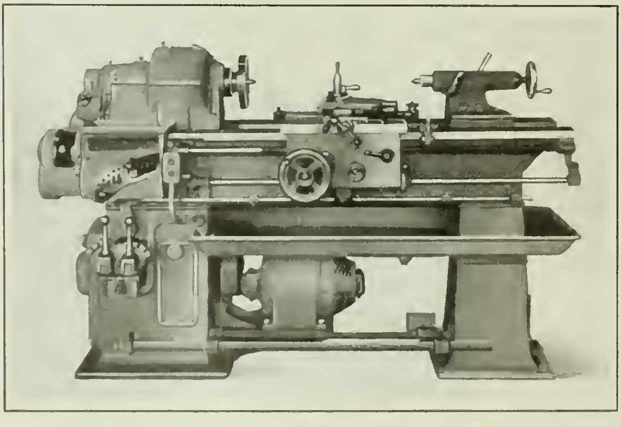
The grinding wheel is 24 inches in diameter, 1 inch thick, and has a hole 5 inches in diameter. It is protected by a heavy guard which confines the spray and particles of abrasive. The footstock carries a holder for the carbon point, by means of which the wheel can be trued without removing work from the centers. Work up to 20¾ inches in diameter and 60 inches in length may be placed on the centers.

HENDEY MOTOR-DRIVEN LATHE

In the 1922 model 14-inch lathe of the Hendey Machine Co., Torrington, Conn., the motor has been placed beneath the oil-pan and the drive is through a speed-box in the left-hand pedestal and thence through a belt to the headstock spindle. By means of this driving arrangement, the lathe retains all the desirable features of the cone type and secures most of the advantages of the geared-head type. Eighteen spindle speeds are obtainable, nine through the speed-box in the pedestal and nine through the customary back-gears in the headstock. Reducing gears are located in the drive between the motor and the speed-box. The latter is oil-tight.

All driving parts of the lathe are enclosed, with the exception of the lead-screw and the faceplate, so as to protect the operator and the machine from injury. The interior of the headstock and speed- and quick-change gear-boxes may be conveniently exposed by the removal of a manhole or cover-plate. The headstock is equipped with a taper spindle and bearings, and is provided with means for taking up end play of the spindle. The single pulley and pinion run on a sleeve readily supplied with oil. An intermediate sliding feed-gear is operated through a conveniently located lever. The back-gear quill may be oiled while in motion. The carriage and compound rest are of improved design, and the tailstock has a graduated sleeve and effective clamping means.

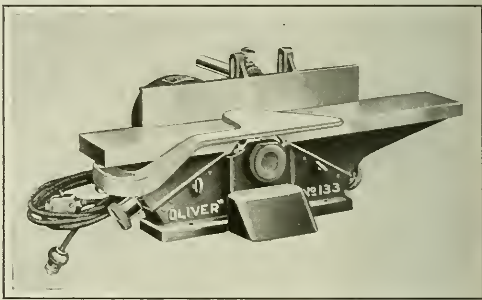
The motor is controlled by push-buttons. An interlocking mechanism between the shifting levers and the starting panel enables the speed of an alternating or direct-current motor to be reduced automatically while gears are being shifted. Supplementary control of the spindle is obtained through a treadle running the full length of the bed. Pressure on this treadle instantly causes the spindle to stop rotating, and permits quick examination or calipering of work. The tension on the driving belt may be altered by means of a single-screw adjustment.



Motor-driven Lathe placed on the Market by the Hendey Machine Co.

OLIVER HAND PLANER AND JOINTER

The work of patternmakers in jointing and fitting small patterns, is facilitated by the portable motor-driven hand planer and jointer shown in the accompanying illustration. This machine is now being placed on the market by the Oliver Machinery Co., Grand Rapids, Mich. It is made in two sizes, 6 inches and 4 inches, which plane to a width of 6¼ and 4¼ inches respectively, and rabbet up to ½ inch.



No. 133 Hand Planer and Jointer added to the line of Patternmaking Equipment built by the Oliver Machinery Co.

The tables are mounted on inclined dovetailed ways on which they are raised or lowered by means of a handwheel and screw. They may be easily locked in any position. The fence can be quickly adjusted across the tables and tilted and locked in any position up to 45 degrees. When not in use, the fence can be swung out of the way of the knife jointing and setting attachment with which the machine may be furnished.

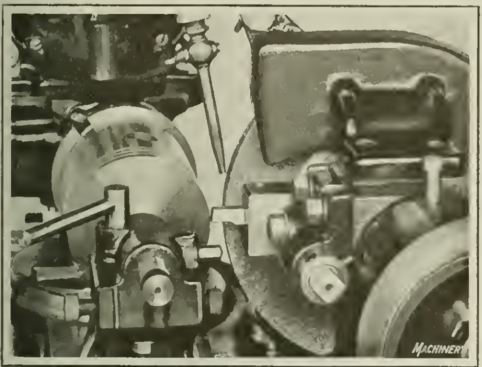
An automatic aluminum guard keeps the unused portion of the knives covered. The cutter-head is of the three-knife circular safety type fitted with three tungsten-chromium knives, ⅛ inch thick and 1 inch wide. The cutting diameter of this head is 3½ inches. The head is direct connected to the motor by means of a universal coupling and runs in self-aligning ball-bearings.

A ¼-horsepower motor is supplied for the 4-inch machine, and a 1/3-horsepower motor for the 6-inch machine. Power for the motor may be taken from a lamp socket, the current supply being controlled through a push-button switch. The machine may be furnished with a rabbeting arm which is mounted on the in-feed table. The knife jointing and setting attachment previously referred to consists of a right-angle way with a sliding block, jointing stone, and aluminum guard. It serves as a guide for setting the knives, and by sliding the jointing stone back and forth while the cutter-head revolves, the knives are sharpened and jointed. This machine may also be provided with a floor stand.

"RE-LI-O" WET GRINDING MACHINE

Machining automobile pistons on a semi-manufacturing basis is one of the operations for which the No. 2 "Re-li-o" grinding machine now being placed on the market by the Van Norman Machine Tool Co., 160 Wilbraham Ave., Springfield Mass., proves especially useful. The machine is like the "Re-li-o" grinding machine described in December, 1921, MACHINERY except that it is equipped for wet grinding and has an improved type of turning-tool holder. Pistons may be finished to size either by grinding only, or by a combined turning and grinding operation. When a considerable amount of metal is to be removed, it may be desirable to run off the larger portion and then grind to size.

A close-up view of the turning-tool holder is shown in the accompanying illustration. This holder can be swung in to and out of the operating position without interfering with the piston set-up or the grinding wheel. In the illustration, the tool is shown in contact with the work. Before bringing the grinding wheel into the operating position, the tool-holder is swung downward. An adjustable collar with a locating stop-pin is mounted on the outer end of the tool-holder shank. This stop-pin swings clear when the tool-holder is released and contacts when the tool is swung up for turning. The illustration also clearly shows the diamond truing tool mounted on the rear side of the tailstock. This machine is also suitable for grinding wrist-pins, valves, armature commutators, etc. In addition, it will be found valuable in the tool-room.

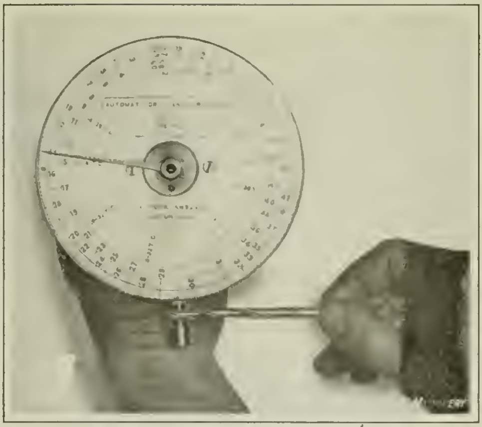


Improved Turning-tool Holder in Use on No. 2 "Re-li-o" Grinding Machine, made by the Van Norman Machine Tool Co.

LAWSON DIAL DRILL AND WIRE GAGE

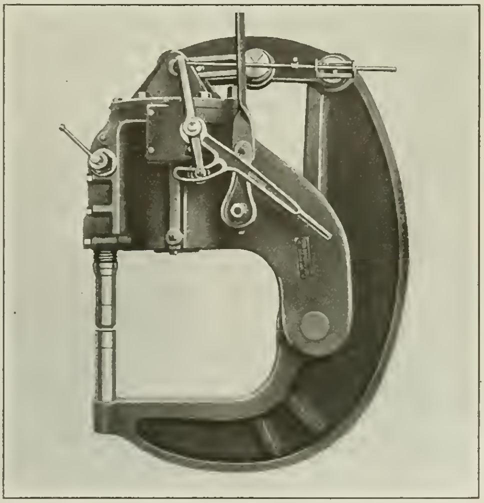
Drills and wires ranging from No. 1 to 60 gage can be quickly and accurately checked to see whether they are under or over size, or to determine the gage number, by means of the dial gage illustrated. This device is being introduced to the trade by the Victor R. Lawson Co., 35 Hartford St., Boston, Mass. The graduations on the dial show variations to 0.0005 inch. The dial also shows the proper tap drill to be used for drilling holes that will be tapped to a full thread when the corresponding tap is used.

The drill or wire to be gaged is placed between the two jaws at the bottom of the dial. The upper jaw is stationary, and the lower jaw is attached to a rod which extends into a square groove running across the back of the dial. The lower jaw is normally held in contact with the upper one, but to measure a drill it is depressed by pushing downward on the upper end of the rod to which it is attached. In this way the lower jaw may be moved sufficiently to permit a drill to be placed between the two jaws. After a drill has been placed in position, all pressure is released from the sliding rod. The lower jaw then automatically rises into contact with the drill. Movement of the sliding jaw actuates the dial indicator, and so the gage of the drill may be ascertained by observing the position of the indicator. The device is particularly intended for sorting out batches of small drills of mixed sizes. It may be operated by means of a foot-treadle which leaves both hands of the operator free for inserting drills.


Method of using the Drill and Wire Gage made by the Victor R. Lawson Co.

SHEPARD PNEUMATIC RIVETING MACHINE

Light and medium structural riveting, such as is done when constructing roof-trusses, plate beam-box, and crane girders; plate and channel or angle columns, etc., is the service for which the "Pinch-Bug" riveting machine here illustrated was designed. This machine is a product of the Hanna Engineering Works, 1763 Elston Ave., Chicago, Ill. The angular movement of the machine is small, owing to the


Shepard Pneumatic Riveter made by the Hanna Engineering Works

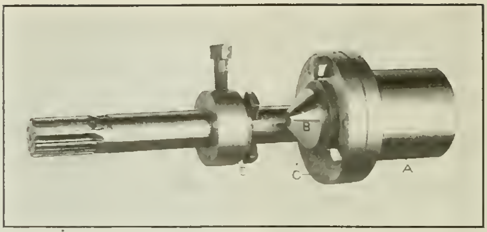


Fig. 1. Non-floating Reamer-holder which is a product of the Marvin & Casler Co.

long radius from the hinge-pin to the die axis. When the machine is suspended with the dies vertical and the cylinder up, the upper die does not move as the rivet is driven. The rivets are put in from the top and driven from below. They may be inserted in advance of the machine, and it is thus possible for the man who inserts the rivets to devote some of his time to other details without interrupting the continuous operation of the machine.

The suspension pin about which the machine is free to oscillate is so located relative to the center of gravity of the equipment that the machine, when suspended, assumes a position in which the upper die screw is vertical. The die screw remains vertical when the unit is opened or closed, because the center of gravity shifts but slightly during operation. A proper working suspension is easily obtained by hoisting the machine to a position in which the upper die will just rest on the work. The machine has a reach of 20 inches, and a gap of either 11½ or 18 inches, depending on whether a short or a long jaw is supplied. It has a capacity of 50 tons on the dies at an air pressure of 100 pounds per square inch and weighs 1490 pounds.

MARVIN & CASLER PRODUCTS

A non-floating reamer-holder, designed on the theory that in order to ream a straight true hole it is necessary to hold the rear end of the reamer in alignment with the center line of the spindle and the hole to be reamed, has been placed on the market by the Marvin & Casler Co., Canastota, N. Y. This holder may be supplied with an adapter sleeve to fit the turrets of turret lathes, the holder in Fig. 1 being supplied with a sleeve *A* to suit the Jones & Lamson turret lathe. Inserted in the sleeve is a cone-shaped machine-steel center plug *B*.

Before lining up the holder with a piece of work, the latter is first bored to a convenient size to receive the center plug, faced a short distance, and the hole slightly chamfered. Then the adapter sleeve is mounted in the turret with the faceplate *C* held to the sleeve by three cap-screws. The holes in the faceplate for these screws are over-size so as to allow the faceplate to float slightly on the sleeve when the screws are not tightened up. After the center plug *B* has been inserted in the sleeve, the turret is advanced to seat the plug in the hole of the work. While in this position the three cap-screws are tightened to hold the faceplate in position, after which the turret is withdrawn from the work and the reamer-holder collar *D* substituted for the center plug. Only one center plug is required for a group of machines. The reamer-holder collar can be furnished in different sizes.

Fig. 2 shows a T-slot nut which is made in different sizes from ½ to 1 inch by the same company. In many cases work being machined is of such a shape that, when old-style T-slot bolts are employed for holding the work to the table, the bolts must be located before the work is set in place. By employing the nut illustrated, however, bolts may be quickly added for more securely clamping work, even after the machining has begun. The nut and stud used with it are made in sizes to suit the small milling machine slots and the large slots of planers and drilling machines. The nut is so designed that its continuous use does not result in wear of the T-slots.

The use of a line of blocks and jacks, made by the Marvin & Casler Co., in supporting work on a machine platen, is illustrated in Fig. 3. The line consists of a jack and a number of blocks and pipe extensions. The jack has a screw member, one end of which is a point while the other end is a flat surface. At *A* is shown a jack at the top of a pipe extension, with the point end of the screw member uppermost, while at *B* the flat end of the screw member supports the work. The jack body is provided with a flange and is also reversible, the flange permitting the use of the body with the pipe extensions. The location of the flange and lengths of the pipe extensions of a set are such that any height between minimum and maximum may be obtained. When using the point end, the jack alone has a minimum height of 1¾ inches, and when using the flat surface of the screw member, 1½ inches. With four pipe extensions the range of height obtainable is from 1¾ to 19 inches.

NEW JERSEY FOUNDRY & MACHINE CO.'S "HANDIMAN"

Users of hand-power hoists of 5 tons or greater capacity will be interested in a patented electric machine which may be suspended in the bight of the operating chain of such hoists, for overhauling the chain, which it accomplishes at the rate of 138 feet per minute, with a pull of 150 pounds. This machine is known as the "Handiman" and is manufactured by the New Jersey Foundry & Machine Co., 90 West St., New York City. It is portable so that it may be used with different hoists about the shop.

The machine has a cast-iron housing in which are con-

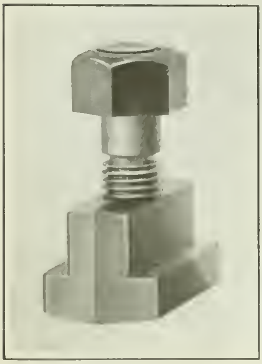


Fig. 2. Casler T-slot Nut

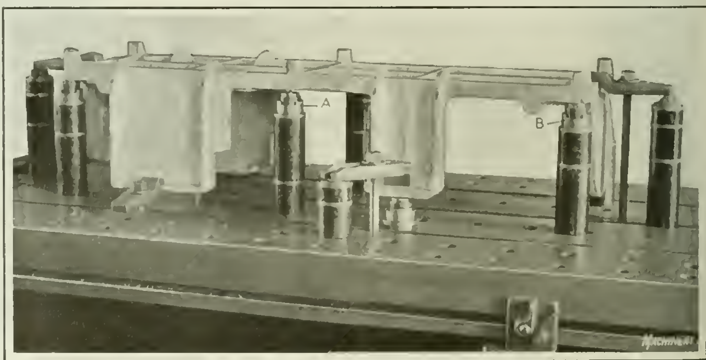
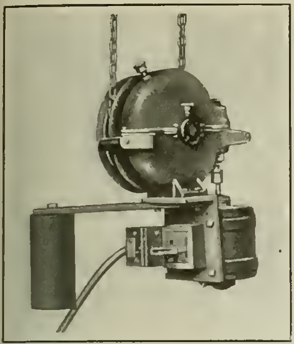


Fig. 3. Supporting Work on a Planer Table by the Use of a Line of Jacks made by the Marvin & Casler Co.



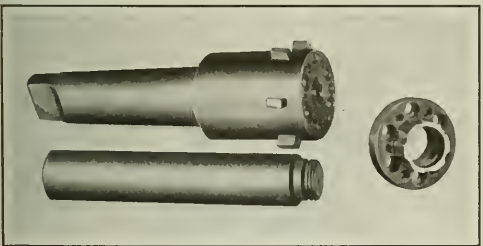
"Handiman" manufactured by the New Jersey Foundry & Machine Co.

tained a worm and worm-gear driven by a ¾-horsepower motor. The worm-wheel shaft extends outside of the housing and carries a grooved sheave having a rubber V-shaped tread which fits any size or pitch of chain and gives a sufficient tractive effort to pull the chain without slippage. The entire unit is so counterbalanced that it hangs in the plane of the chain in which it is mounted.

Current may be supplied from lighting sockets or from a conductor suspended from the hoist, if it is more desirable to bring feeders to that point. A reversing switch provides for running the motor in either direction, for hoisting or lowering. The machine is intended for use in instances where it is desired to obtain faster and easier operation of hoists than is possible by hand, but where the installation of a standard electric hoist would scarcely be warranted.

MADISON ADJUSTABLE BORING HEAD

A boring head intended for both rough- and finish-boring, which can be quickly adjusted by means of a center-pin having a dial graduated to 0.001 inch, is made by the Madison Mfg. Co., Spring and Elton Sts., Muskegon, Mich. One complete revolution of the center-pin increases the diameter across the cutters 0.025 inch. The center-pin is hardened and ground to insure an accurate adjustment. It supports the cutters in a direct line with the thrust of the cut.



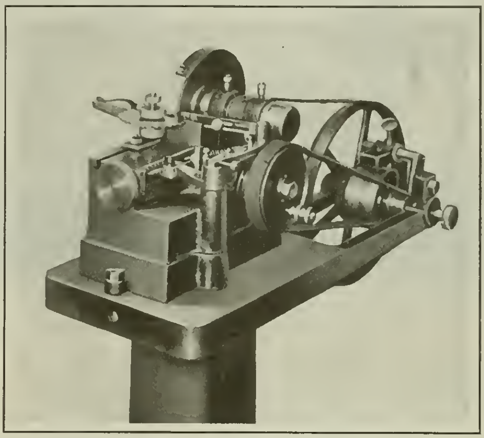
Adjustable Boring Head placed on the Market by the Madison Mfg. Co.

This boring head is designed for use in high-powered machines where rapid production is desired, and as it is provided with six blades, a heavy feed can be employed. High-speed steel blades are generally furnished, but stellite blades may also be supplied. The head is made with any form of shank, and from 2½ to 8 inches in diameter across cutters. The pilot-bar shown is used when boring deep holes.

SCHERR AUTOMATIC SAW SHARPENER

The sharpening of small metal-cutting saws, screw-slotters, etc., 8 inches and less in diameter, may be conveniently accomplished by means of a No. 2 automatic saw sharpener now being introduced to the trade by George Scherr, 126 Liberty St., New York City. Accuracy is assured by an indexing arrangement which, through the intermittent movement of a finger, brings the teeth of the saw successively in alignment with the grinding wheel. This finger is of such design that it functions, even though a tooth may be broken out. The saw is mounted on a slide which is reciprocated to and from the wheel after each indexing. The movement of this slide is set for each job by means of a knurled-head adjusting screw on the slide.

After the saw has been mounted in place and the necessary adjustments have been made, power is transmitted to the feeding and indexing mechanisms through a clutch on the driving shaft. From then on, the operation is automatic until the sharpening of the saw has been completed. The grinding wheel revolves continuously, regardless of whether the clutch is in or out of mesh. The wheel is dressed to suit the shape of the saw teeth. This machine handles saws from 1½ to 8 inches in diameter and up to about 5/32 inch in



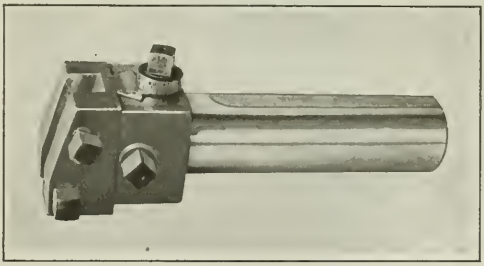
Sharpening Machine for Small Saws, placed on the Market by George Scherr

thickness, with a distance from tooth to tooth, measured along the periphery of the saw, up to ⅜ inch. The weight of the machine on a 30-inch column is about 135 pounds.

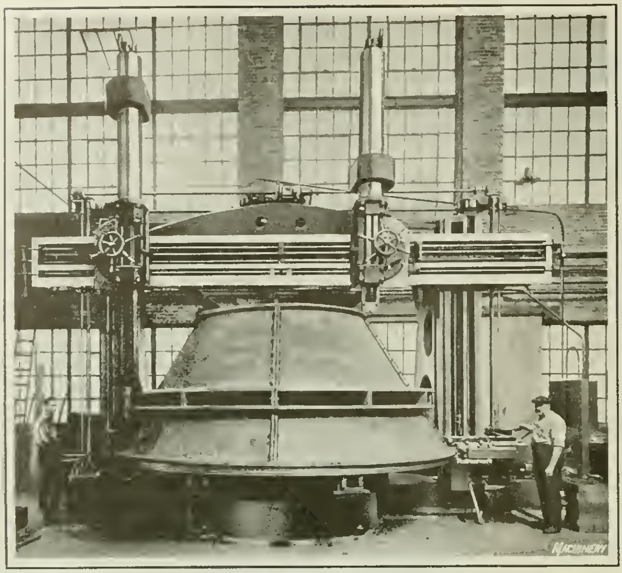
A No. 1 machine of the same general design but of a smaller size is also built, while a No. 3 machine provides for the automatic sharpening of circular and band metal- and wood-cutting saws and milling cutters up to 3/16 inch thick.

WARNER & SWASEY ADJUSTABLE CUTTER-HOLDER

In turning work to accurate size on a turret lathe through the use of a cutter-head, at least two cuts must be taken over the surface being machined. The roughing cut can be held to a limit of about 0.004 inch, when using a common holder, by tapping the cutter lightly with a hammer. Considerable skill, however, is required in taking the finishing cut by the same method, to prevent moving the cutter too far and spoiling the work. An adjustable cutter-holder designed by the Warner & Swasey Co., Cleveland, Ohio, which is here illustrated, eliminates guesswork in adjusting the



Adjustable Cutter-holder made by the Warner & Swasey Co.



Large Boring and Turning Mill built by the Betts Machine Co.

cutter to close limits. The cutter is held at an angle and adjusted by turning the graduated screw which operates the cutter-slide.

The head is made of hardened steel throughout. In using the tool, the locking screw is drawn up tightly and kept in that position. An adjustment can then be made without changing the tension of the screw. An adjustment as small as 0.0005 inch is possible. In addition to the advantage of obtaining the original setting easily, the cutter can be adjusted to cut the work to the desired size when the cutting edges become worn.

BROWN & SHARPE MICROMETER CALIPER

To meet the needs of automobile repair shops for a micrometer caliper having a sufficient range to permit the measurement of both the small-size pistons now supplied on certain automobiles and the large-size pistons used in trucks and tractors, the Brown & Sharpe Mfg. Co., Providence, R. I., has changed the range of the No. 55 micrometer caliper which it manufactures. This caliper will now take measurements from 2 to 6 inches, the range being secured through the use of four anvils. The anvils are held in position by a knurled nut, which enables them to be changed rapidly. The general construction of this tool is similar to other Brown & Sharpe micrometer calipers.

BETTS BORING AND TURNING MILL

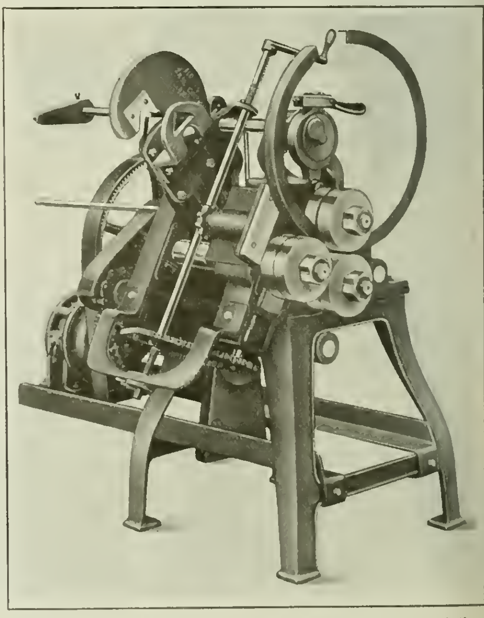
A large boring and turning mill with a capacity for work up to 16 feet 4 inches swing and 8 feet 4 inches height is here illustrated. This machine, which is built by the Betts Machine Co., 400 Blossom Road, Rochester, N. Y., has a number of interesting features. The two tool-heads are equipped with tool-steel spindles of extra long travel, and have a ring-type, self-contained, counterbalancing arrangement. The tool-spindle at the right is provided with a special attachment for turning tapers at any angle from 0 to 90 degrees. The right-hand upright carries a sliding side-head which has both horizontal and vertical power-feeds to the tool-slide. A power rapid traverse is provided for the three heads for each direction in which they may be operated.

This machine is driven by a constant-speed motor through a friction clutch. A brake allows the machine to be stopped instantly without stopping the motor. All speed changes are obtained by means of sliding, hardened steel gears running in a bath of oil. This machine is used principally for turning large castings such as are shown on the table in the illustration.

EXCELSIOR ANGLE-IRON BENDING MACHINE

A machine that will cut to length and bend in a circle angle-iron up to 2 by 2 by ¼ inch has been brought out by the Excelsior Tool & Machine Co., 30th St. and Ridge Ave., East St. Louis, Ill. The machine will also handle bar stock up to 4 by ½ inch and 2-inch T-iron, with the same bending rolls, these being adjustable to meet requirements. Special rolls may also be furnished to suit the bending of pipe channel-iron, or other shapes. The machine has three roll shafts, on each of which are two rolls which may be separated by steel washers of a thickness to suit the angle-iron being bent. Each roll has one straight and one rounded edge. To roll work so that the edge of a leg will be on the outside, the upper rolls should have the square edges together without spacers between them and the lower rolls should have the rounded edges together with spacers between them to allow one leg of the angle-iron to extend between the rolls. Guides are used to insure that the work will be rolled free from twists. With work rolled in this way two pieces may be handled at one time.

To roll work with the edge of one leg toward the inside of the circle, as shown in the illustration, the lower rolls should have the square edges together while the upper rolls should have the rounded edges together with spacers between them. Work of this type must be rolled one piece at a time. The

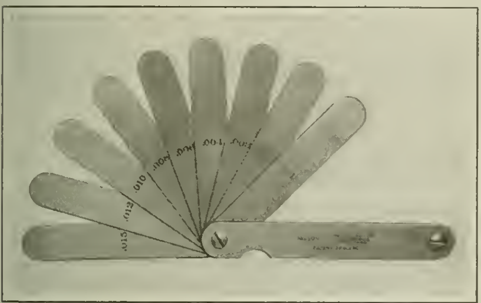


Machine for bending Angle-iron in Circles, which is a Product of the Excelsior Tool & Machine Co.

guides previously referred to are also used for this work. The upper-roll shaft has a 2½-inch movement obtained through eccentrics. This shaft is set with an allowance not exceeding the thickness of the angle-iron leg which extends between the upper and lower rolls. When duplicating work of the same thickness, a set-screw adjustment is used to clamp the eccentric so as to hold the rolls together. The machine is operated through a patented friction clutch and both belt- and motor-driven machines can be started and stopped under pressure. The speed of the rolls is fifteen revolutions or twenty-five lineal feet per minute.

LUFKIN IMPROVED THICKNESS GAGES

The principal feature of a line of improved thickness gages or feelers being placed on the market by the Lufkin Rule Co., Saginaw, Mich., is a patented lock by means of which any leaf may be held firmly in a set position. This feature will appeal particularly to automobile mechanics and repair men. For example, in making adjustments of tappets on engines, the holding of a leaf by means of the lock-nut



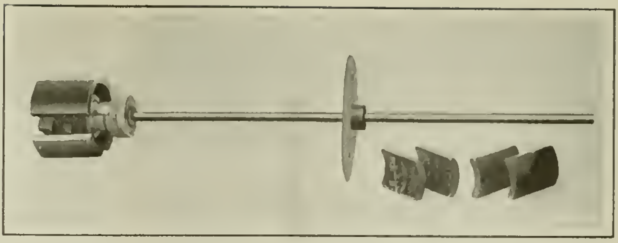
No. 109 Thickness Gage with Patented Lock, which is made by the Lufkin Rule Co.

permits of using the entire length of the leaf. On V-type motors, where work is performed at an angle, the gages are particularly useful.

Each leaf is 3 inches long and ½ inch wide. The No. 06 gage has six leaves ranging in thickness from 0.002 to 0.015 inch; the No. 07, seven leaves ranging from 0.0015 to 0.015 inch; and the No. 09, nine leaves ranging from 0.0015 to 0.015 inch. The thickness of each leaf is clearly marked on one side. On these three gages the thickest leaf and a nameplate serve as a case to protect the other leaves. The No. 109 gage, which is here illustrated, has the same leaves as the No. 09 gage, but is provided with a case into which all the leaves fold.

STIMSON INTERNAL LAPPING TOOL

An internal lapping tool developed particularly for lapping automobile cylinders but which can be furnished in any special size to meet machine shop requirements, has been placed on the market by the Stimson Engineering Co., 598 Sixty-eighth Ave., Milwaukee, Wis. The tool consists of a shaft, at one end of which lapping shoes are mounted. Two sets of shoes are regularly furnished, one of which may be adjusted to from 2¾ to 3½ inches in diameter, and the other to from 3½ to 4¼ inches in diameter. These shoes are held in place by cotter-pins and may be quickly substituted for each other. They are adjustable to the proper diameter by simply turning a tapered nut which is firmly held in position after an adjustment by means of a lock-nut. A disk placed loosely on the shaft rests on top of the casting being



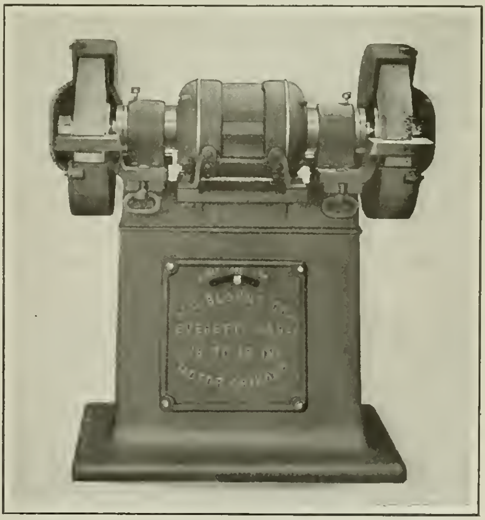
Internal Lapping Tool brought out by the Stimson Engineering Co.

lapped. A collar is employed to regulate the maximum distance between the disk and the lapping shoes, thus controlling the depth to which the tool is fed into the work. This lapping tool may be driven by an electric or air drill or by connection to a machine spindle through the use of a flexible coupling. A patent has been applied for on this device.

BLOUNT HEAVY-DUTY GRINDING MACHINE

A 5-horsepower heavy-duty motor-driven grinding machine equipped with an alternating-current motor and either 18- by 3- by 1½-inch or 16 by 3 by 1½-inch grinding wheels, is a recent addition to the line of machine tool equipment built by the J. G. Blount Co., Everett, Mass. The machine is equipped with S K F ball bearings throughout. The motor end shields are iron castings on which a recess is turned, and they are bolted directly to the motor frame. The shields are further secured in position by supports clamped around their hubs and bolted to each side of the head casting. The shield flanges are screwed into the shields. These flanges are machined all over and recessed on the inside. Either plain or exhaust type adjustable wheel guards may be furnished, as desired.

A Westinghouse safety starting switch is mounted within the column on a separate panel, which is easily removed from the rear of the machine without disconnecting the switch. This switch protects the operator and equipment against accidental starting of the motor. The switch cannot be held closed on an overload. The machine weighs 1200 pounds.



Five-horsepower Heavy-duty Grinding Machine brought out by the J. G. Blount Co.

NEW MACHINERY AND TOOLS NOTES

Tool-holder: Lovejoy Tool Works, 331 W. Ohio St., Chicago, Ill. A tool-holder, known as the "Use-em-up," which is intended to effect savings by making it possible to use up short tool bits. It will hold full-length tool bits, but is particularly useful when the tool bits become short through repeated grinding, tool bits as short as 11/16 inch being rigidly held.

Combination Punching and Shearing Machine: Amplex, Inc., 6 W. 32nd St., New York City. A punching and shearing machine having a solid steel frame. The operator's side of the machine is clear of all such encumbrances as flywheels and driving gears. A slanting centering slide allows for making mitering cuts without lifting the work. The machine is arranged for punching both the webs and flanges of structural shapes, and the throat is designed to accommodate broad-flanged Bethlehem shapes. The punch has a lowering device for locating center marks before punching.

Engine Lathes: Carroll & Jamieson Tool Co., 257 Davis St., Batavia, Ohio. A line of lathes designed primarily for tool-rooms and automobile service stations. The 14- and 16-inch machines are of the quick-change type and can be supplied with either single or double back-gears. A semi-quick-change lathe with a single back-gear can be supplied in the 13-inch size. The quick-change gear mechanism provides for cutting all standard and odd threads from 3 to 64 per inch, either right- or left-hand. On the semi-quick-change lathe, three changes of feed are obtainable by shifting a lever, and additional changes may be secured through the use of change-gears.

Elevating Platform Truck: Clark Tructractor Co., Buchanan, Mich. A gasoline-driven elevated truck having a loading platform 26 inches wide by 54 inches long. This truck will elevate a load of 4000 pounds from a minimum height of 11 inches to a maximum height of 16 inches, in eight seconds. Automatic stops control both the upper and lower limits of travel, and the load can be stopped at any point. The lifting mechanism is operated by hydraulic pressure. Power both for driving the truck and elevating the load is obtained from a 15-horsepower, four-cylinder tractor engine. The driving and elevating controls are at the rear of the engine compartment where the operator rides in a standing position.

Crane Magnet Cable Retriever: Pawling & Harnischfeger Co., 38th and National Aves., Milwaukee, Wis. A feeder cable retriever that differs from the ordinary types of cable take-up drums which have positive geared or chain sprocket drives. This retriever is designed to keep the cable taut at all times, a fixed but moderate tension being maintained on the cable. The cable winds up and pays out without slack or undue strains. The drum is driven only in the hoisting direction, the gearing being proportioned to drive the drum at a greater peripheral speed than that at which the magnet is being hoisted. This arrangement causes the friction drive to slip and produces a tension on the cable which may be adjusted by tightening a thrust spring in the friction drive.

* * *

EXAMINATIONS FOR PATENT AND TRADEMARK EXAMINERS

Examinations to fill vacancies in positions of assistant examiner in the Patent Office will be held by the Civil Service Commission on May 10, 11, and 12 and on June 21, 22, and 23 throughout the United States. The entrance salary for these positions is $1500 a year plus a bonus of $20 a month, and there is provision for promotion to positions paying from $1650 to $3900 a year. Technical training is necessary. Announcement is also made of an open competitive examination for assistant examiner of trademarks, to be held on May 24. The salaries for this work range from $1500 to $2050 a year. Full information and application blanks may be secured from the United States Civil Service Commission, Washington, D. C., or the Civil Service Board in any city.

GERMAN MACHINE TOOL EXPORTS

Figures received from Germany by the Department of Commerce indicate that there was a considerable decrease in the volume of Germany's machine tool exports during 1921, as compared with 1920 and the pre-war year of 1913. Germany's custom-house returns show that the total machine tool exports for the seven months from May to November, 1921, were 39,046 metric tons. Of these exports 7547 metric tons went to Belgium, and 5087 to France. The Netherlands received 4559 metric tons and Italy 3466, while Austria received 2823. Other countries receiving over 1500 metric tons were Czecho-slovakia, Switzerland, and South America. Countries receiving over 1000 metric tons were Great Britain and Spain, while those receiving over 350 but less than 800 metric tons, were Denmark, Alsace-Lorraine, Norway, and Sweden. Other countries not mentioned in the report received a total of 6000 metric tons. In comparing these figures it should be borne in mind that the German classification of machine tools is an extremely broad one, and includes metal-working, woodworking and stone-working machinery, as well as hydraulic presses, riveting machines and power hammers.

A recent Commerce Report shows that Germany's total machine tool exports during the year 1920 were 94,921 metric tons. During 1920 the Netherlands took over 19,000 metric tons of Germany's machine tool exports and France 13,668, while Switzerland ranked next in importance, taking 11,760 metric tons. Belgium and Italy each took approximately 7500 metric tons; Sweden 5433; Austria 4978; Czecho-slovakia 3360; Spain 3268; Denmark 2806; and South America 2949 metric tons.

* * *

RELATION OF UNEMPLOYMENT TO BUSINESS DEPRESSIONS

The President's Conference on Unemployment, held under the chairmanship of Secretary Hoover last fall, recommended that a serious attempt be made to analyze the causes of alternate periods of expansion and depression in industry, reflected in the so-called business cycle, and to find remedies for practical use in business. Acting upon this recommendation, Secretary Hoover appointed a committee which is undertaking a survey through the National Bureau of Economic Research, of which Dr. Wesley C. Mitchell is director.

At the first meeting of the director and the committee, preliminary surveys of the sources of information for such a study, by committees representing the Editorial Conference of Business Paper Editors and the Federated American Engineering Societies, were requested. A second meeting of the committee was held on April 13, at the Department of Commerce, at which the various sub-committees made reports before the general committee and a representative group of trade association secretaries and editors of leading engineering and trade journals. The general committee especially requested cooperation in securing definite suggestions as to members of trade associations who had evolved plans of minimizing the waste of the business cycle.

The report of the general committee will be divided into three parts: (1) a diagnosis of unemployment; (2) relation of unemployment to business cycles; and (3) the proposed measures and preventives of cyclical unemployment. The committee especially asks the industries for suggestions so as to make the third part of the report as practical as possible. Preliminary surveys indicate that constructive measures may be found in long-range planning of construction work, in various plans for stabilizing production, and in the use of statistical indexes of business conditions to meet periods of depression.

Anyone who has had experience along these lines is requested to forward this information to E. E. Hunt, secretary of the committee, Bureau of Foreign and Domestic Commerce, Chamber of Commerce, Washington, D. C.

HARDENING HIGH-SPEED STEEL CUTTERS

By JAMES CRAN

On page 481 of February MACHINERY there appears a note under the heading "Hardening High-speed Cutters." It is the writer's opinion that the procedure here outlined represents rather a short-cut method and that better cutters of high-speed steel would be obtained by the process described in the following. Any small standard furnace, whether oil, gas, or electrically heated, provided it is of the muffle or semi-muffle type and capable of being heated to about 2300 degrees F., answers the purpose. For the best results it is advisable to use three furnaces, but two are more generally used, and good work can be done with only two furnaces.

Method of Hardening when Using Two Furnaces

When two furnaces are used, the cutters to be hardened should be heated in one of them to 1600 or 1650 degrees F. and then transferred to the other furnace registering about 2300 degrees F. While 2300 degrees F. is rather a high temperature for high-speed steel, 2250 degrees F. is considered ideal. As soon as a cutter which has been preheated to about 1600 degrees F. is placed in a furnace registering 2300 degrees F., the temperature of the furnace will drop while the temperature of the cutter rises, and the result is that by the time the cutter has reached the desired temperature of 2250 degrees F. the heat of the furnace will have dropped 50 degrees.

On removing the cutter from the furnace, it should be immediately immersed in oil, which may be fish, linseed, cottonseed, rape, or any of the standard quenching oils in general use. The cutter should be kept moving slowly in the quenching bath until it has reached a black heat, which will be indicated by the cessation of smoke bubbles; it may then be allowed to cool down to the point where it can be handled without gloves. While movement of the cutter in the quenching oil is necessary to facilitate carrying off the heat, this should be done carefully, for if the cutter is moved too fast a vacuum will be formed behind it with the result that only one side of the cutter will actually be in contact with the oil.

Method of Hardening when Using Three Furnaces

When conditions will permit of three furnaces being used, more and better hardening can be done. It is best to have one furnace heated to a temperature of about 1300 degrees F. in which the cutters are preheated slowly and thoroughly until they have reached the temperature of the furnace. They should then be transferred to another furnace having a heat of about 1800 degrees F. and then to one of about 2300 degrees F. The rest of the procedure is the same as stated previously.

Final Heat-treatment

To give the maximum service, all high-speed steel cutters should be subjected to a second or tempering heat of about 1050 degrees F. This second heat makes the cutters much harder and tougher than they are when they come from the quenching bath. In quenching cutters of high-speed steel, it is advisable to leave some of the initial heat in them until they can be heated the second time or tempered, as this will tend to prevent cracking. High-speed steel is harder after being subjected to a second heat than it is when it comes from the quenching bath, because of the alloys it contains and their action in quenching.

It is well known that all steels, when they are in solution (which is the right condition for quenching) are austenitic, or have a grain structure the same as any pure metal. While straight carbon steel and some alloy steels are austenitic at the quenching temperature, the austenite changes to martensite in cooling, and in consequence, if the heating and other conditions are right, the steel will be in the hardest possible condition when quenched.

High-speed steel usually contains from 3½ per cent to 4 per cent chromium and about 18 per cent tungsten. Both of these alloys deter its passing into and coming out of solution; thus it is necessary to heat high-speed steel to a higher temperature than straight carbon steel, to get the various alloys of which it is composed saturated with the iron or ferrite, which comprises the major part of the steel. But it is also possible to make high-speed steel pass into solution at a much lower temperature than 2250 degrees F. by allowing it to soak for a time at 2000 degrees F. or even less. When this is done, however, it is likely to have a very much overheated structure, and in consequence will not stand up like a tool that has been brought quickly to the proper heat.

By watching a high-speed steel cutter closely when it is nearing the critical point, it will be noticed that it begins to have a greasy or sweaty appearance and small bubbles appear which work through each other; this is the ideal condition for quenching. If it is left longer in the furnace, the bubbles will change to blisters, which is a sure sign of overheating. In quenching high-speed steel, the chromium and tungsten tend to keep it in the austenitic condition, making a second heat necessary to bring it to martensite.

Effect of Second Heat on High-speed Steel Cutters

A good example of what a second heat on high-speed tools will do can be had by watching a lathe or planer tool which has been put to work directly after being quenched and ground and then noting the difference in the quality of the tool after a second grinding. After the second grinding it will stand up better than it did at first on account of the heat generated in removing the chip, which changes the structure from austenite to martensite on the extreme end or cutting edge.

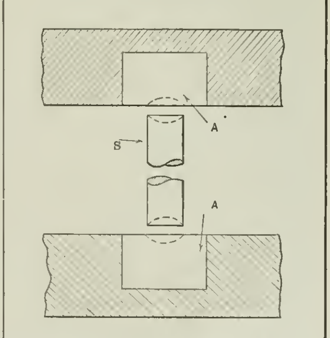
The temperatures here given are intended only as a basis to work from, and it is necessary for the hardener to use judgment according to the size of the pieces to be hardened. Very small tools can be hardened perfectly in a furnace having a temperature as low as 2250 degrees F., because they are not likely to bring the heat of the furnace down very much, but with heavy cutters it may be well to have the temperature of the furnace slightly higher than any of the temperatures here given so as to bring the work to the desired heat without danger of oversoaking it and thereby impairing the structure.

* * *

COLD RIVETS FOR ELECTRICAL APPARATUS

By JOHN E. UNGER

Several types of cold rivets and heading buttons used in making electrical apparatus were described by the writer in an article appearing in March MACHINERY, page 569. In the accompanying illustration is shown another type of button *A* which is being used in a certain plant for upsetting the ends of rivets of the type shown at *B*. It will be seen that the ends of the rivet, as well as the ends of the buttons are concave. In the writer's opinion, this represents poor practice as the heading operation will swell the rivet from end to end without forming a satisfactory head. The upsetting buttons shown were being used in a hydraulic press.



Example of Rivet-heading Buttons of Poor Design

EXPORTS OF MACHINE TOOLS AND METAL-WORKING MACHINERY FOR 1921

Country*	Lathes	Sharpening and Grinding Machines	Other Machine Tools	Total of Machine Tools	All Other Metal-working Machinery	Total of Machine Tools and Other Metal-working Machinery	Comparison with 1920 Exports: Machine Tools	Comparison with 1920 Exports: Other Metal-working Machinery	Comparison with 1920 Exports: Total of Mch Tools and Other Metal-working Machinery
Europe:									
Azores and Madeira Is.	......	$2,328	$481	$2,809	$4,063	$6,872	$6,077	$2,604	$8,681
Belgium	$236,996	37,652	125,003	399,651	262,476	662,127	1,195,942	724,230	1,920,172
Bulgaria	......	......	1,409	1,409	200	1,609	14,071	......	14,071
Denmark	3,040	2,474	21,013	26,527	5,244	31,771	167,782	66,709	234,491
Finland	4,539	1,486	4,243	10,268	10,372	20,640	40,683	22,423	63,106
France	556,265	127,140	715,879	1,399,284	2,645,077	4,044,361	3,839,113	3,756,620	7,595,733
Germany	116	13,352	33,819	47,287	71,222	118,509	73,630	70,562	144,192
Greece	10,470	625	30,717	41,812	8,742	50,554	32,620	22,752	55,372
Iceland and Faroe Is.	950	......	......	950	......	950	1,702	......	1,702
Italy	2,972	11,575	65,151	79,698	159,572	239,270	899,740	589,078	1,488,818
Jugoslavia, Albania, etc.	......	124	......	124	......	124	......	......	......
Netherlands	35,544	8,594	69,455	113,593	40,368	153,961	273,967	87,057	361,024
Norway	2,614	3,436	17,743	23,793	5,659	29,452	112,794	45,406	158,200
Poland and Danzig	29,474	1,366	35,340	66,180	42,101	108,281	28,327	10,349	38,676
Portugal	921	636	6,521	8,078	5,942	14,020	47,758	16,328	64,086
Rumania	106,643	5,640	24,629	136,912	107,462	244,374	67,597	37,244	104,841
Russia in Europe	400	......	754	1,154	25	1,179	88,444	89,826	178,270
Spain	72,389	48,894	120,322	241,605	127,426	369,031	781,306	363,538	1,144,844
Sweden	12,853	6,993	42,193	62,039	47,767	109,806	316,485	130,302	446,787
Switzerland	2,091	738	3,484	6,313	12,576	18,889	202,543	55,392	257,935
Turkey in Europe	7,123	616	1,361	9,100	1,295	10,395	29,787	2,750	32,537
United Kingdom:									
England	134,630	165,472	703,305	1,003,407	1,541,986	2,545,393	6,096,086	4,664,871	10,760,957
Scotland	......	12,025	51,662	63,687	89,241	152,928	154,950	83,190	238,140
Ireland	516	2,562	2,261	5,339	56,858	62,197	25,482	110,988	136,470
North America:									
Bermuda	2,157	70	840	3,067	25	3,092	2,386	......	2,386
British Honduras	......	291	......	291	180	471	66	41	101
Canada	94,369	148,343	399,764	642,476	575,536	1,218,012	3,298,542	2,516,772	5,815,314
Central American States:									
Costa Rica	64	1,145	2,511	3,720	3,665	7,385	18,058	999	19,057
Guatemala	4,100	164	1,432	5,696	8,230	13,926	8,998	925	9,923
Honduras	14,346	1,239	9,303	24,888	2,653	27,541	19,199	11,299	30,498
Nicaragua	23,624	68	1,471	25,163	380	25,543	4,226	1,811	6,037
Panama	25,841	2,967	14,274	43,082	18,920	62,002	30,143	41,657	71,800
Salvador	1,734	445	1,605	3,784	1,724	5,508	3,522	272	3,794
Mexico	170,186	43,068	251,737	464,991	283,903	748,894	345,056	265,516	610,572
Miquelon, Langley, etc.	19	......	......	19	......	19	1,105	......	1,105
Newf'land and Labrador	60	91	2,348	2,499	5,380	7,879	10,646	3,100	13,746
West Indies:									
Barbados	498	......	256	754	421	1,175	689	99	788
Jamaica	3,778	267	1,371	5,416	955	6,371	13,871	10,703	24,574
Trinidad and Tobago	15,843	927	11,264	28,034	28,566	56,600	38,663	11,981	50,644
Other British Possessions	750	89	140	979	763	1,742	2,840	413	3,253
Cuba	209,870	23,879	150,919	384,668	191,015	575,683	941,883	276,986	1,218,869
Dominican Republic	30,439	195	6,923	37,557	17,375	54,932	31,087	18,016	49,103
Dutch West Indies	4,797	1,865	836	7,498	7,649	15,147	1,124	173	1,297
French West Indies	......	12	610	622	4,257	4,879	2,040	1,428	3,468
Haiti	118	110	924	1,152	240	1,392	4,481	......	4,481
Virgin Is. of U. S.	2,265	20	1,553	3,838	65	3,903	3,565	1,445	5,010
South America:									
Argentina	69,337	33,197	111,034	213,568	137,585	351,153	385,423	165,984	551,407
Bolivia	2,460	1,005	2,167	5,632	501	6,133	8,514	6,317	14,831
Brazil	246,106	70,084	165,568	481,758	244,470	726,228	306,282	148,902	455,184
Chile	46,826	16,548	59,192	122,566	132,202	254,768	129,018	314,361	443,379
Colombia	24,237	6,813	12,491	43,541	64,368	107,909	87,653	24,390	112,043
Ecuador	11,959	1,941	9,185	23,085	2,096	25,181	16,319	2,417	18,736
Guiana:									
British	......	122	96	218	113	331	5,094	1,368	6,462
Dutch	1,207	......	2,333	3,540	15,489	19,029	1,266	780	2,046
French	4,316	305	8,183	12,804	69	12,873	9,955	......	9,955
Peru	28,175	10,710	82,952	121,837	68,776	190,613	133,102	89,727	222,829
Uruguay	3,680	1,521	12,665	17,866	2,032	19,898	42,207	11,626	53,833
Venezuela	11,451	2,889	16,720	31,060	19,553	50,613	28,848	22,027	50,875
Asia:									
China	121,253	23,766	38,254	183,273	188,111	371,384	709,789	222,562	932,351
Kwangtung, Leased Territory	......	5,192	868	6,060	1,398	7,458	1,995	8,626	10,621
Chosen	......	3,869	127	3,996	451	4,447	7,723	4,680	12,403
East Indies:									
British India	84,975	33,059	307,780	425,814	996,370	1,422,184	719,778	654,290	1,374,068
Straits Settlements	1,649	2,691	16,306	20,646	7,148	27,794	48,929	4,491	53,420
Other British Possessions	......	......	1,310	1,310	......	1,310	6,280	10	6,290
Dutch	76,512	17,165	104,660	198,337	163,059	361,396	194,589	131,497	326,086
French Indo-China	......	......	276	276	200	476	2,777	205	2,982
Hejaz, Arabia, Mesopotamia	......	128	......	128	......	128	......	......	......
Hongkong	6,948	866	57,556	65,370	46,081	111,451	82,858	114,480	197,338
Japan	301,028	198,236	430,462	929,726	1,706,292	2,636,018	1,954,242	2,296,341	4,250,583
Palestine and Syria	49	......	352	401	......	401	......	......	......
Persia	......	......	2,070	2,070	2,355	4,425	......	......	......
Siam	336	1,772	1,781	3,889	3,301	7,190	1,771	729	2,500
Turkey in Asia	2,737	......	100	2,837	25	2,862	5,457	......	5,457
Oceania:									
Australia	83,410	68,884	167,284	319,578	171,399	490,977	667,094	218,396	885,490
New Zealand	19,571	29,334	37,995	86,900	32,795	119,695	164,155	34,106	198,261
Other British Possessions	......	1,672	197	1,869	......	1,869	55	12	67
French	......	......	477	477	724	1,201	820	4,060	4,880
Other Oceania	918	......	......	918	22	940	......	1,283	1,283
Philippines	29,880	15,728	39,323	84,931	101,727	186,658	164,782	86,649	251,431
Africa:									
Belgian Kongo	80	34	63	177	1,426	1,603	5,404	1,818	7,222
British Africa									
East	......	6,464	596	7,060	......	7,060	6,745	180	6,925
South	49,570	12,453	109,492	171,515	141,310	312,825	223,175	113,007	336,182
West	......	141	579	720	714	1,434	4,584	3,475	8,059
Canary Islands	......	......	......	......	328	328	1,079	......	1,079
Egypt	56	334	9,477	9,867	4,552	14,419	27,519	3,893	31,412
French Africa	......	559	574	1,133	1,124	2,257	5,767	3,982	9,749
Madagascar	......	......	17	17	......	17	1,025	1,025	2,050
Morocco	678	292	196	1,066	......	1,066	3,073	2,264	5,337
Portuguese Africa	33,097	837	27,032	60,966	13,173	74,139	15,080	7,212	22,292
Total:†	2,997,689	1,217,280	4,774,294	8,989,263	10,668,558	19,657,821	25,481,856	18,830,377	44,312,233

*There were no machine tools or metal-working machinery exported in 1921 to countries not listed.
†The 1920 totals include exports to a few of the smaller countries not listed in the table.

PERSONALS

P. R. Hoopes, formerly associated with the Automatic Machinery & Equipment Co., Philadelphia, Pa., is now connected with Lorenz & Lorenz, Hartford, Conn., as mechanical engineer.

W. C. Ames has been appointed district sales manager of the Sharon Pressed Steel Co. at 20 E. Jackson Blvd., Chicago, Ill., and Ralph E. Phillips has been appointed district sales manager at 66 Broadway, New York City.

W. H. Miller has been appointed supervisor of tools and gages of the inspection and testing department of the Westinghouse Electric & Mfg. Co. at East Pittsburg, Pa., and W. F. Ablauf has been appointed supervisor of mica and mica processes.

Leslie H. Taylor, formerly sales manager of the machine tool division of the Greenfield Tap & Die Corporation, Greenfield, Mass., has become sales manager of the Williams Tool Corporation, Erie, Pa., manufacturer of pipe and bolt threading machinery.

Fred Mathews, formerly vice-president of the Union Metal Products Co., has become general railway sales representative of the A. O. Smith Corporation, Milwaukee, Wis., manufacturer of pressed steel products. Mr. Mathews' offices are at 1306 Consumers Bldg., Chicago, Ill.

W. L. Garcia has become associated with the Fairbanks Co., 416 Broome St., New York City, in the engineering and power transmission department. He has had twenty-five years experience as a transmission engineer. The Fairbanks Co. is sales agent for the Lewellen variable-speed transmission.

R. P. Raymond, formerly chief draftsman for the Columbia Graphophone Co., Bridgeport, Conn., has been appointed superintendent of manufacture for the Columbia Graphophone Co., Ltd., of Toronto, Canada, and will have charge of the manufacture of complete grafonolas, including the cabinets, motors, and records.

H. A. Eaton, Indianapolis and Cincinnati representative of the Precision Grinding Wheel Co., Inc.,. Philadelphia, Pa., has been transferred to the Boston territory and will make his headquarters at the Davis Hardware Co. of Boston. J. O. Smith, previously at Boston, has been transferred to Mr. Eaton's former territory.

H. L. Jones, formerly assistant superintendent of the switchboard and detail department of the Westinghouse Electric and Mfg. Co., East Pittsburg, Pa., has been appointed superintendent of that department. A. J. Bastian, formerly assistant superintendent of the insulating department, has been made superintendent of that department.

W. C. Peterson, formerly metallurgical engineer for the Atlas Crucible Steel Co., has been made manager of the alloy steel division of the Electric Alloy Steel Co., Youngstown, Ohio. Prior to his association with the Atlas Crucible Steel Co., Mr. Peterson was connected for twelve years with the Packard Motor Car Co., having charge of the metallurgical laboratories and heat-treating departments.

George K. Atkinson was elected president and general manager of the Langhaar Ball Bearing Co., Aurora, Ind., at a recent meeting of the board of directors. Mr. Atkinson was formerly connected with the Modern Machine Tool Co. of Cincinnati, and recently was eastern sales manager for the Manufacturers' Equipment Co. of Chicago. L. Langhaar was elected vice-president and will also act as sales manager.

F. G. Davis, for three years representative of the Atlas Crucible Steel Co. in the Detroit district has become district manager of sales in Detroit for the Electric Alloy Steel Co., Youngstown, Ohio. Mr. Davis will occupy a temporary office in Room 1716, Ford Bldg. The company is installing a complete warehouse stock in Detroit, and the district offices will be moved to the new warehouse as soon as arrangements are completed.

Harrison P. Reed, for many years electrical engineer and more recently head of the elevator department of the Cutler-Hammer Mfg. Co., of Milwaukee and New York, has been appointed general manager of the A. Kieckhefer Elevator Co., Milwaukee, Wis. Mr. Reed is a graduate of the Electrical Engineering Department of Cornell University, and is a member of the American Institute of Electrical Engineers and the Engineers' Society of Milwaukee.

Edward Blake, Jr., vice-president of the Greenfield Tap & Die Corporation, Greenfield, Mass., who has been general manager of the company's drill plant at Taunton, has been appointed vice-president in charge of sales and will make his headquarters in Greenfield. Mr. Blake was connected with the Wells Bros. Co. for several years, and eleven years ago became vice-president and general manager of the Lincoln Twist Drill Co. at Taunton, which was sold in July, 1920, to the Greenfield Tap & Die Corporation.

William Ochse, for the last two years sales representative of Manning, Maxwell & Moore, Inc., at Chicago, has become efficiency engineer of the Ohio Machine Tool Co., Kenton, Ohio, manufacturer of shapers and planers. Before joining the sales organization of Manning, Maxwell & Moore, Mr. Ochse was connected for twenty years with Gould & Eberhardt, Newark, N. J., manufacturers of shapers and automatic gear and rack cutting machinery, latterly having charge of their planning and tool design department.

William L. Colt, for nearly five years division manager of Willys-Overland Inc., in the eastern district, with headquarters in New York, has resigned to become president of the Overland Providence Co. Carl P. Spiegelberg, who organized the Overland Providence Co. under the supervision of Mr. Colt, will continue to operate the business as vice-president and general manager. Mr. Colt is well-known in the automobile business. Prior to his association with Willys-Overland, Inc., he was president, for eight years, of the Colt-Stratton Co., distributor of Dodge automobiles in the New York district.

G. F. Sherratt has been appointed manager of the Pittsburg office of the Chain Belt Co., Milwaukee, Wis., which is located in the Union Arcade Bldg. Mr. Sherratt will have charge of all the company's chain and engineering business in the Pittsburg territory, and will render engineering service on power transmitting and material handling problems. The Pittsburg office will handle a complete line of "Rex" chain and material-handling equipment. The Ward Equipment Co., of Pittsburg, will continue to handle the complete line of "Rex" concrete mixers and pavers, and the United Equipment Co. will handle "Rex" traveling water screens.

C. E. Skinner, manager of the research department of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., has been appointed assistant director of engineering of the company. His duties will cover research standards and other work along these lines, and he will be located in the main offices of the company. Mr. Skinner is known throughout the electric world for his extensive research work, especially on insulation, and his efforts in that direction have had a marked effect on the development of electrical machine design. S. M. Kintner, who is well known for his research and engineering work in the development of radio apparatus, will succeed Mr. Skinner as manager of the research department.

Ralph Barstow, general sales manager of the Greenfield Tap & Die Corporation, Greenfield, Mass., has resigned to go into business for himself as merchandising counselor, in association with Marquis Regan, Inc., at 21 E. 40th St., New York City. The business is not that of advertising, but has to do with sales direction and plans for selling merchandise. Mr. Barstow went to Greenfield in July, 1919, after nine months' service as director of the department of selling and advertising in the American Expeditionary Forces University at Beaune, France. For two years he has been an instructor in sales methods for the State University Extension, which previously adopted a course in sales and advertising of which he is the author.

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OBITUARIES

Edward P. Maguire, general manager of the Lapointe Machine Tool Co., Hudson, Mass., died March 28 in St. Vincent's Hospital in Hudson. Mr. Maguire was born in Sharon, Mass., in 1889. He came to Hudson about fifteen years ago and entered the employ of the Lapointe Machine Tool Co. as bookkeeper. When the company was reorganized in 1914 he was made general manager of the plant, and held that position until the time of his death. He is survived by his wife and two children. Mr. Maguire was regarded with esteem and respect by all those who knew him.

Peter Lowe, assistant secretary of the Kempsmith Mfg. Co., Milwaukee, Wis., died in Garrett, Ind., on April 13, aged forty-five years. He was born in Adrian, Mich., in 1877, and started his career as a city reporter for a daily newspaper. Later he was employed as chief bookkeeper and teller in a savings bank, and after six years connection with the bank he started to learn the machinist trade with the ultimate object of becoming a machine tool salesman. As a mechanic he was employed by the Port Huron Engine & Thresher Co., the Gisholt Machine Co., and the Nordyke & Marmon Co. While he was working he took a correspondence course in mechanics, and later took up industrial accounting. He entered the employ of the Kempsmith Mfg. Co. in 1906, taking charge of the cost department. During the time that he was in charge of this department he devised many new methods of recording machine shop costs and making time studies. He also had charge of the finished stock, thus gaining a knowledge of the customers' requirements. In 1911 Mr. Lowe entered the sales department, and was a stockholder and assistant secretary at the time of his death. He had retired from active association with the sales department some time previous to his death on account of ill health.

COMING EVENTS

May 8-10—Annual convention of the National Supply and Machinery Dealers' Association in Atlantic City, N. J.; headquarters, Marlborough-Blenheim Hotel. Secretary, Thomas A. Fernley, 505 Arch St., Philadelphia, Pa.

May 8-10—Twenty-seventh annual convention of the National Association of Manufacturers in New York City; headquarters, Waldorf-Astoria Hotel. General offices of the association, 50 Church St., New York City.

May 8-11—Spring meeting of the American Society of Mechanical Engineers in Atlanta, Ga., Assistant Secretary (Meetings), C. E. Davies, 29 W. 39th St., New York City.

May 9—Meeting of the Society of Industrial Engineers in Chicago, Ill. Business Manager, George C. Dent, 327 S. La Salle St., Chicago.

May 10-12—Ninth National Foreign Trade Convention in Philadelphia, Pa. Secretary, O. K. Davis, 1 Hanover Square, New York City.

May 15-20—Seventh annual convention and exhibition of the National Association of Purchasing Agents in Rochester, N. Y. For further information, address S. M. Crosland, care of the Todd Protectograph Co., 1050 University Ave., Rochester, N. Y.

May 18-20—Annual conference of the National Association of Office Managers in Washington, D. C. Secretary, F. L. Rowland, Gilbert & Barker Mfg. Co., Springfield, Mass. Guests are invited to attend.

June 5-9—Annual convention and exhibit of the American Foundrymen's Association and allied societies in Rochester, N. Y. Secretary C. E. Hoyt, Marquette Bldg., 140 S. Dearborn St., Chicago, Ill.

June 14-21—Annual meeting of the Mechanical Division of the American Railway Association in Atlantic City, N. J. Secretary V. R. Hawthorne, 431 S. Dearborn St., Chicago, Ill.

June 15-24—International exhibition of foundry equipment and materials in Birmingham, England, in connection with the annual convention of the Institution of British Foundrymen.

June 20-24—Summer meeting of the Society of Automotive Engineers at White Sulphur Springs, W. Va. Chairman of Meetings Committee, C. F. Scott, 29 W. 39th St., New York City.

June 26-July 1—Twenty-fifth annual meeting of the American Society for Testing Materials in Atlantic City, N. J.; headquarters, Chalfonte-Haddon Hall Hotel. Secretary, C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

August 28-September 2—Annual Safety Congress of the National Safety Council in Detroit, Mich. Secretary, S. J. Williams, 168 N. Michigan Ave., Chicago, Ill.

December 7-13—National Exposition of Power and Mechanical Engineering at the Grand Central Palace, New York City. Charles F. Roth, manager, Grand Central Palace, 46th St. and Lexington Ave., New York.

The sectional meetings of the American Society of Mechanical Engineers for the month of May are as follows: May 2—Cleveland Section at the Cleveland Engineering Society Rooms in Hotel Winton, Cleveland, Ohio; May 3—Buffalo Section at Buffalo, N. Y.; May 4-5—Mid-continent section, in joint meeting with other national engineering sections and chapters, at Tulsa, Okla. May 5-6—Virginia section at Charlottesville, Va.

NEW BOOKS AND PAMPHLETS

Engineers' License Laws. 136 pages, 6 by 9 inches. Compiled by the American Association of Engineers, 63 E. Adams St., Chicago, Ill. Price, 50 cents.

This is a compilation of exact copies of the license laws for professional engineers in various states, and it contains sixteen laws now in force in the United States. It has been prepared and published as a service to the profession, for the use of engineers who desire to practice engineering in more than one state, and also for the assistance of those engaged in the preparation of a law in states where engineers are not registered.

The Public Refuses to Pay. By F. Lauriston Bullard. 89 pages, 5 by 8 inches. Published by the Marshall Jones Co., 212 Summer St., Boston, Mass. Price, 50 cents.

This book contains a reprint of editorials appearing in the Boston Herald on the railroad and building situation. It points out how the public pays the cost of excessive building construction, and how the regulations made by the unions have hampered efficient work in railway shops and affected the public welfare. The book is not issued as propaganda in behalf of any cause, the purpose being merely to render a public service by showing how the public suffers from regulations that restrict production and decrease efficiency.

Handbook on Controllers for Electric Motors. 29 pages, 4 by 6¾ inches. Published by the Electric Power Club, 1017 Olive St., St. Louis, Mo. Price, 25 cents.

This pamphlet contains a simple description of controllers for electric motors, and definitions for the various terms applied in that connection. Words which do not appear in the regular dictionaries are explained in simple language, and the meaning of terms with which all users of electrical apparatus should be familiar is given. In addition, information relative to the use of electric controllers is included. Copies may be obtained from the leading manufacturers of electric power and control apparatus or from the secretary of the Electric Power Club, S. N. Clarkson.

Pulling Together. By John T. Broderick. 141 pages, 5 by 7½ inches. Published by Robson & Adee, Schenectady, N. Y. Price, $1, net.

This book deals with the live subject of human relations in industry. It is dedicated to "employers and employes alike, who help each other and the public to see a soul in industry." The introduction, written by the noted scientist, Dr. Charles P. Steinmetz, gives a brief analysis of present industrial conditions, and points out that thinking people in all walks of life are forced to realize more and more that something must be done to bring about better industrial relations. "The great problem before the industrial world today," says Dr. Steinmetz, "is the problem of conciliation and cooperation." This book tells, in a readable way, how a large corporation tried out the plan of employe representation, with highly satisfactory results.

Cooperative Competition. 56 pages, 8½ by 11 inches. Published by the New York Evening Post, 20 Vesey St., New York City. Price, 25 cents.

The subject treated in this pamphlet is of particular interest at this time in view of the wide discussion of trade associations in the technical and general press, and the recent conference of trade association representatives and editors of the technical press with Secretary Hoover. The pamphlet contains twenty-five articles which have appeared daily in the New York Evening Post, outlining the ideas of business men, lawyers, economists, and government officials concerning the proper and legitimate field of the trade association. The introductory article is by Herbert Hoover. The articles point out the field of usefulness of trade associations, and the pitfalls they must avoid. The purpose of the Post, in publishing these articles, is to support the legitimate activities of trade associations, and to bring before the public more prominently the benefits to be derived by such organizations.

The Design and Construction of Oil Engines. By A. H. Goldingham. 480 pages, 5 by 7½ inches. Published by Spon & Chamberlain, 120 Liberty St., New York City. Price, $4.

The remarkable progress in the oil engine industry during recent years has made necessary a new revised and enlarged edition of this book on the construction of oil engines. The new edition has been brought up to date by the addition of 140 pages of new matter and 72 illustrations. Because of the quantity of material added, the book has been divided into two parts, the first of which deals with modern high-compression two-cycle and four-cycle engines, and the second with historical and earlier types of low-compression oil engines. The descriptions of the older engines have been retained, as this information is of great value where such engines are still in service and is also useful for purposes of comparison. The book contains full directions for testing, installing, operating, and repairing oil engines, and describes different American and European types. It is illustrated with many diagrams, which serve to simplify and clarify the descriptive parts of the text.

Crain's Market Data Book and Directory of Class, Trade, and Technical Publications. 456 pages, 6 by 9 inches. Published by G. D. Crain, Jr., 537 S. Dearborn St., Chicago, Ill. Price, $5.

The 1922 edition of this directory has been completely revised, and new industrial and merchandising data, as well as new lists of publications have been included. All of the most recent government census figures are included in the marketing surveys, and figures on the cost of doing business and turnover are given for all retail merchandising fields. In addition to the list of American publications, a complete list of foreign trade and technical papers is given, which should be especially serviceable to those interested in advertising work abroad. The arrangement is the same as in the previous edition. The basic idea of the book is to present statistical and marketing data regarding each industry, trade, or profession and to give a list of publications serving each field, for the benefit of the advertiser or merchandiser. The publication data includes the principal items which advertisers desire to know about mediums, namely, field covered, publication date, closing date, size of type page, maximum and minimum page rates, circulation, etc. Both the markets and the publications are indexed.

Success through Vocational Guidance. By James McKinney and A. M. Simons. 270 pages, 5½ by 8¼ inches. Published by the American Technical Society, Chicago, Ill. Price, $2.

Occupational analysis has received considerable attention in the industrial world in the last few years, and a book on this subject will doubtless be of interest at the present time. The book under discussion is intended to assist people who are starting out on a business career or those who are dissatisfied with their occupations to choose a life work for which they are fitted and which they will find congenial. It outlines, in a general way, the qualifications necessary and the education and training required for different branches of work, and gives an idea of the opportunities offered (or the remuneration received). The lines of work covered include professions, engineering, commerce, accounting, advertising, manufacturing, banking, transportation, building trades, hotel and restaurant keeping, mining, forestry, civil service, social service, and agriculture.

NEW CATALOGUES AND CIRCULARS

A. M. Byers Co., Pittsburg, Pa. Pamphlet entitled "Concerning Pipe. By a Piper," containing information on Byers' wrought-iron pipe.

Columbia Mfg. Co., Belleville, Ill. Supplement A to Grinder Book No. 26, giving list prices of the electric buffers and grinders made by this concern.

New Departure Mfg. Co., Bristol, Conn. Loose-leaf circulars 145 and 146 FE, illustrating installations of New Departure ball bearings in motor-driven wood saws and wood shaper spindles.

Northern Engineering Works, 210 Chene St., Detroit, Mich. Crane and hoist booklet No. 24 G, illustrating installations of Northern electric travelling cranes, gantries, and electric hoists.

Templeton, Kenly & Co., Ltd., 1020 S. Central Ave., Chicago, Ill. Catalogue of "Simplex" jacks, giving data covering the capacity, dimensions, and prices of the different types and sizes.

Climax Motor Devices Co., Chagrin Falls, Ohio. Circular descriptive of the "Climax" cord disk coupling, which is made in four sizes of 5½, 6½, 7½ and 9 inches diameter, for transmitting any desired power load.

Mercury Mfg. Co., 4118 S. Halsted St., Chicago, Ill. Circular showing illustrations of a "trackless train" installation made by this company in Japan. The installation consists of four Mercury Type L-4 tractors and several Mercury Type A-132 warehouse trailers.

Twentieth Century Brass Works, Belleville, Ill. Circular giving specifications for the line of ice-cooled bubbling fountains made by this concern, which are applicable for use in factories, shops, offices, schools, stores, theaters, and other buildings.

Engineering School of Drawing, 457 Main St., Springfield, Mass. Circular outlining the features of the engineering service offered by this school, which includes the making of tracings, detailing, designing, and the developing of inventions.

Sprague Electric Works of General Electric Co., 527 W. 34th St., New York City. Bulletin 67900, descriptive of Sprague narrow-unit panelboards of the safety type, which have been designed to meet the demand for a safety type panel at a moderate price.

Cleveland Punch & Shear Works Co., Cleveland, Ohio. Instruction sheet containing information on the proper care of punches and dies, which is intended to be posted where operators using this class of tools may readily refer to it.

Turbine Air Tool Co., 710 Huron Road, Cleveland, Ohio. Pamphlet entitled "Face the Issue," illustrating and describing a number of production tools, including portable turbine drills and grinders. The weight, capacity, and speed are given for the different sizes.

Chase Metal Works, Waterbury, Conn. Circular entitled "Why Brass Pipe?—Doesn't it Cost More?" containing tables showing weight per lineal foot of seamless brass and copper tubing in plumbers' sizes and iron pipe sizes. The base prices are given for the different sizes.

Chapin-Skelton Corporation, 406 Ash St., Syracuse, N. Y. Catalogue containing tables of dimensions and prices, as well as general descriptive material, covering the line of tools made by this concern, which includes reamers, boring-bars, lathe arbors, counterbores, production tools and special machines.

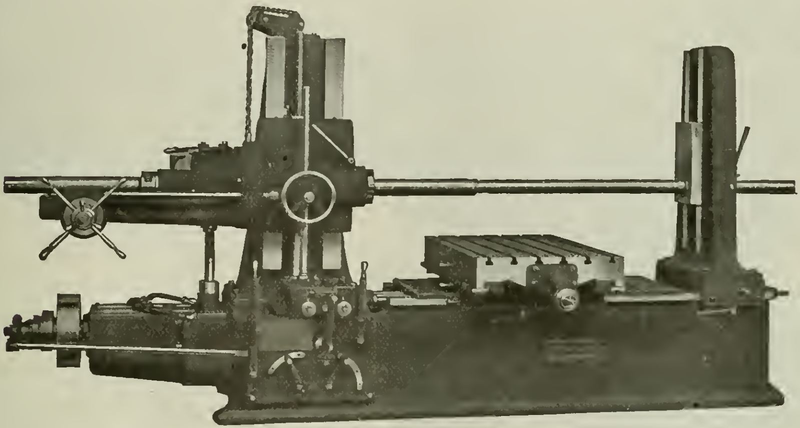
Reynolds Engineering Co., 101 Third Ave., Moline, Ill. Circular illustrating the use of the "Ever-Ready" connecting-rod aligning gage. The advantages of this gage are pointed out, and operating instructions are given. The Blood-Davies Co., 122 S. Michigan Ave., Chicago, Ill., is selling agent for this gage.

Necessity Wrench Shop, 415 Barclay Block, Denver, Col. Pamphlet descriptive of a drop-forged steel wrench, known as the "Necessity" wrench, which is designed for use in places where a double-end tap wrench cannot be employed. Price lists are given for the two different sizes in which this wrench is made.

Monitor Controller Co., Baltimore, Md. Bulletin 102, containing "Thermaload" starter instructions. Directions are given for the installation and care of these starters, and methods of locating and remedying trouble are described. A table of ampere rating of thermal elements to be used with induction motors is included.

It is sometimes astonishing to discover the obvious. One of our customers was astonished to discover that the job he had always been obliged to send to one of his neighbors who had an open side planer, could easily be done on his new

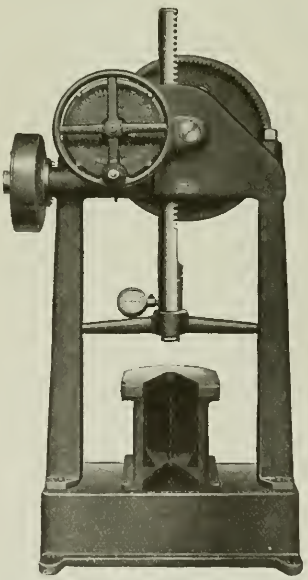
"Precision" BORING, DRILLING & Milling Machine



There is no more "power" in a Press (or other machine) than is put into it. If the power is put in by hand, it is only one man power. In the

LUCAS Power Forcing Press

the power is put in by belt or motor, but it has all the sensitiveness and delicacy of control of the best hand press, with the necessary power for heavy work.



LUCAS MACHINE TOOL CO. NOW AND ALWAYS OF **CLEVELAND, OHIO, U.S.A.**

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry. Societe Anonyme Belge, Alfred Herbert, Brussels. Aux Forges de Vulcain, Paris. Allied Machinery Company, Turin, Barcelona, Zurich. Benson Brothers, Sydney, Melbourne. V. Lowener, Copenhagen, Christiania, Stockholm. R. S. Stokvis & Zonen, Rotterdam. Andrews & George Company, Tokyo, Japan.

Golden Co., 405 Lexington Ave., New York City, has issued two bulletins in French, containing a description of RBF ball and roller bearings, and data on the application of these bearings to electrical machinery, hoisting machinery, cranes, etc. The calculation of loads is given, as well as numerous illustrations of bearing applications.

Fairbanks Co., 416 Broome St., New York City. Bulletins illustrating and describing the Lewellen variable-speed transmission, which is made in two types—the self-oiling design and the ball-bearing design. This transmission is made in sizes of from 1 to 150 horsepower, and the sizes carried in stock range from 1 to 25 horsepower, inclusive.

W. S. Rockwell Co., 50 Church St., New York City. Bulletin 241, on forging and heating furnaces, pointing out fundamental principles affecting the quality and cost of forgings, and other formed parts. Illustrations of typical equipment are shown, and descriptions are given of the heating and handling methods employed to meet a wide variety of manufacturing conditions.

Lovejoy Tool Works, 331 W. Ohio St., Chicago, Ill. Catalogue 10, illustrating and giving specifications for the line of tools and machinery made by this company for railways, boiler makers, and steel workers. These tools include ratchet drills, drilling posts, screw punches, ratchet wrenches, "Use-Em-Up" drill sockets, roller expanders, flue cutters, pneumatic hammers, ball-bearing jacks, etc.

Kurtz Equipment Co., 57 Houston St., New York City. Circular 294 of "Hallowell" steel lift truck platforms, which are made with steel runners that flare outward at both ends, so that the truck can slide in between skids without damaging them. Booklet R, outlining the features of construction of "Bond" anti-friction swivel truck casters, which operate in ball bearings to insure easy operation under heavy loads.

Ideal Electric & Mfg. Co., Mansfield, Ohio. Bulletins 102 and 103, containing specifications and illustrations of Ideal direct-current motors and generators, and Ideal squirrel-cage and slip-ring induction motors. The bulletins give ratings and speeds for the different sizes and types of motors included in the standard line, as well as other detailed information relative to the construction and application. Copies will be sent to those interested, upon request.

South Bend Lathe Works, 460 E. Madison St., South Bend, Ind. Circular showing South Bend lathes in use on a variety of operations, including grinding, drilling, turning, boring, threading, and milling. The illustrations give a clear idea of the wide range of work for which these machines are adapted. The circular also illustrates some of the different sizes of South Bend quick-change gear lathes, bench lathes, silent chain motor-driven lathes, and gap lathes.

Uehling Instrument Co., Paterson, N. J. Bulletin 112, containing information relative to Uehling carbon dioxide equipment, which is intended to guide the engineer and fireman in reducing fuel waste. The pamphlet points out the advantages of this equipment, outlines the principles of operation and describes the different units. Particular attention is called to the "Pyro-porus" filter which is a recently developed product designed to keep the gas sampling lines clean.

Kingsbury Machine Works, 4320 Tackawanna St., Frankford, Philadelphia, Pa. Catalogue C, treating of Kingsbury thrust bearings. The book contains data on dimensions, principle of operation, lubrication and cooling, unit pressures, friction losses and wear, results of tests, power loss determinations, and standardization of power losses. The different types of thrust bearings produced by this company are illustrated and described and instructions are given for installing and operating them.

Page Steel & Wire Co., Bridgeport, Conn. Catalogue 560, containing information on Page-Armco welding rods and electrodes for oxy-acetylene and electric welding. A list of the fields in which these products are especially applicable is given, and examples of welding operations are shown. Considerable welding data of general interest are included, as for example, diameter of rods used on various thicknesses of metals to be welded, American Welding Society specifications for electrodes, table of deposited metal for a given thickness of plate, electrical units, etc.

F. J. Littell Machine Co., 4125 Ravenswood Ave., Chicago, Ill. Catalogue covering this company's line of automatic feeds for all makes and sizes of punch presses, including automatic roll feeds, dial feeds, and special feeds. Attention is called to the advantages of automatic feeds, namely increased production and safety. The pamphlet also illustrates a line of special machinery made by this concern, which includes automatic straightening and cutting-off machines, wheel-truing tables, winding heads, and crank-shaft and camshaft straightener and tester. Copies will be sent to those interested, upon request.

Jacobs Mfg. Co., Hartford, Conn., has published a reference work known as the "Spindle Book," which is intended for free distribution, particularly among dealers in machine tools and supplies. The book contains spindle specifications of various types of machine tools using either taper-shank drills, taps, or drill chucks. The types of machines included comprise centering machines, drill grinders, flexible shafts, portable electric drills and portable pneumatic drills, tap grinders, tapping machines, drilling machines, bench lathes, and other lathes. The names and addresses of the manufacturers of the various machines and the spindle specifications are given in each case, and an alphabetical list of the manufacturers is given in the back of the book. A chart of arbor holes of Jacobs drill chucks is also included.

Niles-Bement-Pond Co., 111 Broadway, New York City, is issuing a series of pamphlets called the "Progress Reporter," recent numbers of which are especially devoted to railroad requirements. Pamphlet No. 29 deals with roundhouse repair facilities, and contains lists of machine tools required in roundhouse repair shops and terminal dispatching shops. A large number of illustrations of Niles-Bement-Pond machines adapted for this class of service are included. Progress Reporter No. 30 is devoted to modern railroad foundries, and smith and hammer shops. Tables containing lists of machines required in smith and hammer shops and in foundries are given, as well as diagrams showing lay-outs of machine and foundry equipment. This book also contains illustrations of Niles-Bement-Pond foundry and hammer shop equipment.

TRADE NOTES

Whiting Corporation, Harvey, Ill., has moved its Chicago sales office from 1245 Marquette Bldg. to 945 Monadnock Bldg.

Langhaar Ball Bearing Co., Aurora, Ind., is beginning the construction of a new factory, 40 by 150 feet, in Aurora.

Hess-Schenck Co., Cleveland, Ohio, dealer in new and used machinery is now occupying the first floor and basement of its remodeled building at 801 St. Clair Ave.

Monarch Machine Tool Co., 209 Oak St., Sidney, Ohio, is considering installing a sprinkler system in its factory and would like to get in touch with firms making such equipment.

Ready Tool Co., 650 Railroad Ave., Bridgeport, Conn., has discontinued its association with the Mayhew Steel Products, Inc., by mutual agreement, and hereafter will handle all sales of the company direct from Bridgeport.

Electric Furnace Co. has moved its general and sales offices from Alliance to Salem, Ohio. By this change all departments of the company will be consolidated at its works at Wilson St. and Pennsylvania Railroad in Salem.

Simmons Machine Co., Inc., Albany, N. Y., manufacturer and dealer in machinery and tools, has opened a machine tool warehouse at 182 Lafayette St., New York City. All the machines displayed in this warehouse will be tools that have been rebuilt in the Albany plant.

Knauel Tool Works have moved from 1544 24½ St. to 210 Fifth Ave., Rock Island, Ill., where they will continue to manufacture calipers and to develop special machinery and tools for inventors. The new quarters will afford the company about four times the previous shop space.

Tool Equipment Sales Co. is a new sales organization formed by Jesse B. Alton and C. B. Cole in Chicago, Ill., at 18 S. Clinton St. The concern will carry complete stocks for the Alvord Reamer & Tool Co., of Millersburg, Pa., and the Standard Saw & Tool Mfg. Co., Inc., of Boston, Mass.

Gits Bros. Mfg. Co., 1940 S. Kilbourn Ave., Chicago, Ill., manufacturer of the Gits oil-cups for machine tools and all kinds of machinery, has just completed an addition to its factory, of 50 by 75 feet, and reports business in its line to be good. This company is bringing out a one-piece oil-cup.

Meldrum-Gabrielson Corporation, Syracuse, N. Y., has constructed a large new factory at West Fayette and Niagara Sts. The factory is completely equipped with machinery for the manufacture of milling machines, adjustable-limit snap gages, and wood and metal patterns. The firm also has facilities for handling contract work.

Ludlum Steel Co. Watervliet, N. Y., announces that the suit brought by the American Stainless Steel Co. of Pittsburg, Pa., alleging infringement by the Ludlum Steel Co. of the Brearley and Haynes stainless steel patents has been dismissed by the United States District Court at New York on the ground that no infringement was shown.

Sandvik Steel, Inc., has consolidated its general steel and steel belt conveyor departments, both of these departments now being located in the Woolworth Bldg., Suite 2001, 230 Broadway, New York City. The officers of the company are as follows: President and general manager, W. D. Thomas; vice-president, Anders Johnson; secretary, Garrick M. Spencer; and sales manager, Harry Carlson.

William K. Stamets, dealer in machine tools, has moved the Cleveland office of the concern to 971-976 Kirby Building. Agency arrangements have recently been concluded with a group of Hartford manufacturers, including Billings & Spencer Co., Hanson-Whitney Machine Co., Hartford Tap & Gauge Co., Taylor & Fenn Co., and the Whitney Mfg. Co. George D. Miller is manager of the Cleveland office.

Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., was recently awarded a contract for the electrical equipment of a hot strip mill which is to be installed in the plant of the West Leechburg Steel Co., of Leechburg, Pa. The contract includes direct and alternating-current motors, motor-generator sets and control equipment.

Abrasive Co. of Canada, Ltd., Hamilton, Ont., Canada, manufacturer of artificial abrasives, at its annual meeting of stockholders in Philadelphia, Pa., in March re-elected the directors and the following officers: Frederick S. Dickson, chairman of the board of directors; Louis T. Byers, president; J. Harvey Byers, vice-president and general manager; Lawrence J. Morris, vice-president; and Samuel P. Byers, secretary and treasurer.

Driver-Harris Co., Harrison, N. J., has moved the Chicago branch of the company to larger quarters at 562-574 W. Randolph St. For some time the Chicago facilities have been inadequate, and it is believed that with the larger quarters the office will be able to give better all-around service to the various industries using "Nichrome" products.

Ogden R. Adams, Rochester, N. Y. will hold the third annual machinery demonstration given by the concern, at the Adams plant on Central Ave. and St. Paul St., June 2 and 3. This year two days will be given to the demonstration, which will be on a larger and more diversified scale than heretofore. Manufacturers and their technical experts from various parts of the country will be present to demonstrate their products. Other unusual and interesting features will be presented to make the two days helpful and entertaining to all who attend.

Rockford Milling Machine Co., Rockford, Ill., announces that the Mid-West Machinery Exchange, of Kansas City, Mo., will handle the complete line of Sundstrand lathes manufactured by the Rockford Tool Co., in the Kansas City territory. The English Tool & Supply Co., of Kansas City, will handle the cone-drive milling machines manufactured by the Rockford Milling Machine Co., and the Peden Iron & Steel Co., of Houston, Texas, will handle Rockford milling machines in the state of Texas. The Greensboro Supply Co., of Greensboro, N. C., has been appointed exclusive agent for Rockford milling machines in North and South Carolina.

Mexican Chamber of Commerce of the United States has been incorporated under the laws of the state of New York, with headquarters in the Woolworth Bldg., New York City. The object of the Chamber will be to promote business and economic relations between Mexico and the United States; to spread general information of reciprocal interest, and to foster friendly feeling. The directorate is composed equally of citizens of both countries who will furnish members with accurate information and assistance in the development of actual business. Offices of the Chamber have also been established in Mexico at 45 Bolivar St., Mexico City.

Rivett Lathe & Grinder Co., Boston, Mass., announces that although the extraordinary business conditions have made it necessary for a receiver to be appointed for the company in order to protect the creditors, safeguard the assets and maintain uninterrupted operation of the plant, the receivership will be of a temporary nature. A financial reorganization plan is being worked out to provide sufficient working capital. Although the company, like many other machine tool builders, lacks working capital, it is not insolvent, as the assets are nearly three times the liabilities, according to actual appraisal. The plant will continue in operation on an increased schedule during the receivership, and the company is in a position to accept and ship orders and to contract for new business.

Air Reduction Sales Co., 342 Madison Ave., New York City, has given out further details concerning the activities of this company and the Davis-Bournonville Co., the amalgamation of which was mentioned in the Trade Notes column of April MACHINERY. The Air Reduction Sales Co. owns and operates nineteen oxygen plants in industrial centers of the country, as well as a large number of plants manufacturing acetylene and other gases, and welding and cutting equipment; in addition, extensive laboratories are maintained for carrying on research work in connection with its various activities. The Davis-Bournonville Co. was organized in 1907 by Augustine Davis, Eugene Bournonville, and C. B. Wortham. At this time Mr. Davis and Mr. Bournonville acquired the rights in the United States and Canada for the Gauthier-Ely oxy-acetylene torch. From that time on, the efforts of the company were directed toward the development and improvement of the original positive-pressure torch. Later its line was extended to include oxy-acetylene cutting torches and acetylene generators, and finally a line of machines for welding and cutting was added. It is the intention of the Air Reduction Sales Co. to continue the manufacture of the Davis-Bournonville products under the supervision of the men who developed these apparatuses. The equipment will be marketed under the trade name of Airco-Davis-Bournonville.

Reclaiming a Railroad Scrap Pile

How the Canadian Pacific Railroad Turns its Scrap Pile into a Source of Revenue

By EDWARD K. HAMMOND

IN the operation of an extensive railroad system a vast quantity of scrap material inevitably accumulates. The small quantities which accumulate at various points along the system may not appear to have any great value; but if this waste material is systematically collected and salvaged to the best advantage, the total saving is likely to prove higher than even the best informed men would think possible.

The way in which the Canadian Pacific Railway Co. gathers up scrap in that zone of its system served by the Angus Shops, and sends it to be reclaimed at these shops in Montreal will give an idea of the value of material which can be recovered from a railroad scrap pile. The magnitude of this work will be realized when it is known that at the time the writer visited the plant, there were approximately 7000 tons of scrap piled on the storage space adjacent to the reclaiming dock. This material is shipped to Montreal in freight cars, into which it is dumped without any attempt to sort it at the source.

Upon arrival, the contents of these cars are dumped on the storage grounds, and day laborers are set to work picking over the piles and sorting the material. A preliminary sub-division will result in the piling together of car couplings, brake beam heads, journal boxes, and various other parts which it may be possible to reclaim. Likewise, scrap rubber, broken glass, and other material of the same general nature, are sorted out and later prepared for sale as junk. As an example, armored steam hose is slit in order that the wire may be removed; then rubber and canvas is sold in that form. Scrap glass is packed into barrels for shipment, and in order to make paper more convenient to handle, it is compressed into bales of convenient size for handling. Fig. 1 shows a partial view of the storage space in which usable material is stored, after the contents of the junk cars have been sorted. The slitting of armored rubber steam hose is shown in Fig. 2.

Salvaging Bolts and Nuts Reclaiming Steel Castings

A wide diversity of work is done in the reclaiming department. Many parts can be reclaimed or repaired, so that they can be used again. For instance, if bolts are in fairly good condition, it may be possible to simply rethread the end to adapt them for additional use, but if the bolt is badly bent or the thread is too far gone to lend itself to recutting, the end is sheared off and an entirely new thread is cut, thus making a bolt of shorter length. Similarly, old nuts are sorted for size and retapped to put them in condition for continued use. A special machine is provided for removing broken bolts from nuts. The work of reclaiming nuts is illustrated in Fig. 3.

Many of the malleable and steel castings that are returned to the scrap dock can be made fit for additional service. These castings are frequently cracked, and in such cases the defect is repaired by welding. In other cases the trouble may be due to bending, which is a defect quite often found in the shanks of car couplings. For correcting trouble of this kind, the shop of the reclaiming dock is equipped with several types of hydraulic and pneumatic presses which enable bent pieces to be straightened out in a comparatively short time. One

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Economy of operation is the great need of the railroad shop, as well as of all branches of industry, at the present time. Every source of waste must be eliminated—every leak must be stopped—if the great railway systems are to be brought back to a paying basis. One of the leaks in railroad operation is the scrap pile. Vast quantities of scrap metal and other waste material accumulate on an extensive railway system, and the transforming of this scrap into useful articles is one of the problems of efficient management. The reclaiming of the scrap pile requires a carefully thought out plan. How this is accomplished on a large Canadian railway system is told in this article.

Fig. 1. Partial View of Storage Space in which Usable Materials are kept in Bins carrying their Part Numbers

of these presses is shown in Fig. 4, engaged in straightening the shank of a car coupling.

How Sheet Steel is Utilized

There are various forms in which sheet steel comes to the reclaiming dock; old shovels of various types are received, sheets of steel that have been scrapped after doing service in various ways, old wheelbarrow trays, etc. When the sheets are large, the oxy-acetylene torch is used to cut them up into sections of a size that may be conveniently handled. In the case of shovels the only thing necessary is to cut off the handle and remove the reinforced section that connects the handle socket to the bottom of the shovel. When this work has been completed, the steel goes to a power press equipped with a compound blanking die which is used for stamping out washers from the scrap sheet metal. This machine is shown in operation in Fig. 5.

Many of the shovels that come to the reclaiming dock have broken handles, while the bottoms are still good enough to be capable of giving a considerable amount of additional service. Conversely, the bottom may be worn out while the handle is in good condition. In addition to using the worn out shovel bottoms for washers, good shovel bottoms and good handles are collected together and refitted.

Methods Used in Reclaiming Steel Rod

In the material sent to the reclaiming dock, there are often considerable quantities of steel rod which is salvaged by either of two methods. In the case of rods of standard size, the procedure is simply to run them through a set of straightening rolls that put the rods into condition for subsequent use. Odd-sized rods have to be treated according to a different method, and the same practice is followed for the utilization of certain other classes of steel. In such cases, the material is heated and rolled out through a "three-high" type of rolling mill into rods of smaller diameter, the scrap material so treated being handled in exactly the same way as billets for hot-rolled steel rods.

Reclaiming Wiping Waste and Recovering the Oil

All railroads have occasion to use large quantities of wiping waste, and instead of following the usual practice of

Fig. 2. Slitting Armored Rubber Steam Hose preparatory to removing the Wire

Fig. 3. Multiple-spindle Nut-tapping Machine used for rethreading Old Nuts

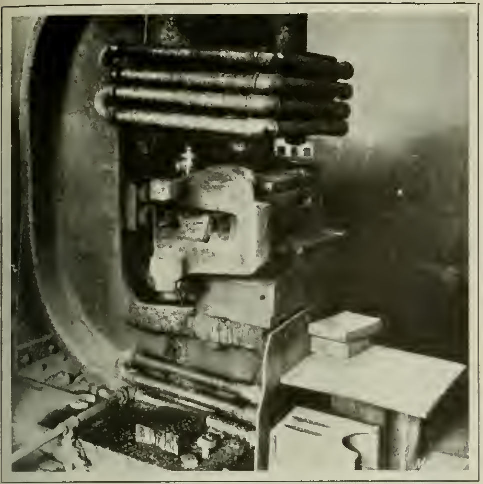

Fig. 4. Special Hydraulic Press used for straightening the Shank of a Bent Car Coupling

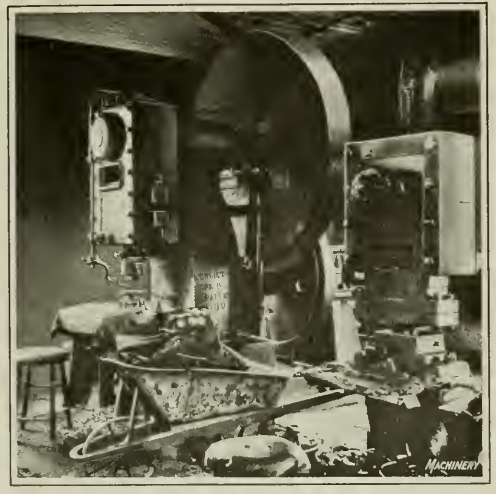

Fig. 5. Power Presses equipped with Compound Dies for piercing and blanking Washers

throwing this material away when it becomes too badly soiled for service, the C. P. R. shops in the zone served by the Angus shops collect it and send it back to these shops, where it is treated by a process that not only cleans the waste, but also recovers a considerable amount of oil. As the greasy waste first comes to the shop, it is placed in a centrifugal separator having a perforated bowl, in which the waste is held while the oil is thrown out through the perforations and caught in a suitable container. Next, the waste is cleaned in a washing machine of the same type as that used by laundries for washing clothes; and finally, the water is removed by subjecting the waste to a second treatment in a centrifugal separator.

Utilization of Scrap Pipe

Scrap pipe is utilized in a number of different ways, the two most important uses being in the construction of frames for farm crossing-gates, and in the making of pipe fitting nipples. In the case of the crossing-gates, it is simply a matter of cutting up the pipe into suitable lengths and threading the ends, so that by the use of couplings, elbows, and tees, a frame is constructed that will be covered with either wire mesh or strands of barbed wire. In using scrap pipe for making nipples, the procedure is quite simple: the material is worked through a pipe cutting and threading machine which cuts off pieces of the required length and threads the ends.

Resetting Spiral Springs

Large quantities of steel springs of various sizes come to the reclaiming dock. After a considerable amount of service, a compression spring often is flattened or a tension spring is drawn out too far to make it capable of fulfilling the required conditions. In the process of reclamation, the first step is to heat each spring and pull it out or subject it to a process of compression, according to the type of spring, after which it is retempered in order to give the steel the required physical properties.

Fig. 6. Accumulation of Scrap Sheet Metal outside the Tinsmith's Shop

How the Tinsmith's Shop is Supplied with Sheet Metal

One of the most extensive branches of the work of reclaiming scrap material at the Angus shops is carried on at the tinsmith's shop. In general no attempt is made to sort out the various classes of material prior to their shipment to the scrap dock. However, an exception is made in the case of the tinsmith's department, to which all sheet metal scrap from the different division shops of the C. P. R. system is shipped direct. A large supply of scrap metal is obtained from old brine tanks from refrigerator cars. The metal from both these sources is galvanized iron, and it is adapted for a variety of purposes. An accumulation of such material outside the tinsmith's shop is shown in Fig. 6.

Where lighter sheet metal is required, a considerable source of supply is obtained from old paint pails, all of which are shipped to Angus after their contents have been used. These pails are dipped into a tank of hot Wyandotte solution, which removes the paint and leaves the sheet metal clean and practically as good as new, without attacking the solder or otherwise affecting the surface of the metal. Some of these pails are cut up and used in sheets, while others are utilized by putting on a special cover and spout and making them into oil-cans of one-half gallon or one gallon capacity. Oil-cans of this type are shown at *R* and *T* in Fig. 7. This illustration also shows a variety of other products made in the Angus tinsmith's shop from scrap sheet metal, including water pans and pails, buckets, oil-cans, etc., the uses of most of which are self-evident. At *I* is shown a steam shield and at *K* a smoke-jack shield; *J* shows a car-heater top, *M* a smoke-jack, *N* a globe ventilator, *O* an engine-cab lamp shade, *P* a fireman's case kit, *Q* a tapered connection for a smoke-jack, *S* an engineer's tool-box, *U* a boiler inspection card-case, and *X* a car ventilator. The articles shown, however, by no means represent the entire range of products obtained as a by-product of the sheet-metal scrap pile.

Recovery of Solder from Joints in the Old Work

An important economy in the utilization of this scrap sheet metal is effected by the reclamation of all the solder used in sealing the joints. Obviously, all sheets of scrap metal that are utilized to advantage must be so cut that the seams carrying solder are removed. The scrap produced

Fig. 7. A Variety of Articles produced from Scrap Sheet Metal

Fig. 8. Furnaces used for the Recovery of Solder from Sheet Metal

in this manner is sent to an oil-heated furnace where the metal is heated sufficiently so that the solder melts and drips through the grate bars into a pan. From this pan the solder is transferred to a refining furnace, where it is remelted in a pot from which the dross is skimmed off, leaving the pure solder in a condition to be cast into bars for subsequent use. In Fig. 8 is shown a view of the equipment used for this purpose.

The value of material recovered at the reclaiming dock has run as high as $71,000 a month. With such savings as this possible, railway executives would do well to ascertain the possibility of applying a similar system for the recovery of all valuable material from the scrap that is produced in the operation of their own shops and in the maintenance of their lines and rolling stock.

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SPANISH AUTOMOBILE INDUSTRY

The Hispano-Suiza Co., which is by far the largest of the three principal automobile manufacturing companies of Spain, has a total annual production capacity of about 2000 cars according to a recent Commerce Report. This company is located in Barcelona, but also operates a factory at Guadalajara for making trucks and various kinds of motor vehicles for the Spanish army. The Elizalde and the Espana automobile companies which are next in importance are also located at Barcelona.

According to Department of Commerce Reports, Spanish factories, as a rule, build only the engine and body of motor vehicles, importing the chassis and using foreign makes of carburetors, ignition, lighting, and oiling systems, etc. It is also stated that in the Spanish automobile field the United States unquestionably holds first place. The number of American-made automobiles in Spain today exceeds the total of all the other cars put together, including those made in Spain. Trucks of German and French manufacture, however, showed a decided gain in the Spanish market during the past year. Official statistics indicate that of the motor trucks imported into Spain during the first nine months of 1920, about 40 per cent came from France, 30 per cent from Germany, while only about 4 per cent came from the United States.

Changes in Patterns that Facilitate Molding

By M. E. DUGGAN

CHANGES in the design of a pattern can sometimes be made which will result in simplifying the method of molding, decreasing the cost of the work, or increasing production. An example of a change of this kind which materially increased the production of castings is shown in Fig. 1. The pattern is for a pouring basin, and the illustration shows the changes that were made to facilitate the production of castings. The patternmaker should realize that it is not always necessary to follow the design exactly;

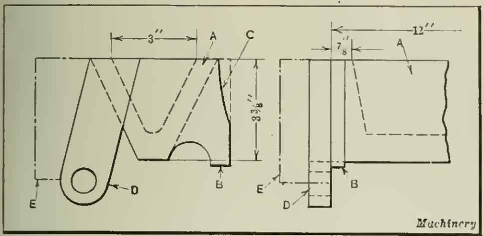

Fig. 1. Pouring Basin Pattern, showing how Improvements in Design simplify Molding

if simple changes can be made which will be of assistance in the molding work and will not affect the product, these changes should be made. If a pattern is to be molded in green sand, it may cause the molder considerable trouble in making the mold and in extracting the pattern, or if the mold is to be made with the assistance of dry sand cores, the extra cost of making these cores and the work of setting them in the mold may make it necessary to employ a different method.

In the present instance, sixteen sizes of pouring basins of various lengths were to be made from gray iron. The basin proper *A* is V-shaped and has a 3/16-inch radius at the bottom on the inside. This point in design would not have materially affected the method of molding if only a few castings were required, but when a number were to be produced the difficulties caused by this small radius made the pattern entirely impractical and the molding method slow and unsatisfactory. The time required to secure the thin edge of hanging sand in the cope and the possibility that it would drop or be washed away by the molten metal were factors that made it desirable to change the pattern.

First a change was made in the method of molding and then the design of the pattern was changed. In the first change the pattern was used as a core-box for making a dry sand core, which was suspended from the cope face of the mold. This method produced a good casting, but it resulted in a loss to the foundry owner. The second change consisted simply of increasing the size of the radius at the bottom of the basin to 7/16 inch so that it could be molded in green sand as was originally done. The sand was supported in the cope and secured by small pieces of wood. By this simple change the casting could be produced economically and satisfactorily.

These basins had a leg *B* cast at each end, having a graceful curve as indicated at *C* where the leg joined the body of the casting. This design necessitated making the legs loose and pinning them to the pattern, to avoid a deep parting and heavy "cope lift." This design was rejected by the foundry, and the pattern was returned to have the loose pieces secured to the pattern and built out in a straight line as indicated by the dotted outline so that the parting could come in a straight line and the pattern be readily drawn.

A hinge piece such as shown at *D* is also cast at each end of the basin which, in the original design, was intended to be molded in green sand. The slight change made to simplify the molding of this hinge was the use of a dry sand core placed at each end of the mold as indicated at *E*. A standard core-box was made for the hinge core, which was rammed up with the pattern in the mold. After the mold had been finished, it was a simple matter to remove the dry sand cores and draw the pattern without danger of injuring the mold. The cores were then returned to their place in the mold and the cope closed. The alterations here noted were later incorporated in the design of the pattern without affecting the usefulness of the casting.

Improvement in Molding Method

The casting shown in Fig. 2 was intended to be produced by a certain molding procedure, but it was found that by making slight changes in the method of molding, it was possible to produce it more economically. The pattern was originally made in two pieces, allowing 10 inches to extend into the cope and 16 inches into the drag. The intention was to mold the 1¾-inch slot in green sand, since the slots were cut from the pattern, but the molder realized that if this procedure were followed there would be a heavy body of sand hanging in the cope which would require the provision of sand-bars in the cope flask, extending down nearly to the parting line. It would probably have been necessary also to employ gaggers in order to help secure this deep body of sand and prevent it from dropping when the cope was closed.

The changes made by the molder were as follows: He fastened the two parts of the pattern together and made provision for molding the entire pattern in the drag. The pattern was made use of as a core-box to make a core which would extend down to the ribs *A*, and the core was placed

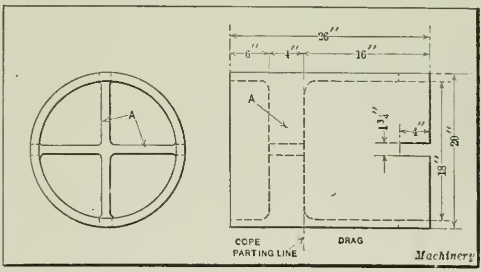

Fig. 2. Casting which was produced more economically through a Change in Molding Methods

in the pattern and made part of the cope by suspending it in the flask, using wire fastened to wooden bars placed crosswise on the top of the flask. This permitted the dry sand core to be lifted with the cope. In ramming up the drag, the four slots already made in the pattern were utilized for locating dry sand cores by means of which these slots were molded. The pattern was drawn out of the drag and the mold finished in the usual way before returning the cope with its hanging dry sand core to its place on the drag. It should be noted that the casting is molded on end, instead of horizontally, as shown in the illustration.

Simplification in Design of Patterns

It is frequently advisable when making castings for replacement, as in repairs, to simplify the design of the pattern in order that the repair part may be molded more quickly. Original designs usually have certain graceful outlines which are not necessary as far as service is concerned, so that when a casting or two is wanted for repairs, certain changes may be made (if a new pattern is required) which will enable the foundry to make the casting without any unnecessary work. A case of this kind is shown in the illustration Fig. 3.

The casting to be replaced was a journal bearing, 15 inches in diameter, provided with anchorages for the babbitt lining. An inspection of the partial section view at the left in the illustration will show that the finished strip at the top of the casting, the pads around the bolt holes and certain other features of design require the use of dry sand cores and other molding work which does not lend itself to rapid production. The view at the right shows the changes in design that were made and how they simplified the production of the casting. In this particular case the patternmaker was empowered to use any means that he felt advisable to produce the casting in the quickest possible time. This privilege

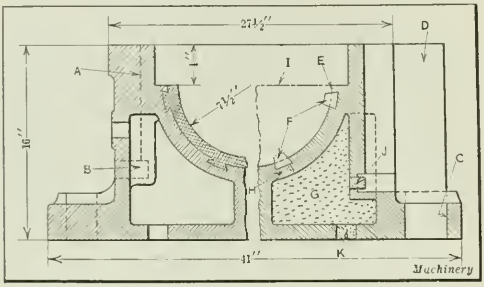

Fig. 3. Casting before and after changing the Design of the Pattern

is not always granted the patternmaker without first consulting the engineering department; but in a repair shop, where the regular manufacturing routine is not so rigidly adhered to, when the patternmaker has that liberty, changes will often be made which will simplify both the design and the molding.

Referring to the changed pattern, it will be seen that the finish strip and pads have been removed and the side of the bearing made straight; also that the bolt slot *A* has been extended and the cored opening *B* for the bolt head located on a level with the pads which surround the bolt hole in the base of the casting. This permits the use of one core for molding the bolt slots, the bolt head slots (of which there are two on each side), and the slotted clamping bolt hole *C*. This core was located in the mold by means of the core-print *D*. Provision was made for molding the babbitt circle *E* in dry sand by loosely attaching core-prints, as at *F*, to the pattern and using the pattern in this condition as a core-box for making the dry sand core *I*. Anchor cores, as shown, were then set into the slots produced in the bearing core at *F*, and pasted in place for producing the anchorage slots for the babbitt.

Provision for locating and supporting the water-chamber core *G* in the mold and for liberating gases was made in the following manner: Stud cores *H* were set on the anchor cores, and other stud cores *J* were located in a hole formed in that section of the main core by which the bolt head slot was produced. This provided the necessary locating and supporting means for the water-chamber core and permitted the use of stud cores at *K* for clamping the water-chamber core down against its supporting cores. These stud cores also provided an outlet for any trapped gases.

PLASTER MOLDS FOR SMALL CASTINGS

By FRANK LUX

Plaster-of-paris molds have been in use for many years, but despite that fact, few people interested in the production of castings realize their value. They are especially useful as a means of producing small castings for experimental work, and in some cases they can also be used to advantage in the production of castings required in the construction of commercial products. A casting made in a plaster-of-paris mold is smoother than one made in a sand mold. This is quite an advantage when the appearance of the casting is important. For instance, if the levers, arms, brackets, etc., used in working models are cast in fine sand molds it is usually necessary to file the castings all over in order to obtain the desired finish, whereas if plaster-of-paris molds are used, a satisfactory surface is produced without filing.

Mixing Plaster for the Molds

Plaster-of-paris alone will not withstand the heat of molten metals, and experience has shown that the addition of asbestos is necessary to insure the success of so-called "plaster-of-paris" molds. Pure plaster would crack when heated, and the castings produced would not be uniform. The percentage of asbestos may be varied according to the material to be cast, although equal amounts of plaster-of-paris and asbestos generally produce very satisfactory results.

The mixing of the plaster is very simple, yet there are several points that require careful consideration. A pan or pail of suitable size is partly filled with water (the amount depending on the quantity of plaster required) and powdered plaster sifted into the water. When the sifted plaster thus piled up reaches the surface of the water, an equal amount of asbestos is added. Care should be taken not to stir the water and plaster-of-paris before adding the asbestos. After the addition of the asbestos the ingredients are stirred thoroughly. The asbestos is used in pulverized form.

Making the Molds

In making the mold, the pattern is placed on a piece of glass or smooth board and enclosed by a frame. If a frame is not obtainable, boards or strips can be used. At *A*, Fig. 1, is shown a frame of standard design. This frame rests on the glass *B*, although a slate-top table can be used if desired. The pattern *C* is located at the center of the frame, and the plaster is poured in until it has covered the pattern and fills the cavity in the frame.

In the lower view of the illustration, is shown a method of using four strips *D*, *E*, *F*, and *G* in place of frame *A*. The strips should be of sufficient height to allow the plaster to cover the pattern entirely, and they should be arranged to suit the size of casting to be made. A small amount of plaster should be poured on the pattern, and a soft brush used to brush the surface of the pattern over with the plaster before filling up the frame. This insures covering the entire surface and prevents the formation of air pockets.

Wooden and metal patterns should be covered with a coat of oil before pouring the plaster. This facilitates the removal of the pattern from the mold after the plaster has set. A mold of this kind will set in from twenty to thirty minutes. The frame is then removed and the top scraped to a flat surface. The plaster forming the drag, with the pattern still in position, is then turned over to permit casting the cope. The entire matching surface of the drag is covered with a solution of soapy water, which prevents the plaster forming the cope from adhering to that of the drag. Thus the two parts of the mold can be easily separated when the plaster has set.

Dowel-pins may be set into the drag before pouring the cope to insure alignment of the two members after the removal of the pattern. It is possible, however, merely to countersink the top surface of the drag, as shown at *A* in Fig. 2. Three or four countersunk depressions, such as shown at *A*, are sufficient to insure proper alignment. When the cope is poured, the depressions in the drag form corresponding projections in the cope, thus providing a means of accurately matching these two members.

In making a mold for the knob shown at *B*, a somewhat different method is used. The knob is placed in a clearance hole *D* of a plaster slab *C*. Putty or wax *E* is then filled in around the knob, bringing the center up to the parting line. This allows half of the pattern to project above the surface. The plaster is then poured in the usual manner, after side frames or strips such as indicated at *F* have been suitably placed. In making the cope for this work, the plaster forming the drag is turned over after it has been separated from the plaster slab. The pattern or mold, in this case, is allowed to remain in the drag. The projecting part of the pattern is next coated with oil, and the parting surface of the plaster slab is coated with soapy water, as previously described. Dowels or countersunk holes are then provided to insure alignment, after which the plaster is poured to complete the cope.

When the mold has set, it is turned up on edge and the two parts are separated by inserting a knife blade in the parting line. Separation is not difficult if the knife blade is inserted in the parting line on all four sides of the mold. The general method of gating molds of this kind is to gouge out sufficient plaster to form the gate while the plaster is comparatively soft and moist. Standard gating methods should be used, since the metal flows the same in a mold of this kind as it does in the ordinary type. Gates can be built in the mold or patterns if desired.

Baking Plaster Molds

A plaster mold is somewhat moist for a considerable time after it has been made, and the best results are obtained by baking the mold in an oven, before using, for from twelve to twenty hours, according to the size, at a temperature of 650 degrees F. If no oven is available, the mold should stand for forty-eight hours in a dry place, after which it should

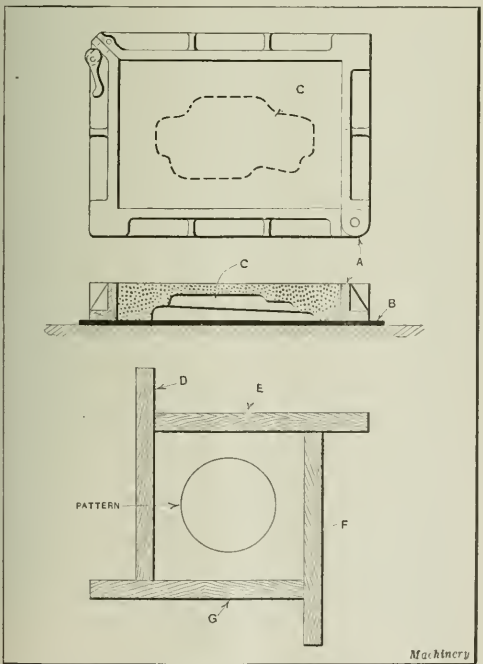

Fig. 1. Frames used in making Plaster-of-paris Molds

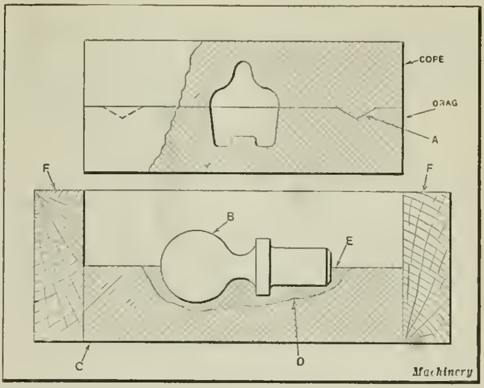

Fig. 2. Examples of Plaster Molding

be thoroughly dried and ready for use. After the mold has been baked or been thoroughly dried, it is clamped together with ordinary wooden clamps and placed on the floor or table so that the gate is at the top. The molten metal is then poured into the mold in the usual way.

Heating Furnaces

When the number of metal castings required is not sufficient to warrant the use of a large metal furnace, it is convenient to use an electrical furnace of the crucible type. The metal is brought to the proper heat, and then poured into the mold, where it is allowed to cool sufficiently to become set. The mold is then broken up and the casting removed and placed in a pickling solution. Some of the metals that can be molded satisfactorily in plaster molds are aluminum, and various grades of brass and cast iron. Stellite has also been cast successfully in plaster molds, and in some instances the results obtained have been better than with carbon or sand molds.

The following examples will serve to show some of the advantages of plaster molds: Assume that a connecting-rod, 5 inches long, of ordinary design is required to be cast in bronze. A wooden pattern could be used or the connecting-rod could be molded in wax, such as may be purchased in an art store. The wax mold can be worked out in a comparatively short time and is immediately ready for use. The surface is covered with oil, and the drag and cope are made as previously described.

Another example is the reproduction of a tablet bearing a face, figure, or some inscription. In this case the tablet is laid on a piece of glass and covered with oil, after which the plaster is poured. After setting, the plaster mold is turned over and the upper surface covered with a solution of soapy water. The dowels are next inserted, and the plaster backing is made. The two members forming the mold are then separated, gates cut, the pattern removed, and the mold dried or baked. By this method the original plate or pattern is reproduced in sharp detail.

Shrinkage Allowance

The allowance for shrinkage of castings made in plaster molds is the same as with other types of molds, and varies only according to the metal to be cast. Plaster generally keeps its size, although some plaster swells slightly. This swelling is governed by the proportions of the ingredients used. A foundry for producing castings from plaster molds does not require much equipment. Metal patterns can be used in making plaster molds, and production methods can be worked out with little difficulty.

There are many little kinks in the use of plaster molds that can be learned only through experience, but this article outlines general methods that will give successful results.

Cutting Internal Spur Gears

Milling Internal Gear Teeth with Formed Cutters—Generating the Teeth on Gear Shaper—Use of Form-copying Gear Planer

By FRANKLIN D. JONES

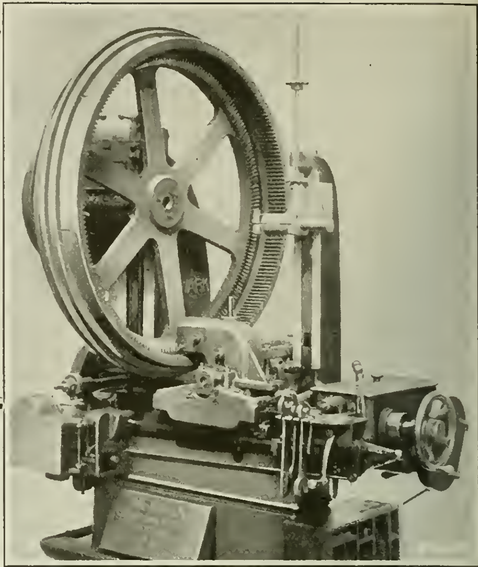

Fig. 1. Cutting an Internal Gear on a Machine equipped with an Internal Attachment

INTERNAL spur gears are cut by methods similar in principle to those employed for external spur gears, although the equipment used may vary somewhat owing to the fact that internal gears have teeth on the inside of a rim and frequently have a web at one side which limits the amount of clearance space at the ends of the teeth. Internal spur gears are usually cut by one of the following methods: (1) By using a formed cutter and milling the teeth; (2) by a molding-generating process, as when using a Fellows gear shaper; (3) by planing, using a machine of the templet or form-copying type (especially applicable to gears of large pitch); and (4) by using a formed tool which reproduces its shape and is given a planing action either on a slotting or a planing type of machine.

The machines used ordinarily for cutting internal gears are designs intended primarily for external gears. These machines are arranged for internal gear-cutting by using some form of attachment which provides means of holding the cutter in the position required for forming gear teeth around an inner surface. Attachments for cutting teeth by the milling process also transmit motion to the cutter.

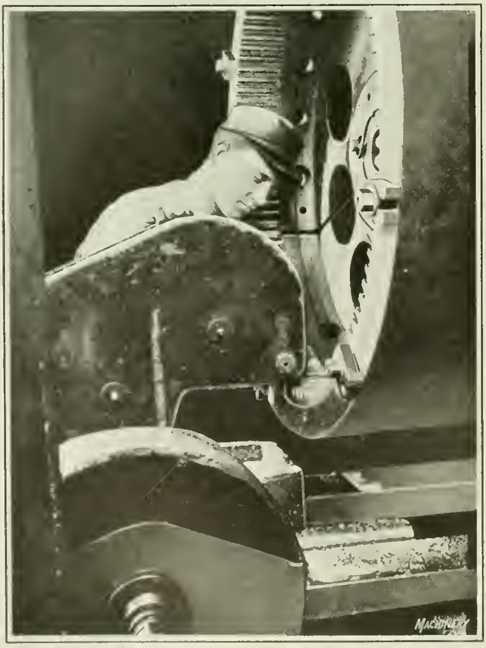

Fig. 2. Detail View of an Internal Gear-cutting Attachment at Work

Automatic gear-cutting machines of the formed-cutter type and designed primarily for spur gearing, are often used for cutting internal spur gears. The machine is adapted to this work by equipping it with a special attachment. Fig. 1 shows one of the Newark machines equipped with an internal attachment, cutting a large cast-iron internal ring gear. This attachment is mounted upon the regular cutter-slide of the machine, and the cutter is held at the end of a rigid arm which projects far enough to enable the cutter to operate on the teeth of an internal gear. The cutter is driven through a train of gearing from the regular cutter-spindle, the locations of the gear-shafts being clearly indicated in the illustration. The ring gear shown in this particular illustration is held in position by means of a cast-iron spider to which the gear is bolted, and the spider, in turn, is mounted on the regular work-spindle. These ring gears have 220 teeth of 5 diametral pitch, 2¾-inch face width, and a pitch diameter of 44 inches. Each tooth space was finished from the solid at one cut, using a feed of 5 inches per minute, and a cutter speed of 68 revolutions per minute. A high-speed steel cutter was used, and as twelve ring gears were required, a special cutter was made and ground to form after hardening.

In Fig. 2 is shown another example of internal gear-cutting. This is a close-up view of a machine made by the Cincinnati Gear Cutting Machine Co., equipped with an internal attachment for cutting steel internal gears having 96 teeth of 2 diametral pitch and a pitch diameter of 48 inches. These gears are also of the ring form, and are held in a special fixture mounted on the machine spindle.

When internal gears having webs are to be cut by means of rotary cutters, it is necessary to provide a clearance at the inner ends of the teeth which is somewhat greater than the radius of the cutter. As this amount of clearance may be objectionable, and as it may be very desirable to have the gear and web formed of one solid casting, the use of formed cutters and the internal gear-cutting attachment may not always be desirable or practicable.

Formed Cutters to Use for Internal Gears

When internal gears are cut by means of formed cutters, a special cutter is usually desirable, because the tooth spaces

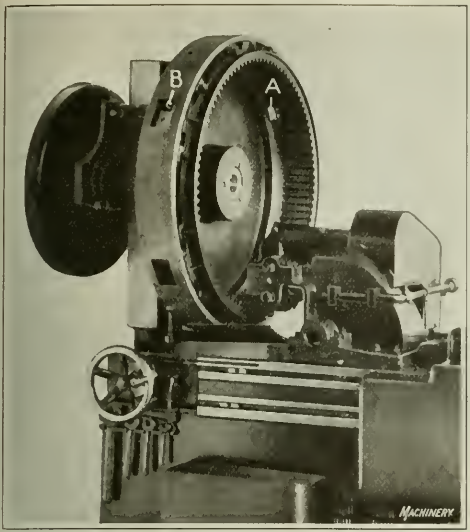

Fig. 3. Special Design of Internal Gear-cutting Attachment

of an internal gear are not the same shape as the tooth spaces of external gearing having the same pitch and number of teeth. This is due to the fact that an internal gear is a spur gear "turned inside out." According to one rule, the standard No. 1 cutter for external gearing may be used for internal gears of 4 diametral pitch and finer, when there are sixty teeth or more. This No. 1 cutter, as applied to external gearing, is intended for all gears having from 135 teeth to a rack. The finer the pitch and the larger the number of teeth, the better the results obtained with a No. 1 cutter.

According to the Brown & Sharpe Mfg. Co., if internal gears of high grade are required in quantity, it is preferable to have a special cutter made. The standard No. 1 cutter is considered satisfactory for jobbing work, and usually when the number of gears to be cut does not warrant obtaining a special cutter, although the use of the No. 1 cutter is not practicable when the number of teeth in the pinion is large in proportion to the number of teeth in the internal gear. If the difference between the number of teeth in the gear and in the pinion is less than 6, it is necessary to depart from the regular 14½-degree shape and use either a reduced depth or a greater pressure angle, or more often both. Ordinarily, the difference should not be less than 15 for the 14½-degree pressure angle. This number may be smaller for a larger pressure angle. According to the Newark Gear Cutting Machine Co., if a special formed cutter is not made to conform to the internal gear to be cut, it is considered preferable to use a straight-sided 29-degree worm milling cutter rather than a regular spur-gear cutter.

Special Attachment for Cutting Internal Gears

The special internal gear-cutting attachment shown in Figs. 3 and 4, applied to a Brown & Sharpe machine, was made for the purpose of cutting internal gears for tractors. This attachment, unlike the standard design, is driven from the cutter driving shaft by a silent chain and sprocket transmission, and it is not connected with the regular cutter-spindle. Fig. 4 shows the attachment with the guards removed. The special chuck or holding fixture receives two blanks at one time. These are held in place by hook-bolts. Recesses *A* and drain-holes *B* allow the cutting compound to escape from the fixture.

Double cutters are used, one for roughing and the other for finishing. The comparatively slow feed for the first cut is automatically increased for succeeding cuts. These cast-steel internal gears have 99 teeth of 3-4 pitch (stub teeth), and the total face width is 4¼ inches. The cutting speed is 74 revolutions per minute, with cutters 4¾ inches in diameter, and the feed is 1¾ inches per minute. The two gears are cut in 6¼ hours.

Cutting Internal Gears on a Gear Shaper

Internal spur gears are cut on a Fellows gear shaper by the same general process as that employed for cutting external spur gears. The same type of cutter is used, and the machine is geared so that cutter and work are rotated in unison like a pinion in mesh with an internal gear. An example of internal gear-cutting on a Fellows machine is illustrated in Fig. 5. Special cutters are not required for internal gearing, and frequently the cutter used for the mating gear or pinion is also used for cutting the internal gear.

The push or downward stroke is ordinarily used for cutting internal gears, instead of the pull or upward cutting stroke commonly employed for external gears. By using the push stroke, it is possible to cut internal gears having a web located very close to the ends of the teeth. In fact, if the groove is wide enough to prevent the chips from packing between the cutter and the work, that is the only requirement. In the case of internal spur gears, the minimum width of the recess or clearance space varies from 3/16 to 9/32 inch for gears ranging from 24 to 4 diametral pitch.

When setting up the machine, an intermediate gear is inserted in the train of change-gears, so that the cutter and work will rotate in the same direction when the machine is at work, instead of in opposite directions as is required when cutting a spur gear. In other words, the machine is geared to give the same relative motion between cutter and work as is obtained when a pinion is running in mesh with a gear, rotation of the pinion and gear being in the same direction for internal gearing and in opposite directions for external gearing.

The four standard sizes of gear shaper cutters having pitch diameters of 1, 2, 3, and 4 inches, respectively, meet all ordinary requirements in cutting internal gears. The size of cutter to use is governed by the number of teeth in the internal gear and the pitch. In the design of internal gear-

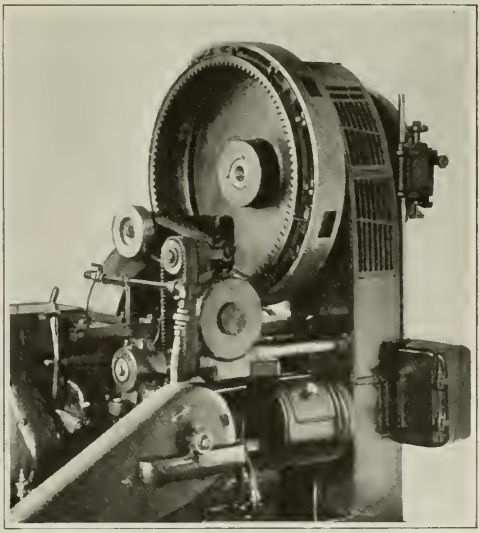

Fig. 4. Guards removed to show Chain Drive of Internal Attachment illustrated in Fig. 3

ing, if the pinion is made too large in proportion to the size of its mating gear, the teeth will not mesh properly because of interference. This also applies when selecting a cutter, since the latter represents a pinion and generates the tooth curves as the cutter and work rotate in unison at the proper ratio. If the difference between the number of teeth in the gear and the number of teeth in the cutter is too small, the cutter will trim off the tops of the teeth due to improper meshing, the result being teeth of incorrect shape.

Internal gears are ordinarily held in special fixtures, the design of which depends on the shape of the gear and the number to be cut. For instance, a simple type of faceplate fixture may be employed when only a few gears are to be cut; whereas, for quantity production it would be economical to construct a special fixture, such, for example, as would enable the gear blanks to be accurately located with greater rapidity than when using a fixture designed for general work.

A typical design of internal fixture is shown in Fig. 6. It consists of a pan-shaped body having a machined seat *A* in which the gear blanks are held by clamping straps *B*. These straps have elongated bolt-holes, and are supported by springs so that they can be pushed back readily for inserting or removing work. The particular fixture shown is used for holding two ring-shaped gears *C*. The fixture is accurately centered in relation to the work-spindle by plug *D*, and it is supported on the cutting side by a roller at *E*.

Internal gears for speed-reducing mechanisms, etc., are often made with helical teeth in order to obtain a more perfect rolling action, and such gears may be cut on the helical type of gear shaper which will be referred to in a succeeding article.

Machine of Slotter Type for Cutting Internal Gears

A machine adapted for cutting internal spur gears, which is designed along the lines of a slotter, is shown in Fig. 7. This machine, which is of an automatic type, is used at the Bilgram Machine Works. When the machine is at work, the table is given an indexing movement, corresponding to the circular pitch of the gear, each time the tool clears the work on the upper stroke. The inward feeding movement occurs after each revolution of the gear blank. The indexing movement is derived through the change-gears *A*; just after this motion occurs, a cam-operated pawl or anchor engages a notched disk and holds the work-table securely during the downward or cutting stroke.

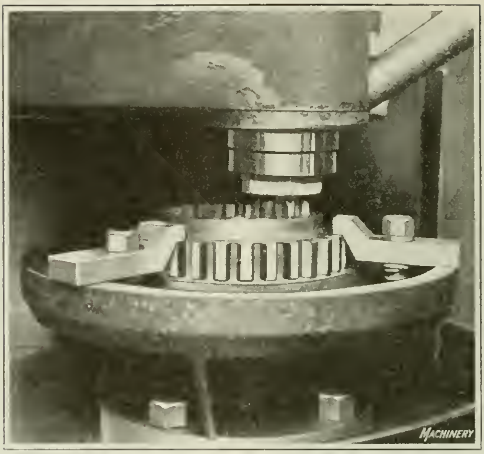

Fig. 5. Cutting an Internal Gear on a Gear Shaper

The feeding movement is obtained through a very ingenious pawl and ratchet mechanism. The ratchet wheel *B* has teeth formed along a spiral which makes several turns around the wheel as the illustration shows. Between the rows of teeth there is a narrow slot engaged by a projection extending below the hub of pawl *C*. This pawl is free to slide along rod *D*, and the projecting part causes the pawl to follow the spiral row of teeth as the ratchet wheel is rotated. As previously mentioned, this feeding mechanism operates after each complete revolution of the work-table, and it is so adjusted that when the tool has been fed to the proper depth the pawl slides out of engagement with the teeth on a blank space so that it cannot rotate the ratchet wheel further. The cutters used on this machine are of the formed type, the tooth curves being a direct reproduction of the cutter itself. The part shown on the machine is made of steel and contains sixty-seven teeth of 8 diametral pitch.

Cutting Large Internal Gears on a Templet-type Planer

The most practical method of cutting large internal gears is on a planer of the form-copying type. An example of internal gear planing on a Gleason machine is illustrated in Fig. 8. This is a regular spur gear planer equipped with a special tool-holder for locating the tool in the position required for cutting internal teeth. The holder is of a heavy, rigid design, which prevents excessive deflection of the tool.

The templets used to control the path followed by the tool conform to the shape required for internal teeth, and

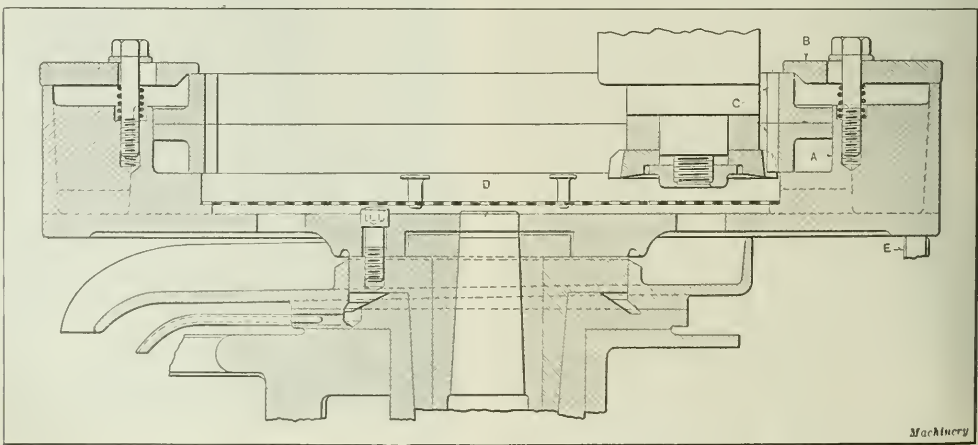

Fig. 6. Fixture for holding Internal Gears while cutting on a Gear Shaper

differ in shape from those used for external gears of the same size. Very satisfactory internal gearing may be cut on planers of this type, which are especially adapted for large work. The chief features governing the operation of gear planers of the templet type were described previously in connection with their application to large spur gears. The procedure of cutting internal gears is practically the same as for external spur gearing, after the machine has been equipped with the special tool-holder referred to.

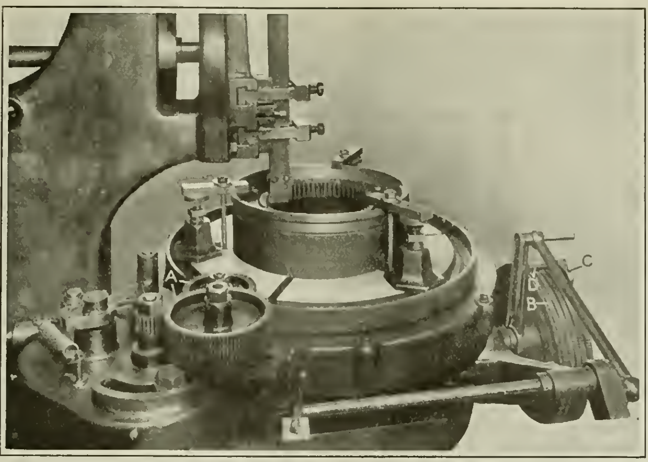

Fig. 7. Internal Gear-cutting Operation on Automatic Machine of Slotter Type

Dimensions for Cutting Internal Spur Gears

As the position of the teeth of an internal gear are reversed as compared with an external gear, the addendum of an internal gear is inside the pitch circle and the dedendum outside; consequently, in machining blanks for internal gears the inside diameter is made equal to the pitch diameter *minus* twice the addendum. If the pitch diameter is not known, the inside diameter may be found by first dividing the number of teeth by the diametral pitch (thus obtaining the pitch diameter) and then subtracting twice the addendum. The addendum of an internal gear, the thickness of the tooth on the pitch circle, and the whole depth of the tooth may be obtained by the same rules or formulas as are used for external spur gears.

Internal gearing is frequently utilized in connection with various forms of speed-reducing mechanisms, since this type of gearing is often conducive to compactness in design. In fact, one advantage of internal gearing is that the center-to-center distance between gear and pinion is much shorter than between two external gears of the same ratio. If the diametral pitch and numbers of teeth in the gear and pinion are known, the center-to-center distance for internal gearing may be determined by subtracting the number of teeth in the pinion from the number of teeth in the gear, and dividing the remainder by twice the diametral pitch. Ordinarily, considerable reduction in speed is obtained through internal gearing, but occasionally gears of low ratio are required and then it may be advisable to use gear teeth of the cycloidal form. When using the involute form, the internal gear should have at least fifteen more teeth than its mating pinion in order to avoid excessive interference.

* * *

The Belgian automobile industry has been unable to supply the home demand since the Armistice, according to a Commerce Report, its total output being not more than 5000 cars a year. American cars are said to be more satisfactory as regards price and quality than the home products.

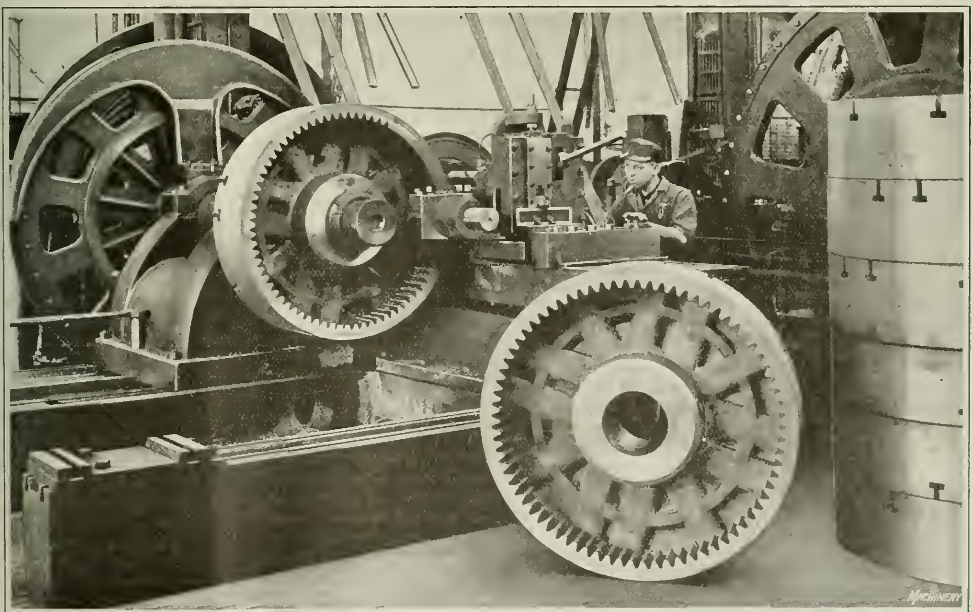

Fig. 8. Example of Internal Gear-cutting on Planer of Form-copying or Templet Type

The German Machine Tool Industry

Berlin, May 3

GERMAN industry in general, and the machinery and machine tool industry in particular presents to the casual observer a picture of activity and apparent prosperity. Were it not for the scarcity of raw materials and fuel, there would apparently be no cloud on the industrial horizon. In reality, however, conditions are not quite so satisfactory as they appear. The great industrial activity is due to the continuation of the selling-out process of Germany, which is accompanied by increases in prices to domestic consumers to such an extent that the great mass of the people in the country must deny themselves all those necessities that are on the price level of the world's markets. It is, therefore, not without fear and uncertainty that the captains of industry look into the future.

A foreboding of what might happen was presented by the strike of the railway employes early in the year. This strike was due to the extremely high prices of food, much of which has to be imported from abroad—and therefore must be sold at the world's market prices—as Germany cannot support its entire population with the agricultural products of its own soil. When imported products have to be bought with the depreciated German mark, prices compared with earning power rise to an almost unbelieveable level. While the skilled workman in Germany earns 10 marks an hour or 80 marks a day, a good suit of clothes costs as much as 6000 marks—in other words, it takes the entire earning power of a workman for seventy-five days to obtain a suit of clothes that at present exchange would be worth $20.

The railway strike lasted about six days, but no strike has ever so seriously threatened the economic existence of the country. Nearly everything came to a standstill, and in the six days the loss to the railroads was 1,800,000,000 marks, the value of destroyed materials 552,000,000 marks, and the estimated direct loss to the country 2,400,000,000 marks.

Results of the Leipzig Fair

More than 15,000 foreign buyers were attracted to the Leipzig Fair this spring, and on one day there were more than 140,000 visitors. The number of orders placed at the fair may be said to have been overwhelming. This applied to the machine tool industry as well, many orders being placed; but this must be considered as a selling-out fair for Germany, because if German money continues to depreciate, the manufacturers will be unable to replenish their stocks of such raw materials as have to be imported from abroad, and will not be in a position to continue production after present supplies are exhausted. Buyers conversant with the conditions in Germany know this, and if the difference between the German and the foreign price is not very large, they are reluctant to place orders in Germany, because they are uncertain as regards deliveries. There are examples on record of foreign makers underbidding German manufacturers by 30 per cent, especially in cases where the German manufacturer is forced to use imported raw materials.

Sliding Scale of Prices

In view of the uncertainty as to prices, orders for future deliveries are not taken at a fixed price, but in accordance with a sliding scale. Several methods are employed to determine this sliding scale. The Association of German Machine Tool Builders has formulated a rule intended to protect the interests both of the manufacturer and of the buyer. In accordance with this rule, current prices are quoted, but these prices are increased, if found necessary, by a certain percentage which is stipulated monthly by the association, the percentage of increase being added from month to month to the original price quoted.

Another rule that is followed on orders for certain classes of equipment is that the prices shall increase by 0.4 per cent for each per cent increase in the prices of raw materials during the first half of the period intervening between the placing of the order and the delivery; and by 0.4 per cent for each per cent of increase in average wages of skilled workmen during the second half of the time intervening between the placing of the order and the delivery.

Prices of Machine Tools in Germany

Expressed in marks, German machine tool prices are from forty to fifty times the prices previous to the war. At that time prices varied from 0.25 to 0.75 mark per pound, according to the size and type of the machine. At pre-war exchange, this meant a variation of from 6 to 18 cents a pound. At the present time the average price per pound of smaller machine tools is 25 marks per pound (from 8 to 9 cents per pound); on larger machine tools the price is approximately half of this, or about 5 cents per pound. A number of examples of present prices are given below:

24-inch lathe, 10-foot bed, weighing 13,200 pounds, 130,000 marks (present exchange, $435).

18-inch engine lathe, 3½ feet extreme distance between centers, weighing 3200 pounds, 48,000 marks (present exchange, $160).

16-inch relieving lathe, 3½ feet between centers, weighing 4200 pounds, 100,000 marks (present exchange, $335).

Vertical milling machine with rotary table, weighing 6500 pounds, 150,000 marks (present exchange, $500).

Centering machine for pieces up to 6 inches in diameter, weighing 700 pounds, 20,000 marks (present exchange, $67).

High-speed drilling machine with capacity for drills up to one inch in diameter, automatic feed, weighing 660 pounds, 15,500 marks (present exchange, $52).

Drilling machine, with capacity for drills up to 1⅝ inches in diameter, weighing 1200 pounds, 20,000 marks (present exchange, $67).

Small vertical boring and turning mill (20-inch capacity) weighing 3300 pounds, 100,000 marks (present exchange, $335).

Horizontal milling machine with single-pulley drive, weighing 10,000 pounds, 200,000 marks (present exchange, $670).

Planer, 40 inches between housings, extreme height of work, 32 inches, weight, 12,000 pounds, 180,000 marks (present exchange, $600).

Planer, 60 inches between housings, extreme height of work, 52 inches, length of table, 13½ feet, weight, 35,000 pounds, 430,000 marks (present exchange, $1435).

Tool grinding machine with 20-inch wheel, weight 1000 pounds, 19,000 marks (present exchange, $64).

Shaper, 26 inches travel of ram, weight 4500 pounds, 105,000 marks (present exchange, $350).

Punch press for holes up to 1¾ inches in diameter and 13/16 inch thickness of plate, weighing 34,500 pounds, 360,000 marks (present exchange, $1200).

Cold saw, 40-inch diameter of saw, weighing 13,600 pounds, 180,000 marks (present exchange, $600).

Plate-bending machine for plates ½ inch thick and up to 6½ feet wide, weighing 9000 pounds, 150,000 marks (present exchange, $500).

General Conditions in the Machine Tool Industry

As already mentioned, business is at a high peak. The shops are overcrowded with orders, and the demand continues to be very brisk. Ludwig Loewe & Co. of Berlin, for example, now employ 3200 men in their shops, and the office employes number 620. It is stated, however, that this firm, like all other machine tool plants, finds it difficult to obtain the necessary raw material and coal.

The wages in the industries are approximately 10 marks per hour (4 cents per hour, present exchange) for skilled workers over twenty-four years of age. The wages for unskilled workers are only 5 per cent less than the wages of skilled men. Women engaged in shop work are paid about 6 marks per hour (2 cents per hour, present exchange). When working on piece-work, all workers earn at least 15 per cent over the hourly wage. For certain skilled work, the wages may be 10 per cent above those mentioned. The working day is eight hours for six days, or a forty-eight hour week. Six to nine days vacation is allowed annually with pay. Men in the engineering departments, capable of independent designing work, are paid from 3500 to 4400 marks a month (present exchange, from $12 to $15), while assistants, draftsmen, etc., earn from 1300 to 1900 marks a month (present exchange, $4.35 to $6.35).

General Industrial Conditions

General industrial conditions are paradoxical. The depreciated value of the mark has created an apparently large export trade with plenty of employment, yet the great masses of the people suffer want and the middle class is brought to the verge of actual poverty. Combinations in the industries are the order of the day, both in the machine tool building industry and in the general machine building field. The aim of these combinations is to lessen competition and reduce production and selling costs. These combinations include not only firms engaged in a similar line of manufacture, but also businesses that are using the raw materials of some other industry. As an example may be cited a combination including one of the largest locomotive builders in Germany, one of the steel mills, and one of the coal mining companies, so that the control of the production from the raw material to the finished product is in the same hands.

In 1921 Germany was still holding second place as a producer of iron and steel—the United States being the leader in this respect, France coming third, and Great Britain, fourth. In 1921 Germany bought 40 per cent of the copper exported from the United States, as compared with 33 per cent previous to the war. Iron ore being scarce in Germany, contracts have been placed for ore in Canada. During the past year exports have increased, but unless raw materials can be obtained from abroad at reasonable prices, Germany cannot continue indefinitely to export, as it is necessary that she first import many of the raw materials which are not found in sufficient quantity, or at all, in Germany. As an example of present methods of trading, it may be mentioned that the Krupp firm of Essen has obtained from Argentina an order for rails, part of which will be paid for by shipments of wool.

The Soviet Government has placed orders for 1000 locomotives in Germany, 85 of which have already been delivered. An order for 1000 locomotives has also been placed by the Soviet Government in Sweden, and the requirements are that all the parts of the locomotives built in Germany and in Sweden must be interchangeable with each other.

Negotiations have been completed between the Siemens-Schuckert Works and large Japanese copper interests, and an agreement has been made to erect a large factory in Tokio for the building of electrical machinery. Twenty of the leading engineers of the Siemens Works, as well as other technical employes and foremen, are just leaving for Tokio. The machinery for the starting of the works will also be supplied by the Siemens-Schuckert Works.

Orders for rails have also been placed in Germany by Brazil, the German bid being 3 per cent lower than that of Belgian makers. An order for a large iron bridge in Argentina has also been obtained by a German concern.

SAVINGS IN THE FOUNDRY

The practice of molding the cylinder casting for a pitcher pump as followed in the foundry of the Goulds Mfg. Co., Seneca Falls, N. Y., shows how money can be saved by giving attention to foundry details. The casting, which is illustrated in Fig. 1, was formerly molded with a green sand core that was rammed up in a core-box and then immediately put in position in the mold. Much difficulty was experienced by this procedure, and it was necessary to have considerable extra work done by an experienced core-maker. A core-box split through the spout was employed, and this core was rammed by hand first from one end and then from the other. When removed from the core-box and placed in position in the mold, it was necessary to be exceptionally careful in handling, and much loss of effort resulted through the disintegration of the core and the overhanging sand in the spouts falling off.

These castings are still molded with a green sand core, but other means of ramming the core are employed. A Mumford jolting machine is used on which a cast-iron box is attached, as illustrated in Figs. 2 and 3. In Fig. 2 the box

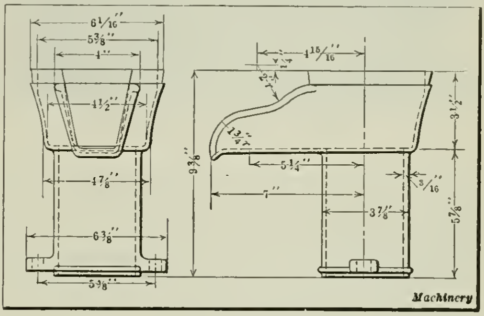

Fig. 1. Pitcher Pump Cylinder Casting

is shown closed and clamped, and the sand is jolted around a central arbor *A* which has ribs for supporting the sand and a square socket at the bottom to locate it in the cast-iron core-box. After the sand has been air-jolted, the top is swept off and the box opened as shown in Fig. 3. There is a pin in the upper end of the central arbor for lifting the core conveniently from the box. After the core has been removed from the box, it is dried in the air, the socket at the lower end of the arbor fitting over a pin to support the core while drying. In jolting this core, the arbors are wet with a clay wash so that the sand will hold, and the sand itself is, of course, dampened. Provision is made for jolting large quantities of these cores at a time and for standing them on pins where they can dry thoroughly and evenly.

Before this arrangement was adopted, blow-holes were produced in the casting by the sand not being evenly or thoroughly dry at the time that the molten iron came into contact with the core. The core-box is rigidly supported at the bottom and at the spout end, and the front cover is located by dowel-pins and can be quickly removed. These facilities make it possible for a boy to make 350 cores a day. This represents a considerable saving as compared with the former practice, which required an experienced molder and core-maker. The use of the jolting machine not only effected a saving in time of more than 50 per cent, but also produced more satisfactory cores than could be made with a hand-rammed core-box, and eliminated the expense of an experienced core-maker.

Economies in Molding Air Chambers

The Goulds piston pump is equipped with an air chamber of the style illustrated by full lines in Fig. 4. The dry sand core for producing the interior of this air chamber at one time was made in a core-box which left a hole in the curved

Fig. 2. Jolting Machine with Cast-iron Core-box in which the Core is jolted

Fig. 3. Jolting Machine shown in Fig. 2, with Front Cover of Core-box removed

end at *A* so that the casting had to be machined at this end and the hole closed with a 3/4-inch gas pipe plug. It was realized that something should be done to reduce this expensive procedure and eliminate, if possible, the necessity for plugging a hole in the casting. This was accomplished by the use of a balanced core, shaped at each end as indicated by the broken line, with a balancing connection of sand at the center so that two cores held together by this body of sand could be placed in the mold and supported without the use of chaplets or any other means. In addition, two sound castings were obtained from each mold so that the subsequent machining operations were entirely dispensed with and double the number of castings were produced in the same time.

* * *

CUTTING THERMIT WELDING COSTS

Investigations recently conducted by the research department of the Metal & Thermit Corporation indicate that the amount of thermit used in making welds is generally needlessly large, and that a saving can be effected by reducing the size of collars or reinforcements, width of gaps, and dimensions of gates and risers. It is claimed that the saving in thermit thus obtained reduces the cost of welding large members or sections at least 10 per cent, and in the case of small sections the saving is much greater.

As an example it was found that a 2- by 4-inch section for which 40 pounds of "railroad thermit" was formerly recommended, could be welded with only 10 pounds of thermit under the new specifications. On the average locomotive frame section a saving of over 10 per cent is generally effected. The use of pneumatic rammers, smaller mold boxes and various labor-saving devices introduced in the past year are also cost-reducing factors.

RESERVE SUPPLIES OF GASOLINE

The greatest reserve of gasoline in the history of the industry is now in storage in the United States, according to a statistical summary issued by the Bureau of Mines, which shows stocks totaling 818,500,000 gallons on hand March 1. The figures indicate an increase of 112,800,000 gallons over the reserve of February 1. The previous high figure set in May, 1921, is exceeded by 18,000,000 gallons. The amount of gasoline in storage March 1 is 138,000,000 gallons more than on the same date a year ago. The production of gasoline during February was 46,000,000 gallons less than for January, but was 10,000,000 gallons more than for February a year ago. The total production for February amounted to 398,223,146 gallons; the imports totaled 4,979,625 gallons, exports 38,169,593 gallons, and the domestic consumption amounted to 251,759,440 gallons.

Stocks of lubricating oils reported to the Bureau of Mines show an increase of 15,000,000 gallons during the month of February. The supply of these oils on hand March 1, amounting to 260,000,000 gallons, is the greatest since June, 1921, and lacks but 2,000,000 gallons of the high point reached in the storage of lubricating oils in May, 1921. Stocks of gas and fuel oils on hand March 1 amounted to 1,314,740,284 gallons.

* * *

New Zealand's new tariff law, as published by the British Board of Trade Journal, contains several evidences of preferential duties for imports from other parts of the British Empire. Machinery and metal products are either free or assessed at various duties up to 20 per cent if from other parts of the Empire, but are subject to from 10 to 35 per cent duty if from other parts of the world. For the most part the duties are ad valorem.

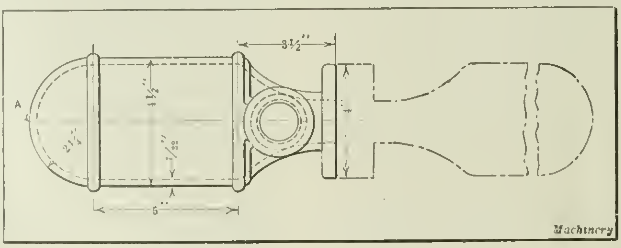

Fig. 4. Piston Pump Air Chamber and Core used in molding the Casting

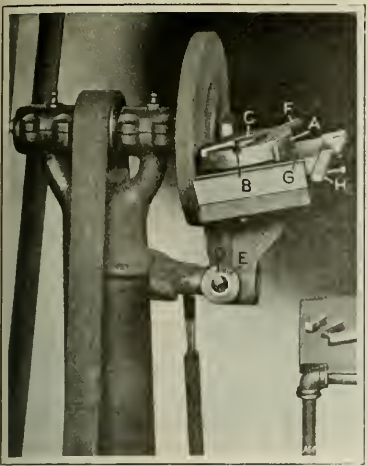

Fig. 12. Disk Grinder with Swiveling Attachment for grinding End of Chasers

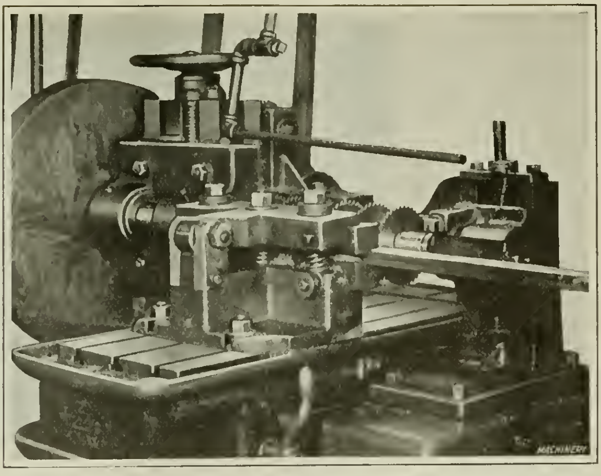

Fig. 13. Cutting Bar Stock into Blanks on a Milling Machine equipped with Multiple Saws and a Holding Fixture

Pipe Threading Tools and their Manufacture

Methods Used in Making Die-stocks and Chasers—Second of Two Articles

THE first article on pipe threading tools and their manufacture, published in May MACHINERY, contained a description of several machining operations required in the manufacture of Beaver die-stocks, as well as a detailed description of a special machine for milling the pin slots in the chaser cam-plates. The present article describes the methods employed in manufacturing the thread chasers, including the heat-treatment and inspection. The methods used for determining the pull required in threading pipe, expressed in pounds, is also included.

Making the Chasers

The steel used in manufacturing the chasers is a hot-rolled high-carbon tool steel. It is claimed that hot-rolled steel gives better results than cold-rolled steel, because the desired accuracy of the chaser can be more easily maintained with the hot-rolled product. The bars are cut off on a Becker milling machine of the Lincoln type, on the arbor of which a gang of cutting-off saws is carried. The set-up is illustrated in Fig. 13, which shows the stock held in a special fixture. The jaws of this fixture are spring-actuated, which permits the stock to be readily freed after the blanks have been cut off and it is desired to advance the bar into the jaws preparatory to cutting off another series of blanks. After the blanks are cut off, they are ground on a Blanchard or a Pratt & Whitney grinder and the pin-holes drilled in which the pins that engage the cam-plates are assembled.

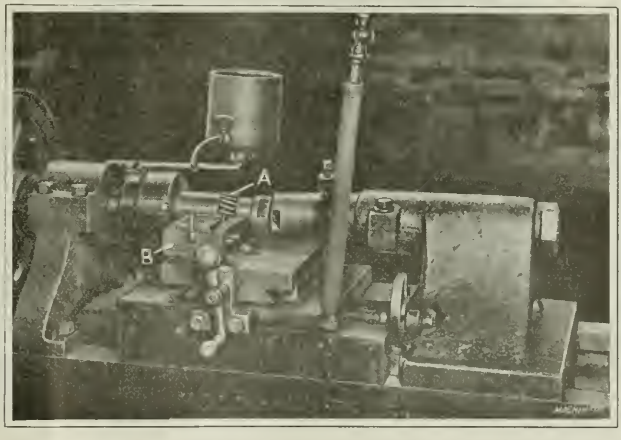

Fig. 14 Equipment used in milling the End Surfaces of the Chasers in which the Threads are subsequently cut

The next operation is that of milling a curved surface on the end of the die blanks. This surface, besides being curved, is in an angular plane, so that a taper cutter mounted in the horizontal plane of the center of the chaser is required. In Fig. 14 is shown a special milling machine equipped with a tapered cutter *A* such as just referred to. The blank is held in a slot in tool-block *B*, and is located by means of the previously assembled cam-plate pin. There is nothing novel about the design of this machine, but the outstanding feature in its construction is its rigidity. The carriage is heavy and the tailstock substantially braced. The milled surfaces produced on this machine are those in which the threads are subsequently milled.

For the thread-milling operation a special machine of the type illustrated in Fig. 15 is employed. The blank *A* is clamped to the fixture *B*, and is positioned by the pin in the work, and stop *C*. In connection with this operation, it should be borne in mind that the lead of the threads in each chaser of a set is advanced one-fourth of a turn, so that all chasers for the first position are milled at one setting of the machine. When the second lot of chasers is to be milled, it is simply necessary to advance the position of the lead-screw nut *E* a distance equal to one-fourth the pitch of the thread (provided that four chasers constitute a set), throw the nut into mesh with feed-screw *F* by means of handle *G*, and proceed as before. There is a micrometer adjustment, the knurled adjusting screw of which is shown at *D*. for setting the lead-screw nut accurately when another chaser in a set is to be milled. The third and fourth sets will be milled after advancing the lead-screw nut a like amount.

There are two operations of great importance, as regards the operation of the die-stock, which follow the thread-milling operation. These are the grinding away of the thin fin where the thread starts, and the grinding of what is termed the "lead," which is a bell-mouthed enlargement of the chaser opening to facilitate the start in cutting the thread.

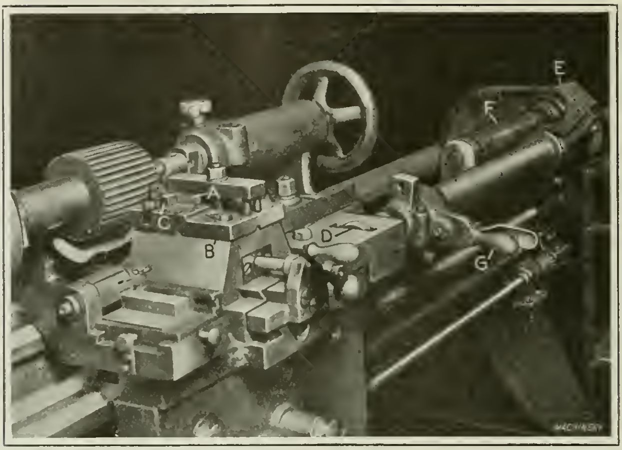

Fig. 15. Milling the Threads in the End of Chaser Blanks, using Special Machine and Tapered Milling Cutter

Chasers used on die-stocks of the type shown in Fig. 3, of the first installment of this article have an angular surface at the rear which has a cam action in relation to the inner wall of the outer housing. This angular surface is ground on the grinding machine shown in Fig. 12, to which there is attached an auxiliary rest, tilted at an angle, on which a swiveling block *A* is attached. This swiveling block has two radial slots *B* and a circular clearance space around the center post *C*, on which washers of various thicknesses may be placed so that chasers of various lengths may be ground. Two of these washers are shown at *D* and *E* hanging on a set-screw.

The swiveling block is swung back and forth, passing the end of the chasers over the grinding wheel, by means of the lever *F*. The angle at which the swiveling block is mounted corresponds, of course, with the angle required at the end of the chasers. The carriage *G* rides in parallel ways in the cast-iron base, and is operated against spring tension by handle *H*. when carriage adjustments are required. Before being sent to the hardening room, the chasers are marked to show their relative position in the die-head.

Heat-treating and Inspection

The dies are heated in molten lead, first being preheated to a temperature of between 1000 and 1100 degrees F., and later to a final hardening temperature of 1550 to 1600 degrees, depending on the grade of steel used. The quenching medium is salt water, which is agitated by a circulating pump. After hardening, the parts are drawn in oil at 350 to 400 degrees F. Two hardness tests are employed; first the hardness is tested by a file, and then it is checked by the scleroscope, the required reading being between 65 and 75. Finally, the chasers are ground on the side to gage limits on a disk grinder and sharpened.

There are a number of interesting gages used in the inspection of the chasers, three of which are illustrated in Fig. 18. The gage shown at *A* is used for inspecting the chasers for the small dies, both for length and for lead and location of the thread. There is a set of master blocks *D* provided with the gage for the purpose of setting the center indicator *E* at zero prior to the inspection of a lot of chasers. The adjustment is accomplished by means of the knurled screw *G*. After adjusting the indicator with handle *M*, it may be swung down against the chaser *F* to determine the length.

The chaser is located by stop-pin *H* against block *I*, the threads of the chaser engaging with threads in the master mating members. There are four of these masters, one at each station, as may be clearly seen at *J*. This gage may be used to check the elements of all the chasers in a set of four by indexing the turret *K*, which may be locked by key *L*. If the chaser does not properly engage the master on the turret, it is too long, and this will be indicated on the graduated scale of the center indicator.

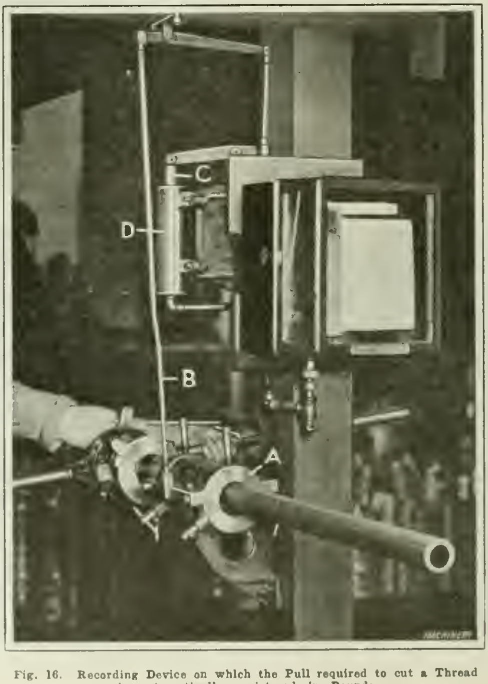

Fig. 16. Recording Device on which the Pull required to cut a Thread is automatically registered in Pounds

The gage shown at *B* in this illustration is used for checking the over-all length and the pitch of threads on the larger sized chasers. The chasers are located by the cam-pin against block *N*, in which position they are inspected by means of the two micrometer heads with which the gage is provided. The anvil *O* of one of these heads has a conical point to correspond with the angle of thread, in which it engages for checking the length. The other micrometer spindle is then used to check the distance from the thread in which the pointed anvil is engaged to the side of the gage against which the chaser rests. This checks the proper location of the threads.

The gage shown at *C* consists of a block carrying a master gage *P* which has the appearance of a pipe tap. By turning this master gage so that the chasers of a set may be successively inspected, and by the use of a dial gage, the length and thread may be quickly tested. The chaser is

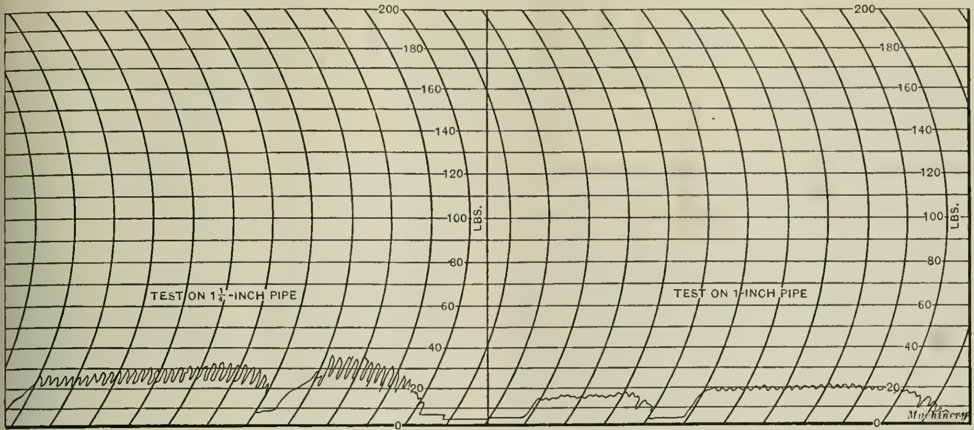

Fig. 17. Reproduction of a Section of the Recorder Tape on which the Amount of Pull in Pounds is registered

located in the gage against a block, and is held in contact with the master gage by a spring block Q, which may be withdrawn from contact with the end of the chaser by means of knob R. A flat spring S exerts tension against the side of the chaser and serves to hold it in the proper position for gaging.

After the work has been placed in the position described, the operator permits the spring block Q to bear against the end of the chaser, noting at the same time the reading of the dial indicator. This shows him, at a glance, the deviation, if any, that exists in the length; the engagement of the threads of the chaser with the master gage may also be readily observed. The spring block carries a pin T on the side which is held in contact with another pin U, driven into the small cross-shaft V, by a light coil spring. As the cross-shaft V is rocked when the spring block is moved in and out, a finger on the opposite side of the shaft extends under the vertical plunger W of the dial indicator and operates the indicator needle. In setting this master gage, it is necessary, of course, to obtain a zero reading on the dial, and this is done by regulating the adjusting screw X at the rear of the gage.

Recording the Pull Required to Cut a Pipe Thread

The method of testing the pull required to cut a thread with die-stocks of various sizes is of considerable interest. The apparatus used is illustrated in Fig. 16 and consists, briefly, of a Bristol recording instrument, which is operated by hydraulic pressure through the medium of a series of levers, so that the exact amount of exertion required to thread a pipe is graphically recorded on a chart. As the die-stock is turned, the vise A in which the pipe is held, can swivel slightly, due to the force exerted by the operator, with the result that the connecting-rod B and a series of levers operate the plunger C in the oil cylinder D, producing an amount of pressure which shows the exertion required to cut a thread. The number of pounds pull required is recorded on the chart.

The tape in the recorder travels at the rate of 6 inches per minute, so that in addition to the pull required, it is possible to determine very closely the amount of time consumed in the operation. A section of one of these recorder tapes is reproduced in Fig. 17, showing the results of tests made on pipe of 1 inch and 1¼ inches diameter, respectively. In the first instance a pull of 20 pounds was exerted during the first part of the work. It will be noticed that the traced line then drops abruptly down, during which period the operator was probably engaged in oiling the chasers. At the resumption of the pull after oiling, the pressure is shown to be about 3 pounds less than before oiling. Referring to the other test, it will be noticed that the maximum pull was 38 pounds before oiling; the recording needle dropped down during the oiling operation, and afterward a maximum pull of 34 pounds was exerted.

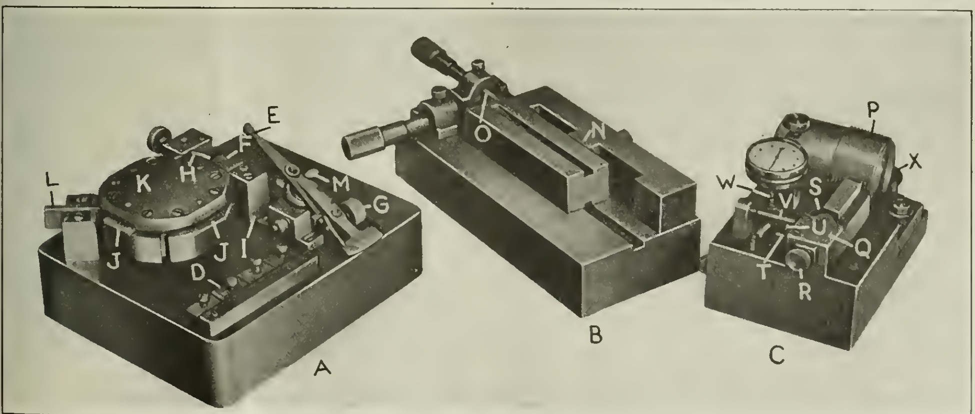

Fig. 18. Group of Master Gages used in inspecting the Various Types of Pipe Thread Chasers

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MACHINE TOOL STANDARDIZATION

The important decision reached at the last meeting of the National Machine Tool Builders' Association, to undertake extensive standardization work, will be welcomed by the entire metal-working industry. Lack of standardization, which prevents using cutting tools, fixtures, and accessories interchangeably on different makes of machine tools, has added greatly to manufacturing costs by increasing the amount of tool equipment required. The cooperation now existing between the National Machine Tool Builders' Association and the American Society of Mechanical Engineers, fostered by the American Engineering Standards Committee, will undoubtedly result in noteworthy economies, both to builders and users of machine tools.

In his address before the National Machine Tool Builders' convention, A. H. Tuechter, the president, emphasized the needs for standardization, and referred to the growing demand for it from users of machine tools. Mr. Tuechter mentioned one case where the standardization of the dimensions of one hole enabled the manufacturer to utilize more than $5000 worth of tool equipment which he was using on another machine. Mr. Tuechter also referred to the standardization of milling machine spindles by the Associated British Machine Tool Makers, which will enable the interchangeable use of milling cutters and arbors.

In connection with this new departure by the National Machine Tool Builders' Association, it is not intended to standardize the individual features of machines which may be considered superior to those of competing tools—driving and feeding mechanisms, for example, may be of different designs without being subject to standardization. It is to the advantage of the user that improvements are continually being made in such features. Standardization is required principally in the work-holding and tool-holding parts or appliances of machines, and this important feature of the work should be undertaken first. Should it be found desirable later to standardize other features, this can be done step by step, in accordance with the judgment and experience of the manufacturers themselves. The buyer is interested principally in the interchangeability of tooling equipment between machines of different makes, and he is justified in asking for the standardization that directly affects this.

* * *

UNIFORM APPRENTICESHIP SYSTEMS

The need for a uniform apprenticeship system in the metal-working industries is generally recognized and a most promising step toward meeting it has been taken by the National Metal Trades Association in endorsing the report presented at the annual meeting by Harold C. Smith, president of the Illinois Tool Works of Chicago, who is chairman of the Industrial Training Committee of the association. His report provides for an apprenticeship system in which is embodied many good features of several systems that have been in use in American shops, and also includes a number of suggestions relating to new and improved features. A thorough examination of apprenticeship systems now used in various shops and in communities where manufacturers cooperate in the training of young shop men, was made by the committee. The report frames courses of shop training, suggests a standard diploma for apprentices in the metal-working industries, and provides for an exchange of apprentices among shops which are too small to furnish alone thorough and all-around training.

The committee dealing with the problem is one that commands the respect of the entire metal-working industry, the members, besides Mr. Smith, being John C. Spence, works manager of the Grinding Machine Division of the Norton Co., Worcester, Mass., and William Taylor of the Chandler & Taylor Co., Indianapolis, Ind. Manufacturers everywhere are strongly urged to investigate thoroughly the proposed apprenticeship system, and to arrange for putting it into effect in their own plants.

Where shops are too small to maintain individually the kind of apprenticeship system proposed, some active manufacturer should begin immediately to cooperate with his neighbors and start a group movement in his community. If shops are running at greatly reduced capacity it may not be possible to begin actual operation immediately; but plans can be formulated now, while there is ample time for that part of the work, and carried out when business is more active. The future of the American machine-building industries undoubtedly depends upon a constantly increasing supply of highly skilled all-around mechanics.

* * *

SHOP PRACTICE AND DESIGN

A designing engineer said recently that the present tendency in technical book publishing was to bring out a great many books on shop practice but very few on subjects pertaining specifically to machine design. He felt that the needs of the designer were being overlooked; but in this assumption he was in error.

During the early period of technical book publishing, the larger number of volumes related to machine design—the theoretical or preliminary part of the work necessary to produce a machine or mechanism. In recent years the tendency has been to record more accurately and comprehensively than formerly, methods of building or manufacturing machines and mechanisms efficiently—that is, at the lowest cost commensurate with the required quality. There is a very good reason for this change.

The most important work of the machine designer is not merely to produce a mechanism that will function mechanically, but one that will meet this requirement and that also can be sold at a price which will insure for it a market. A widely known machine tool designer has said that anybody can design a machine to do almost anything, but that it takes real brains to design a machine that will do what is wanted at a reasonable cost.

This is one reason that accurate and complete information on shop methods and manufacturing procedure is so important. The successful machine designer must not only know how to design a machine or apparatus that will function according to mechanical laws, but he must also understand how the machine is to be built and how the parts are to be machined and assembled, so that every part incorporated in the machine will be so designed and arranged that it can be produced at the minimum cost. That is real machine designing, and in order to impart to designers this knowledge, publishers have brought out better literature on modern shop methods. The designer's needs have not been neglected thereby; they have been taken better care of.

Spring Meeting of Mechanical Engineers

AT the spring meeting of the American Society of Mechanical Engineers, held at Atlanta, Ga., May 8 to 11, mechanical engineering problems that are especially pressing for solution in the South were dealt with. A great deal of attention was given to the design, construction, and maintenance of textile machinery. A session of considerable interest in the machine-building field, relating to oxy-acetylene, electric, and forge welding methods, proved of great value to the engineers present. The technical program of the meeting was spread over three days and included two general sessions, two textile machinery sessions, and one session each on materials handling, fuels, power, management, and welding.

Investigations Relating to Oxy-Acetylene, Electric and Forge Welding

In a paper entitled "The Strength of Electrically Welded Pressure Containers," R. J. Roark of Madison, Wis., described pressure tests made on electrically welded, gas-welded, and riveted pressure containers, and tension and shear tests made on specimens cut from such containers and on specially prepared specimens of welded metal. The tests were made for the Vilter Mfg. Co., of Milwaukee, Wis., and had for their purpose the demonstrating of the strength and uniformity of construction in which the electrical weld is employed.

The results of the tests indicate that in containers of the type studied, electrically welded head joints are sufficiently strong to develop the full strength of the shell and heads; that it is practicable to make electrically welded joints which are uniform in respect to tensile strength, shearing strength, and structure of fused metal; that for the particular combination of metals tested, the tensile strength of such welded joints is about 28,500 pounds per square inch and the shearing strength about 25,500 pounds per square inch; that for the combination tested, the metal in the weld is less strong and less ductile than either the base metal or the filling metal before fusion; that the electrically welded joints tested were stronger in shear but weaker in eccentric tension than the riveted joints tested.

An extensive paper dealing with the principles of construction of unfired pressure vessels was prepared by S. W. Miller, of the Rochester Welding Works. In this paper the author discussed, in general terms, forge and fusion welding and riveting, and commented on the factors affecting welding efficiency. The composition of the best base weld metal and welding wire was touched on, and proper welding conditions were mentioned. The weakness of the single V-weld was pointed out, and the use of lower-tensile-strength material advocated. The question of relieving welding strains by annealing was also treated, these and the foregoing observations being all based on the practical experience of the author.

Professor E. A. Fessenden and Professor L. J. Bradford, both of State College, Pa., had prepared a paper giving the results of tests made on welded cylinders, in which four types of construction were referred to: (1) Flange-steel shell, acetylene-welded longitudinal seam, concave heads forge-welded to shell; (2) seamless-pipe shell, convex heads acetylene-welded to shell; (3) seamless-pipe shell, concave heads forge-welded to shell; and (4) flange-steel shell, acetylene-welded longitudinal seam, convex heads acetylene-welded to shell. This paper described the method of conducting the tests, presented the data obtained, and discussed the results. The authors concluded that vessels having forge-welded heads are the least reliable and that burnt steel is often present in the weld. They also stated that the principal defects in acetylene welds are the coarse granular structure and occasional porous spots and pin-holes that develop with high pressures, and poor adhesion of the welding material. Remedies for these defects were proposed.

Another paper of interest in connection with welding practice was that presented by Frank N. Speller, of the National Tube Co., Pittsburg, Pa., in which the principal factors—the method of manufacture, chemical composition, fluxing quality, susceptibility to heat and welding temperature—affecting the welding quality of steel were discussed and the average results of eighty tests made on forge welds of hammer-welded pipe, as compared with the original material were given. Tests have demonstrated that steel with not over 0.15 per cent carbon and a minimum tensile strength of 47,000 pounds per square inch, and with not over 0.20 per cent carbon and a minimum tensile strength of 52,000 pounds per square inch, is satisfactory for forge-welding of pipe lines, penstocks, tank-car work, and similar construction.

Care and Maintenance of Textile Machinery

The maintenance of textile machinery was dealt with in a paper by Edwin H. Marble, president of the Curtis & Marble Machine Co., Worcester, Mass., particular attention being called to the value of ball bearings in textile machinery, and the importance of proper lubrication. Reference was also made to a number of the common abuses of textile machinery and means suggested for preventing neglect in the care of this type of machines.

A paper on weaving machinery, by L. B. Jenckes of the Compton & Knowles Loom Works, Worcester, Mass., described in a general way the development of the weaving art, and dealt briefly with the most interesting developments in modern looms and the functions of parts of these machines.

The paper "Modern Shop Practice in the Building of Revolving Flat Cards," by F. E. Banfield, Jr., Newton Upper Falls, Mass., gave details of special machines developed for this work and showed how much the production cost per unit has been lowered by efficient shop arrangement, careful machine design, and standardization.

Material-handling Equipment

The material-handling equipment used in the iron and steel industry was dealt with in a paper read by F. L. Leach, of Perin & Marshall, New York City. This paper described the handling machinery and apparatus used in the manufacture of steel. From the time that the ore leaves the mines until the steel goes through the last process at the mill it is moved about by different types of heavy machinery designed especially for the purpose. The author expressed the hope that through his description, attention will be given to weak points in present-day practice and means of improvement be suggested.

Power and Fuel Session

The papers relating to power and fuel dealt with "Power Development in the Southeast"; "Economics of Water-Power Development"; "Hydro-electric Power-plant Design"; "The Accuracy of Boiler Tests"; "Boiler-room Performance and Practice of Colfax Station, Duquesne Light Co."; "The Control of Boiler Operation"; "Efficiency Tests of a 60,000-kilowatt Cross-compound Triple-cylinder Steam Turbine"; "Using Exhaust Energy in Reciprocating Engines"; and "Reduction of Fuel Waste in the Steel Industry."

Copies of any of the papers mentioned may be obtained upon application to the American Society of Mechanical Engineers, 29 W. 39th St., New York City.

The Gleason Works System of Bevel Gears*

By F. E. McMULLEN and T. M. DURKAN of the Gleason Works, Rochester, N. Y.

For a long time a need has been felt for a definite system of designing bevel gear teeth, which would give the most desirable tooth form for use under average conditions. It has been common practice in the past to use spur gear formulas, such as those of Brown & Sharpe, in figuring bevel gears. These formulas were worked out for an interchangeable spur gear system, which necessarily required some compromise, so that when they are applied to bevel gears, where interchangeability is not a factor, the possibilities of the involute curve are not fully utilized. The Gleason 0.3 and 0.7 long and short addendum tooth was brought out to improve this condition, and various other alterations of the standard spur gear design have been used, but for the most part these can be applied to certain combinations only, and therefore are not universal. Recent applications of bevel gearing covering a wide range of ratios have made it imperative that a system embracing all ratios and any number of teeth in common use, be worked out.

An investigation has been conducted by the Gleason Works with the idea of developing a practical system of designing the quietest form of tooth consistent with strength and wear considerations, and the results of this research have been incorporated in simple tabular form. This system applies to any pair of generated spiral or straight-tooth bevel gears operating at right angles where the pinion is the driver and has ten or more teeth. Bevel gears cut on former-type planers are the subject of a special study, as the system cannot be applied to such gears without modification.

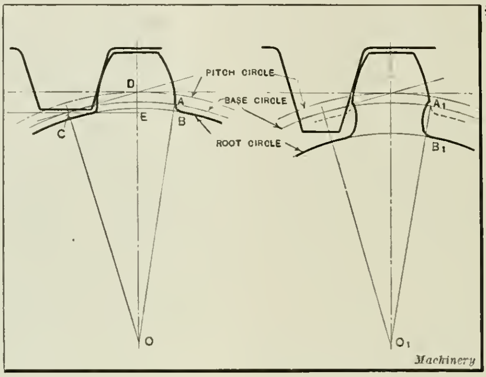


Fig. 1. Involute Tooth in Mesh with Rack

Fig. 2. Longer Rack Tooth and Resulting Under-cut

Factors Governing Selection of Pressure Angle

The principal qualities considered in arriving at this system, arranged in the order of their importance, are quietness, strength and durability. In regard to quietness, experience shows that bevel gears cut with a lower pressure angle will operate more quietly than those with a higher one, other conditions being equal. There are several reasons for this: When the lower pressure angle is used, a greater arc of action is obtained, any eccentricity has less effect, and the radial component of the tooth load is minimized. Thrust forces also make it desirable to avoid the higher angle, not only because of the introduction of an axial or cone thrust not present in spur gears, but also because the majority of bevel gears are overhung from their supports, so the total load should be kept as low as possible. For these reasons the basis of the system is the use of the lowest pressure angle that can be employed without sacrificing strength by introducing excessive under-cut.

Under-cut in Connection with Bevel Gears

It might be well to describe what is meant by under-cut. In Fig. 1 is shown an involute tooth in mesh with a rack. The tooth profile consists of two parts, namely, the involute curve which has its origin at *A* and continues to the top of the tooth, and the fillet *AB* lying between the base and root circles. If the rack, which represents the generating tool, does not project below point *C*, beyond which involute action cannot take place, the fillet *AB* will always lie outside of a radial line *OA* drawn from the origin of the involute. When the rack tooth is made longer so that it extends below point *C*, the condition is as shown in exaggerated form in Fig. 2. In this diagram the fillet A_1 B_1 is seen to come inside of a radial line O_1 A_1 and also to cut away part of the involute curve slightly.

An examination of Fig. 1 shows that the value for dimension *DE*, which is the distance from *C* to the pitch line, is equal to the back cone radius *DO* $\times$ $\sin^2$ pressure angle so that a generated bevel gear tooth may be said to be under-cut when the dedendum is greater than the back cone radius $\times$ $\sin^2$ pressure angle. However, it can be shown mathematically that it is possible to exceed this value consider-

*Abstract of a paper read before the American Gear Manufacturers' Association, April 22.

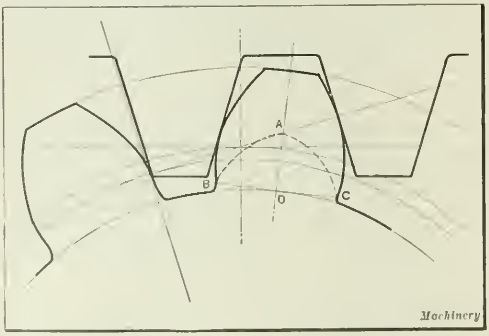


Fig. 3. Spiral Bevel Gear of 10—47-tooth Ratio and 14½-degree Pressure Angle

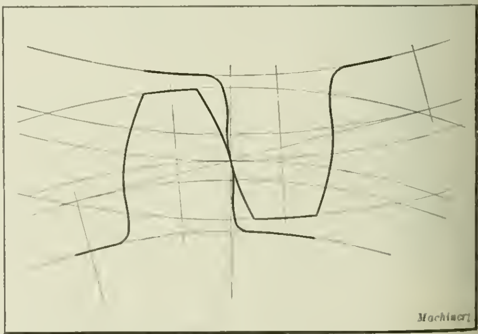


Fig. 4. Straight Bevel Gear of 14—16-tooth Ratio and 14½-degree Pressure Angle

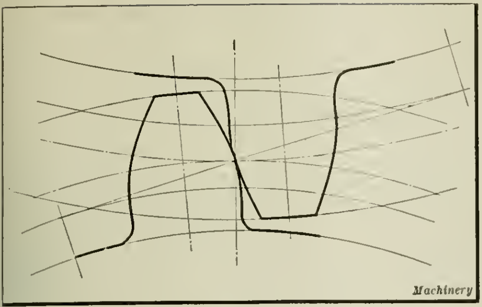


Fig. 5. Straight Bevel Gear of 14—16-tooth Ratio and 17½-degree Pressure Angle

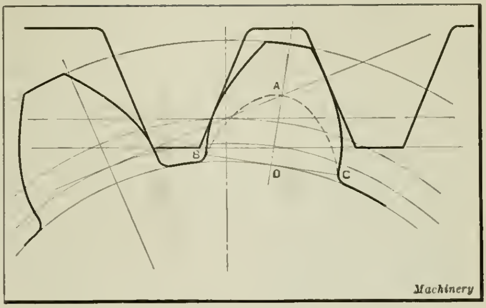


Fig. 6. Spiral Bevel Gear of 10—47-tooth Ratio and 20-degree Pressure Angle

ably before there is any appreciable under-cut; in fact, for the ordinary automobile rear axle pinion having anywhere from ten to thirteen teeth, the dedendum is nearly always more than this critical value, sometimes being as much as 100 per cent greater. The point at which to limit under-cut in the present system has been determined by a study of successful automobile practice, because that application represents a condition where both silence and strength are paramount.

The 10–47-tooth 14½-degree spiral bevel ratio shown in Fig. 3 has a pinion dedendum 60 per cent greater than the back cone radius × sin² pressure angle, and although the under-cut is about as great as for any job in the spiral bevel system, it cannot be called excessive. Likewise, the 14–16-tooth 14½-degree straight bevel gears shown in Fig. 4 represent as extreme a case of under-cut as will be encountered in the straight-tooth system; yet they have a tooth profile which is not weakened to any great extent. The same ratio with a 17½ degree pressure angle is shown in Fig. 5, but the strength of the gears is increased less than 5 per cent, although it has the appearance of being more than this.

Pressure Angle and Strength

The selection of a low pressure angle in preference to a higher one does not result in a considerably weaker tooth, as is ordinarily supposed, because the stronger section of the higher pressure angle tooth is offset by the greater arc of action with the lower angle. Reference to Figs. 3 and 6 will make this clear. Fig. 3 shows a 10–47-tooth ratio with a 14½-degree pressure angle, and in Fig. 6 the same ratio is laid out with a 20-degree pressure angle. In each case the pinion tooth at the left is just on the point of engaging so that the tooth at the right is carrying the full load. This is the worst condition of loading on each tooth as any further movement to the right brings another tooth into contact, with consequent distribution of the load over two teeth, while movement to the left lowers the line of application of the force toward the base of the tooth.

In this position the comparative strength of the teeth can be found by passing a parabola through the intersection point A (See Figs. 3 and 6) of the line of action and the center line of the tooth, and tangent to the tooth profile. The value of $(BC)^2 \div AD$, which is a measure of the strength, can then be obtained. For the 10–47-tooth ratios shown in Figs. 3 and 6, the 20-degree gear is about 14 per cent stronger than the 14½-degree gear, but the pinions are of equal strength. The 20-degree gear, however, is much more difficult to caseharden on accouut of the narrow width of the top land. A pair of 15-tooth 14½-degree and another pair of 15-tooth 20-degree miter gears are shown in Figs. 7 and 8; here the 20-degree gear is less than 10 per cent stronger than the 14½-degree gear.

This method of calculating the strength is similar to that used in deriving the Lewis formula, except as regards the point of application of the load. The Lewis formula is based on the assumption that the load is applied at the end of the tooth, but in modern generated gearing this is a condition that practically never occurs. Professor Marx, in his experiments at Leland Stanford University, found that the force was not at the end of the tooth when failure took place, and also proved that the strength was increased as the arc of action became greater. From a consideration of these conditions, it is evident that the choice of a 14½-degree instead of a 20-degree pressure angle is not made at any extreme sacrifice of strength, but that for a large number of designs there is very little difference between the two.

Wear as Related to Sliding Action and Unit Pressure

The question of durability, viewed from a theoretical standpoint, would seem to resolve itself into a problem of obtaining a minimum of sliding and a maximum of rolling motion, as it is natural to assume that the wear would vary directly with the sliding action. But it is well known that the greatest wear often takes place near the pitch point where there is no sliding action. This is because the big factor causing wear is unit pressure and not sliding action. When the

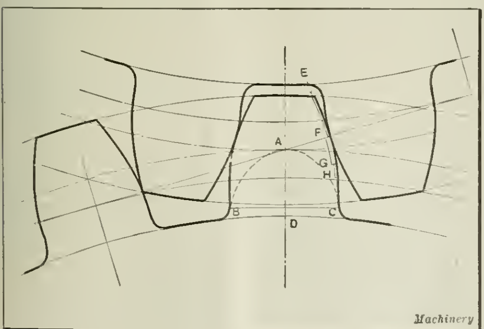


Fig. 7. Spiral Bevel Miter Gear, 15 Teeth, 14½-degree Pressure Angle

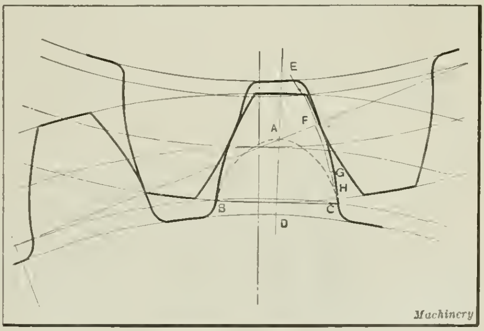


Fig. 8. Spiral Bevel Miter Gear, 15 Teeth, 20-degree Pressure Angle

TABLE 1. GLEASON WORKS SYSTEM FOR GENERATED STRAIGHT-TOOTH BEVEL GEARS

For Straight-tooth Bevel Gears Only, Operating at Right Angles, where Pinion is Driver and has Ten or More Teeth.

$$\text{Working Depth} = \frac{2.000''}{\text{D.P.}} \qquad \text{Full Depth} = \frac{2.188''}{\text{D.P.}}$$

Pressure Angle

	Deg.
Ratios having 14 or more teeth in pinion	14½
Ratios 13–13 to 13–24	17½
Ratios 13–25 and higher	14½
Ratios 12–12 and higher	17½
Ratios 11–11 to 11–14	20
Ratios 11–15 and higher	17½
Ratios 10–10 and higher	20

Addendum

$$\text{Addendum of gear} = \frac{\text{Addendum for 1 D.P. (Table 2)}}{\text{D.P}}$$

$$\text{Addendum of pinion} = \frac{2.000''}{\text{D.P.}} - \text{addendum of gear}$$

Dedendum

$$\text{Dedendum of gear} = \frac{2.188''}{\text{D.P.}} - \text{addendum of gear}$$

$$\text{Dedendum of pinion} = \frac{2.188''}{\text{D.P.}} - \text{addendum of pinion}$$

Circular Thickness

Circular thickness of gear for all ratios using 14½° =

$$\frac{1.071''}{\text{D.P.}} + \left[0.5 \times \text{addendum of gear}\right] - \frac{\text{K (Table 2)}}{\text{D.P.}}$$

Circular thickness of gear for all ratios using 17½° =

$$\frac{0.971''}{\text{D.P.}} + \left[0.6 \times \text{addendum of gear}\right] - \frac{\text{K}}{\text{D.P.}}$$

Circular thickness of gear for all ratios using 20° =

$$\frac{0.871''}{\text{D.P.}} + \left[0.7 \times \text{addendum of gear}\right] - \frac{\text{K}}{\text{D.P.}}$$

Circular thickness of pinion for 14½°, 17½° or 20° =

$$\frac{3.142''}{\text{D.P.}} - \text{circular thickness of gear}$$

Machinery

TABLE 2. GLEASON WORKS SYSTEM FOR STRAIGHT-TOOTH BEVEL GEARS

Addendum for 1 Diametral Pitch

To obtain addendum select from table value corresponding to ratio given by the formula:

$$\text{Ratio} = \frac{\text{Number of teeth in gear}}{\text{Number of teeth in pinion}}$$

Ratios From	Ratios To	Add., Inch	Ratios From	Ratios To	Add., Inch	Ratios From	Ratios To	Add., Inch	Ratios From	Ratios To	Add., Inch
1.00	1.00	1.000	1.15	1.17	0.880	1.42	1.45	0.760	2.06	2.16	0.640
1.00	1.02	0.990	1.17	1.19	0.870	1.45	1.48	0.750	2.16	2.27	0.630
1.02	1.03	0.980	1.19	1.21	0.860	1.48	1.52	0.740	2.27	2.41	0.620
1.03	1.04	0.970	1.21	1.23	0.850	1.52	1.56	0.730	2.41	2.58	0.610
1.04	1.05	0.960	1.23	1.25	0.840	1.56	1.60	0.720	2.58	2.78	0.600
1.05	1.06	0.950	1.25	1.27	0.830	1.60	1.65	0.710	2.78	3.05	0.590
1.06	1.08	0.940	1.27	1.29	0.820	1.65	1.70	0.700	3.05	3.41	0.580
1.08	1.09	0.930	1.29	1.31	0.810	1.70	1.76	0.690	3.41	3.94	0.570
1.09	1.11	0.920	1.31	1.33	0.800	1.76	1.82	0.680	3.94	4.82	0.560
1.11	1.12	0.910	1.33	1.36	0.790	1.82	1.89	0.670	4.82	6.81	0.550
1.12	1.14	0.900	1.36	1.39	0.780	1.89	1.97	0.660	6.81	∞	0.540
1.14	1.15	0.890	1.39	1.42	0.770	1.97	2.06	0.650	......	....	......

Values of K for Circular Thickness Formula

Select value corresponding to number of teeth in pinion and ratio given by formula.

Values of K (in Inches) for Different Ratios

Number of Teeth in Pinion	Ratios 1.00 to 1.25	1.25 to 1.50	1.50 to 1.75	1.75 to 2.00	2.00 to 2.25	2.25 to 2.50	2.50 to 2.75	2.75 to 3.00	3.00 to 3.25	3.25 to 3.50	3.50 to 3.75	3.75 to 4.00	4.00 to 4.50	4.50 to 5.00	5.00 and higher
10	0.025	0.070	0.100	0.120	0.140	0.160	0.175	0.190	0.205	0.215	0.225	0.230	0.240	0.250	0.255
11	0.010	0.015	0.050	0.080	0.105	0.125	0.145	0.160	0.170	0.180	0.190	0.195	0.200	0.210	0.220
12	0.000	0.040	0.070	0.100	0.120	0.140	0.155	0.170	0.180	0.185	0.190	0.195	0.205	0.210	0.215
13	0.000	0.015	0.040	0.045	0.050	0.060	0.070	0.080	0.090	0.100	0.110	0.120	0.135	0.150	0.165
14	0.000	0.015	0.030	0.050	0.065	0.080	0.090	0.100	0.110	0.120	0.125	0.130	0.140	0.150	0.160
15 to 17	0.000	0.000	0.010	0.020	0.030	0.045	0.060	0.070	0.080	0.090	0.095	0.100	0.110	0.115	0.120
18 to 21	0.000	0.000	0.000	0.000	0.010	0.030	0.045	0.060	0.070	0.080	0.085	0.090	0.095	0.100	0.100
22 to 29	0.000	0.000	0.000	0.000	0.010	0.030	0.040	0.050	0.060	0.065	0.070	0.070	0.080	0.085	0.085
30 and up	0.000	0.000	0.000	0.000	0.010	0.025	0.035	0.040	0.045	0.050	0.055	0.060	0.065	0.070	0.070

Machinery

TABLE 3. GLEASON WORKS SYSTEM FOR GENERATED SPIRAL BEVEL GEARS

For Spiral Bevel Gears Only, Operating at Right Angles, where Pinion is Driver and has Ten or More Teeth.

Working Depth $= \dfrac{1.700''}{\text{D.P.}}$ Full Depth $= \dfrac{1.888''}{\text{D.P.}}$

Pressure Angle

	Deg.
Ratios having 12 or more teeth in pinion	14½
Ratios 11–11 to 11–19	17½
Ratios 11–20 and higher	14½
Ratios 10–10 to 10–24	17½
Ratios 10–25 and higher	14½

Addendum

Addendum of gear $= \dfrac{\text{Addendum for 1 D.P. (Table 4)}}{\text{D.P.}}$

Addendum of pinion $= \dfrac{1.700''}{\text{D.P.}} - \text{addendum of gear}$

Dedendum

Dedendum of gear $= \dfrac{1.888''}{\text{D.P.}} - \text{addendum of gear}$

Dedendum of pinion $= \dfrac{1.888''}{\text{D.P.}} - \text{addendum of pinion}$

Circular Thickness

Circular thickness of gear for all ratios using 14½° =

$$\frac{1.061''}{\text{D.P.}} + \left[0.6 \times \text{addendum of gear}\right] - \frac{\text{K (Table 4)}}{\text{D.P.}}$$

Circular thickness of gear for all ratios using 17½° =

$$\frac{0.976''}{\text{D.P.}} + \left[0.7 \times \text{addendum of gear}\right] - \frac{\text{K}}{\text{D.P.}}$$

Circular thickness of pinion for 14½° or 17½° =

$$\frac{3.142''}{\text{D.P.}} - \text{circular thickness of gear}$$

Machinery

point of contact is near the pitch point, all the load is borne by one tooth, while it is distributed over two teeth near the beginning or end of the action with a consequent reduction of unit pressure.

In Figs. 7 and 8 the part of the pinion profile that will wear most rapidly is *FG*, because it has to carry the whole load; *EF* and *GH* will not wear as fast, even though the sliding action is higher, on account of the lower unit pressure. For this reason no attempt has been made in this system to maintain any predetermined percentage of rolling action, but rather to balance, between approach and recess, the amount of rolling already fixed by the requirements of quietness and strength. Wherever possible, the action during approach has been favored in order to compensate for the change in direction of the friction component which tends to increase the obliquity of the line of action during approach and decrease it during recess. Account has also been taken of the high velocity of sliding action which occurs

TABLE 4. GLEASON WORKS SYSTEM FOR SPIRAL BEVEL GEARS

Addendum for 1 Diametral Pitch

To obtain addendum, select from table value corresponding to ratio given by the formula:

$$\text{Ratio} = \frac{\text{Number of teeth in gear}}{\text{Number of teeth in pinion}}$$

Ratios From	Ratios To	Add., Inch	Ratios From	Ratios To	Add., Inch	Ratios From	Ratios To	Add., Inch	Ratios From	Ratios To	Add., Inch
1.00	1.00	0.850	1.15	1.17	0.750	1.41	1.44	0.650	1.99	2.10	0.550
1.00	1.02	0.840	1.17	1.19	0.740	1.44	1.48	0.640	2.10	2.23	0.540
1.02	1.03	0.830	1.19	1.21	0.730	1.48	1.52	0.630	2.23	2.38	0.530
1.03	1.05	0.820	1.21	1.23	0.720	1.52	1.57	0.620	2.38	2.58	0.520
1.05	1.06	0.810	1.23	1.26	0.710	1.57	1.63	0.610	2.58	2.82	0.510
1.06	1.08	0.800	1.26	1.28	0.700	1.63	1.68	0.600	2.82	3.17	0.500
1.08	1.09	0.790	1.28	1.31	0.690	1.68	1.75	0.590	3.17	3.67	0.490
1.09	1.11	0.780	1.31	1.34	0.680	1.75	1.82	0.580	3.67	4.56	0.480
1.11	1.13	0.770	1.34	1.37	0.670	1.82	1.90	0.570	4.56	7.00	0.470
1.13	1.15	0.760	1.37	1.41	0.660	1.90	1.99	0.560	7.00	∞	0.460

Values of K for Circular Thickness Formula

Select value corresponding to number of teeth in pinion and ratio given by formula.

Number of Teeth in Pinion	Ratios 1.00 to 1.25	1.25 to 1.50	1.50 to 1.75	1.75 to 2.00	2.00 to 2.25	2.25 to 2.50	2.50 to 2.75	2.75 to 3.00	3.00 to 3.25	3.25 to 3.50	3.50 to 3.75	3.75 to 4.00	4.00 to 4.50	4.50 to 5.00	5.00 and higher
	Values of K (in Inches) for Different Ratios														
10	0.020	0.055	0.085	0.105	0.125	0.125	0.110	0.120	0.130	0.140	0.150	0.155	0.160	0.170	0.180
11	0.030	0.075	0.105	0.070	0.085	0.095	0.105	0.115	0.125	0.135	0.140	0.145	0.150	0.155	0.160
12 to 13	0.005	0.015	0.025	0.035	0.045	0.055	0.065	0.075	0.085	0.095	0.105	0.115	0.125	0.135	0.135
14 to 16	0.000	0.005	0.015	0.025	0.035	0.050	0.060	0.075	0.085	0.095	0.100	0.105	0.105	0.105	0.105
17 to 19	0.000	0.000	0.005	0.015	0.025	0.035	0.050	0.065	0.075	0.085	0.090	0.090	0.090	0.090	0.090
20 and up	0.000	0.000	0.000	0.005	0.015	0.025	0.040	0.050	0.055	0.060	0.060	0.060	0.060	0.060	0.060

Machinery

at the top of long addendum pinion teeth and which, in extreme cases, has led to abrasion. Safe values for this sliding action were obtained from jobs in service and the design regulated so that these were not exceeded.

How the System was Established

In establishing the various factors that go to make up the system, the aim was to arrange them in as simple and practicable a form as possible without sacrificing any of the three principal qualities of quietness, strength, and durability. In a non-interchangeable system like the one here presented, any of the factors can be made to vary for each ratio and number of teeth, but simplicity and the interests of standardization are opposed to expressing these factors as variable quantities when the probable accuracy of the assumptions made in determining them does not warrant it.

An example of this is the pressure angle. In a purely theoretical system it might have any value, while the same practical results are obtained in this system, which includes all ratios having ten or more teeth in the pinion, with the use of three angles (14½, 17½, and 20 degrees) for straight-tooth bevel gears and one angle (14½ degrees) in all except a few unusual cases, for spiral bevel gears. The pressure angle to be used for any given pair of gears is specified in Tables 1 and 3, and has been selected as the lowest angle which avoids excessive under-cut.

The introduction of the pressure angle of 17½ degrees, which is not universally used, is considered necessary in order to carry out the stated purpose of developing a practical system which will give the quietest form of tooth consistent with strength and wear. It has been found by experience that there is a decided increase in noise when the pressure angle is changed from 14½ to 20 degrees, so that in order not to compromise the system when the under-cut becomes too great with 14½ degrees, an intermediate pressure angle is used. The angle of 17½ degrees has been selected because it has already been used to quite an extent by different gear manufacturers. Although at least one pressure angle between 14½ and 20 degrees is required, more are unnecessary because any new angle would not be more than 1½ degrees different from the three selected, and this change is too small to have any practical effect.

Working Depth and Clearance

The working depth of tooth, which has been fixed as 2 inches ÷ diametral pitch for straight-tooth bevel gears and as 1.7 inches ÷ diametral pitch for spiral bevel gears, is the same as has been successfully used for a number of years. For the average spiral angle of about 30 degrees, the normal pitch is approximately 85 per cent of the linear pitch, so the normal section of a spiral tooth will be proportioned about the same as a straight tooth. Originally the working depth for both straight and spiral bevel gears was made equal to 2 inches ÷ diametral pitch, but some years ago the depth for spiral bevel gears was decreased to 85 per cent of this amount, because the top of the tooth on the normal was too thin and gave rise to hardening troubles. Stubbing the tooth more than 85 per cent decreased the arc of action and gave a noisier gear. It would be desirable from the standpoint of standardization to use the same working depth for straight-tooth bevel gears as for spiral bevel gears, but after considerable experimenting along this line, it was found that straight bevel gears having an 85 per cent stub tooth were noticeably noisier in operation than similar gears with the full depth tooth. For this reason the standard of 2 inches ÷ diametral pitch has been retained for straight-tooth bevel gears.

The bottom clearance which is specified in the system is 0.188 inch ÷ diametral pitch (0.06 × circular pitch) and is the minimum amount which experience shows is necessary for the average job to insure against bottoming of the teeth. In the past 0.05 × circular pitch has been used and found to be insufficient, while 0.07 × circular pitch which has also been tried out, is more than is required.

Addendum and Circular Thickness

The method followed in proportioning the addendum and dedendum was to adjust them until the amount of sliding during approach was about the same or slightly less than the sliding action during recess. This also had the effect of making the arc of recess greater than the arc of approach, which is very desirable, since recess action is quieter than approach. To obtain these conditions, it was necessary to decrease the gear addendum and increase the pinion addendum as the ratios of the numbers of teeth in the gear and pinion became greater. These values of addendum for gear and pinion were originally worked out for each ratio and number of teeth, and from an examination of them it was found possible to make an arrangement in a simple tabular form according to ratios (see Tables 2 and 4) without any sacrifice of practical qualities.

Circular thickness was found entirely by making enlarged lay-outs in which the teeth were balanced up partly on a width of top land and partly on a strength basis. The formulas given in Tables 1 and 3 were worked out so that they would give the same results that were obtained from the lay-outs.

This system is not new or untried, but in the case of spiral bevel gears, at least, is represented in practice by a large number of very satisfactory jobs. It also checks up closely with successful straight-tooth bevel gear practice, although the long and short addendum tooth has not been used as universally for straight-tooth bevel gears as for spiral bevel gears. The system, as presented, represents in a simple and usable form an intensive study of the question of bevel gear tooth design, treated from both a practical and a theoretical standpoint.

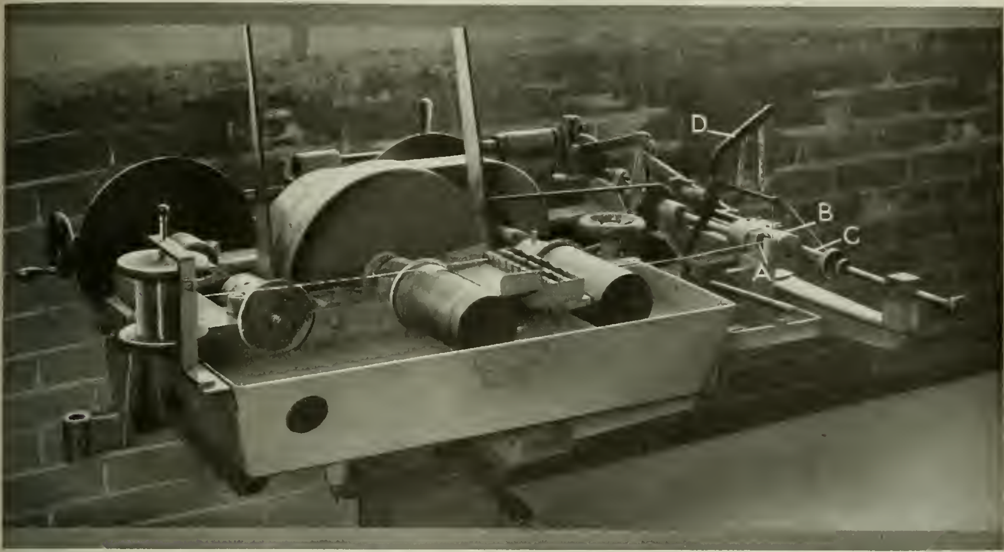
It might not be out of place to express the opinion that a standard non-interchangeable system, possibly along similar lines to the one presented, is needed for spur gears. In fact such a system should be of as great importance as a standard interchangeable system, since a large proportion of spur gears, like bevel gears, are intended to operate in pairs only. The concessions made to allow interchangeability are so great that the case of the non-interchangeable gear should be granted as much consideration in the way of a standard system as is given to the interchangeable gear.

* * *

NEW SAFETY CODE FOR ABRASIVE WHEELS

A new safety code for the use, care, and protection of abrasive wheels has recently been approved by the American Engineering Standards Committee. This code has been in the process of preparation for about two years. It was prepared under the rules of procedure of the American Engineering Standards Committee, and has as its sponsors the International Association of Industrial Accident Boards and Commissions and the Grinding Wheel Manufacturers Association of the United States and Canada. These sponsors appointed a sectional committee to draft the code, consisting of twenty-eight members representing various branches of both federal and state governments, several national manufacturing associations, a number of individual employers, associations of employes using grinding wheels, several technical societies, and insurance associations.

The code gives rules and specifications necessary to insure safety in the use of abrasive wheels operating at speeds in excess of 2000 surface feet per minute. It deals with types of protection devices, storage and inspection of wheels, general machine requirements, protection hoods, work-rests, protection of wheels, flanges, mountings, speeds, operating rules, and general data. Copies may be obtained from any grinding wheel manufacturer or from the American Engineering Standards Committee, 29 W. 39th St., New York City.



Drawing Chromel Wire

Methods of Drawing Special Alloy Wire, Uses and Physical Properties of the Alloy, and Manufacture of the Dies

By E. F. LAKE

CHROMEL is the trade name for a high-grade alloy containing, in its best grade, 80 per cent nickel and 20 per cent chromium. Another grade contains 85 per cent nickel and 15 per cent chromium, while still a third grade contains approximately 61 per cent nickel, 25 per cent iron, 3 per cent manganese, and 11 per cent chromium. All other elements are classed as impurities and are held down to a minimum. Chromel alloys have an electrical resistance from fifty to sixty-five times greater than that of copper, depending on the grade of the alloy, and they also have a very high resistance to heat. The best grade is practically immune to oxidation and corrosion at temperatures up to about 2200 degrees F. The third grade, however, which contains iron, begins to oxidize at about 1500 degrees F., and this oxidation increases with the rise in temperature. Chromel is made by the Hoskins Mfg. Co., Detroit Mich.

The behavior of this alloy under high temperatures makes it suitable for use as a heating element in all kinds of electrically heated devices, from electric toasters to furnaces used for heating steel preparatory to hardening or forging. Iron-free chromel may be found in use in the thermocouples of nearly all pyrometers that work at a temperature up to 2200 degrees F. This alloy is said to be mainly responsible for the rapid growth of the electric heating industry in which it is used for heating apparatus that operates at temperatures between 1500 and 2200 degrees F. The third grade of the alloy, in which iron is an ingredient is used extensively in the construction of flat-irons, ovens, and heating devices that operate below a temperature that does not exceed the oxidizing point of the alloy. Although the alloy has many other important applications, those mentioned are the most common uses for wire that is drawn by the methods described in this article.

In the manufacture of wire, chromel is first melted and mixed in the induction-type electric furnace until all impurities are removed. It is next cast into ingots 4 inches square and 24 inches long. These ingots are reheated to about 2200 degrees F., after which they are rolled into bars 2½ inches square in four passes through the rolls. The end of these bars is then cropped off to remove the pipe, and the bars are again heated and rolled into 1¼-inch squares, in six passes. Each of these bars is next cut into two lengths, and the imperfect ends are cropped off. Then the bars are heated again and rolled to ¼-inch diameter round wire in ten passes, after which the wire is coiled. This hot-rolled wire is then reduced to smaller sizes and sectional shapes by cold rolling and drawing, bull plates and diamond dies being used in the latter operation.

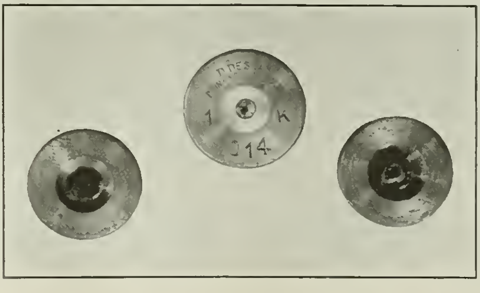


Fig. 1. Diamond Dies used in drawing Chromel Wire

In Fig. 1, three diamond drawing dies in different stages of completion are shown. The diamonds used

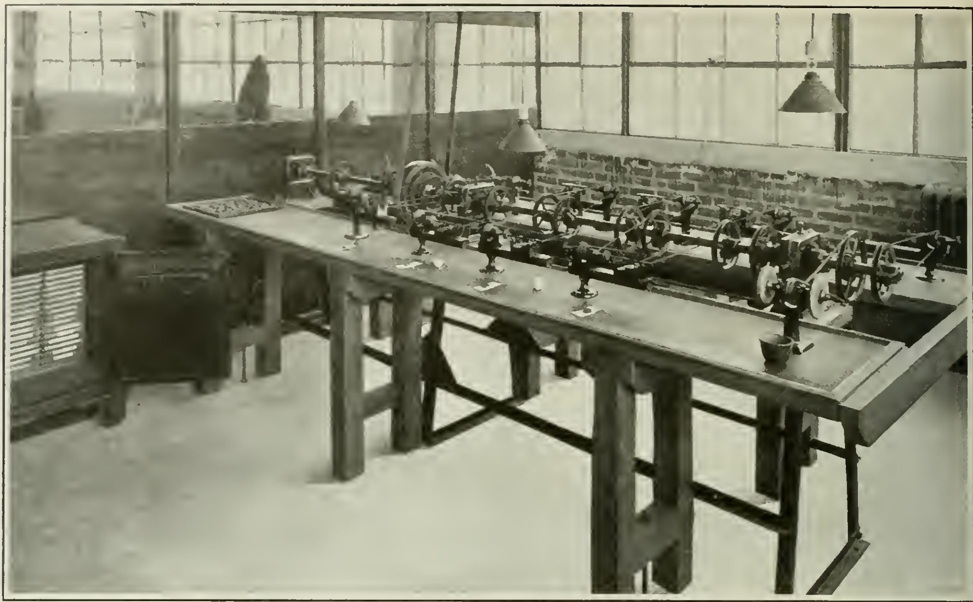


Fig. 2. Corner of the Diemaking Room where the Drawing Hole is lapped through the Diamonds

range in weight from 1/6 to 1/3 of a carat for the smaller sizes of wire up to from 4½ to 5 carats for the larger sizes. Chromel wire that is produced by drawing through diamond dies is not made larger than No. 16 gage (0.051 inch). As the size of the wire increases, the amount of reduction in diameter at each drawing becomes greater. This causes the diamond to be subjected to a greater strain, so that if it is too small it will split through the center of the drawing hole. The amount of reduction per die, as a general rule, is 0.0005 inch when drawing from 0.002- to 0.0015-inch wire; 0.001 inch when drawing 0.005-inch wire; 0.002 inch when drawing 0.020-inch wire; and 0.004 inch when drawing wire 0.051 inch in diameter, which is the largest drawn size. Diamonds that are poor in color or that contain flaws are as suitable for this work as perfect stones, provided the flaws do not interfere with the making of a true drawing hole. Black diamonds are considered best, but the white or Bortz diamonds often give as good results and are much cheaper.

Making the Diamond Drawing Dies

The making of diamond dies for steel wire drawing is work that requires a great deal of care. A description of one method of making these dies was published in November, 1919, MACHINERY. However, a somewhat different and more accurate manufacturing process is required when the dies are to be used for the drawing of chromel alloy wire. The procedure in making diamond dies for this class of work is briefly described in the following paragraphs:

The rough diamonds are set into brass die-holders and temporarily held by means of shellac while a conical center for the drawing hole is being cut. An oxy-acetylene torch is then used to braze around the diamond, which results in filling the hole surrounding the diamond, as shown in the dies to the right and left in Fig. 1. The surface of the brass holder is then ground, to smooth off the brazing so that the die will present a flat surface from which it may be located on the surface plate of a lathe while the drawing hole is being finished. This assures that the hole will be square with the face of the die-holder. A finished drawing die is shown in the center of Fig. 1, the lighter color around the diamond indicating the metal added in brazing.

Finishing the Hole in the Diamond

An installation of a number of bench lathes used both for roughing the holes in the diamonds and for the final finishing work is shown in Fig. 2. At one end of the front bench is located a tool grinder, by means of which the fine-pointed lapping tools are ground to within the extremely close limit of 0.0001 inch that is required. The tools, being common needles, are of such small size that in grinding, a man must wear a magnifying eye-glass. At the opposite end of this bench is shown a tray of diamond dies which are in the process of manufacture; these trays are kept in the safe adjacent.

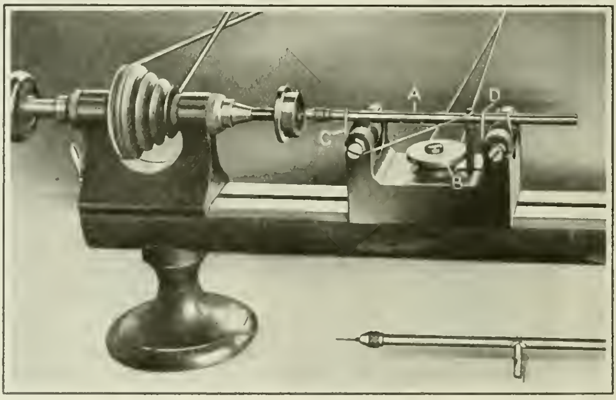


Fig. 3. Set-up of Bench Lathe used in lapping the Drawing Hole in the Diamond

A close-up view of one of these lathes is shown in Fig. 3; here a diamond die is shown centered on the faceplate, to which it is held by shellac. Shellac is

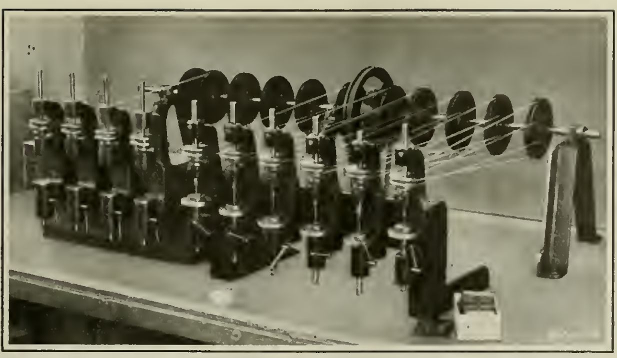


Fig. 4. Multiple-spindle Machines for bell-mouthing both Ends of the Tapered Drawing Hole

a suitable holding medium, as there is no great torsional strain produced while the hole is being lapped through the diamond. The tool used in producing this hole, as stated, is a common sewing needle. The needle is chucked in the end of tool-holder *A* which rests in two V-pulleys supported in the tailstock. The tool is charged with a thin paste of diamond dust and oil, and as the faceplate revolves, the tool-holder moves the needle lap in and out of the hole that is being produced in the die. The reciprocating motion that is imparted to the tool-holder is produced by cam *B* which is driven by a belt from the lineshaft. A vertical post on this tool-holder is held against the cam, and the tool-holder is held down in the front V-pulley by a rubber band *C*. Another rubber band *D* keeps the holder on its seat in the rear V-pulley.

This simple arrangement makes the lapping of the holes through the diamond practically automatic, except for the work of charging the needle lap with diamond dust paste. These machines require so little attention that one man and a helper can easily attend to the nine lathes shown in Fig. 2, and also take care of the machines shown in Fig. 4, while attending to the other work needed in this department. Although the set-up of the lathe appears to be comparatively simple, the required accuracy is maintained, and break-downs seldom occur. The efficiency of the rubber bands is notable; they last for weeks and sometimes months, and if one breaks it can be replaced without delay.

Bell-mouthing the Drawing Hole

The hole produced by the needle lap is tapered and is enlarged at both ends to a slight curve. The wire to be drawn is passed through from the large end of this hole, and the diameter at the small end governs the finished size of the wire and must be held to within limits of 0.0001 inch of the required size. The bell-mouthing is done by the multiple-spindle machines illustrated in Fig. 4.

These bench machines for bell-mouthing the holes are motor-driven, the spindle which carries the needle lap being revolved while the diamond die is held stationary on the platen of the machine. The dies are properly centered relative to the spindle and held in position by shellac. Provision is made for raising and lowering the platen to bring the die up to the needle lap. Directly beneath the pulley on the spindle there is a side cam by means of which the spindle is reciprocated during the performance of the operation. This raises the needle lap on every third revolution of the spindle so that the diamond dust paste, with which the tool is charged, can flow into the hole being countersunk. It will be noticed that the cam is driven by a different belt from that used for revolving the spindle of the machine. These machines are also practically automatic, and after being properly set up they run for hours without further attention.

Drawing the Wire

Fig. 5 shows a machine used for drawing chromel wire. This is a twelve-die machine, five diamond dies *A* being located in the front row and six similar dies in the rear row, the final finishing die being located at *B*. As the drum *C* revolves it draws the wire through the machine from a reel at the opposite end, from which it passes around pulleys, through a tripping lever guide near the floor (see Fig. 6) and over and around rolls *D* and *E*, Fig. 5. Each of the twelve dies reduces the wire in a progressive ratio, until the finished size is produced by die *B*. On this machine the twelve dies reduce the wire size from 0.051 inch (No. 16 gage) to 0.020 inch (No. 24 gage). Obviously, wire can be drawn to any intermediate size by the selection of the proper drawing dies.

The first diamond die through which the wire passes is located in the front row, at the extreme rear. This die reduces the diameter of the wire 0.004 inch, and this amount of reduction decreases with each succeeding die until the reduction produced by the last die in the two rows through which the wire passes is but 0.002 inch. From this die, which is located at the front of the rear row, the wire is passed through the finishing die, which reduces it only 0.001 inch in diameter. The base of the machine is filled with soapy water in which the rolls *D* and *E* revolve while the wire is being drawn, so that both the dies and the wire are thoroughly lubricated.

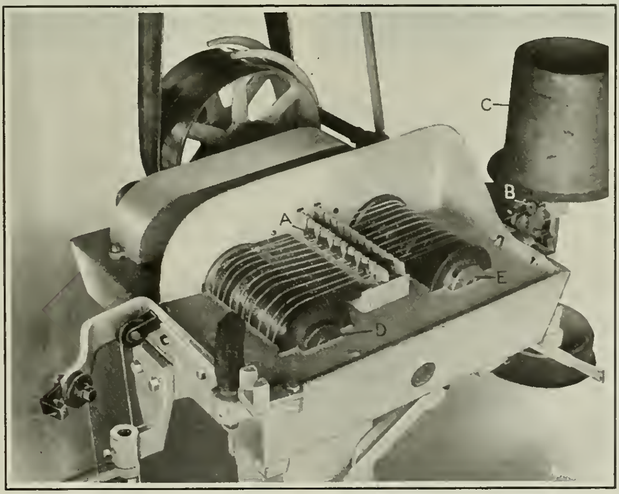


Fig. 5. Wire-drawing Machine, showing Course of Wire during its Passage through the Dies

Another wire-drawing machine of similar construction is shown in Fig. 6, but in this case only one die is used in addition to the finishing die. The tripping mechanism, as well as the manner of passing the wire through a pulley on the tripping lever, is clearly illustrated. Before passing the wire over the rolls and through the dies it is strung from the reel to the weighted lever near the base of the machine. If the wire should become tangled, the tension produced by the drum at the opposite end of the machine will cause the wire to raise this lever, which in turn, will throw out a clutch and stop the machine, preventing breakage. After the wire has been drawn on the machines described, it is made ready for the market by winding on spools. This work is done on automatic machines that wind ten spools at a time. Provision is made on the winding machine for regulating the travel of the rear shaft back and forth to correspond to the length of the spool. The wire is fed on the spool through a holder on this reciprocating shaft, and is thus wound on the spools in even layers.

Rolling Ribbon Stock

Ribbon stock is made by rolling round wire flat in machines similar to that shown in Fig. 7. The ribbon stock varies in size from 0.002 inch thick by 1/64 inch wide to 0.035 inch thick by 1.16 inches wide, and machines of the type shown are used for all sizes. Obviously the larger sizes would require a more powerful machine than that used for the small wire, and when the stock is so heavy that it enters the bar class, it is flattened by hot-rolling. The rolls of the machine illustrated are 4 inches in diameter and 6 inches long, and are made of the best grade of steel that can be obtained. They are properly hardened so that they will not become grooved quickly from the high compressive stresses produced in cold-rolling. The wire thus flattened is rolled to within limits of 0.0001 inch of its specified size on this machine.

The wire must be passed through the rolls at a proper tension, otherwise it will enter the rolls crooked and be fed in jerks. For obtaining the proper tension, the wire is strung from a reel located in front of the rolls around a number of small pulleys and a series of grooved rolls in a more or less zigzag manner. These grooved rolls are located on a plate that is fastened to the machine at *A*, and from these rolls the wire passes between guides *B*, the position of which may be adjusted laterally on the platen so as to enable the entire face of the rolls to be used before it becomes necessary to regrind them. Regrinding is periodically necessary in order to remove the depressions that are worn into the face of the rolls.

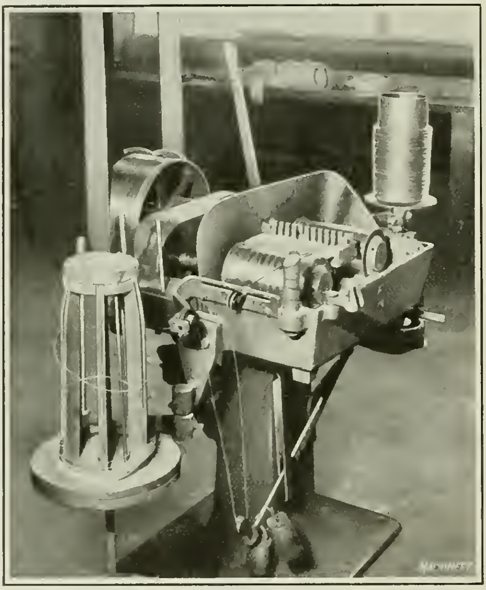


Fig. 6. Another Wire-drawing Machine, showing Automatic Arrangement for stopping

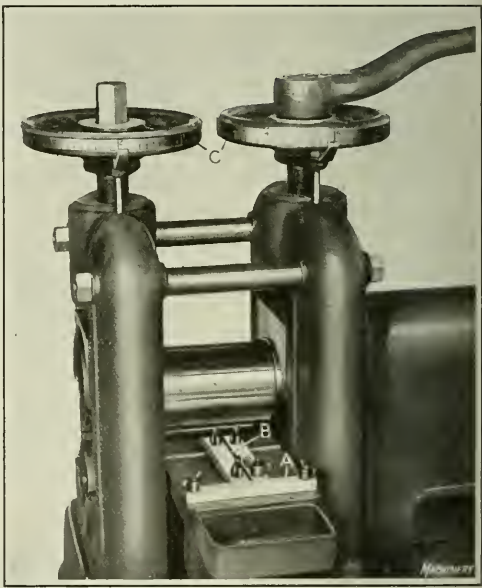


Fig. 7. Type of Machine employed for rolling Circular Wire into Flat Ribbon Stock

Graduated dials *C* enable the top roll to be adjusted to obtain the proper thickness of stock. The graduations on these dials are 1/8 inch apart, and each graduation corresponds to a movement of the upper roll of 0.001 inch so that each end of the roll may be accurately adjusted to bring the face of the top roll parallel with that of the bottom roll. If the rolls are not set absolutely parallel, the ribbon stock will be rolled curved and must be scrapped. In addition to this means for obtaining accurate setting of the rolls, a microscope is always used on the stock itself, which is the most reliable means of furnishing a direct knowledge of its exact thickness.

Machine for Drawing and Winding the Wire Simultaneously

The larger machines used in drawing chromel wire have no provision for winding the wire on spools, but the smaller sizes of wire are drawn and automatically wound on spools by means of the machine shown in the heading illustration. This machine has provision for three instead of two rolls, and fifteen drawing dies instead of the twelve used on the larger machines. The set-up shown in the illustration is for drawing the wire through nine diamond dies, reducing it from 0.2 inch to 0.0015 inch, which is the smallest size in which chromel wire is made. An idea of the size of this wire will be obtained when it is realized that it takes about 212,000 feet or approximately 40 miles of this wire to weigh one pound. One-quarter of a pound, or 53,000 feet of this wire is wound on each spool, and there are seldom more than five breaks in the entire length. Four dies are arranged in each of the rows, as shown, and the finishing die is located at *A*, this die reducing the wire only 0.0005 inch in diameter. If necessary, additional dies up to the maximum of fifteen may be provided, but as many reductions as this are not often made.

The wire is wrapped around the roll *B*, which revolves and produces most of the tension on the wire. The spool *C* on which the wire is wound exerts just enough pull to keep the wire in tension so that it will wind correctly. After traveling around roll *B*, the wire passes up through guide *D* and down around the spool. The shaft on which the spool is carried is given a reciprocating motion so that as it revolves the wire will be wound in even layers. The rate of traverse of the shaft can be regulated to accommodate different sizes of wire.

Difficulties Encountered in Chromel Manufacture

In making chromel wire certain difficulties are encountered that are not met with in making other metals or alloys. Impurities seem to affect this alloy to a greater degree than others. Oxidation, and particularly corrosion, must be guarded against if the alloy is to have a long life at the high temperatures at which it is used. It has been shown by experience in drawing chromel wire that excessive hydrogen in the alloy is responsible for undue breakage. Carbon also makes the alloy brittle, and has to be reduced to traces. Any of the ingredients classed as impurities reduce the heat resistance and electrical resistance of chromel alloy (which are its two most valuable characteristics) and also increase the difficulty of drawing the wire into fine gage sizes.

At one time only pure chromium and nickel were used in making the alloy. However, the chromium need not be entirely free from carbon, as any small percentages contained in it will burn out in the electric furnace during the melt. At first it was thought that electrolytic nickel was absolutely pure, and was therefore most suitable, but it was found that the electrolytic process of manufacture caused the nickel to absorb some hydrogen. This necessitated the use of a small percentage of "shot nickel" for the purpose of reducing the hydrogen of the electrolytic nickel. It has been observed that one English method of making pure nickel, in which the electrolytic process is not used, produces a nickel that is practically free from hydrogen, so that when this nickel enters into the manufacture of chromel, "shot nickel" is not required. This is an advantage, as there is always the danger of introducing other impurities when shot nickel is used.

The iron-chromel must contain the purest iron obtainable, for the inferior grades introduce other impurities that are objectionable, such as sulphur, phosphorus, oxygen, and hydrogen, which are difficult to remove. It may be proper to add in conclusion that this alloy can be readily cast and forged, which adds greatly to its commercial value.

* * *

COMMITTEE ON STANDARDIZATION OF MACHINE TOOLS

Through the cooperation of the American Society of Mechanical Engineers and the National Machine Tool Builders' Association, a committee will be formed consisting of five representatives of the mechanical engineers and five machine tool builders, to work on machine tool standardization problems. The activities of the committee will be carried on under the auspices of the American Engineering Standards Committee, and will relate particularly to the work- and tool-holding parts of lathes, planers, milling machines, drilling machines, grinding machines, power presses and boring mills. Of the representatives appointed by the National Machine Tool Builders' Association, one each will be drawn from one of the groups of manufacturers of the following types of machine tools: Planers; grinding machines; punching and forming machines; machines, using cutting tools, in which the work revolves; and machines, using cutting tools, in which the tool revolves.

Dealers are asked to cooperate by making suggestions to the committee, and the assistance of users is particularly invited, as under the rules of the American Engineering Standards Committee, representatives of three groups must always be consulted in the adoption of standards—producers, consumers, and general interests. Those interested in this matter are requested to communicate either with E. F. DuBrul, general manager of the National Machine Tool Builders' Association, 817 Provident Bank Bldg., Cincinnati, Ohio, or with C. B. LePage, assistant secretary of the American Society of Mechanical Engineers, in charge of standardization committee work, 29 W. 39th St., New York City.

THE INDUSTRIAL ASSOCIATION OF CLEVELAND

Herbert Hoover has said, "A definite and continuous organized relationship must be created between the employer and the employe; by the organization of this relationship, conflict in industry can be greatly mitigated, misunderstandings can be eliminated, and that spirit of cooperation can be established that will advance the condition of labor and secure increased productivity."

Recognizing the value of affording an opportunity for personal contact between industrial employers and employes, aside from their daily contact in manufacturing plants, industrial leaders of Cleveland have established an organization known as the Industrial Association of Cleveland. Its object is educational, the main purpose being to improve industrial conditions. It is believed that the problems confronting industry can be solved by constructive thinking, and it is to stimulate such thought that this institution was founded.

There are two classes of membership, employers and employes. Employer memberships are held by individuals, firms, or corporations, the cost varying according to the number of men employed. Employe memberships cost $5 a year. One of the principles of the association is to keep a balance between the number of employer and employe members. In addition, there is an associate membership for those who are not eligible for either of the full membership classes. Associate members have all the privileges of those in the employer or employe class except that they cannot vote. The membership is open to any employe over eighteen years of age who is interested in promoting industrial prosperity and the ideals for which the association stands. All classes of industry represented in Cleveland are eligible for membership in the association.

Educational Activities of the Association

In line with the educational functions of the Industrial Association of Cleveland, a business training course is maintained to afford an opportunity for instruction in the fundamentals of business. The course for 1922 includes a comprehensive survey of modern business organization and methods. Leaders in their respective fields in the business and professional world have spoken on the following subjects: Economics of business; business plans; finance; organization; plant engineering; advertising; sales and marketing; production engineering; production and control of materials; inspection; shipping; purchasing; accounting and cost finding; credits and collections; commercial law; and maintenance and repairs.

In addition to these lectures, various educational courses are provided to give employe members of the association an opportunity to improve themselves in different departments of business training in which they are interested. For instance, there is a course in stenography, and the business training course mentioned, which has an enrollment of 300. These courses are run on a cooperative basis so that the training is obtained at a comparatively low cost. A number of clubs are also maintained in conjunction with the association, among which may be mentioned the Executives Club, composed of managers and foremen, the Inventors Club, the object of which is to further the interests of men with patentable ideas, and the Faneuil Club, which affords training in public speaking.

The foregoing is by no means a complete account of the activities of the Industrial Association of Cleveland, but it gives a general idea of the work which is being accomplished. In the words of H. B. Bole, the first vice-president of the Hydraulic Steel Co., Cleveland, who is this year's president of the Industrial Association, "The success of the organization is based upon a sincerity of purpose which makes itself actually felt, added to the fact that the organization is based on the sound principle of mutual understanding."

DIRECTIONS FOR USING CHART

To find the horsepower per inch of face width, trace on a horizontal line from the style of tooth desired, to the diagonal line representing the pitch; then trace on a vertical line to the diagonal line representing the velocity in feet per minute; then trace on a horizontal line to the right-hand side of the chart thus obtaining the number of horsepower per inch of face width for either forged steel, cast steel, bronze, cast iron rawhide or micarta.

To find the tooth load at "zero speed" per inch of face width, trace on the horizontal line from the style of tooth desired to the pitch line; then trace on the vertical line to the top of the chart for the tooth load for any of the materials listed.

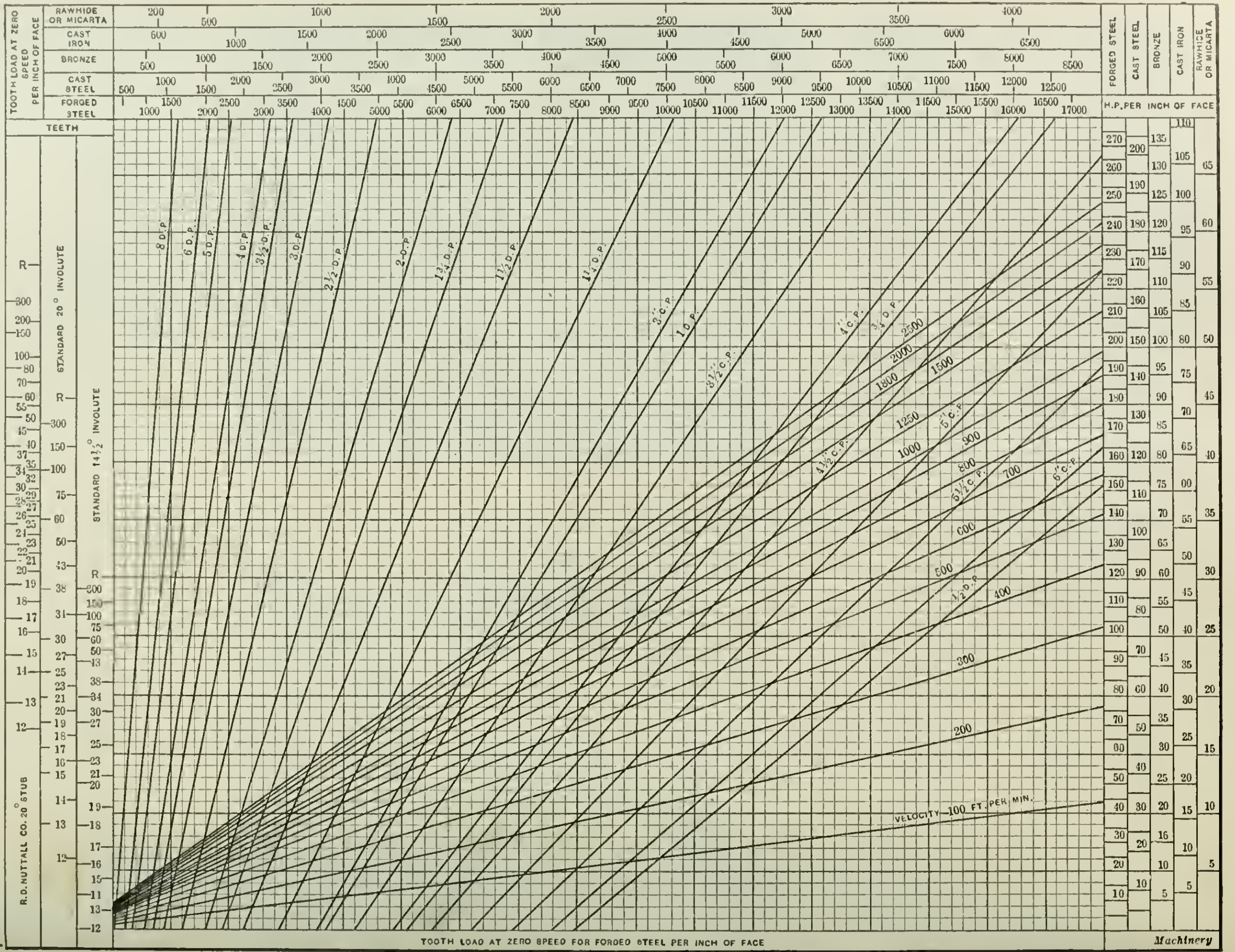


Fig. 1. Chart for determining Power-transmitting Capacities of Gearing and Tooth Loads per Inch of Face Width

Proportions of Industrial Gears*

By G. E. KATZENMEYER, Mechanical Engineer, R. D. Nuttall Co., Pittsburg, Pa.

THE trend of the times is toward more economical and efficient design. A study of the gears in common use discloses wide differences of opinion as to what the engineer considers a suitable design. Evidently if designs can be standardized and a uniform range of sizes adopted, the savings effected in the engineering, pattern, and stock departments and in the shop will be reflected in its costs.

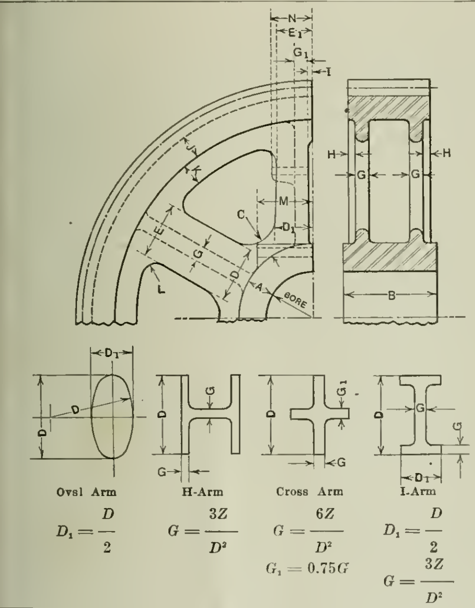
A few years ago it was decided to standardize the design and proportion of industrial gears. Following this decision certain formulas were derived and charts constructed, so that by following a certain procedure, the minimum size of gear for a drive could be readily and conveniently calculated and the sizes thus obtained be inserted on form drawings, without the necessity of making a lay-out on the drawing-board. This was considered desirable when a large number of inquiries were received. When such information as horsepower and revolutions per minute was furnished, it could readily be interpreted and the gear designed, or if the teeth, pitch, and face were specified the design and weight could be determined.

The formulas and charts to be referred to have been developed after a study of various designs and types of gears. What were considered the best proportioned gears were tabulated as to teeth, pitch face, rim thickness, arm sizes and shapes, hub dimensions, etc., and from this information the formulas were derived as a basis for standardization.

In designing a drive to secure the minimum size of gears that can be used, having a sufficient amount of metal under the root of the tooth of the pinion to prevent fatigue and failure, the following method is used: First, calculate the bore diameter of the pinion from the information given, which is generally the horsepower H. P. and revolutions per minute R. The formula used in calculating the bore diameters of pinions and gears is, Bore $= \sqrt[3]{\dfrac{\text{H. P.} \times 80}{R}}$.

This formula is in common use. For general recommendations and for arriving very quickly at an approximate bore, it has proved very satisfactory.

Having thus obtained the size of the bore of the pinion, the next step is to find the minimum pitch diameter which will have enough metal between the keyway and root diameter. To determine the thickness of metal T between the root diameter and keyway, an investigation of a great number of pinions was made, and most of the failures were traced to the inadequate amount of metal above the keyway.



Bore $= \sqrt[3]{\dfrac{\text{H. P.} \times 80}{R}}$

$A = 0.4$ bore or hub diameter $= 1.8$ bore diameter;
$B = 1.25$ bore diameter; (for a gear with a face greater than $1\frac{1}{4}$ bore diameter, make B equal to face; for split gears, make B to suit bolting.)
$C = 0.55A$ or bead diameter $= 2.24 \times$ bore diameter;
$D =$ Dimensions given on chart Fig. 3.
$D_1 = \frac{1}{2}D$ (only for split gears or I and oval arms);
$E = D - \frac{3}{4}$ inch taper per foot;
$E_1 = \frac{1}{2}E$ (only for split gears or oval arms);
$G =$ Dimensions given on chart Fig 3;
$G_1 = \frac{3}{4}G$;
$H = 0.1$ face (only for H or cross-arms);
$I = \frac{1}{4}G$ (only for split gears);
$J = \dfrac{\sqrt[3]{0.5 \text{ No. Teeth} \div \text{No. arms}}}{\text{Diam. pitch}}$
$K = 1.25J$
$L = \dfrac{\text{Pitch diam.}}{4.25 \times \text{No. arms}}$
(J, K, L: See chart Fig. 4)
$M = 2A$;
$N = E_1 + \frac{1}{4}$ inch

Machinery

Fig. 2. Formulas for determining the Gear Dimensions indicated on the Illustrations

From the information collected the formula,

$$T = \frac{\sqrt{\text{No. Teeth}} \div 5}{\text{Diam. Pitch}}$$

was derived, giving the minimum amount of metal permissible above the keyway.

Having the pitch diameter D_p for a certain diametral pitch P, the number of teeth is readily calculated thus: No. teeth $= D_p \times P$. Having the pitch diameter and the revolutions per minute R, the velocity in feet per minute V is obtained by the formula, $V = 0.262D_p \times R$.

Power-transmitting Capacity

Having the number of teeth, pitch, and velocity, the horsepower per inch of face width is found by the Lewis formula.

*Abstract of a paper read before the American Gear Manufacturers' Association's convention, April 22.

Then:

$$W = SP_c Y \times \frac{600}{600 + V} \qquad \text{H. P.} = \frac{W \times V}{33{,}000}$$

where W = tooth load in pounds;
S = fiber stress of material;
P_c = circular pitch;
Y = tooth factor;
H. P. = horsepower; and
V = velocity in feet per minute.

The chart Fig. 1 was constructed from the formulas and is a great help in determining and also in comparing the strengths of different tooth forms and kinds of material. Trace from the tooth column along the abscissa to the pitch line, and then down the ordinate to the velocity line, then along the abscissa to the right and read the horsepower per inch of face width for either forged steel, cast steel, bronze, cast iron, and rawhide or micarta. Multiplying the results obtained by the face width in inches gives the total number

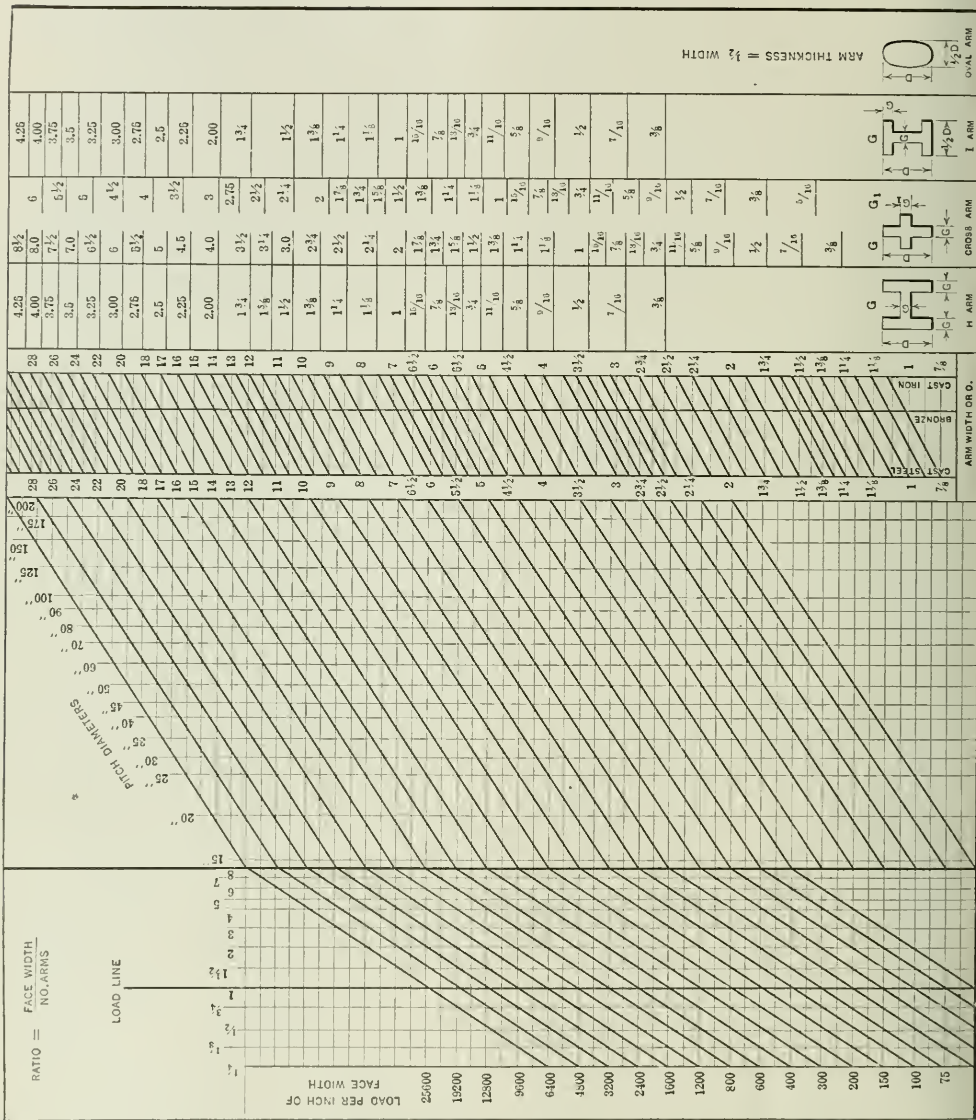


Fig. 3. Chart for determining Widths and Thicknesses of Gear Arms for Different Loads per Inch of Face Width

DIRECTIONS FOR USING CHART

After finding tooth load per inch of face width from the chart Fig. 1, trace from the load line of the accompanying chart, up or down the diagonal line to the ratio of face width to number of arms; then along the horizontal line to the ratio line 8; then up the diagonal line to the pitch diameter, and then along the horizontal line to the vertical line for cast steel, which gives the width *D* of the arm; then trace along the horizontal line to the vertical column representin the style of arm desired (as shown by the diagrams) for other dimensions. If gears are made of bronze or cast iron, trace from the line for cast steel up the diagonal to the line for bronze or cast iron to obtain width of arm; then trace along the horizontal line to the style of arm desired.

DIRECTIONS FOR USING CHART

To find rim thickness *J*, use the left-hand side of the chart and trace from the number of teeth along the horizontal line to the curve representing the number of arms used; then trace on a vertical line to the diagonal representing the pitch; then trace on a horizontal line to vertical line *J* for rim thickness to root circle.

To find height *K* of stiffening rib, trace from line *J* on a horizontal line to the diagonal extending across the center of the chart; then trace on a vertical line to the top or bottom edge of chart, thus obtaining height of stiffening rib.

To find radius *L*, in inches, between arms and stiffening rib, use right-hand side of chart and trace along vertical line from pitch diameter to diagonal representing number of arms used; then trace along horizontal line to the right to obtain the radius.

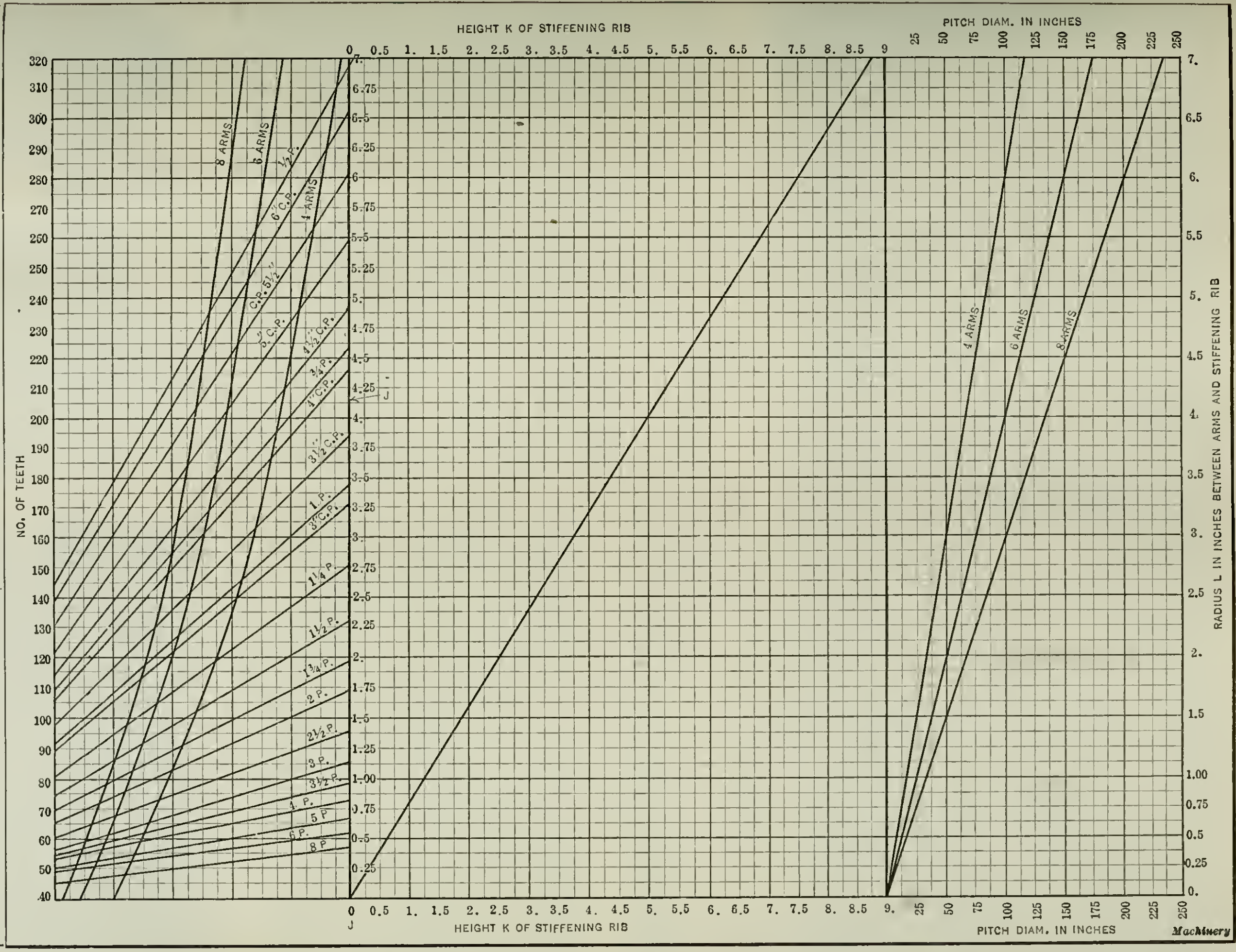


Fig. 4. Chart for determining Rim Thickness J (see Fig. 2) to Root Circle, Height K of Stiffening Rib, and Radius L between Arm and Stiffening Rib

of horsepower. This chart is based on a fiber stress of 20,000 pounds per square inch for forged steel; 15,000 pounds per square inch for cast steel; 10,000 pounds per square inch for bronze; 8000 pounds per square inch for cast iron; and 5000 pounds per square inch for micarta or rawhide.

The face of spur gears is made from three to four times the circular pitch. The minimum face of the helical gears is four times the circular pitch, and the minimum face of herringbone gears is six times the circular pitch. If the velocity factor $\frac{1200}{1200+V}$ is used instead of $\frac{600}{600+V}$ for herringbone or helical gears, the results obtained from the chart can be multiplied by the factor obtained by dividing $\frac{1200}{1200+V}$ by $\frac{600}{600+V}$.

Designing the Gear

After designing the pinion, the gear is designed by using the formulas given in Fig. 2. The bore diameter is determined as previously described in connection with the design of the pinion. Having the bore, the thickness of the hub is made 0.4 times the bore, or the hub diameter is 1.8 times the bore diameter. The hub length is made 1¼ times the bore. If the face is wider than 1¼ times the bore, then the hub length is made equal to the face, except on split gears, the hub length of which is made to suit the bolting, and generally requires a longer hub than a solid gear. The height of bead at the hub is made 0.55 times the hub thickness, or the bead diameter is 2.24 times the bore diameter.

Proportioning the Arms

The next step is the arm design. A six-arm gear is generally used whenever possible in the split and solid type up to approximately 120 inches pitch diameter, and above this size an eight-arm design is recommended. The four-arm design is generally used for split gears under 40 inches pitch diameter with a narrow face and short hub to avoid any special bolting. In calculating the arm sizes, the arm is considered as a cantilever beam with the load equally distributed on each arm. First, calculate for the stalling load or load at "zero speed" which may be found by the formula:

$$\text{Stalling load} = SP_cFY$$

In this formula, F = face width in inches, and the other notation is the same as for the horsepower formula previously given. Having the load, the next step is to find the section modulus of the material, which is,

$$Z = \frac{\text{Stalling load} \times \text{pitch radius}}{\text{No. of arms} \times \text{stress of material}}$$

Having the section modulus, the arm width D (see Fig. 2) is found by the formula

$$D = 2 \times \sqrt[3]{\frac{Z}{0.3927}}$$

This formula is used in calculating the width of all arms and is derived from the formula for an oval section. Let a = ½ width D or the distance from neutral axes to extreme fibers; b = ½ thickness; and $Z = 0.7854\ a^2b$. Then

$$a = \sqrt[3]{\frac{Z}{0.3927}} \quad \text{and} \quad D = 2a \text{ or } 2 \times \sqrt[3]{\frac{Z}{0.3927}}$$

The thickness D_1 of an oval arm is ½ the width D. The thickness of the H-arm section is, $G = \frac{3Z}{D^2}$. The section in this case is considered as a rectangle and the rib joining the two walls is not taken into consideration, as it is intended to give the arm lateral stiffness and not add to the strength in the direction of rotation. The thickness of the cross-arm section is twice that of the H-arm, and the stiffening rib G_1 is made ¾ × G. The width of flange D_1 of the I-arm is made ½ of the arm width, and the thickness of the section is made the same as the H-arm. This arm is used when it is desired to design a gear which will be as light as possible and still be of sufficient strength.

By the use of charts Figs. 1 and 3, the arm sections may be determined readily. On the chart Fig. 1 trace from the teeth along the abscissa to the pitch, then up the ordinate to the load per inch of face for material used. On the chart Fig. 3 use the load obtained from the chart Fig. 1 and trace along the diagonal to the ratio of face width to number of arms, from there along the abscissa to the line marked 8, up the diagonal line to the pitch diameter, then along the abscissa to the material used, and read the arm sizes of the various designs.

The value D_1 = ½D is used with I or oval arms to designate the arm thickness and with split gears as half an arm through the spline at the hub. E is the width of the arms at the rim and is equivalent to D minus ¾ inch taper per foot. E_1 = ½ E and is used with oval arms for the thickness and with split gears as half an arm through the spline at the rim. The H-arms and the stiffening rib of the cross-arm are set back under the rim equal to 0.1 of the face as shown at H, Fig. 2. The amount of relief I from the finished to the rough surface at the spline is made ¼G.

Dimensions of Rim and Stiffening Rib

The thickness of metal J (Fig. 2) between the root of the tooth and rim diameter is equivalent to

$$\frac{\sqrt{0.5 \text{ No. Teeth} \div \text{No. arms}}}{\text{Diam. pitch}}$$

On chart Fig. 4, trace from the number of teeth along the abscissa to the number of arms, then up or down the ordinate to the pitch, then along the abscissa and read the rim thickness. This formula was derived to give varying rim thicknesses, according to the size of the gear and the number of arms used. As a basis, a 100-tooth six-arm gear was considered, having a rim thickness equal to the whole depth of a standard tooth for a given pitch. It will readily be observed that an eight-arm gear with the same teeth, pitch, and face as a six-arm gear does not require the same rim thickness; also that a gear 50 inches in diameter would not require the same rim thickness as a gear 100 inches in diameter, having the same pitch, face, and number of arms.

Height K of the stiffening rib or bead under the rim is made 1¼ times rim thickness J. Referring to the chart Fig. 4, trace from the rim thickness along the abscissa to the diagonal line, then up or down the ordinate and read the thickness of rim bead. Radius L joining the arms and stiffening rib varies according to the pitch diameter and the number of arms, as follows:

$$L = \frac{\text{Pitch diam.}}{4.25 \times \text{No. arms}}$$

From the chart Fig. 4 trace from the pitch diameter up the ordinate to the diagonal representing the number of arms used, then along the abscissa to the right and read the radius.

The height M of the bolt boss at the hub is made equal to $2A$, which is the difference between the hub diameter and the bore. The height N of the bolt boss for the arms is equal to E_1 plus ¼ inch.

When the depth of the keyseat in a hub is checked by measuring across or from the opposite side of the bore, this dimension X may be determined by the formula,

$$X = \sqrt{\left(\frac{Q}{2}\right)^2 - \left(\frac{W}{2}\right)^2} + k + \frac{Q}{2}$$

In this formula
Q = bore diameter;
W = width of keyseat; and
k = depth of keyseat measured at the side.

Although some of the formulas are empirical, the results obtained have been very satisfactory.

Manufacturing Automobile Body Panels

Materials Used in Making Body Panels and Types of Presses Employed

By GEORGE J. MERCER

SHEET steel has come to be used almost entirely during the last twelve years for the panels of automobile bodies wherever quantity production methods are followed. Aluminum is the one other metal used for panels. It is more expensive than steel, but as it is lighter and more ductile, it finds favor where weight is a consideration or where much hand labor is employed in forming the panel. It was these qualities that made aluminum acceptable as the first substitute for wood when automobile bodies made according to carriage practice no longer withstood the severe service to which they were subjected.

Early Use of Sheet Aluminum and Steel

The use of aluminum in the early period increased rapidly throughout the trade, and this demand, together with the needs of other industries, severely taxed the sources from which aluminum was obtained. Consequently, body builders made a practice of ordering their supplies one year in advance, but regardless of this foresight, they frequently had to buy for immediate needs from jobbers who cornered the available supply and charged bonus prices. The unsatisfactory market conditions regarding aluminum compelled the large users to try to find a substitute. A return to wood was not to be thought of and steel was the only other available substitute that could be purchased at a satisfactory price.

Two serious problems faced the pioneer advocates of steel panels: First, there were no large mechanical double-action presses suitable for the work, because similar requirements had never been put up to press builders. Second, with the sheet steel then available it was necessary to heat the metal prior to drawing and forming, in order to prevent it from tearing. Previous work approaching the character of body stampings had been done with dies under a hammer. The metal was also heated in this work, which caused it to scale After such an operation, the scale had to be removed and the part pickled, and much hand labor was involved in finishing and polishing.

The impracticability of continuing under such handicaps resulted in the gradual development of the improved machines and material of the present time. For a short period after power presses were developed for this work, sheet steel was pressed while hot. Present-day accomplishments in any modern stamping plant, such as the cold-drawing

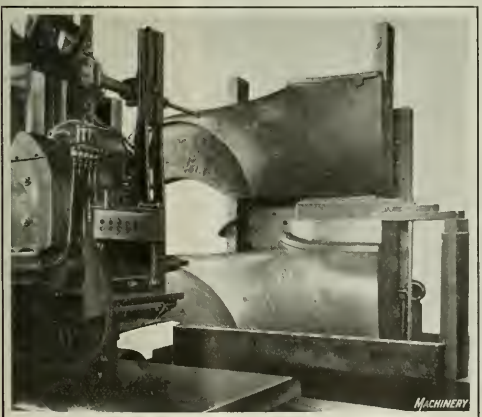


Fig. 1. Machining a Large Die on an Automatic Die-sinking Machine

Fig. 2. Hand Filing a Die after removing it from Die-sinking Machine

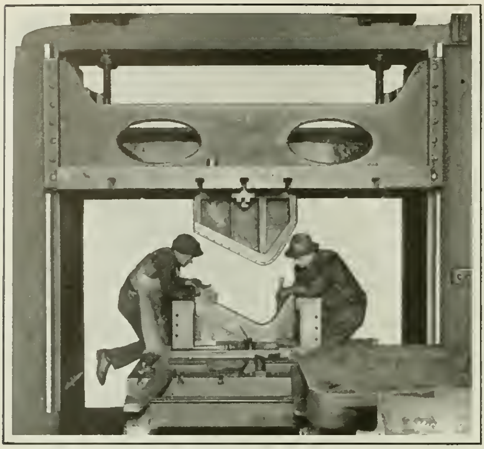


Fig. 3. Matching the Male and Female Die Members of a Set in an Imprinting Machine

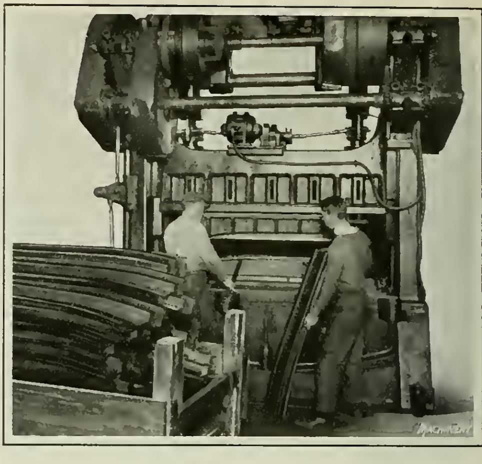


Fig. 4. Forming Two Body Pillar Casings together, which are separated in a Subsequent Operation

of wheel housings from No. 22 U. S. standard gage steel to a depth of 6 or 8 inches in a double-action press, would have been incredible.

Quality and Amount of Sheet Steel Used

The steel used is graded according to the character of the work, and is broadly classed as "automobile body stock." It is a basic deep-drawing stock, pickled, annealed, and refined by cold-rolling so that no roughness or pores will develop on the surface in a drawing operation. This last specification is of the greatest importance because any roughness of the steel will show through the paint. Of course, roughness may be removed by hand-filing, but this represents an additional cost which should be avoided, if possible.

The steel most used for panels is No. 22 U. S. standard gage which is approximately 1/32 inch thick and weighs about 1¼ pounds per square foot. Other steels used, but to a limited extent, are Nos. 20 and 18 U. S. standard gage. The amount of steel necessary for a closed body of the sedan type having a wooden frame and steel panels averages 140 pounds. An open body of the phaeton type requires about 100 pounds. The number of pleasure cars that were built in 1921 approximated 1,500,000, and provided two-thirds of this output had phaeton bodies, this would represent a requirement of 50,000 tons of panel stock. The cost of building a sample phaeton body without painting or trimming, averages $400. In quantities of a thousand and over the same body can be produced at a cost ranging from $35 to $70, the metal work in labor and material in each case representing approximately one-third the cost.

The foregoing figures broadly outline the extent of the automobile body industry. The efficiency of its manufacturing methods depends to a large extent on suitable press equipment for drawing, forming, and flanging the metal in a manner that will leave its surface smooth and true. Hand operations in assembling and finishing are thus reduced to the minimum cost. In the following, some of the methods used in body panel manufacture will be described. The accompanying illustrations were obtained at the plants of the Michigan Stamping Co. and the Clayton & Lambert Mfg. Co., the different examples of press work shown being performed on machines manufactured by the E. W. Bliss Company of Brooklyn, N. Y.

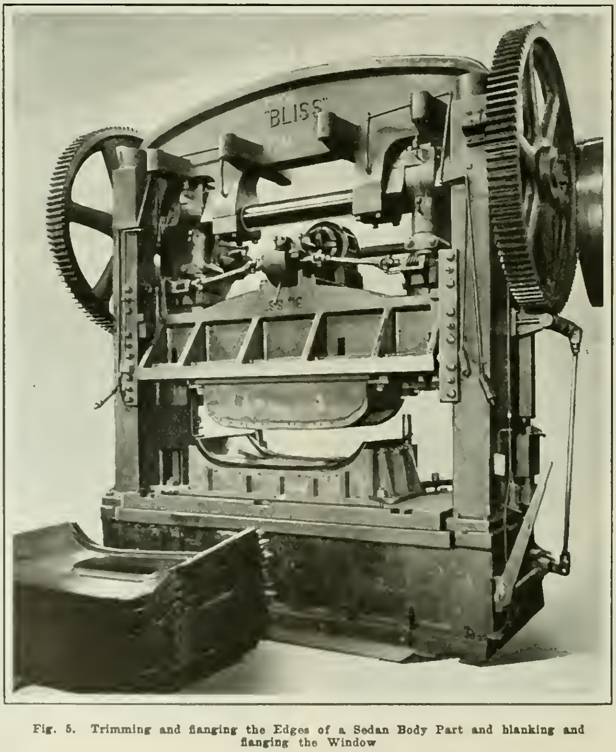


Fig. 5. Trimming and flanging the Edges of a Sedan Body Part and blanking and flanging the Window

The large dies necessary for this work presented a difficult problem at first, as their size and irregular shape made them expensive due to the amount of hand labor involved in making them. The dies are cast, and instead of being filed by hand and ground as formerly, they may now be finished by employing a die-sinking machine. In Fig. 1, a machine built by the Keller Mechanical Engraving Co. is shown finishing the male die of a roadster rear-side panel. This machine is especially designed for handling large forming, stamping, and forging dies.

A master or model above the work and a small roller which registers on the master are utilized to guide the milling cutter on the work. The master can be made either of wood or plaster. As the tracer is moved over the surface of the master, the cutter is moved correspondingly on the casting, with the result that a die that is a facsimile of the master is produced. The tracer touches the master but lightly, so that the surface does not become defaced. However, the tool is held rigidly at every point no matter how slightly indicated by its guide. This machine is electrically controlled through push-buttons. The work can be moved horizontally and vertically, while the cutter has an adjustment for depth. In some instances a two-thirds saving in die cost has been accomplished by using this equipment.

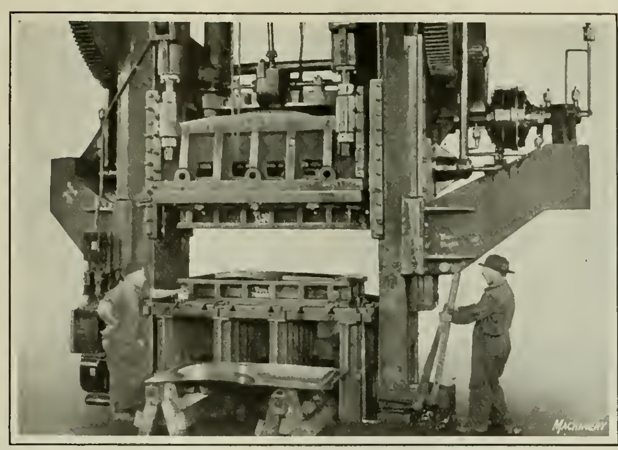


Fig. 6. Toggle Drawing Press with a 9-inch Crankshaft, making Wheel Housings

After the die has been taken from the die-sinking machine, it is hand-filed, as shown in Fig. 2. The final matching of the male and female die members of a pair is performed in the die imprinting machine shown in Fig. 3. This is a machine of recent design which considerably facilitates this work. It affords convenient positions for working on the die, and imprints are easily made. The dies are not taken from this machine until all fitting is completed and they are ready to be set in a press for production. Without such a machine the usual practice has been to hold a press out of production for this work, the imprints being made in the same manner by making a blue mark on one member, then registering the high spots, taking the die out of the press to be filed and finally putting it back for another imprint. Such a method is tedious and laborious, as well as expensive.

The press equipment for making body parts ranges from the large double-crank, double-action toggle drawing press down to the small bench press used in punching nail holes. A typical line of presses of various sizes, all of which are used in panel production, is shown in the heading illustration. The presses used for the major operations are of two types classed as single-action and double-action presses, respectively. Both of these types are of the double-crank style, as often the width of the die bed permits using two dies. Thus blanking and finishing operations can be performed at one downward stroke of the press. In Fig. 7 a large single-action press is shown supplied with two dies, the one at the left being used for blanking and that at the right for flanging.

Single-action presses are used for shallow drawing and forming and for flanging and trimming. They are made in sizes having a crankshaft diameter of from 6 to 10 inches and a die bed usually of from 84 to 124 inches in width, although sometimes the die-bed width is in excess of the latter dimension. When presses of this design are used for forming and drawing, it is necessary to provide additional equipment for holding the metal under pressure. This may consist of spring drawing attachments or pneumatic die cushions. These devices increase the capacity of a single-action press by enabling it to perform, to a limited extent, the same work as a double-action machine. Figs. 4 and 5 show double-crank, single-action presses equipped with spring drawing attachments. The tools in Fig. 5 simultaneously trim and flange the outside of a sedan body part and blank out and flange the window opening. The operation in Fig. 4 consists of forming body pillar casings, two of these being produced from one blank and separated in a subsequent trimming operation.

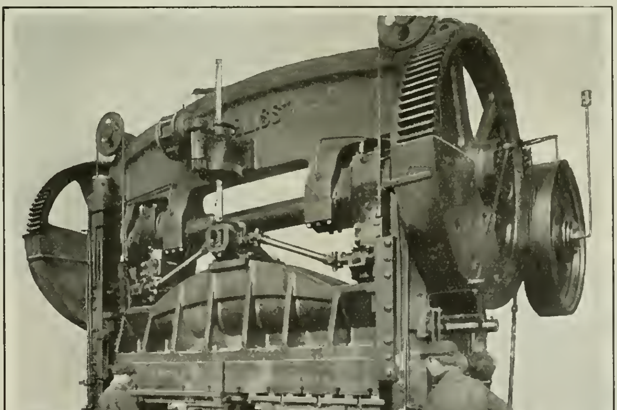


Fig. 7. Large Single-action Double-crank Press used for blanking and flanging a Part at One Stroke

The double-crank, double-action toggle drawing press is used for all the difficult deep-drawing and stretching operations on such work as cowls, wheel housings, mudguards and tonneau backs. Presses of this type are constructed with an inner and outer slide,

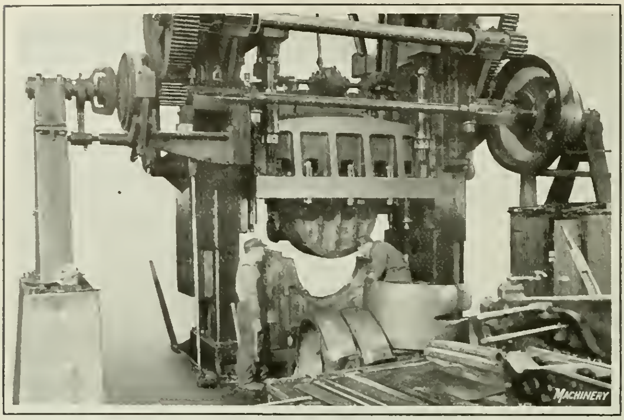


Fig. 8. Another Large-sized Toggle Drawing Press making Mud Guards

and the working tools consist of three members, a lower die, a blank-holder, and a punch. The lower die is fastened to the die bed, the blank-holder to the outer slide, and the punch to the inner or drawing slide. The drawing slide is operated direct from the crankshaft, and therefore has a continuous uniform motion. The blank-holder slide is operated through the toggle mechanism which gives the slide a dwell to hold the sheet-metal blank under sufficient pressure to prevent it from wrinkling or buckling as the punch draws it into the lower die. The amount and distribution of the pressure on the blank means success or failure in deep drawing operations; therefore, blank-holder slides are provided with adjustments so that the pressure may be regulated. The majority of presses of this type have a 9-inch crankshaft which exerts a working pressure of approximately 375 tons. The width of the die bed varies from 86 to 120 inches. There are also some presses with 7- or 8-inch crankshafts, used for door panels, aprons, and other small pieces.

Fig. 6 shows a double-crank toggle drawing press with a 9-inch crankshaft being used to produce wheel housings, and Fig. 8 shows a machine of the same style performing an operation on mud guards. In the latter illustration the operation of pressing a double rear guard has just been completed. Figs. 9 and 10 illustrate two operations on a one-piece cowl. The presses employed are of the same type as those shown in Figs. 6 and 8.

In conclusion, the writer would like to call attention to the warning voiced by those with a varied press experience; that is, when buying a power press, especially if it is to be used for drawing operations, select one with reserve power above the actual requirements. A double-crank toggle drawing press with a 10-inch crankshaft is more economical in the long run for doing the work that a 9-inch crankshaft machine is normally intended for, than a press of the latter size would be. The reserve power of the 10-inch press will give an additional factor of safety and avoid mishaps and breakdowns. A press is subjected to unusual stresses, and the larger machine, having an excess of strength, will not be injured by the overload and consequently will always be ready for continuous production.

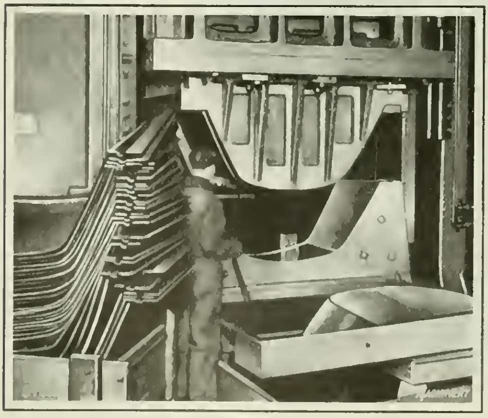


Fig. 9. Close-up View of an Operation on a One-piece Cowl

* * *

The London & Northwestern Railway in England has arranged to make trial runs of a condensing-turbine electric locomotive, which has recently been completed by W. G. Armstrong Whitworth & Co. Ltd., at Scotswood. The locomotive is made up of two engines, the leader being a 2-8-0 type and the trailer 0-8-2. The engines are equipped with four 275-horsepower, three-phase slip-ring motors. Two of the motors drive the leading engine, which also carries the boiler and the impulse-pressure compounded multi-stage turbine and generator. The other two motors drive the rear engine, which carries the condenser, cooling water, and coal. Each engine has eight coupled 4-foot driving wheels, and the total weight is 130 tons.

Fig. 10. Another View of an Operation on a Cowl

* * *

According to the 1919 census of manufactures, there were in that year 4000 factories, with 400,000 employes, engaged in building industrial machinery of all kinds, the production representing $2,200,000,000. Even under the depressed conditions in 1921, the exports of machinery for industrial purposes of all kinds were valued at $254,000,000. Industrial machinery does not include such items as typewriters, sewing machines, etc., not mainly intended for industrial purposes.

Cost Recording and Production Control in Drop-forging Plants

By H. F. OSLER

A system of management that has proved very successful in two large drop-forging plants is described in the following. Before proceeding with a description of the system, a brief analysis will be made of certain conditions in the drop-forging industry that demand the general adoption of more efficient cost-recording systems.

Demand for Accurate Cost Records

Manufacturers in all industries realize now, as never before, the vital importance of a reliable cost-recording system. The conditions of present-day competition are such that contracts must be made at small margins of profit. For this reason, actual production costs must be known and intelligently employed in planning future production and setting contract prices. Unquestionably, a cost accounting or recording system cannot function satisfactorily unless it is closely coordinated with the planning and production control system. The establishment of such a system in a drop-forging plant, however, presents a very difficult problem.

Effect of Inefficient Cost System

In many instances, the manufacturer who cuts his price does so because he does not know his actual production costs, but relies on the ability of his plant to turn out the work at as low a cost as the plant of his competitor can. This practice often results in a contract that cannot be carried out at a profit, and, in many instances, results in an actual loss to the manufacturer. In the attempt to fill such orders or contracts at a profit, quality is often sacrificed. Thus it becomes evident that the manufacturer whose business is conducted on a basis of accurately computed costs has the advantage over his competitor, who can only estimate the approximate manufacturing cost of his products.

Many manufacturers of drop-forgings claim that it is practically impossible to lay out a work schedule in their plants that can be adhered to or successfully followed, and that the processes of manufacturing are such that accurate production costs cannot be ascertained. For this reason, those engaged in the management of drop-forging plants will find the following description of a successful production control system in a drop-forging plant of timely interest. The system to be described owes much of its success to the close coordination that it tends to establish between the production planning, production control, and cost-recording departments or units of a plant.

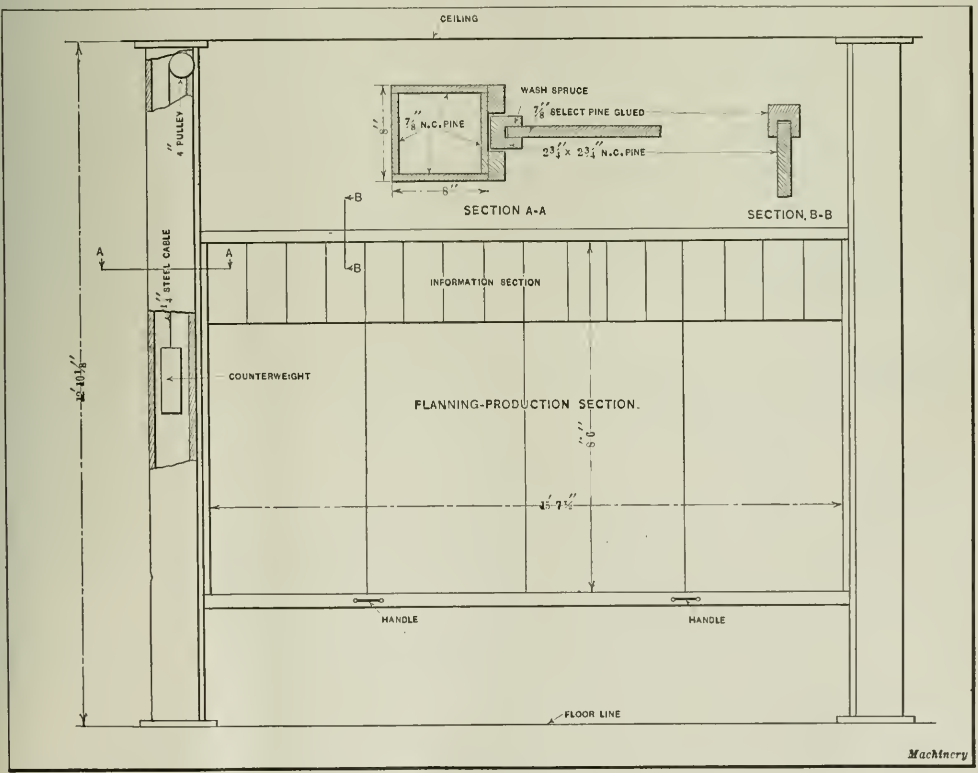


Fig. 1. Information, Planning, and Production Control Board used in the Planning and Production System of a Drop-forging Plant

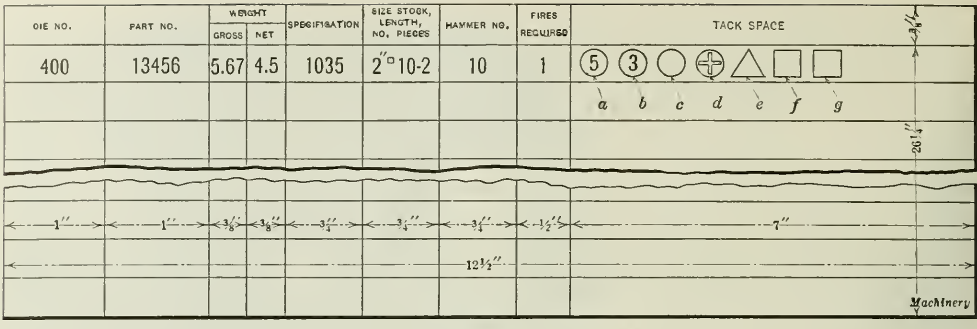


Fig. 2. Information Recording Sheet employed on the Control Board shown in Fig. 1

Production Control System

A simple method of showing graphically the production plans for three months in advance, the existing state of work under way, and the complete history of finished work, forms the basic principle on which the system to be described was developed. One of the most important features of the system is that the collection of data showing the actual cost of each and every individual product is accomplished almost automatically. The system is so carefully worked out in this respect that costs are known at once—not days or weeks after the work is completed.

The Planning and Production Board

The combination information, planning, and production board shown in Fig. 1 forms the backbone of the management system. On the upper section of the board designated "Information Section" are placed the information sheets, one of which is shown in Fig. 2. A board of the dimensions shown in Fig. 1 will accommodate a sufficient number of these sheets for recording the production progress of 100 dies. The lower section of the board carries the planning and production sheets. A section of one of these sheets is shown in Fig. 3. The capacity of this section of the board is sufficient to provide for the production records of the current month and the plans for two succeeding months. When the current period ends, the record sheet is removed and succeeded by the next sheet, and a new one is placed on the board so that the board will carry the plans for practically three months in advance. Thus the progress of work under way and the plans for from two to three months in advance can be seen at a glance.

Information Section

On the permanent information sheet shown in Fig. 2 is placed each die number in its numerical order, and opposite the die number in the second column is placed the number of the part which the die produces. In the illustration, 400 is the number of the die and 13456 the number of the part produced by the die. In succeeding columns are given the gross and net weight of each forging made by the die, the size of material to be used in making the forgings, the length to which the material is cut, the number of pieces each length will make, the number of the forging steel specifications, the hammer for which the die is best suited, and the number of fires and helpers required to make the forgings. Following these columns a space is reserved in which to insert tacks which are used to indicate by their shape, color, or color combinations, all the information required to insure the proper execution of orders for having the stock and dies delivered at the proper place at the right time.

The key or explanation to the tack system of recording information is given in the form of a chart located near the planning board. For instance, the tack at *c* has a round red head, which, according to the chart, would indicate that an order for forgings for part No. 13456 has been received. The tack at *a* has the highest serial number used in connection with this part marked on its head, and the tack at *b*, the serial number then in use or the one last used. Two of these plain tacks on which numbers can be written are required for each die, and they are the only ones that ever bear any written notes or numbers. All the other kinds of tacks employed—forty-three in number—convey the desired information simply by their shape, color, or color combinations.

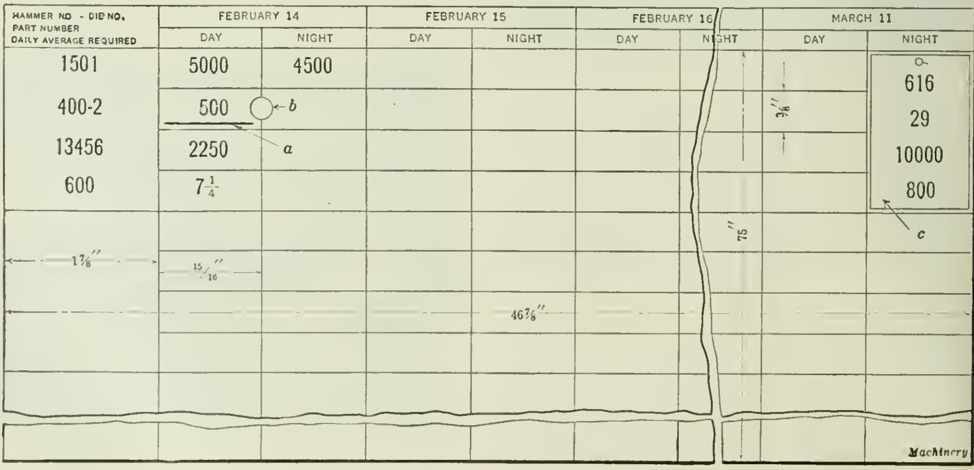


Fig. 3. Production Recording Sheet used on Control Board of a Drop-forging Plant

That is, some of the tacks for a certain class of information will be round and of a solid color, while others may have crosses or bars of a different color.

Still other tacks such as those used for recording information regarding dies or forging trimmers may be square or triangular in shape. Information which must be recorded in connection with all orders is represented by tacks of the more common colors. Considerable attention has been given to the selection of the colors and shapes for the tack heads in order to make the system as easily understood as possible.

Round-headed tacks have the following meanings: When solid red color, orders for forgings; blue, ship freight; pink, ship express; slate, ready to ship; heliotrope, orders held up by customer; black with white cross, steel available; black with white T, steel shipped; black with white horizontal bar, steel ordered; turquoise, hot trim; lavender, cold trim; orange, to be hot restruck; black, to be cold restruck; (square instead of round) slate, to be squeezed; (round) white, to be ground; green, to be pickled; brown, to be tumbled; yellow, to be heat-treated. Square-headed tacks have the following meanings: blue, dies being sunk; yellow, dies to be resunk; brown, dies to be repaired; orange, dies being repaired; green, dies ready for production; white, lead away for approval; red, lead approved.

Triangular-headed tacks have the following meanings: blue, trimmers being made; yellow, trimmers to be made; orange, trimmers being repaired; brown, trimmers to be repaired; green, trimmers ready for production; slate, trimmers scheduled; black square-headed tack, dies scheduled. Round tacks with a dot at center have the following meanings: Red, restriking hot; blue, restriking cold; white, squeezing; green, grinding; brown, pickling; black, tumbling; yellow, heat-treating; orange, forging; turquoise, trimming hot; lavender, trimming cold.

While a large variety of tacks seem to be required, the individual meaning of each can be memorized in a surprisingly short time. Ordinarily, it is necessary to use only a comparatively small number of the different kinds in order to record all the desired information, as the work generally follows a regular course. The presence of a tack in a board of a kind not commonly used immediately calls attention to some break in the usual procedure, and therefore holds the executives attention until the work is again progressing along normal lines.

The hammer numbers are placed in their numerical order on the production sheet shown in Fig. 3. Directly under the hammer number is placed the number of the die which is to be employed at the beginning of the period. Under the die number is placed the symbol or part number and the number of forgings that constitutes a day's work. At the top of the next column is placed the number of forgings required. At the close of each shift, the production department places under this quantity the number of forgings made during that shift. The difference between the number made and the number required is then placed at the head of the next column. This method of recording is continued until the order is completed.

Under the number of forgings made, is placed their total net weight, and under this the hours actually spent in making the forgings. Under the number representing the day's production is drawn a line, such as indicated at *a*, which shows by its color the reason for the delay in production. For instance, a red line signifies that a delay was caused by hammer trouble; a white line, that a delay was caused by absence of the operator; a blue line, die or trimmer troubles; a yellow line, trouble with steel; a black line, power troubles; and a green line, furnace troubles. After the day's production, is inserted a tack *b* which indicates by its color the progress made. For instance, a red tack indicates that production is behind schedule for that particular shift; blue, that production is up to schedule time; yellow, that production is ahead of schedule; black, that production schedule cannot be met.

Opposite each hammer number and under the date on which a new die is to be placed in the hammer, is pinned a ticket *c*, giving the die number, part number or symbol, quantity of forgings to be made, and number of forgings constituting a day's work. This method of recording production plans is carried out for three succeeding months, that is, a new sheet is put up at the end of each month when the sheet carrying the records of the current month is taken down.

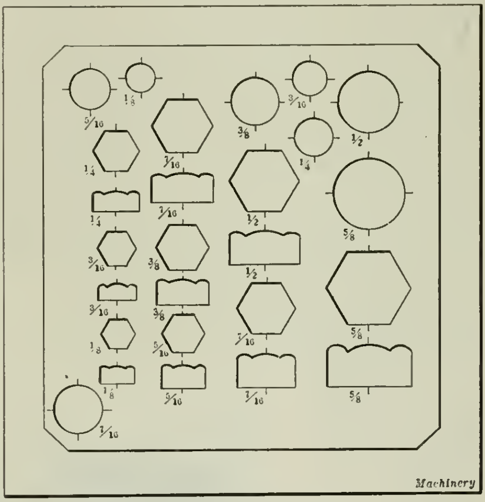
This concludes the first installment of this article; the second installment which will appear in July MACHINERY, will describe the actual operation of the system outlined in the foregoing.

* * *

DRAFTING TEMPLET

By G. EDWARD PORTER

The writer read with interest the description of the Lopez "Draftsquare" on page 331 of December, 1921, MACHINERY. In the accompanying illustration is shown a similar device. About seven years ago the writer made up twenty-four of these templets from celluloid 0.015 inch thick. While the templet described in December MACHINERY and the one here shown are obviously intended for the same purpose, it will be noted that their arrangement is somewhat different. One of the twenty-four templets referred to is still used by the writer and is in as good condition as when new. In using the templet, it is understood, of course, that regular center



Templet for drawing Nuts and Circles

lines must be drawn in order to provide a means of locating the device.

In drawing the plan view of the head of a ½-inch nut the circular opening in the templet designated as ½ is centered over the intersecting center lines on the drawing by means of the four lines equally spaced about the opening. The opening is then used as a guide for tracing a circle which will have a diameter equal to the dimension across flats of a ½-inch nut. The templet is next slid over the drawing until the hexagonal opening designated as ½ is in such a position that its six sides are tangent to the circle. With the templet in this position, the outline of the nut can be readily drawn by using the hexagonal opening as a guide for the pencil. In order to facilitate the drawing of threads, the writer cut suitable notches into the edge of the opening in a 30–60 degree triangle. Before cutting the notches, care was taken to make the edge of the opening parallel with the outside edge.

Making Radio Parts

By FRED R. DANIELS

Typical Examples of Screw Machine and Press Operations Employed in the Manufacture of Wireless Equipment

THE methods used in the manufacture of radio apparatus are quite simple, and reveal no startling developments; but the manufacture of radio instruments has grown so rapidly that it has assumed the proportions of an independent industry. For this reason a description of the more important phases of the shop work in this field will prove of interest. This article deals with screw machine and press work in radio shops, the examples having been selected from the practice of well-known manufacturers in the radio field. They are typical of the class of work required to produce wireless receiving sets. Before describing the manufacturing methods, it will be well to mention the parts used in radio receiving sets. Satisfactory sets of this type, using single-circuit equipment, require six units as follows:

1. The antenna or aerial which absorbs the radio waves in the atmosphere and delivers the electrical pulsations to the receiving instruments of the radio equipment.

2. The inductance or tuning coil which is the means of adjusting the wave length of the receiving apparatus to correspond with that of the transmitting station. This unit may be in the form of a plain tubular winding *A*, Fig. 1, or it may be made with a special winding known as a "honeycomb coil," as shown at *B*.

3. The detector which may be either a suitably mounted galena (lead sulphide) crystal *C*, or for higher efficiency, a vacuum tube *D*. The detector changes current from radio frequency—100,000 or more pulsations per second—to frequencies which can be transformed into sound waves.

4. The condenser which is used in conjunction with the inductance or tuning coil to obtain a finer adjustment of the incoming radio waves than is possible with the tuning coil alone. A fixed-capacity condenser is shown at *E* and one of variable capacity at *F*.

5. The head telephone receiver which transforms the pulsating current into sound waves; these are of the familiar construction common to wire telephony.

6. The ground connection.

Each receiving set is designed for a certain wave-length range and will handle only signals sent out by a particular type of transmitting apparatus. Electromagnetic waves are produced either by means of a spark, an arc, or an oscillating vacuum tube. All three are used for radio telegraphy, the first sending out damped waves, the second, damped or undamped waves and the third undamped or continuous waves (C.W.). For telephony or broadcasting, the oscillating tube is generally used, but the continuous wave must be "modulated" for the transmission of speech. Consequently, most single-circuit sets are designed to receive speech tones sent out by a modulated continuous wave (M.C.W.) transmitter.

The units of non-regenerative or single-circuit receiving sets, previously described, differ from those used in the regenerative circuit sets. The latter are capable of receiving all kinds of radio communication, whereas the non-regenerative set is capable of receiving only modulated continuous wave (M.C.W.) and the damped wave telegraphic signals. In

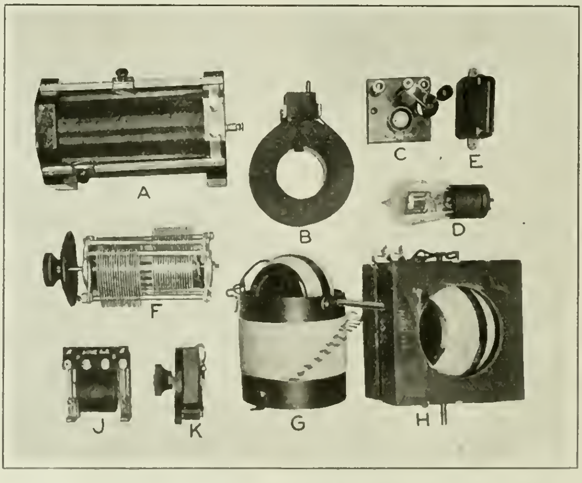


Fig. 1. (A) "Ideal" Tuning Coil; (B) DeForest Honeycomb Coil; (C) Andrea Crystal Detector; (D) Radio Corporation Vacuum Tube; (E) Spitdorf Fixed Condenser; (F) Clapp-Eastham Variable Condenser; (G) and (H) Baldwin Vario-coupler and Variometer; (J) Acme Amplifying Transformer; (K) Radio Corporation Rheostat

the case of the regenerative circuit, the inductance or tuning coil is variably connected by a device, shown at *G*, Fig. 1, which is known as a vario-coupler. The vario-coupler is used for tuning and is connected in circuit with a variometer *H*. The variometer contains a rotor having suitable exterior windings, rotating within the stator which has interior windings and which partially encloses the rotor. The vario-coupler and the variometer together perform the same function in the regenerative type of receiving set that the tuning coils *A* or *B* and the condensers *E* or *F* do in a non-regenerative or single-circuit receiving set. One of the most valuable means for adjusting and controlling the current is the rheostat, which in most types of instruments is of similar design to that illustrated at *K*.

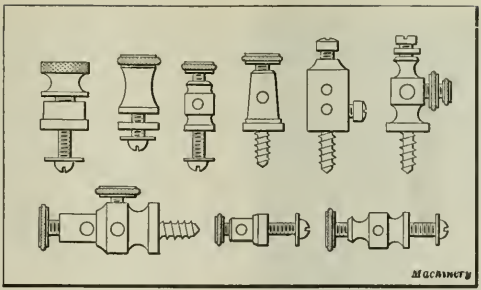


Fig. 2. Various Designs of Brass Binding Posts

In addition to the units necessary for merely receiving wireless messages, it is also highly desirable to include a device for amplifying speech, especially if the transmitting station is so far away that the tones are faint. Almost all commercial tube-detector sets, and even some crystal detector sets, have provision for attaching an amplifier. The amplifier consists of one or more amplifying transformers *J*, connected to the detector circuit and to an amplifying vacuum tube, and a "loud speaker," which is a horn containing a telephone receiver. One amplifier is used to produce what is known as "one-stage amplification"; if a greater volume of sound is required, two or more stages of amplification may be employed.

The vacuum tube forms the most important part of all radio transmitting and receiving sets, except those that operate with a crystal detector. The tube is a glass bulb in which three units are contained—the filament, the grid, which is a coil or mesh of wire surrounding the filament, and the plate which surrounds the grid. This part is clearly shown at *D*.

The collection of radio parts that are illustrated in Fig. 1 was photographed for MACHINERY by the Manhattan Electrical Supply Co., of New York City.

Screw Machine Work in Radio Manufacture

There is a great variety of small screws, washers, contact points, terminal fastenings, binding posts, etc., used in radio instruments. Most of these parts are made of brass and are typical automatic screw machine products. In Fig. 2 are shown a few of the many designs of binding posts—one of the most common screw machine products used in wireless instruments. Another class of screw machine product that is extensively used may be termed "inserts"; these are fastenings, sockets, threaded parts, etc., molded into insulating material such as condensite, bakelite, or formica. The molding of these materials will be dealt with in a separate article, and special attention will be given to the molding of parts containing metal inserts. In the plant of the DeForest Radio Telephone & Telegraph Co., the automatic screw machine work is done on a battery of No. 52 National Acme screw machines, while the Adams-Morgan Co. employs No. 0 Brown & Sharpe automatics.

The variable air condenser, shown in section in Fig. 3, is representative of the classes of machine work found in radio construction. This is a DeForest instrument which consists of a number of hard aluminum plates *A*, assembled in a fixed position, and a number of similar plates *B*, assembled together with provision for turning them to vary their position relative to the fixed plates. The plates may be mounted on the spindle *C* by means of suitable spacing washers, or they may be molded in a lead core on the spindle. These movable plates are operated by a bakelite knob *D* fastened to the spindle. For convenience in making adjustments a graduated bakelite dial *E* is employed. The unit contains numerous examples of screw machine work, such as spacing washers, screws, binding posts, and supporting posts for the two end plates. It also contains good examples of press work, as well as of molded insulator work.

In the manufacture of radio apparatus, use is also made of the hand screw machine or small turret lathe. One example of this class of work is found in the manufacture of vacuum tube sockets in the Adams-Morgan Co. shop. The

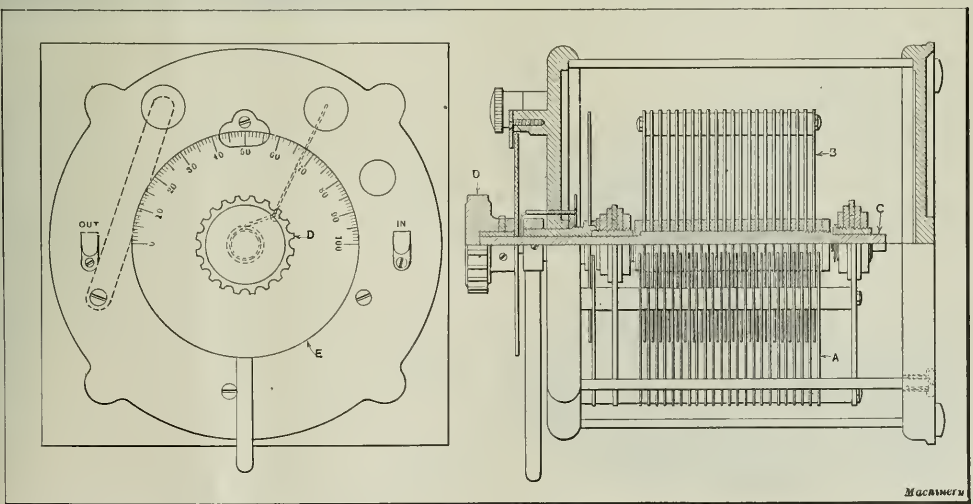


Fig. 3. Variable Vernier Air Condenser used in Radio Receiving Apparatus

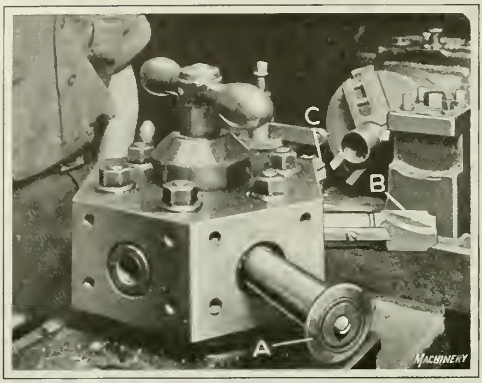


Fig. 4. Turret Lathe used in making Sockets for Vacuum Tubes

sockets are made from 1½-inch brass tubing on a Foster turret lathe, tooled as shown in Fig. 4. The sockets are subsequently molded into a bakelite base, and to help anchor them in the base they are knurled at one end. The operations are: (1) knurling; (2) rough-reaming and forming the end; (3) reaming to size; and (4) cutting off.

The knurling rolls are carried in the front toolpost and the cutting-off tool in the rear tool-holder. The tube is chucked by a three-jaw Union chuck, and the brass collar *A* serves as a stop. For rough-reaming the sockets and forming the end, a special tool *B* is used, to the side of which an auxiliary tool is attached for rounding the end of the tube. A rose reamer *C* is used in the third operation to size the sockets. It may be of interest to add at this time that tube sockets are not always made from brass tubing. The DeForest sockets are molded from bakelite and require no machine work to finish them.

Power Press Work

The tube sockets are molded into a bakelite base, and when returned from the molder they must be polished, plated, and buffed. A bayonet slot, by means of which the vacuum tube is locked in place, is finally punched on a foot-press; this operation is illustrated in Fig. 5. The bakelite base contains molded slots and these are used to locate the bayonet slot properly. The sockets are slipped over a mandrel, and a square-section latch which is hinged to the lower die is swung into engagement with one of the slots

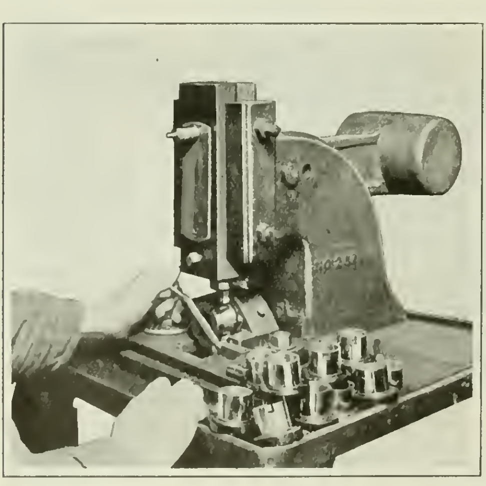


Fig. 5. Punching the Bayonet Slots in Nickel-plated Vacuum Tubes

in the molded base to position and hold the work. The punch, of course, is of the proper shape to produce the L-shaped slot. The thickness of the wall section is 0.065 inch.

Reference previously has been made to Fig. 3 and attention directed to the press work entering into the construction of the variable condenser. The aluminum plates are punched out in dies of similar construction to those illustrated in Fig. 6. The operation illustrated is the punching of the brass end plates for the condenser, the work being performed in the DeForest plant on a V & O press. These end plates are made of sheet brass, 3/32 inch thick, and are punched from strips of sufficient width to permit the stock to be reversed, so that two rows of stampings can be produced from the strip, thus reducing the scrap to a minimum.

Another simple power press operation is involved in making contact points for DeForest inductance coil mountings. One of these mountings, a "honeycomb" coil, and a diagrammatic sketch of the stock from which contact points are punched, are shown in Fig. 7. The mounting is designed

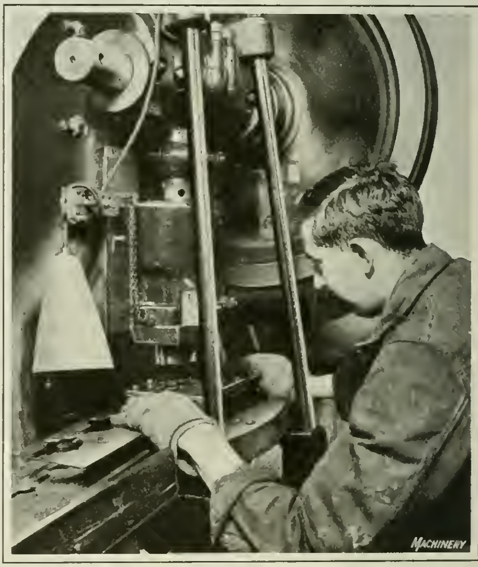


Fig. 6. Power Press equipped with Simple Stamping Dies for making the End Plates of Variable Condensers

so that it may be either attached to a panel or furnished with a suitable base or pedestal for use on a table.

There are three condensite plugs *A*, two of which contain a hinged pin molded in place, by means of which they may swing from side to side. The plugs are also molded with suitable inserts for "plugging in" the coils. The coil is shown in the lower part of the illustration, the plug by means of which the coil is plugged in being indicated at *B*. A spring contact point *C* is assembled to the stud in each of the plugs *A* and *B*, the spring contact being provided to furnish a good connection. The positions of the coils after being plugged into the coil mounting are regulated by means of segment gears *D* which are operated by the bakelite knobs *E*. The middle coil is stationary, the swinging of the side coils varying the "coupling" of the circuits.

At *F* the shape of the spring contacts before forming is shown. These contacts are made from copper, 0.01 inch thick, and the blanks are formed into a thimble shape in two simple press operations. The contacts are punched out with the arms of the star-shaped blank at an angle so that the scrap stock between two punchings may be utilized as spacing washers, thus reducing the amount of scrap. An-

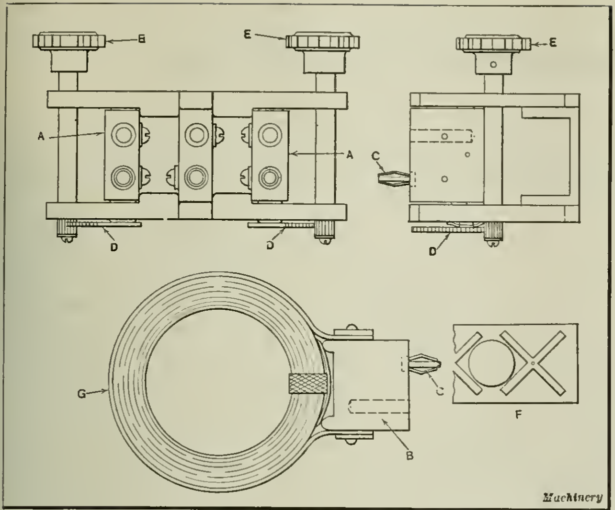


Fig. 7. Honeycomb Inductance Coil Mounting, Assembled Coil, and Diagram of Stock from which the Contact Springs are stamped

other example of power press work in connection with the inductance coil mounting is the punching out of the segment gears *D*, which is done in one operation. The honeycomb coil contains a special winding, and is surrounded by a strip of fiber *G* by means of which it is bound by suitable clips to the plug *B*. Something will be said about the method of winding these coils in a subsequent article, in which several coil windings will be described.

There are comparatively few examples of sheet-metal drawing found in radio work. One of the drawing operations, however, is the forming of the cup in which the galena or other crystal of a crystal detector set is mounted. This crystal mounting contains four miscellaneous examples of press work, which are illustrated in Fig. 8. The cup *A* is made of No. 20 gage (0.0320 inch) B & S sheet brass, and is nickel-plated and buffed. The crystal detector cover *B* is also made from sheet brass, and is nickel-plated, the stock being 0.010 inch thick. The crystal detector ball-sleeve support *C* is made from No. 20 gage phosphor-bronze; this unit is used for producing the universal movement of the contact wire or "cat's whisker." It is necessary, in regulating a crystal detector, to manipulate the contact point until a sensitive spot is found on the galena crystal, and this is done by the use of a ball joint. The crystal holder *D* is made from No. 20 gage (0.0320 inch) B & S stock, and this is also nickel-plated and finished by buffing. These four parts are fairly representative of radio press work other than straight stamping operations.

Pointers for rheostats and control knobs of the type shown at *E* are used in large quantities in radio equipment; these are made from phosphor-bronze and usually assembled to a knob by riveting. The piece of work shown at *F* is a holder for a loud-speaking horn, which is used on the amplifying units of radio receiving sets. This piece consists of a washer punched from flat stock and a threaded sleeve made on a screw machine, the two parts being assembled by spinning.

The use of lathes, drilling machines, engraving machines, tapping machines, and miscellaneous equipment in radio shops will be described in July MACHINERY.

FOREIGN TRADE CONVENTION

The ninth national foreign trade convention held in Philadelphia, Pa., May 10 to 12, attracted a great number of manufacturers and business men from all over the United States. One of the especially valuable features of the convention was the individual advice service in regard to specific foreign trade problems provided for delegates. Appointments were made in advance for those who wished such advice to meet men who were qualified to give them the required information. Among the topics on which advice of this kind was sought and given may be mentioned the following: Financing foreign sales under existing conditions; freight forwarding; contingencies which a marine insurance policy should cover; how to utilize foreign advertising; credit risks and methods of obtaining credit information; preparing salesmen for work abroad; developments in Edge Law banking; the part of the export commission house in foreign sales promotion; how to start an export or import business; protection of trademarks and patents abroad; the use of parcel post for foreign distribution; foreign taxation of American companies and representatives; methods and advantages of forming foreign subsidiaries; relative value of different sales methods; proper use of acceptances; market conditions in various foreign countries; and foreign markets for various commodities. Many papers were read, dealing with almost every conceivable phase of foreign trade. Copies of these papers may be obtained by applying to the Secretary of the National Foreign Trade Council, 1 Hanover Square, New York City.

* * *

The American Engineering Standards Committee has approved as tentative American standard the specifications of the American Society for Testing Materials for cold-drawn Bessemer steel automatic screw stock, cold-drawn open-hearth steel automatic screw stock, methods of chemical analysis of manganese-bronze, and methods of chemical analysis of gun-metal. Copies may be obtained from the American Engineering Standards Committee, 29 W. 39th St., New York.

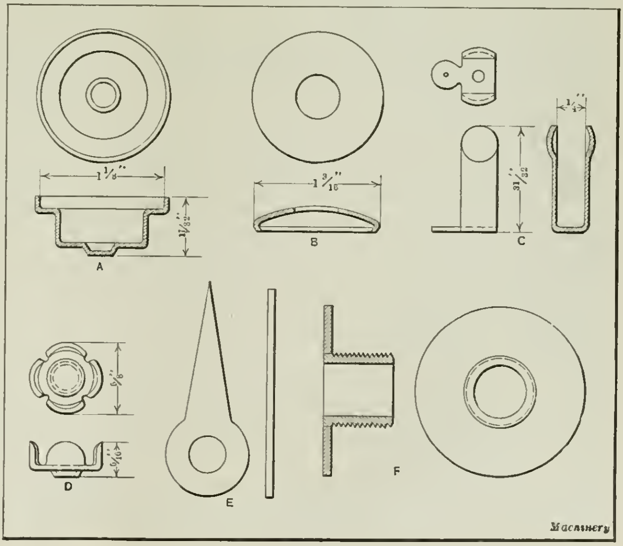


Fig. 8. Examples of Power Press Products used in Radio Apparatus

Power Transmission by Belting

Characteristics of Leather Belting and Charts for Simplifying Calculations

By PETER F. O'SHEA, in Collaboration with Engineers of the Graton & Knight Manufacturing Company

BELTS are rated by the manufacturer as being fit to transmit certain horsepower, but these ratings apply when the pulleys are of equal diameter and the arc of contact is 180 degrees. When the pulleys are of different diameters, the arc of contact is lessened, and it is necessary to decrease the ratings of belts. A wider belt must then be used in order to maintain the desired overload capacity. Any other condition that will decrease the capacity must be carefully considered, as it is necessary to maintain an overload capacity for satisfactory service.

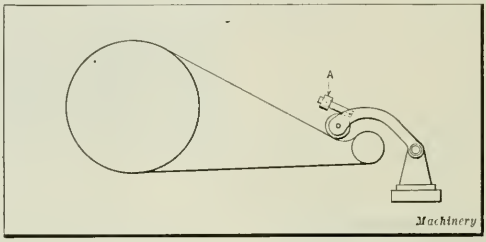


Fig. 1. Swinging Idler on which the Pressure on the Belt may be varied by Means of Weight A

Sometimes the ratings of belts are increased by increasing the arc of contact through the use of idler pulleys, but this practice should be discontinued, as any increased rating above that given for a 180-degree arc of contact is merely a use of the overload capacity of the belt, and, as such, shortens its life. For this reason, the use of idlers in new designs should be abandoned whenever possible. On old drives, however, where the horsepower that must be transmitted has been increased because of additions to the plant, it sometimes seems advisable to install an idler to compensate for the increased load, rather than to go to the expense of installing a new drive.

The method of lacing or fastening the ends of a belt has an important bearing on its capacity. In a test, a belt laced with one of the best types of wire lacing transmitted approximately 15 per cent less horsepower than an endless belt made of the same material and of the identical width. It is therefore evident that belts should be made endless whenever convenient.

Vertical Drives

In vertical drives the arc of contact is often greatly reduced because of the weight of the belt and its stretching under load, which enables the belt to fall away from the lower pulley. When the latter is small and the upper pulley large, a reduction of 50 per cent in the belt efficiency may result, and so a liberal allowance must be made in designing the drive. Failure to observe this point accounts for a large share of the trouble experienced with belts on vertical drives. Thin wide belts have been found to give the best results in drives of this type.

For machines such as power presses, hammers, and planers, on which the load is irregular and shows frequent high peaks, the belt must have a rated capacity equal to the peak load in order to give satisfactory service. In general, to count upon using the overload capacity of the belt for continuous service is to design the drive for a much shorter life than is good practice. On the other hand, while a belt much too large for the work may have an extremely long life, the increased investment involved on the larger belt, as a rule, is not justified.

The coefficient of friction of a piece of leather depends to a large extent on the amount of wear to which it has been subjected. A worn belt which has been well nourished by judicious dressing, and otherwise has received good care will have a higher coefficient of friction than a new one; this shows that the power-transmitting qualities of leather improve with use. A hard-rolled, highly polished belt has a low coefficient of friction and is a poor transmitter of power, while a soft-finished and pliable belt usually possesses a high coefficient of friction.

Relation of Belt Thickness to Pulley Diameter

The type and weight of belt to use on different drives is just as important a consideration as the horsepower rating. In fact, in order to insure that a given belt will transmit its rated capacity, it is necessary that the belt be suitable for the drive. One of the most important factors is the ratio of the thickness of the belt to the diameter of the pulleys over which it must run. This is shown clearly by a test of the horsepower developed by two belts of different weights and thicknesses. In order to obtain a marked difference the motor pulley used was smaller in diameter than the size that would be employed in practice for belts of the thickness used. The belts were new, one being 9/32 inch thick, and the other 1/4 inch thick. They were run from a 4-inch pulley to a 24-inch pulley at a speed of about 1080 feet per minute.

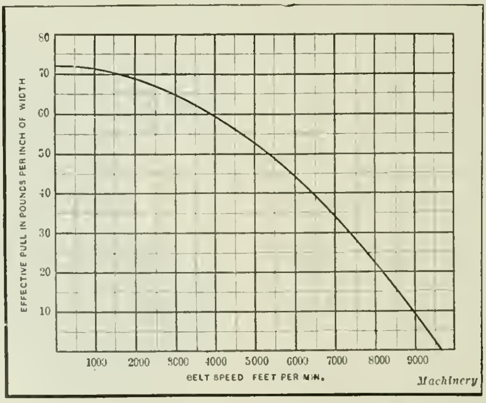


Fig. 2. Chart giving Effective Pull in Pounds per Inch of Width for Single-ply Belts, 3/16 Inch Thick used on Pulleys of Equal Diameter

At this speed the rated capacity of the thicker belt was 14.4 horsepower and of the other belt, 11.5 horsepower. In the test, however, the heavier belt transmitted only 10 horsepower at 2 per cent slip, while the lighter belt transmitted 13 horsepower at 2 per cent slip. Thus, the thicker belt did not transmit as much power as the thinner one, and, in addition, a run of less than one hour of the thick belt caused it to become so hot that it was evidently incapable of continuing for several hours under these conditions without burning seriously and failing on the drive. In the case of the thinner belt, a series of tests extending over several days did not damage the belt in any respect, but rather improved it. These facts show the importance of properly selecting the belt for the drive, as the best belt made may fail utterly if used under unsuitable conditions.

Speed as a Factor in the Selection of Belts

The belt speed is an important consideration in this connection, the heating of the belt being dependent upon the rate at which the belt passes over the pulleys. For this reason, belts running at slow speeds may be safely run over small pulleys, while belts run at high speeds may be unsatisfactory. A belt running at a high speed must be uniform in thickness and well balanced. If a belt runs under little or no load and at a fairly high speed, it will sway from side to side and may run off the pulleys. High-speed belts should not be larger in either thickness or weight than is necessary to carry the load, because when the belt passes around the pulleys and the direction of belt travel is reversed, there is a momentum which must be overcome. This momentum depends considerably upon the size of the belt.

Belts running at high speeds over small pulleys should always be made with waterproof cement, as this material resists the heat generated by the bending and slipping of the belt and does not granulate as easily as ordinary cement. All high-speed belts should also be of the endless type, because any fastener throws the belt out of balance, causing it to flop and perhaps run off the pulleys.

Belts used in damp and wet places, and those exposed to cutting and grinding fluids, should be made with waterproof cement and be waterproof-dressed. Machine oil has a deteriorating effect on belts, and every effort should be made to prevent its coming in contact with belting. When it is impossible to prevent this, a brand of belting should be used which is as nearly as possible oilproof. Certain brands resist the alkali in cutting and grinding fluids, whereas an oak belt would be ruined by it. Oak leather belting should not be run in places where the temperature is higher than 115 degrees F., because the leather is likely to be damaged and the cement softened.

CORRECTION FACTORS FOR DIFFERENT WEIGHTS AND THICKNESSES OF BELTS

Single-ply Belts			Double-ply Belts		
Thickness, Inch	Ounces per Square Foot	Factor	Thickness, Inch	Ounces per Square Foot	Factor
9/64–5/32	12–14	0.8	13/64–1/4	22–26	1.28
11/64–3/16	14–16	0.9	1/4–9/32	26–29	1.44
3/16–13/64	16–18	1.0	9/32–11/32	29–33	1.60
7/32–1/4	18 up	1.1	11/32–13/32	33 up	1.76

Machinery

Belts used on shifting drives should have round edges and possess sufficient lateral stiffness to prevent the edge from curling through contact with the shifter. The same is true of belts running on cone pulleys, and, in this case, the belt should not be the full width of the pulley face; this is a mistake that is commonly made. Shifting belts should also be made endless if possible; otherwise the shifter may catch on the fastener and tear the belt. If an endless belt cannot be used, the ends should be laced tightly together.

Idler Pulleys

As previously mentioned, in cases where a belt is being used in a drive consisting of two pulleys of different diameters, the capacity of the drive may be increased by the use of an idler pulley. The general rule is to place the idler on the slack side of the belt, near the small pulley, so that the arc of contact on the latter will be increased. This arrangement increases the capacity, decreases the slippage, and lessens the tension under which the belt operates. When the tight side of the belt is on top, an idler is of special advantage.

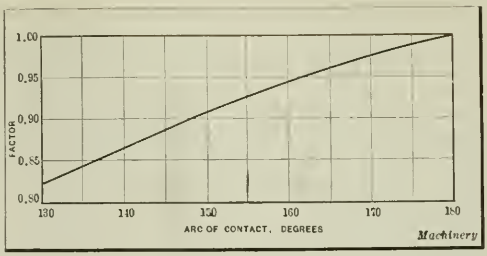


Fig. 4. Correction Factor Chart for Pulleys on which the Arc of Contact is other than 180 Degrees

Screw adjustment idlers are often used successfully, but one trouble with idlers of this type is the danger of imposing an excessive amount of strain on the belt—a point which cannot be too strongly emphasized. Swinging idlers of proper construction cause the belt to wrap the pulleys efficiently, and automatically take up the slack caused by the stretch of the belt under load. They permit the belt to be run very slack, thus decreasing friction in the bearings and eliminating excessive stretch. Idlers of all types must be carefully lined up or they will cause the belt to run off the pulleys. Adjustable idlers are often misaligned through carelessness in making the adjustments, while swinging idlers sometimes work loose and lose their alignment.

An excellent type of swinging idler is shown diagrammatically in Fig. 1. Weight *A* may be varied to take care of different conditions, but should never be excessive. One of the chief advantages of this construction is the short center distance which it makes possible between the pulleys. Such an installation may replace geared, friction, chain, and rope drives. In using any idler, it is necessary to avoid too sharp a bend in the belt between the pulley and the idler, as belts often crack and break under such conditions. A fixed idler pulley is frequently necessary in order to make a belt clear a beam or some other obstruction. In such cases, it is permissible to place an idler on the tight side of the belt, but the action is not that of a true idler. Whenever an idler is used in this manner, it should be looked upon as a necessary evil, since the frictional load on the belt is increased.

Belts running under their rated capacities should have a slight sag on the slack side, which shows that there is no excessive tension, resulting in an unnecessary bearing friction that would cause burnt bearings. Calculations of the capacity of belts are usually based on a low starting load, and if a heavy load is to be applied suddenly, a belt with a high rating should be employed. A high starting torque causes an initial stretch in the belt which cannot be easily calculated. If a tight belt is forced on the pulleys, a crooked spot will develop at the point where it is strained, and a diagonal crease across the belt also indicates that the belt has been too tight on the pulleys.

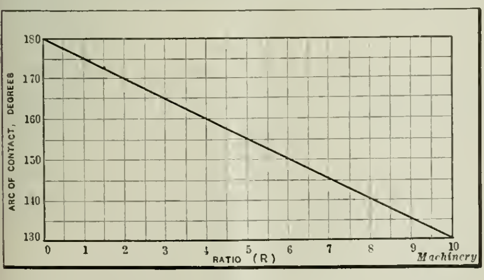


Fig. 3. Chart for determining Belt Arc of Contact on the Smaller Pulley when the Distance between the Pulleys and their Diameters are known

Charts Simplifying Belt Calculations

A number of charts developed by the Graton & Knight Mfg. Co. to simplify the calculations of belt drives are presented herewith. These charts are applicable when the conditions are good and the belt has been well taken care of. The effective pull per inch of width for a single-ply belt, 3/16-inch thick, weighing from 16 to 18 ounces per square foot, may be determined by the chart, Fig. 2, for various speeds up to 9500 feet per minute. This chart is based on the use of pulleys of equal diameter having 180-degree arcs of contact, and so, when the pulleys are of different diameters, a certain correction must be made in the values given. The correction factors for different arcs of contact may be read from the chart in Fig. 4.

Corrections must also be made when the belts are of different thicknesses and weights from those on which the chart in Fig. 2 is based, and these correction factors are given in the accompanying table. The chart in Fig. 3 enables the arc of contact on the smaller of two pulleys to be determined when the diameter of both pulleys and their center-to-center distance are known.

The method of using these charts will be apparent by an example: What horsepower may be transmitted by a single-ply belt, 4 inches wide, weighing 15 ounces per square foot, and running at the rate of 4200 feet per minute over two pulleys, 60 and 12 inches in diameter, respectively, the center-to-center distance between the pulleys being 12 feet? Referring to the chart in Fig. 2 the effective pull for a belt weighing from 16 to 18 ounces per square foot, having an arc of contact on the smaller pulley of 180 degrees and running at a speed of 4200 feet per minute, is found by approximating 4200 on the bottom line of the chart, following a vertical line from that point up to the curve, and then following a horizontal line to the left side of the chart, where the effective pull is found to be about 58 pounds per inch of width.

As the pulleys are of unequal diameter, a correction must be made for the arc of contact, by the use of the chart Fig. 3. In order to use this chart, ratio R must be calculated; this ratio is equivalent to the difference in the diameters of the two pulleys in inches, divided by the center-to-center distance between the pulleys in feet. Thus in the problem under consideration, $R = (60 - 12) \div 12 = 4$. The arc of contact is then found by locating 4 on the bottom line, following the corresponding vertical line to its intersection with the diagonal line and then following the horizontal line at this point of intersection to the left side of the chart. The arc of contact in this case is found to be 160 degrees.

The correction factor for this arc of contact is found from the chart in Fig. 4 by first locating 160 on the bottom line of the chart, then following the perpendicular at this point to the intersection with the curve, and finally following a horizontal line from this point to the left side of the chart. In this case the factor is about 0.94. From the table, the correction factor for a belt weighing 15 ounces per square foot is found to be 0.9. With these values known, the effective pull of the belt per inch of width may be calculated as follows: $0.94 \times 0.9 \times 58 = 49$ pounds.

The horsepower which the belt is capable of transmitting may then be calculated by the formula:

$$\text{H. P.} = \frac{SVW}{33{,}000}$$

in which

S = effective pull of belt per inch of width, in pounds;
V = velocity of belt, in feet per minute; and
W = width of belt in inches.

Inserting the known values in this formula:

$$\text{H. P.} = \frac{49 \times 4200 \times 4}{33{,}000} = 25$$

For a double-ply belt the effective pull determined from the chart in Fig. 2 should be multiplied by 1.6.

[An article published in March MACHINERY, entitled "Charts for Determining Belt Widths" has been criticised on the ground that the belt widths indicated by the charts for transmitting a given horsepower are excessive according to the results of tests and the recommendations of leather belting manufacturers. Wide differences of opinion exist as to the power-transmitting capacity of belts, and the relatively low values represented by the charts previously published are evidently intended to provide belt drives that will reduce, to a minimum, maintenance costs and manufacturing losses due to interruptions incident to belt repairs. According to some investigators, it is economical, in the long run, to use a belt that is wide enough to permit a much lower effective tension value than is usually recommended, the object being to minimize total costs throughout the life of a belt instead of considering largely the initial cost of the belt itself.

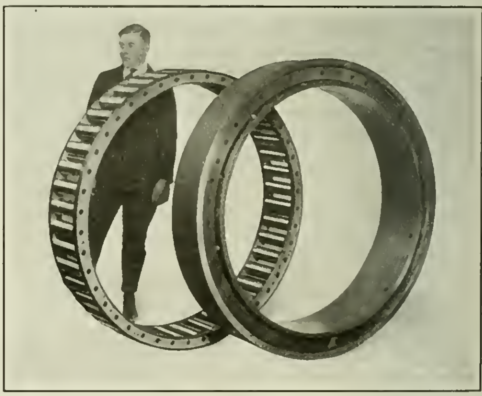
While it is true that a comparison of belts operating under different tensions should take into account all losses during the life of each belt, the quality of belting is a factor that must not be overlooked, as it decidedly affects the allowable working stress, permitting higher values for the better grades of belting with the advantage of lower initial costs. It is evident, therefore, that effective tension must also be related to belt quality although this introduces a variable that is difficult to provide for in any general formula.

The power transmitting capacities of belts as determined in connection with the foregoing article are much higher than those given by the charts previously published. We believe, however, that the information given in this article represents approved practice as applied to good leather belting and as determined by recent tests, although apparently even more extensive experiments and tests will be necessary before the power ratings for belts of different kinds and grades are definitely established with reference to all factors that should be considered.—EDITOR]

* * *

LARGE ROLLER BEARING

The accompanying illustration shows a very large roller bearing recently completed by the Railway Roller Bearing Co., Syracuse, N. Y., for the United States Navy Department. The working load of this bearing is 65,500 pounds, and in testing, it was submitted to a load, while rotating, of 90,000 pounds, and to a static load of 113,500 pounds. The bearing is assembled from 44 rollers, each 10¾ inches long and 3 inches in diameter. The width is 13¾ inches; inside diameter, 49 inches; and outside diameter, 59½ inches.



Large Roller Bearing having a Working Load of 65,500 Pounds

* * *

The National Safety Code Committee of the American Engineering Standards Committee has changed its name to the Safety Code Correlating Committee. This committee gives out all national safety codes to the sponsor bodies. The sponsor bodies form representative sectional committees to handle their codes, the personnel of which must be approved by the American Engineering Standards Committee.

Testing Gear and Gear-Cutter Teeth*

By RALPH E. FLANDERS, Manager, Jones & Lamson Machine Co., Springfield, Vt.

THE screw-thread comparator was devised by Mr. Hartness, president of the Jones & Lamson Machine Co. for testing screw threads. The original invention related particularly to a special means of supporting the screw between a source of light and a projection microscope, and a special chart with tolerances indicated on it to receive the projected image. The combination of these novel elements made it possible to inspect all the significant dimensions of a screw thread at a single glance, indicating the degree of error in outside diameter, pitch diameter, root diameter, form, lead, quality of finish, etc., and, more important still, the total effect of all these errors on the fit of the screw in a standard hole for any desired length of engagement. Since some of the elements are common to both thread testing and gear testing, the machine will first be considered briefly as a thread-testing apparatus.

An arc lamp is used ordinarily as a source of light. Its brilliance permits the apparatus to be set in any suitable dimly lighted location, a completely dark room being desirable but not necessary. The small area of the light source also adds to the sharpness of the image—a prime requirement where accuracy is desired. The microscope is of a special construction, the problem solved in this microscope being that of getting a magnification of 200 diameters at a distance from the operator of about five feet, without chromatic diffusion (that is to say, without having the edges of the image show wide bands of color instead of clear, sharp black and white), and without measurable distortion.

Now it is easy enough to meet these requirements if the screen or chart is permitted to be forty or fifty feet away. It is likewise easy enough to get the magnification at close range and with a sharp outline if we do not care about distortion; or with an undistorted image if we are not troubled about hazy color bands instead of a sharp edge to the shadow. But to get all three conditions of nearness, sharpness and accuracy of image is very difficult. The writer believes this result has been attained in this microscope to a degree hitherto unknown.

The machine is a comparator as its name indicates. The final standard is not the outline on the chart, but the plug gage whose shadow is set to coincide with the chart. This principle of using the apparatus as a comparator is followed in the measurement of gear and cutter outlines in that they are ordinarilly referred to an outline on an actual standard instead of to a drawn outline on a chart. The advisability of this will be discussed later.

Fig. 1. Testing Outline of a Gear Tooth, the Image of which is reflected against the Mirror seen in the Background and then forward to a Ground Glass Screen at the Operator's Position

Inspection of Gear-cutters

The simplest application of the machine is for inspecting gear-cutter outlines. The cutter is mounted on a true arbor between dead centers in front of the lens. The microscope, in this case, must have a large aperture to take in the whole tooth. A stop is provided against which the cutting face registers to keep it in the vertical plane for which it is focussed.

Now to get the required degree of magnification (say 90 or 100 diameters for the work) at a distance of five feet, where the operator can observe it and at the same time manipulate the work, would require an angle of projection so wide that no lens system can be devised to preserve both freedom from distortion and achromatism (or freedom from color bands). Therefore the image was reflected against a

*Abstract of a paper read before the American Gear Manufacturers' Association's convention, April 20.

mirror placed at a distance (see Fig. 1) and then back to the operator's position where it is received on the back of a ground glass screen. On the front of this screen the operator can work freely, drawing lines or erasing them, comparing the image with his drawings, etc., all without throwing his own shadow on the screen at the operating position. Another point of equal importance is that a considerable group of men can examine the image at close range without interference.

The mirror is not an ordinary one with a "silvered" or amalgam back, but has an actual deposit of silver on its front surface from which the reflection is made. This is the same method as that used in coating the parabolic mirror of reflecting telescopes. This gives a more nearly total reflection of the light, and above all avoids the double reflection from both front and back faces of the ordinary mirror. The accuracy of the result can be judged from the fact that with a magnification of 100 diameters, differences of 0.0001 inch can be detected.

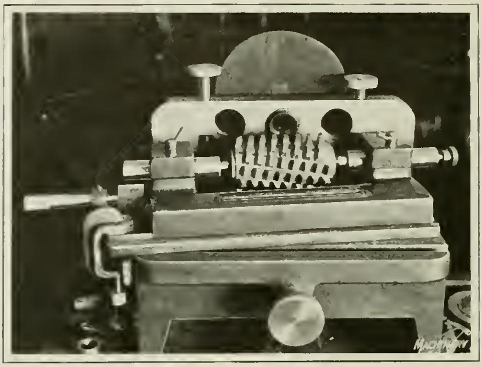


Fig. 2. Hob in Position for testing Accuracy

Testing Uniformity of Form Cutter Teeth

When projecting a form cutter, a most direct and valuable use of the machine lies in testing the regularity of the teeth, one with another. If the outline of the first tooth projected is carefully drawn on the screen, successive teeth may be indexed around into position and compared with the first one. By this means differences in outline may be discovered, whether due to hardening distortion or to inaccurate grinding and also any inaccuracy of the teeth, either sidewise or radial. Furthermore, the teeth of a cutter giving satisfactory results may be compared with one that is not satisfactory and the reasons determined. By reversing the cutter on the arbor it can be seen whether or not the tooth outline is symmetrical. The foregoing relates to the use of the machine as a comparator. The use of this or any other projection apparatus for the direct comparison of tooth outlines with diagrams drawn to an enlarged scale is a more difficult matter—more of a laboratory job than an ordinary shop process.

Testing Accuracy of a Hob

In Fig. 2 is shown a hob mounted for testing on the comparator. The inspection is carried out in somewhat the same way as for a cutter, but, in this case there is the additional element of lead variation to consider. This is taken care of by mounting the hob arbor between centers which are carried by a frame rolling on ball bearings in tracks machined in the base of the device. The advance of each tooth is measured by matching it with an outline on the chart, and reading the axial distance through which it has moved by means of the micrometer or precision measuring blocks, or both.

The center line of the hob must be set at the proper angle to bring the face of the tooth to be inspected as nearly as possible in the focal plane. This angle is presumably the helix angle of the hob, measured at or near the pitch diameter. A stop is used preferably to locate the cutting edge in the focal plane. It should be noted, however, that the stop can be omitted by an expert, as bringing the outline to a sharp focus indicates that it is within less than 0.001 inch of the required position. A movement of this amount either way will blur the outline. This incidentally shows the excellence of the microscope objective.

Method of Projecting and Testing Gear Shaper Cutters

A fixture for projecting spur gears or cutters of the Fellows gear shaper type is shown in Figs. 3 and 4. Fig. 4 shows the fixture with a cutter mounted in place. There is a frame carrying a stud on which the gear or cutter is mounted, and an index-pin or spring plunger carried in a holder adjustable for diameter. This pin has a conical point to engage and locate the tooth space. The stud on which the gear or cutter is mounted is cut away to give two fixed contacts on the side toward the index-pin. In the case of gears with holes varying in diameter, this insures a nearly uniform presenttation of the teeth to the microscope.

When testing the gear shaper cutter (Fig. 4) the following important points should be noted: First, the tops of the teeth are not ground square but at an angle of 5 degrees, so that it is necessary to set the attachment at that angle on the work-table of the machine to bring the cutting edge uniformly into the focal plane. Second, in comparing one cutter with another, due to the nature of the relief on the cutter, the image must be brought to a focus, not by shifting the cutter along the optical axis by the regular focussing screw, but by shifting the cutter along its own axis which

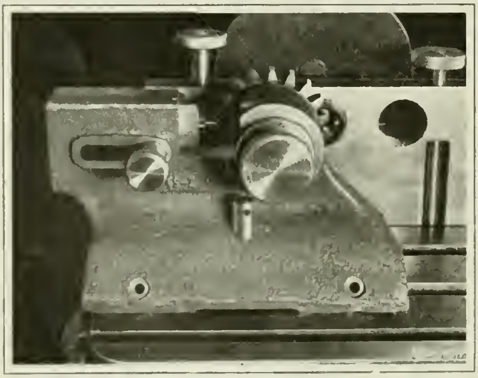


Fig. 3. Front View of Fixture used for projecting Spur Gears or Gear Shaper Cutters

Fig. 4. Opposite Side of Fixture shown in Fig. 3, with Attachment for Gear-testing in Position

is at an angle of 5 degrees with it. Otherwise the comparison will be worthless.

Two kinds of tests may be made with the gear shaper cutter. The first is for indexing. In this test an outline of one of the teeth is drawn on the screeu, and then successive teeth are indexed past this outline and the amount of variation in position is noted. The other, and perhaps more interesting test, is comparing the outlines of the different teeth on the same cutter, or the teeth on one cutter with those of another, or with a standard made for the purpose. In this case the accurate index-pin previously used is replaced by one having a point slightly eccentric. By turning this pin, the cutter can be very delicately rotated to bring the image of each tooth accurately into coincidence with the drawn diagram, irrespective of any slight errors that may occur in indexing.

Besides the precautions previously mentioned, other points inherent in the involute system must be observed. The thinner tooth of the ground down cutter, as compared with a new one, is an essential for theoretical accuracy, and not a mistake. Within certain limits, changes in shape at the fillets, or anywhere below the base circle of the cutter, do not affect the acting surfaces of the cutter or of the gear cut. In the event of an attempt to compare cutter outlines with drawn diagrams, due consideration must be given in this case, as in all others, to the precautions mentioned previously. In this case also the most satisfactory use of the machine is as a comparator, or in other words, as a means of comparing outlines with each other or with a standard, rather than with an unregistered diagram.

Fig. 5. Needle mounted and focussed in Plane to be tested

Fig. 6. Image of Gear Tooth and Needles as seen on Screen

Method of Testing Spur Gears

Projecting cutter outlines is comparatively simple, owing to the sharp, definite nature of the cutting edges, but testing gears is a more difficult problem. The edge is rubbed over on the entering side of the cut and provided with burrs on the other side, which cannot be removed with any assurance that the true outline will be retained. Worse than this, many gears, especially in automobile work, have the teeth chamfered at one or both edges, thus making a reliable outline impossible. Until recently, the best method available was to clamp a thin sheet of metal between two thicker blanks of the same material and cut teeth in all at the same time. This produced a thin templet, which was practically free from burrs and of correct outline, thus being suitable for projection. Theoretically this was all right, but such a gear could not be tested in actual running, nor could it be compared with one that had been run. The problem was thus practically unsolved. What was needed was some method of projecting and tracing the tooth outline on any section from one end to the other. This difficult problem was solved in a very simple manner by Messrs. Beardsley & Porter, of the Jones & Lamson Machine Co.

If a gear with ground, lapped, or otherwise polished tooth surfaces is placed in the fixture shown in Fig. 4, and the device clamped on the work-table so that it makes a slight angle with the optical axis (say, 1 degree) in a direction that tends to display the tooth surfaces to the microscope, an interesting thing may be observed. The diagram on the screen tends to show an outline on the focal plane, whether that be located close to one end of the tooth or somewhere midway. This is due to the fact that the microscope tends to define anything in the focal plane and confuse everything else. Owing to the "thinness" of the focal plane of these special microscopes, the infinitesimal details thus picked out tend toward a sharp outline, but the outline is not sharp enough for practical purposes. How shall this outline be developed?

This was done in a most simple manner. As shown in Fig. 5, a needle was mounted and focussed in the plane it was desired to explore, and then the tooth outline was traced by its point. The junction of the point and its reflection, furnished a location for the surface measurably accurate within 0.0001 inch; and it made possible the rapid drawing of the outline with nearly this degree of accuracy. With the outline once drawn, other teeth of the same gear, or of other gears, can likewise be indicated with the moving needle point, and compared with the drawn outline.

For extreme accuracy, the reflected image of the needle is required, but this does not confine the use of the process to highly polished surfaces. Even roughly cut hardened gears, with the black of the furnace on them, show some reflection under the glare of the arc. The conclusion is that, in general, any ordinary gear will show reflection enough to allow measurement in reasonable proportion to the accuracy of the surface measured.

What promises to be the most practical application of this principle is embodied in the device shown mounted above the index-pin in Fig. 4. A whole battery of needles is laid side by side in the shallow groove of a suitable holder and held in place by a sheet rubber pad which is placed between them and a rotatable spindle (shown in the illustration as a small twist drill). When a gear is mounted in the fixture, and the spindle is revolved between the fingers, the needles approach the tooth outline, stopping in contact with it for its entire length from top to root. Fig. 1 shows the whole apparatus at work, with the inspector in the operating position, and Fig. 6 shows the image on the screen. The appearance of these antenna-like projections and their reflections as they approach each other is weird; but it is satisfying as well, for it represents the solution of a difficult and vital mechanical problem.

The French Machine Tool Trade

By W. P. MITCHELL

THE French machine tool market is decidedly dull. It may be merely "blunt" so far as the French home product is concerned, but the word "dull" is mild when it comes to American or British machinery in the French market. On the other hand, there is an influx of the "made-in-Germany" product, which is penetrating to the utmost corners of France. The small shops using machine tools and equipment, and even the small dealers, apparently care little about the origin of what they buy. Furthermore, capital is not available for modernizing plants with the more expensive American or British product, even though it may be acknowledged to be superior, and many French manufacturers are satisfied if they are able to keep the wheels turning part time without any thought of improvements or expenditures.

Three factors have prevented the continuance of business with America—the abnormal exchange, the increased import duties, and the high freight rates. Certain well-known American manufacturers of machinery in the general field, who have their own establishments in France, have been able to meet the conditions fairly well, but other American manufacturers have found it practically impossible to break into the French market at this time. One firm has become affiliated with a French manufacturing concern, and has been able to do more business than could have been done by selling machinery directly imported from America. This method, however, would not be as applicable in the machine tool field as in the general machinery field.

The solution of the problem is difficult, and there is no likelihood that there will be any improvement in conditions in the near future. The tariff duties will not come down, probably, for years, and it is a question, in view of the French financial situation, whether the value of the dollar will fall materially below ten francs to the dollar. When real peace is established again, the situation may improve, but certainly not before the unsecured paper money becomes a thing of the past.

French Tariff Duties on Machine Tools

The French tariff duties on machine tools, per 100 kilograms (220 pounds), in effect at the beginning of this year, are as follows:

	Country of Origin		
Weight	United States	Great Britain	Germany
200 kilograms or less	50 francs	50 francs	200 francs
200 to 1000 kilograms	24 francs	24 francs	96 francs
1000 to 5000 kilograms	16 francs	16 francs	64 francs

The figures given are multiplied by the coefficient in use at the time of importation, this coefficient being now 3.3. The coefficient may be changed by the administration without legislative action. The tariff on German machines is four times as high as the rates for American or British products; but the transportation charges on the German product are only about one-fifth those on American machinery.

Competition with Germany

Because of present exchange conditions, this is what happens when a machine tool weighing say 200 kilograms and selling for $250 in America is to compete with a similar machine from Germany, which may be priced today at, say, 5000 marks. The American machine will cost the French buyer approximately 3000 francs, while the German machine will cost but little over 1000 francs. Obviously, the Frenchman will buy in the German market if he buys at all, as the figures for the imports of machinery into France in 1921 from America, England, and Germany plainly show. There seems to be little doubt that Germany's financial situation must be improved in the interest of the industrial and trading world everywhere. Competition with Germany in nine-tenths of the European buying market is becoming impossible.

It has been pointed out that Germany is no more formidable today industrially as to ability and equipment than she was before the war, and that the rest of the world found enough to do then and will again. This is true, but an adjustment has to be made first. In the depressing dullness of the French trade in 1921, Germany sent machinery to France exceeding in value by 15 per cent the machinery imported from America, and in tools and other metal appliances, Germany supplied approximately four times as much as the United States, and twice as much as England. Another significant fact is that England sent small tools and other metal appliances to France last year to a value twice that of the imports from America. The following figures give the exact values of French imports in 1921:

FRENCH IMPORTS

	Country of Origin		
	United States	Great Britain	Germany
Machinery and Mechanical Appliances			
Kilograms	65,347,800	55,946,000	71,028,000
Value, francs	331,556,000	385,072,000	386,683,000
Tools and Other Metal Appliances			
Kilograms	5,254,200	13,739,000	20,297,000
Value, francs	28,858,000	52,438,000	104,164,000

Improvement in French Industrial Conditions

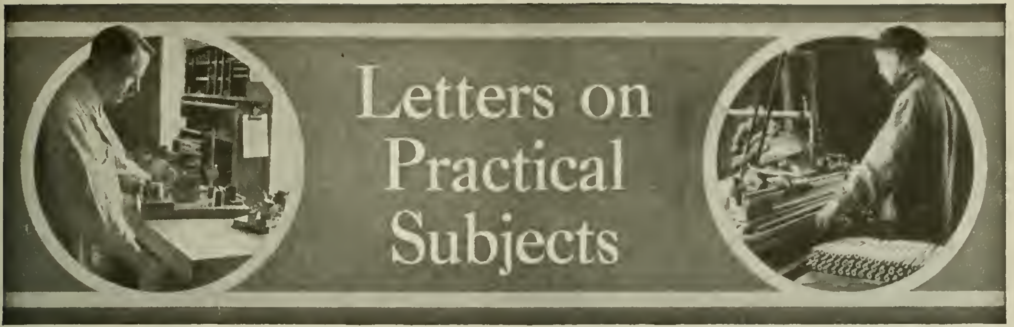
It is true that business in France is improving; at least, production is increasing and, indeed, in 1921, the drop in production in France was considerably less, proportionately, than in either America or England. The increase in the exports of machinery and tools from France to the United States during the last three years is remarkable. The exports of machines, mechanical appliances and tools for 1919, 1920, and 1921 are given below in francs:

	1919	1920	1921
Machines and Mechanical Appliances	1,742,000	5,565,000	16,411,000
Tools and other Metal Appliances	1,304,000	9,563,000	69,304,000

By comparing the import and export figures from the United States into France and vice versa in 1921, we find that the French exports of machinery to the United States amounted to only 5 per cent of the imports from the United States, but in the case of tools and other metal appliances, the exports from France to the United States were almost two and one-half times the exports from the United States to France.

Prospects for the Future

In spite of all, there are reasons to believe that there is a future for the market of American machinery in France. To hold that market, however, courage is required, and stocks must be kept for the occasional buyer; an educational campaign must also be carried on, through which the American manufacturer will some day come into his own. Those manufacturers who are selling to France today—and something must have been sold to account for the 1921 imports valued at over 330,000,000 francs of machinery and mechanical appliances—are those who know the ground, who have tilled it and sown. They will reap, but to do so they must be on the ground at the time of the harvest.



MOLDING BARREL CASTINGS

The evolution of a pattern and core-box for use in the production of large quantities of accurate cylinder or barrel castings is described in this article. The principal dimensions of the casting are shown at *A* in the accompanying illustration. The casting was to have core holes at each end 2½ inches square. It was desired to eliminate all machine work, and it therefore became necessary to hold the castings as close as possible to the specified dimensions.

Probably nine out of ten patternmakers would make the pattern with the parting line through the center, and the 2½-inch core-prints attached to the ends of the pattern as shown at *A*, the core-box being designed to produce half-cores that could be pasted together to form the complete core. A mold made from this pattern would, of course, be poured with the casting on its side in the position indicated at *A*. The first pattern was actually made and used in this way, but it proved unsatisfactory, as the core-prints were not large enough to support the core or prevent it from rising in the mold when the casting was being poured.

The second method tried was molding the pattern on end as shown at *B*. This method was also a failure, because it was very difficult to pass the core down through the mold and enter the print properly in the recess in the bottom of the mold. The end face of the core also proved too small to support the heavy core, so that the latter frequently sunk down into the molding sand.

A slab core, such as shown at *C*, was then provided to overcome this difficulty. The slab core was rammed up in the mold in both the cope and the drag. This prevented the core from sinking into the molding sand, but did not eliminate the difficulty experienced in entering the core in the drag. The core-prints were next cut down to the size and shape indicated by the dotted lines at *b* in view *D*. "Ram-up" cores *a* were made to fit over the prints. These cores remained in the mold and provided a hard surface on which to set the core. The castings produced from this pattern were found to vary in thickness, due to the failure of the cope flask to line up properly with the drag. This method of molding was therefore discarded.

The rather unusual method that was finally adopted with success was suggested by the foreman of the foundry. The pattern was made split through the middle and provided with core-prints attached to each end, as shown at *E*. These prints were made 6½ inches in diameter or ½ inch smaller than the diameter of the body core. The core-prints were given a ¼ inch taper, as shown in the illustration. The

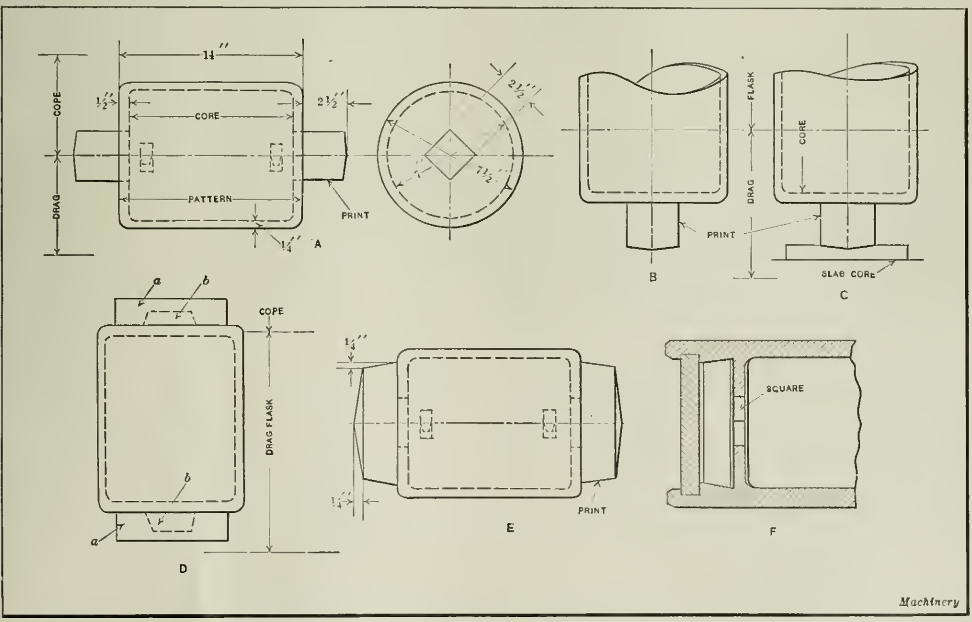


Illustration showing Evolution of a Pattern Core-box for Cylinder or Barrel Castings

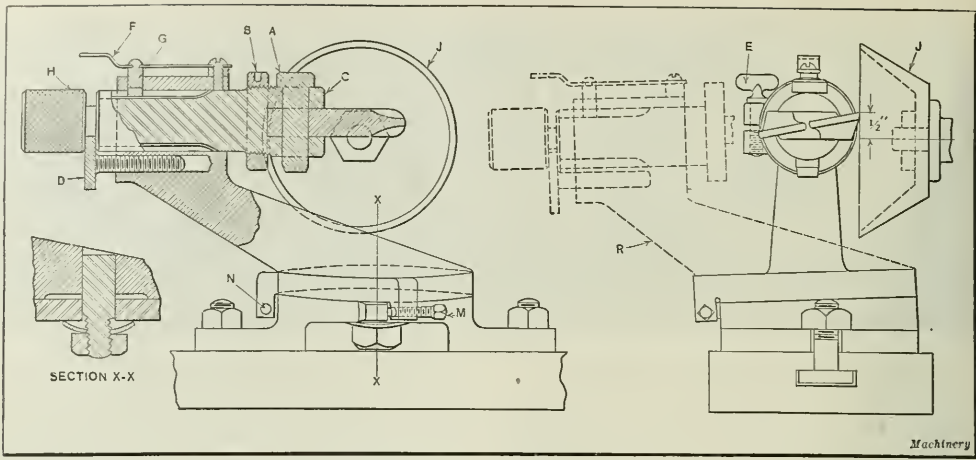


Fig. 1. Details of Reamer-grinding Fixture, a Plan View of which is shown in Fig. 3

core-box for the pattern was made with ends of the shape shown at *F*, particular attention being given to the accurate tapering of the ends of the box. The core-prints attached to this pattern were of sufficient size to support the core properly and hold it in place. With the split pattern and the tapering core-prints, the molder was enabled to mold the pattern either on its side or on its end, as desired.

Kenosha, Wis. M. E. DUGGAN

REAMER AND REAMER-GRINDING FIXTURE

The reamer and reamer-grinding fixture described in this article was designed and placed in successful operation by the writer while engaged as a tool-room foreman in a large shell manufacturing plant. While designed for use in the production of 3.3-inch high-explosive shells, both the reamer and its grinding fixture embody features that can be employed to advantage in the design of tool equipment for various peace-time products.

The reamer, as will be seen from Fig. 2, has a clearance back of the cutting edge of approximately 4¾ degrees. When this type of reamer was first tried out, the grinding of the side and front cutting edges was done on a universal grinder, using a vise to hold the blade. The radius was ground by hand, a profile gage being used to obtain the ½ inch radii. The latter operation alone required about one-half hour. By the use of the grinding fixture shown in Figs. 1 and 3, the total time for finish-grinding was reduced to less than two minutes per reamer. The amount of stock left for finish-grinding was 0.025 inch. The reamer blades were shaped, formed, lipped, the back clearance ground by hand, and the blades hardened before being sent to the finish-grinding department.

The object of the grinding fixture is to hold the reamer in a flat plane while grinding the sides and then to swing it into an angular plane while grinding the radius, this angular position being retained during the grinding of the front cutting edge. As will be seen by referring to Fig. 1, the fixture is provided with a base having an inclined pivot or swivel face upon which swivels an arm mounted on a flat plate. A suitable device for holding and positioning the reamer is mounted on the upper end of this arm. The reamer blade is held in the arbor bar by a pin *A* which passes through a hole in the blade, and a collar *B* which is tightened against the rear end of the blade. The arbor *C* slides through the upper bearing of the arm, and is moved in either direction by a small knurled feed-screw *D*, being locked tight by the thumb-screw *E* acting on the split bearing. The arbor can be indexed 180 degrees, and is held in the two positions by the pin *G* riveted to the spring key *F* mounted on top of the mechanism.

The knurled end *H* of the arbor serves as a handle for operating the fixture. A cup- or deep saucer-wheel *J* is mounted on the wheel-arbor and squared off at right angles to the table, with the center of the wheel about ½ inch below the top edge of the reamer. Stops are provided for grinding the straight side and the radii, and for squaring the end. Referring to Fig. 3, stop *K* consists of a pointer on a sliding member and a stationary plate with a scribed line on it. This indicator is employed when positioning the table for grinding the radii. The radii are ground by swinging the cutter-carrying arm on its pivot base. After grinding one corner to the required radius in this way, the table is fed to the left until stopped by the micrometer stop *L*. During this movement of the table, the cutter-holding arm is at right angles to the face of the grinding wheel, as indicated by the dotted lines at *R*, Fig. 1. Adjustable stops *M* and *N*, which are fitted to the baseplates, limit the rotation of the arm carrying the cutter to an angle of 90 degrees. The accurate location of the diamond used for truing the wheel is of great importance. The point of the diamond must be kept in a line which is parallel with the finish-ground edge of the reamer in order to maintain the accuracy of the set-up. As the reamer is swung around to form the radius and into a position for squaring the end, it is tilted into an angular position in such a way that the portion of the edge in contact with the wheel is always parallel with the wheel-base. A peculiar end-mill effect is produced on the web of the reamer which will cut a clean and perfect center. This end-mill effect is due to the pivoting of the cutter-holding arm in a

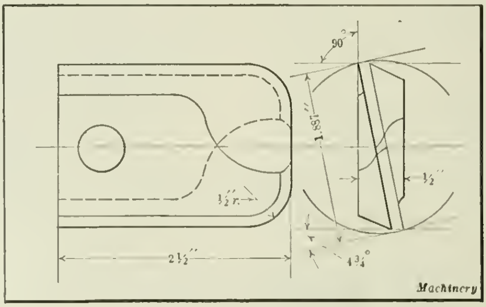


Fig. 2. Special Reamer Blade

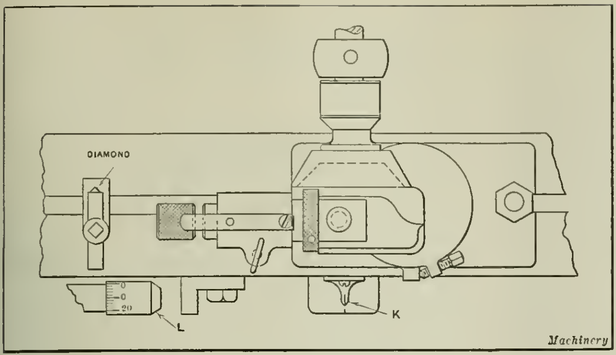


Fig. 3. Plan View of Reamer-grinding Fixture shown in Fig. 1

plane at an angle to that of the wheel-spindle. The best results are obtained with the wheel in the lowered position.

It should be noticed that the exact center of the radius of the cutter and the swivel or pivot center both lie in the same vertical line. By registering the graduation of the handwheel when truing the wheel, and carefully setting the machine to this graduation when finish-grinding, the diameter of the reamer can be held to close limits. When the fixture is in operation, the table is first brought forward so as to take a light trial cut, beginning at the rear end of the reamer and working the table to the left until the pointer lines up with the radius center line of the stationary plate. The table feed is then stopped and the arm carrying the cutter swung through an angle of 90 degrees to form the half-inch radius. The table is again moved to the left until the center stop *L* is reached. The movement of the table is then reversed and brought back to its original position where the cutter is indexed around 180 degrees, or one-half turn. The grinding operations are then repeated.

Hand feed and hand pressure on the arbor, while in both positions, are necessary, as mechanical feeds cannot be used. After finish-grinding, the rear of the side edges are stoned off slightly tapering, the clearance being worked into a negative one. This stoning prevents the rear of the blade from scraping the side of the cavity if slightly out of alignment. The reamer, when ground and stoned as described, produces a very smooth finish, and in the case of high-explosive shells gave the finish required to pass the rigid government inspection. Those familiar with the manufacture of high-explosive shells know that the cavities must be perfectly smooth, as any rough spots would cause friction with the explosive which is set in a rotary motion only by its frictional contact with the walls of the cavity. In order to prevent dangerous premature explosions, it is therefore necessary that exceptional care be used in the manufacture and inspection of munitions of this type.

Allentown, Pa. JOE V. ROMIG

TORCH FOR CUTTING METAL UNDER WATER

A new type of metal-cutting torch designed for operation under water has recently been tried out at the shipbuilding works of the Chantiers du Rhone at Lyons, France. Demonstrations conducted by Eugene Royer, assisted by an American naval attaché and a former representative of the United States Shipping Board, showed that a clean cut can be rapidly made while the metal is submerged. Experiments were made on a piece of armor plate about 11/16 inch thick and 6 11/16 inches long which was entirely submerged in a basin of water. When the blowpipe or torch was plunged into the water the latter immediately began to bubble. The metal finally became severed under the action of the torch, which is said to attain a temperature of about 6500 degrees F. In one minute forty seconds the 11/16-inch steel plate was completely cut through its entire length of 6 11/16 inches.

The lighting of the torch is automatic, and the torch can be readily adjusted to the proper distance from the work. It is claimed that the development of this apparatus will make possible the repairing of ship hulls under water, so that the ships will not have to be put in drydock or careened, and that wrecks or obstructions in shipping channels can be cut up so that they may be readily removed.

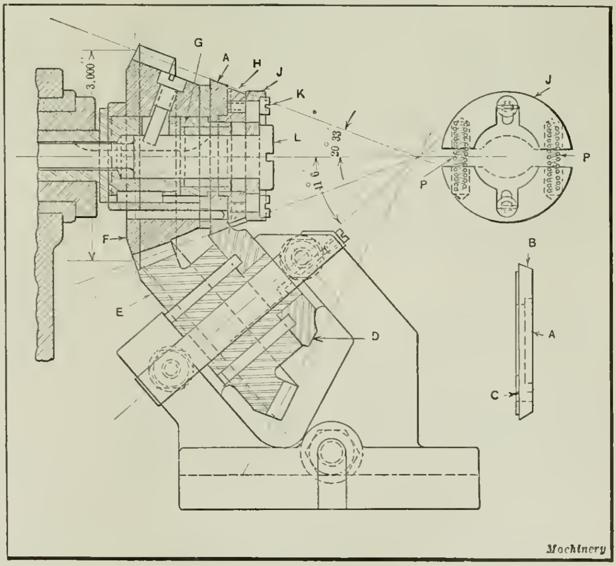
Paris, France W. P. MITCHELL

KNURLING FIXTURE

A large quantity of aluminum castings like the one shown at *A* were required to be knurled on unequally spaced portions of the smoothly finished beveled edge *B*. The knurled portions were to be located in a given position relative to a hole *C*. To meet these requirements, a fixture such as shown in the illustration was made. The knurling tool *D* and the work *A* are mounted on bevel gears *E* and *F*, respectively. This prevents slippage between the work and the knurling tool and enables the knurled surfaces on the tool to be accurately reproduced on the work. Sufficient allowance was made in cutting the bevel gears to provide for feeding the tool in 0.01 inch, which was the depth of knurl required.

The work is held on arbor *G* by a spring washer consisting of members *H*, *J*, and *K*. When the clamp bolt *L* is released, the halves of member *J* are separated sufficiently to pass over the head of bolt *L*, by means of springs *P* shown in the view to the right.

Waynesboro, Pa. D. A. NEVIN

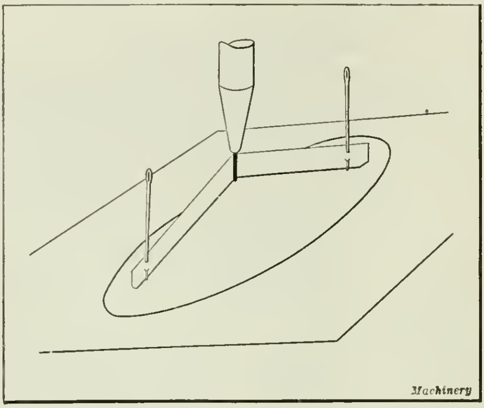


Fixture for performing a Special Knurling Operation on Work A

METHOD OF DRAWING AN ELLIPSE

When it is necessary to draw ellipses quickly, the writer employs a modification of the well-known "string-and-pin" method. With the modified or improved method, the string is replaced by a strip of vellum or bond tracing paper 5/16 inch wide. Two sewing needles are used for pivots, as the needles have finer points and a smoother finish than ordinary pins. Two crosswise pencil marks are made on the paper strip a distance apart equal to the length of the large main diameter of the desired ellipse plus 1/16 inch. The strip of paper is then pierced by the needles on these lines in a "weaving" manner, as shown in the illustration. The ends of the paper strip should extend 1/4 inch beyond the needles.

A thin lead held in a pencil-holder is used for drawing the curve. The lead should protrude a little over 5/16 inch from the holder. By holding the pencil vertical and keeping the paper strip stretched at an even tension, the resulting ellipse will be fairly accurate and even. The paper strip is sufficiently wide to assist in supporting the pencil perpendicular to the paper. As the end of the pencil-holder is wider than the lead, it prevents the paper strip from slipping up



Quick Method of drawing an Ellipse

on the lead. One strip of paper is usually suitable for drawing at least half a dozen ellipses before it wears out.

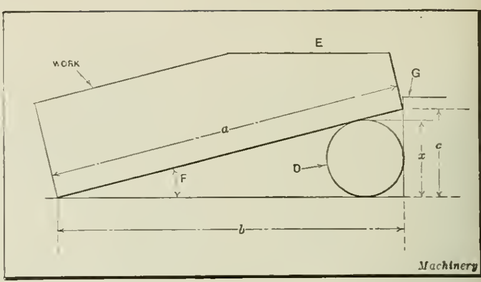
By locating the needles in the drawing-board at varying distances it is possible to produce ellipses of varying small diameters that always have the same large diameter, or in other words, ellipses that are projections of the same circle at varying angles. The pencil lines may be inked in by the use of celluloid curves or a compass. It is necessary to add 1/16 inch to the large diameter when marking off the lines on the paper strip, to compensate for the thickness of the lead. Permanent templets may be produced from thin sheet celluloid by first tracing the ellipse with a steel point in place of the lead, and then carefully cutting the celluloid on the traced outline.

Detroit, Mich. A. L. Vargha

SETTING WORK AT AN ANGLE BY USE OF DRILL ROD

The writer has found that drill rod provides a simple means of setting up work at an angle for testing or grinding. The accompanying illustration shows graphically the method of using the drill rod. It is, of course, necessary that the opposite sides of the work be straight and parallel, as otherwise some deviation from the proper angle will result.

Referring to the diagram, E represents the surface of the work to be ground. The lower edge rests on the magnetic chuck, and the other end is supported by the drill rod or



Method of setting Work at an Angle by Use of Drill Rod

plug D. Both the work and the drill rod are in contact with the straight edge of the chuck, or a ground parallel G.

The following is a simple rule for finding the proper diameter of drill rod to use: Having the angle F given, multiply the dimension a by the cosine of the angle to determine dimension b, and multiply a by the sine of the angle to determine c. Deduct b from a and then deduct the remainder from c. The result is x which is the diameter of the drill rod or plug D. Written as a formula,

$$x = c - (a - b)$$

As an example showing the application of the formula, let $F = 5$ degrees, and $a = 2$ inches; then

$$b = a \times \cos 5 \text{ degrees} = 1.992$$

and

$$c = a \times \sin 5 \text{ degrees} = 0.174 \text{ inch}$$

Then

$$a - b = 2 - 1.992 = 0.008$$

and

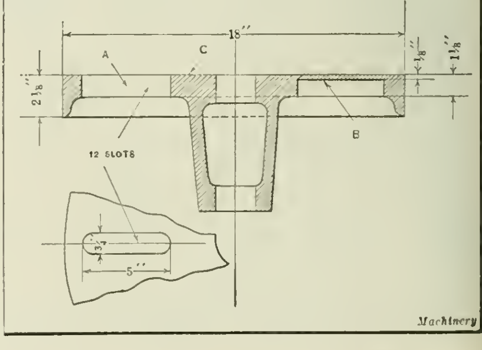
$$x = 0.174 - 0.008 = 0.166 \text{ inch}$$

Bridgeport, Conn. Walter W. Wright

REDESIGNING SLOTTED CASTING TO FACILITATE MACHINING

The machining of a casting similar in appearance to a slotted faceplate was greatly facilitated by a simple change in the casting as indicated at B in the accompanying illustration. This casting was used on a special machine and was required to be face-turned on the surface C. Ordinarily castings of this kind would be made with the slots extending clear through the flange as indicated at A.

To insure a clean turned face without the edges of the slotted holes being broken or ragged, the foreman ordered the castings made with a filler 1/8 inch thick at the top face of the holes, as indicated at B. This permitted the first, or roughing, cut to be continuous. The fine finishing cut, which followed the roughing operation, was of just sufficient depth to cut through the 1/8-inch filler section, leaving the face of the plate and the edges of the slotted holes clean and smooth.



Casting which was redesigned to facilitate Machining

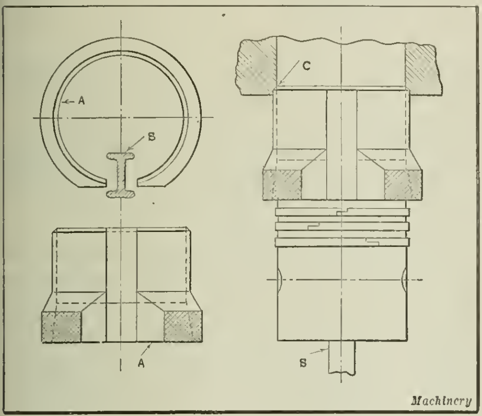
The castings were made in green sand, but better castings could, of course, be made if dry sand cores were used to produce the slot recesses. The stock *B* at the top of the slots should not be less then ⅛ inch in thickness.

Kenosha, Wis. M. E. Duggan

DEVICE FOR ASSEMBLING PISTONS IN CYLINDERS

The ring shown at *A* was developed to facilitate inserting assembled pistons into the cylinder bores of automobile engines. The ring is in the form of a sleeve with a tapered hole in one end which enables the piston-rings to be compressed or forced into position in the piston-grooves before entering the cylinder bore. It will be noted that the ring is split or slotted on one side to allow it to be slipped off the connecting-rod *B* after the piston is in place.

The ring is made heavy at one end to insure sufficient strength at the point where the rings are compressed, while the end which slips into the countersunk bore of the cylinder at *C* is only about 1/16 inch thick. The outside of the large end is knurled to enable the ring to be handled easily, even when covered with oil.



Device used in assembling Pistons in Cylinders

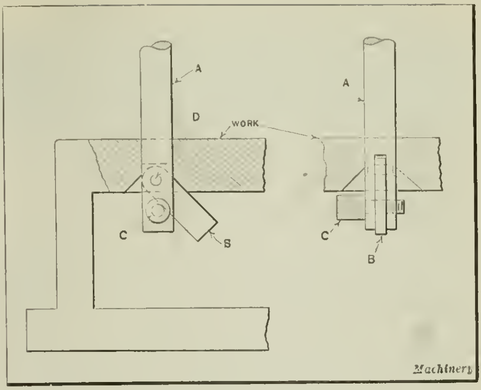
This device is inexpensive, and saves time and unnecessary labor, because all the mechanic has to do is slip the ring over the piston, insert it in the countersink at the bottom of the cylinder in the position indicated in the view at the right, and then push the piston up into position.

Pittsburg, Pa. William Owen

COUNTERSINKING TOOL

It is sometimes necessary or desirable to countersink the inner end of a hole which has been drilled through a cast-iron shell or through work such as that shown in the accompanying illustration. Countersinking operations of this kind can be easily performed by the use of a tool like the one shown in the illustration. This tool consists of a shank *A* made from drill-rod stock, a tool-steel cutter *B*, and a knurled-head screw *C*. The shank of the tool is held in the drilling machine spindle. From the illustration it will be noted that the drill-rod shank is slotted to accommodate the cutter *B* which swivels on a pin *D*.

The cutter is held in the correct angular position for countersinking holes by the knurled-head screw *C*. Screw *C* also serves to prevent the slot in which the cutter is held from spreading when the cut is being taken. When the knurled-head screw is removed, the cutter *B* folds down into the slotted end of shank *A*, thus permitting the tool to be inserted in the hole which is to be countersunk. When the end of the tool projects a sufficient distance from the



Tool for countersinking Inaccessible Holes

inner end of the hole to permit the cutter to be pivoted into the correct cutting position, as shown in the illustration, screw *C* is inserted after which the countersinking operation can be performed by feeding the tool upward. After the hole is countersunk to the required depth, screw *C* is removed to permit the tool to be withdrawn from the hole.

Rosemount, Montreal, Canada Harry Moore

SUPPORTING SHOULDERED WORK ON V-BLOCKS

It is sometimes desirable to place V-blocks under a shaft having two or more shoulders, or sections of different diameters. In order to keep the center line of the work parallel with the surface plate, a parallel pad or series of shims and pads must be put under the V-blocks which are used to support the smaller sections. In the accompanying illustration the pad *P* is employed to bring one of the V-blocks up to the correct height for supporting the section having the smaller diameter. The method of determining the correct height *H* of pad *P* is as follows:

Let a = angle of V-block;
R = radius of large part of work; and
r = radius of small end of work.

With these values known, it is desired to find the height *H* of pad *P*.

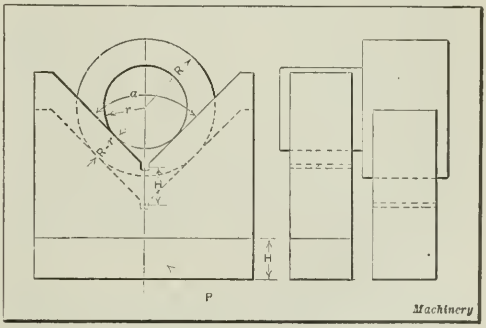
By trigonometry

$$H = (R - r) \text{ cosec } \frac{a}{2}$$

Therefore, when the angle a of the V-block is 90 degrees we have

$$H = 1.4142\ (R - r)$$

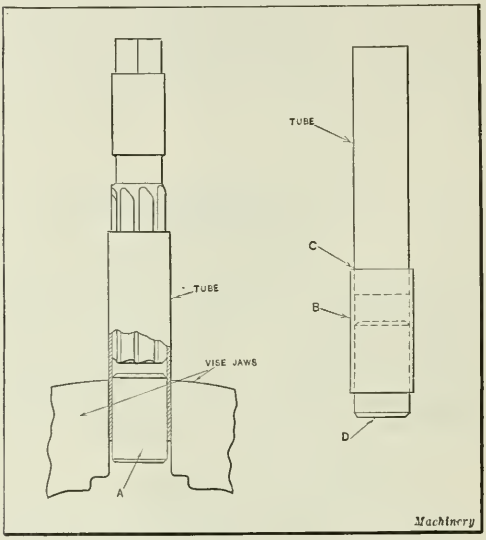
Flint, Mich. W. G. Holmes



Method of using V-blocks to support Shouldered Work

HAND-REAMING THIN TUBING

In making small pump cylinders or other apparatus from thin brass tubing, it is often necessary to ream out the tubing to size with a hand reamer. In performing the reaming operation, difficulty is sometimes encountered in holding the tubing without distorting, cutting, or crushing it. If only a small amount of metal is to be removed, one end of the tube may be gripped by a fine-tooth Stillson wrench, but there is always danger of damaging the work when this method is used. The best way is to drive a brass or iron plug *A* into one end of the tube as shown in the illustration, and then grip this end in the vise, preferably with a V-block between one jaw and the tube. The reamer may then be run in without difficulty. If the tube to be reamed is short, it can be driven into a larger one, as shown in the right-hand view. In some cases the sleeve *B* is split and spread out, after which it is soldered into place at the joint *C*. A plug *D* can then be driven into the extension sleeve *B* and gripped in the vise as shown in the view previously referred to. The extension sleeve should be long enough to



Method of holding Tubing while reaming

allow the reamer to run through the upper tube before bottoming on the plug. After reaming, the sleeve may be released by heating it so as to melt the solder.

Oakland, Cal. H. H. Parker

REGRINDING THE TEETH IN METAL-SLITTING SAWS

It is not always cheaper to regrind the teeth in metal-slitting saws than it is to buy new saws. There are times, however, when regrinding a saw that is practically worn out may be profitable. It may happen that there is a particular job to be rushed through which requires a certain size saw, and the saw available for this job may be dull or of no further use in its present state. If the time required to obtain a new saw would delay the job considerably, the regrinding method described in this article can often be used to advantage. It may be mentioned that the method was devised by the writer when a circumstance of this nature arose. By referring to Fig. 1, the idea of the arrangement will be readily grasped.

The block *A* on which the saw rests was one of the attachments supplied with the grinding machine. Across the top face of this block there is a groove and on the opposite

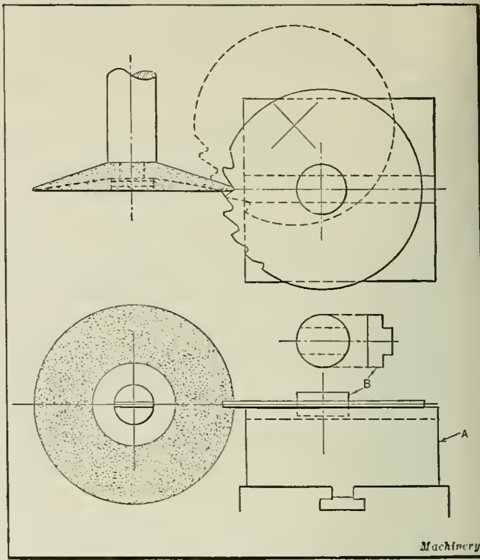


Fig. 1. Method of grinding Metal-slitting Saws

face a tongue. A small stud *B* with a tongue or key across one end, of the proper width to fit the groove in block *A*, is the only part that was required to be made in this particular instance. The saw fits and rotates about stud *B* as a center, and the key permits the saw to be drawn back and forth, to and from the grinding wheel.

The grinding wheel should be of a coarse grade and fairly hard, as the nature of the work tends to wear the wheel away rapidly. The teeth are first notched, the eye being relied upon to determine the proper depth. If the cutting edge is to be radial, a scale or straightedge placed across the grinding wheel will enable the center piece to be properly located. If the teeth are to be under-cut, the table or block can be adjusted to give the angle of under-cut desired.

In grinding the backs of the teeth, the table and block are adjusted to permit the cutter to take the position shown by the dotted lines in the upper view. The angles and general dimensions of the teeth on the most commonly used saws are shown in Fig. 2. Nearly all saws are ground with back clearance, as indicated, and after repeated regrinding the cutter will become slightly under size. By using paper shims the saw can be made to run out of true a sufficient amount to produce the correct width of slot.

Chicago, Ill. Clifford Cornwall

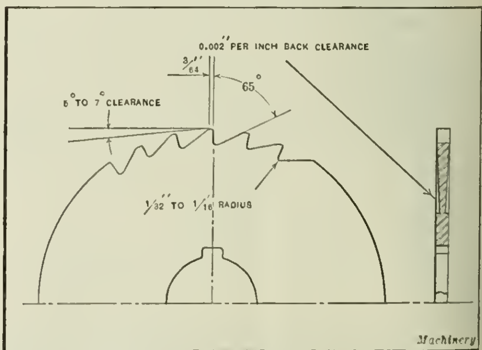


Fig. 2. Diagram showing Clearance Angles usually employed on Slitting Saws

HOW AND WHY

QUESTIONS ON PRACTICAL SUBJECTS OF GENERAL INTEREST

TOOLMAKER'S PROBLEM

R. T.—Please show how to find dimension *W*, Fig. 1.

A.—First lay out the diagram shown in Fig. 2 from the dimensions given in Fig. 1. Referring to this diagram we have $b = 2$ inches; $a = 3.375$ inches; angle $D = 20$ degrees; and angle $A = 180$ degrees minus 20 degrees = 160 deg. Referring to MACHINERY'S HANDBOOK, page 152, we find that

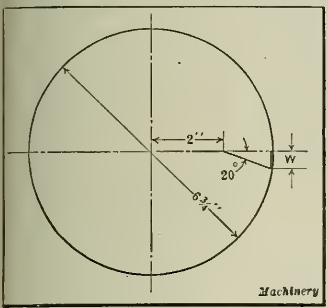


Fig. 1. Toolmaker's Problem

$$\sin B = \frac{b \times \sin A}{a}$$

$$C = 180 \text{ degrees} - (A + B)$$

Then

$$W = a \times \sin C$$

Substituting the numerical values in these formulas, we have

$$\sin B = \frac{2 \times 0.34202}{3.375} = 0.20268$$

and

$$B = 11 \text{ degrees } 41 \text{ minutes } 37 \text{ seconds}$$

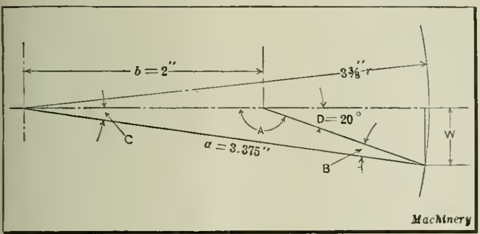


Fig. 2. Diagram used in finding W, Fig. 1

$$C = 180 \text{ deg.} - (160 \text{ deg.} + 11 \text{ deg. } 41 \text{ min. } 37 \text{ sec.})$$

$$C = 8 \text{ deg. } 18 \text{ min. } 23 \text{ sec.}$$

Then

$$W = 3.375 \times 0.14447 = 0.48759 \text{ inch.}$$

ELASTIC LIMIT AND YIELD POINT

H. C. A.—What is the difference, if any, between the elastic limit of steel and its yield point?

A.—The following definitions of the physical properties of materials have been established for use in the testing materials laboratories of the Bureau of Standards:

Elastic limit is the stress which produces a permanent elongation 0.001 per cent of a gage length, as shown by an instrument capable of this degree of precision. This is determined from set readings with an extensometer.

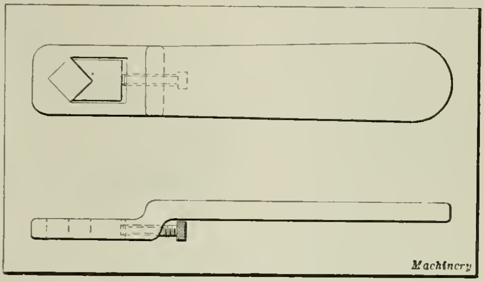
Yield point is the stress at which marked increase in deformation of the specimen occurs without increase in load. This is determined usually by a drop of the testing machine beam or with dividers.

Proportional limit is the stress at which deformations cease to be proportional to the load. This value is determined with an extensometer.

FINISHING WRENCH FORGINGS

S. E.—The writer is having difficulty in attaching abrasive grain to felt polishing wheels for finishing box wrenches, such as shown in the illustration. Patternmakers' glue is used in coating the wheel; this is allowed to dry for a short time and is then stoned down. A second coating is next applied hot, and the wheel immediately rolled in emery. With this method trouble has been experienced from the emery peeling off almost immediately when the wheel is used. The wrenches are made from steel forgings, and are first roughed on a solid emery wheel. Can you give me any information that will assist in overcoming the trouble?

A.—In answering this question it is necessary to know the degree of finish desired. If an ordinary grade of finish is required, after the forgings have been roughed on the solid wheel, use No. 120 alundum for dry-fining. If a better finish than this is required, a second wheel set up with



Adjustable Box Wrench which is finished by polishing

No. 150 alundum may be used. The second wheel should be used with grease in cake form, made from beeswax and suet.

A felt wheel is hardly suitable for a job of this kind; better results will be obtained with a solid bullneck leather wheel. The utmost care is necessary in selecting and preparing the glue. A good grade of blended hide stock glue is recommended. Preheat the wheels so that the hot glue will not become suddenly chilled in setting up the wheel. After the wheels have been rolled in the abrasive, let them dry thoroughly so that the head will become set. This does not mean until they are cold and appear hard, but they should be permitted to set for forty-eight hours before using, in a normal temperature of about 70 degrees F. Drafts near the glue-pot chill the glue and lower its holding efficiency.

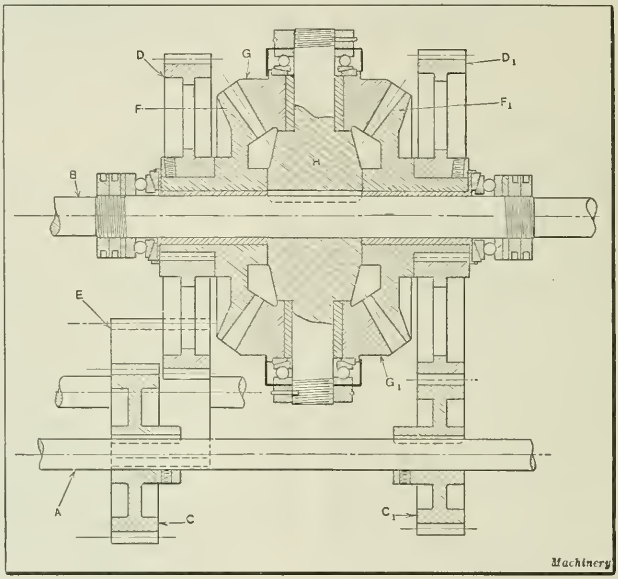
For the highest efficiency in handling a job of the kind mentioned, it is probable that the use of a "compress" polishing wheel made of canvas or leather with a medium density cushion is best. This type of wheel is more expensive than the disk type or the leather-covered wheel, and if such wheels are used, complete instructions as to their preparation can be obtained from the manufacturers of the wheel. With this type of wheel, the wrenches could be finished from the rough without the use of a solid grinding wheel; that is, the wrenches would first be ground with a No. 80 alundum flexible wheel, followed by dry-fining with No. 120, and finishing with No. 150. This will give a high degree of finish, and may be modified somewhat for the ordinary finish, in which case the flexible grinding would be performed with No. 60 alundum and the finishing with No. 120, these two being sufficient. A wheel of medium density cushion would be suitable for covering the entire surfaces of this wrench, if it were not desired to retain the sharp edges of the forging.

SPEED REDUCTION BY DIFFERENTIAL GEARING

By FRANK C. PENNY

A problem that cannot always be easily solved by the machine designer is that of obtaining a speed reduction of large magnitude. Belting may not be suitable, either because it does not give a positive drive from the driving to the driven shaft, or because there is not sufficient room for the pulleys. Lack of room may also prevent the use of chains and sprockets. Spur gear trains often require too many gears, thus introducing high costs and an undue amount of power loss through friction. Worm-gearing is also often objectionable on account of friction losses and the attendant heating. In order to overcome these difficulties, the writer developed, at the plant of the Bridgeport Safety Emery Wheel Co., Bridgeport, Conn., a method of employing differential gearing as a means of obtaining a satisfactory speed reduction mechanism of compact form.

The principle can, of course, be applied in a number of forms and modifications. The form shown in the accompanying illustration is a simple one. The speed reduction is made from the shaft A to the shaft B. As may be seen, the gears C and C_1 are fixed on shaft A. Gear E is merely an idler meshing with gears C and D. Gear D is fixed on the hub of bevel gear F, which is bushed and free to revolve on the shaft B. Gear C_1 meshes directly with gear D_1. Gear D_1 is mounted on the hub of the bevel gear F_1 which is bushed and free to revolve on shaft B, the same as gear F. The crank H is keyed to the shaft B, and on its two arms are mounted the bevel idler gears G and G_1 which are bushed and free to revolve on the arms.



Speed Reduction Mechanism employing Differential Gearing

Now as C and C_1 are keyed to the shaft A, it is evident that they must always turn or rotate in the same direction. It should be noted further that C_1 drives direct to D_1 and that C drives D through the idler gear E. Therefore D and D_1 must revolve in opposite directions. Their speeds are also different, as gear C has more teeth than gear C_1. Gears F and F_1 must, of course, revolve with gears D and D_1 which are mounted on their respective hubs. The bevel gears G and G_1 meshing with both F and F_1 must therefore revolve on their own axes. If F and F_1 should revolve at the same speed but in opposite directions, gears G and G_1 would be stationary with respect to the axis of the shaft B, that is, they would revolve on their own axes, but they would not revolve about shaft B. Now if F and F_1 should revolve at different speeds, G and G_1 must revolve about the axis of the shaft B, and thus revolve shaft B through crank H.

Determining Amount of Speed Reduction

The calculations entering into the design of a speed reduction device of this kind are simple. As in laying out gear trains of any type, it is largely a matter of employing cut-and-try methods. The number of revolutions per minute of shaft B, which is driven by crank H will be one-half the algebraic sum of the number of revolutions per minute of the speeds of the bevel gears F and F_1. In order to make this clear, let it be assumed that a point on the pitch circle of gear F_1 is traveling at a rate of $x + y$ feet per minute, and that gear F is stationary. It is obvious that a point the same distance from the center of shaft B on the axis of G and G_1 will travel at a speed of $\frac{1}{2}$ $(x + y)$ feet per minute.

Now assume that a corresponding point on gear F is traveling at a rate of x feet per minute in the opposite direction or $-x$ feet per minute, and consider gear F_1 to be stationary. The corresponding point on the axis of gears G and G_1 will now travel at a rate of $\frac{1}{2}$ $(-x)$ feet per minute. Next assume that both gears F_1 and F are traveling at their respective speeds of plus $x + y$ and minus x feet per minute. Now adding the speeds of F_1 and F we obtained $x + y - x = y$ feet per minute. Then a speed of one-half y feet per minute equals the speed of the point under consideration on the axis of gears G and G_1.

Now as the pitch diameters of gears F and F_1 are equal and cannot be otherwise, and as these gears mesh with gears G and G_1, it is evident that the number of revolutions per minute can be readily employed to designate the speed. Therefore, the speed of shaft B can be expressed as one-half the algebraic sum of the revolutions per minute of gears F and F_1. The selection of the bevel gears is merely a matter of choosing such sizes as can be used in the available space, and still be of sufficient size to give the necessary tooth strength for the material used and the load imposed. The diameters of gears G and G_1 should, of course, be made as large as permissible so that they will not revolve on the crank H at a higher speed than necessary. In determining the sizes of the spur gears to be used, it is only necessary (not considering the available space) to select such sizes as will give the desired difference in speed between F and F_1, together with a suitable surface speed.

The following example will serve to make clear the procedure followed in laying out or designing a speed reduction device of the type shown in the illustration. We have shaft A running at a speed of $-$ 625 revolutions per minute (anti-clockwise), and it is desired to drive shaft B from shaft A so that shaft B will revolve in a clockwise direction at a speed of approximately 3 revolutions per minute. The algebraic sum of the speeds of gears F and F_1 must, therefore, be about $+$ 6 revolutions per minute. Taking 300 revolutions per minute as an approximate speed for F_1, we may proceed to determine the pitch and size of the gears to be used.

Let it be assumed that we select an 8-pitch gear having a pitch diameter of $7\frac{1}{2}$ inches for D_1 and an 8-pitch gear having a pitch diameter of $3\frac{1}{2}$ inches for gear C_1. These gears will give bevel gear F_1 a speed of $+$ 291.67 revolutions per minute. The speed of gear F should therefore equal approximately — 291.67 + 6 or — 285.67 revolutions per minute. Now if gear D has a pitch diameter of 7 3/8 inches and gear C has a pitch diameter of 3 3/8 inches, gear F will have a speed of approximately — 286.02 revolutions per minute. The difference between the number of revolutions of gears F and F_1 will then equal 5.65 revolutions per minute, and the speed of shaft B will be one-half as great or + 2.82 revolutions per minute.

It is, of course, difficult to obtain an exact speed for shaft B, but by using gears of as fine a pitch as possible without an undue sacrifice of strength, we can obtain very nearly the exact speed desired. The center distance between the two shafts can in some cases be varied, thus increasing the range in speed reduction that may be obtained.

The possibilities of a speed reduction device of this kind is readily apparent to the designer. The speed of the shaft B with respect to shaft A is governed entirely by the speed

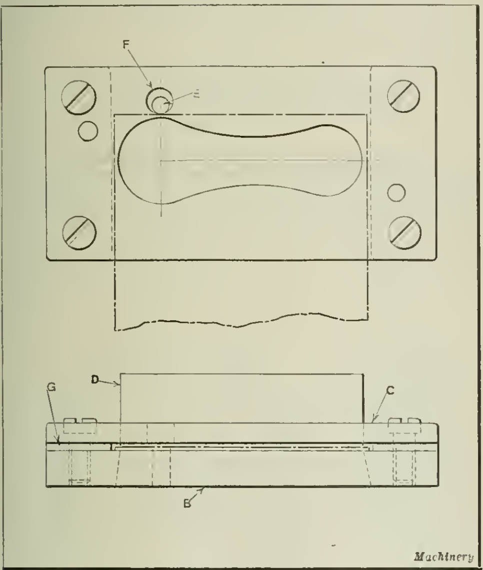


Fig. 1. Temporary Blanking Die

ratio existing between the gears D and D_1. The speed of shaft A may be as high as the successful operation of the gears will allow, and still by the right combination of gears it may be possible to obtain a very low speed for shaft B. At the same time the whole gear assembly is very compact, and may be installed where other forms of speed reduction mechanisms cannot be used. In order to obtain the best results, all the running parts should, of course, be well oiled and this may be readily accomplished by running the whole assembly in an oil bath or in a case partly filled with oil. Operated under these conditions, the friction loss is very low.

* * *

With the general recovery of trade, South American exchanges may be expected to rise. The Argentine Republic will unquestionably return to gold exchange within a comparatively short time. The fall of exchange usually caused by excessive buying and insufficient selling carries within itself its own remedy. By cutting down the country's buying power it reduces imports and lowers prevailing wages by comparison with outside standards, which should in time foster exports. The reason for the activity of the copper mines in Chile while the mines in the United States were idle, was the low cost of Chilean labor in gold.—Paper by Mr. De St. Phalle, read before the Foreign Trade Convention.

BLANKING AND PERFORATING DIES FOR EXPERIMENTAL PURPOSES

By D. A. NEVIN

The use of so-called "temporary" dies has effected a great saving in many instances in the cost of producing sheet-metal parts. The discarding of expensive blanking and perforating dies during the process of developing and perfecting a new model is unnecessary when temporary dies are used, as dies of the latter type can be employed until the stamp of approval has been placed on the product by the purchasers. The expense of making alterations in the product during its period of development is generally less if separate dies are used for the blanking and perforating operations, as was done in the case of the temporary dies described in this article. This practice allows alteration of the shape of the part without affecting the punch and die for perforating, and the

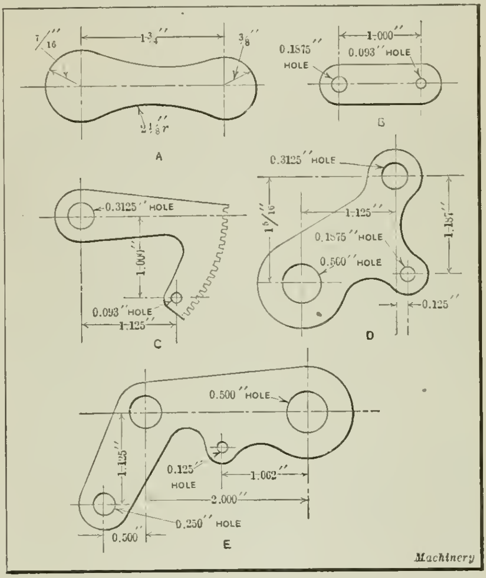


Fig. 2. Parts produced on Temporary Dies

perforating die can be altered without affecting the design of the blanking die.

Construction of Blanking Die

The blanking die shown in Fig. 1 is used for blanking the piece shown at A, Fig. 2. This piece is made from 0.050 inch flat steel. Referring to Fig. 1, the die proper B is made from 0.3125-inch tool steel, and the stripper plate C is made somewhat thicker than is the usual practice (0.1875 inch in this case) for the purpose of guiding the punch D, which is ground flat on its top surface. A plain stock stop-pin E is shown just under the sight-hole at F. The spacer guides G allow sufficient clearance to permit the stock to be raised up over the stop-pin when feeding the stock to the next position. By this method of construction a self-contained punch and die is obtained, thus saving the expense of the sub-press design, as well as the cost involved in assembling the punch and die.

It is also an improvement over the old-style of temporary punch and die which did not have the punches guided in the stripper plate and which required the punch to be fastened to the ram and the die to the bolster after alignment of the members. The tool here described, produced very satisfactory work and stood up well during the production of more than 50,000 parts. If properly made and if the requirements

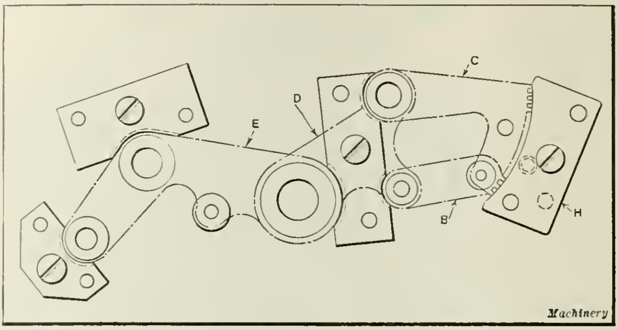


Fig. 3. Perforating Dies of Temporary Type

of production justify the expense, a die of this type can be mounted on a standard sub-press.

Construction of Combination Perforating Dies

Considerable saving in the cost of constructing perforating dies can be obtained by grouping the parts in suitable combinations, provided a large production is not required. In Fig. 2 pieces *B*, *C*, *D*, and *E* are flat parts such as are used in cash registers, adding machines, typewriters, etc. These parts are blanked out in a die similar to that shown in Fig. 1 and are perforated in a separate operation in the combination die shown in Fig. 3, the locating nests being removed or replaced to suit the part being perforated.

In designing a die of this kind a careful study of the parts to be perforated is made, and the parts are grouped or located on the die in such a way that holes of the same size on different parts can be perforated with the same punch. The nest plates for the die shown in Fig. 3 were designed, as far as practicable, to accommodate more than one piece. In laying out this die, the 0.3125-inch holes of parts *C* and *D*, Fig. 2, were matched so that the same punch could be used to perforate both parts. A study of the other parts and the relative sizes of holes showed that the 0.093-inch hole in part *B* checked with the smaller hole in part *C* and that part *B* also required the punching of a hole 0.1875 inch in diameter which was the same size as the smaller hole in part *D*, so that in locating the latter part it was swung around the center of the 0.3125-inch hole until the 0.1875-inch hole was placed 1 inch from the 0.093-inch hole in part *C*, thus providing for perforating both holes in part *B* without adding any more punches.

The remaining part *E* has only a 0.500-inch hole which is common to any of the other parts. This part is located with the 0.500-inch hole matched with the same size hole in part *D*. The number of parts that the punch and die is designed to perforate depends on the production required and the number of parts that can be accommodated without the overlapping of holes in the die-plate. The locating nests should be shown on an assembly of all the nests in order to prevent the screw and dowel holes from overlapping. The die-plate is not hardened, the perforating bushings being a light press fit therein, allowing for their ready removal.

Part *C* or *E*, Fig. 3, may be perforated without removing any of the nests. For perforating part *B*, the nest *H* is removed and exchanged for the nest *J* shown in Fig. 4. In Fig. 4 are also shown the nests *K* for locating part *D*. The perforating punch was mounted in a large sized sub-press in order to allow space for additional parts.

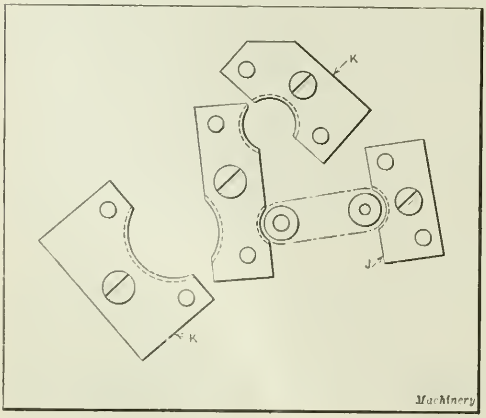


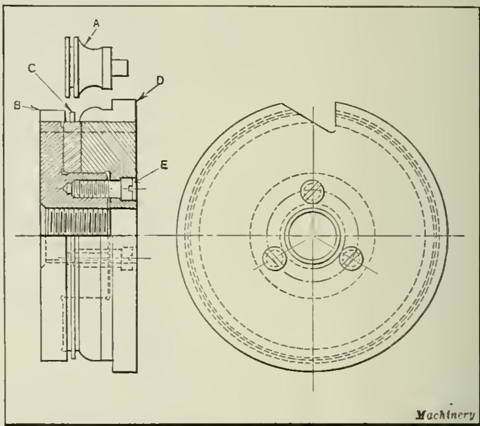
Fig. 4. Diagram showing Method of attaching Locating Nests

* * *

BUILT-UP FORMING TOOL

By EDWARD C. PERRY

A circular forming tool is only as efficient as the weakest point in its outline. When one point fails, the better sections alone cannot produce perfect work. In an ordinary forming tool, the broken point is made serviceable only by grinding



Forming Tool of Built-up Construction

away the entire cutting edge. To overcome this apparent waste, the forming tool here illustrated was designed.

The work to be machined is shown at *A*. The difficult feature is a narrow groove 3/64 inch wide by 3/32 inch deep. The thin projection on the forming tool, which cuts this groove, invariably breaks down before any other part, and frequently requires to be replaced. For this reason, the forming tool is divided into three parts *B*, *C*, and *D* as shown. Part *B* is made with a hub which carries part *C* and fits into part *D*. Part *C* is free to revolve on part *B*, except when held in place by the clamping action of three small screws, one of which is shown at *E*.

When the cutting edge of part *C* has worn out, the screws are loosened and the broken down edge raised above the cutting edge of parts *B* and *D* by revolving *C* about its central bearing. The screws are then tightened and the tool ground. The screws *E* are not depended upon to hold the parts in line while the tool is in use; when it is in the machine, the toolpost screw threads into part *B* and draws the latter toward the post, thus clamping the three parts securely in place.

The British Metal-working Industries

From MACHINERY'S Special Correspondent

London, May 15

DESPITE the serious labor disputes that have hampered industry for some time, it is generally agreed that the long period of depression, though by no means over, is now on the mend. There is a steady expansion in iron and steel production, and this indicates a general improvement.

Effect of Engineering Lock-out in Metal-working Industries

The effect of the continued lock-out is felt in varying degrees in the metal-working industries. With demand much below normal, deliveries have been fairly well maintained, but disorganization is becoming more apparent as a whole. Manufacturers who employ a large proportion of skilled workers have naturally suffered more severely than those engaged on work that is done principally by automatic and semi-automatic machinery.

In the automobile and motorcycle industries, which have considerable orders on hand, output has been reduced by 25 per cent; there is a less marked effect in the machine tool field, as this branch has been greatly depressed for a long time, and the output has been very low. Foremen, apprentices, and machine operators have kept the shops open, and some progress has thus far been made with what few orders were in process when the lock-out started.

Machine Tool Trade

The improved prospects in other spheres of engineering are beginning to make themselves felt in the machine tool field. During the past month and before the full effect of the lock-out was felt, home inquiries for new machine tools were numerous, and for the first time in over a year, a moderate amount of business had been transacted in general engineering tools. In the Clyde district, there have been inquiries for special machines to drill and face pipe flanges, and for heavy vertical drilling and boring machines. Radial drilling and tapping machines are being sold to general engineering firms, and prices are generally very low. There is also some demand for boring and turning mills and ordinary light horizontal drilling, boring, and milling machines. Export trade in machine tools is developing, some inquiries having been received from Australia, South Africa, and India.

British products seem generally to be in greater demand on the Continent, but trade in the Far East which recently has been developing has lately fallen off, although to offset this South America is becoming a more active buyer.

Iron and Steel Industries

It has already been mentioned that the iron and steel trade is showing steady progress in output, and British producers have entirely regained the proportion of the home market that went to the Continent a year or so ago. The demand for alloy steels is strong, principally on account of the needs of the automobile industry. Inquiries are being received from Germany, and fairly large quantities of iron are going to that country; France and Italy have also recently become fairly large customers, and substantial business is expected shortly for reconditioning Indian railways.

A Darlington firm is reported to have secured contracts for the construction of eighteen steel bridges for the Siam State Railways; these railways are also asking for quotations for ten locomotives. The Bulgarian Ministry of Commerce is in the market for machinery, tools, and materials, for the exploitation of the state mines in that country. Canadian buyers seek to place orders in the United Kingdom for 1200 tons of 12-inch cast-iron pipes for spring delivery, and a quantity of electric cranes and other loading and unloading equipment for docks is required.

A contract for 400 locomotives has definitely been placed by Rumania with prominent British builders. Not only is this contract among the largest ever placed in this field of engineering, but there is also talk of further purchases of a similar nature being made.

New Gearing Developments

In the field of gearing, two interesting departures from general practice have been made. One is the Hotchkiss-Taylor gear in which the normal rack form is contained in a plane tangent to a cylinder, the basic gear form of the system being a crown wheel, the teeth of which are involutes in a plane normal to the crown wheel. In this tangent rack system, any gear whether cylindrical or conical, can be meshed with any other gear if it is conjugate to the basic tangent rack crown wheel, and if the base circles or normal pitches are equal. A spiral bevel set with intersecting axes, a double helical bevel set with intersecting axes, and a spur gear set have been made. In each of these sets the larger gear is a crown wheel. Bevel gears with non-intersecting axes, and a worm-gear, the axis of which lies in the tangent plane, can also be produced. Great interest is being displayed in the new system.

Another gear development suggested is even more revolutionary. In this case the pinion of a pair of gears, instead of having teeth, is made with an annular space completely filled with rollers that are long enough to extend across the full face of the pinion. The rollers are held in position radially by lips at each side of the pinion, and the teeth of the gear form their own spaces in the pinion by displacing the rollers as they engage the pinion.

Imports and Exports of Machine Tools

The March returns of imports and exports of machine tools, as compared with the month immediately preceding, show a substantial increase in exports—from 990 to 1447 tons, and from £125,082 to £184,776 in total value; these figures are higher than at any time since last August. The general direction of the curves appears to be changing from downward to upward, and seems to bear out the more optimistic feeling as to increasing trade. The value per ton has risen slightly, from £126 to £128. The imports have risen to a less extent—from 268 to 343 tons and from £35,387 to £37,338 in total value. There is a heavy fall in the value per ton of imports, namely, from £132 to £109. Compared with the first three months' exports of last year, the exports for the same period this year are barely half in value, and little difference is noticeable in value per ton.

Prices and Materials

Metal prices have remained steady during the past month, although one or two items, namely finished iron bars and copper, show a tendency to increase in price. Steel-making irons are in greater demand, and the market for semi-finished material remains satisfactory. The demand for foundry iron is low, but preparations are being made for the blowing-in of more furnaces to meet the increased requirements that are expected.

Billings and Spencer Die Milling Machine

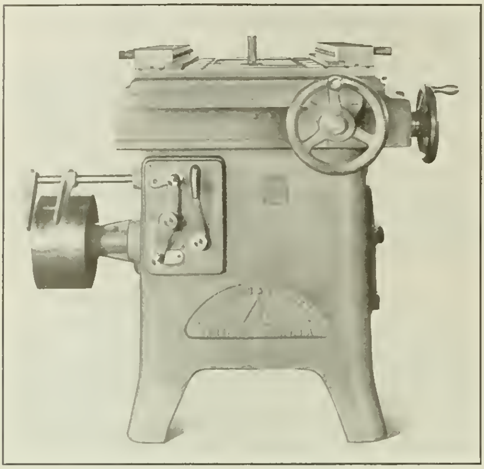


Fig. 1. Machine for milling the Outline of Blanking and Trimming Dies, which has been redesigned by the Billings & Spencer Co.

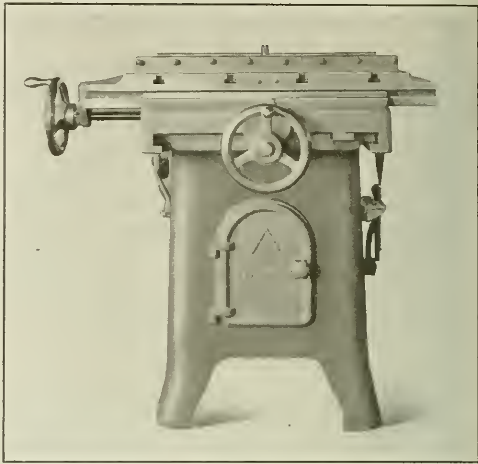


Fig. 2. End View of Die Milling Machine which clearly shows the Construction of the Horizontal and Transverse Slides

MILLING the irregular outlines of blanking dies and dies for trimming the flash from drop-forgings is frequently a troublesome operation on ordinary vertical milling machines because of the difficulty of observing the work clearly while the operation is in progress. For facilitating such work, the Billings & Spencer Co., Hartford, Conn., is introducing a redesigned milling machine which is shown in the accompanying illustrations. All types of cutting dies for presses may be milled on this machine, with or without clearance draft. The outline of the work is in full view of the operator at all times. The main feature of the machine is the inverted spindle at the center, in relation to which the work is shifted horizontally and transversely at the will of the operator.

This adjustment of the work in relation to the spindle is accomplished by means of two slides, on the top one of which the work is clamped by two parallels adequately supplied with clamping screws. Eight slots on the top slide provide for placing these parallels various distances from the center of the machine so that work varying considerably in size can be handled. The arrangement of the top slide may be clearly seen in Fig. 3. Movement of the slides is obtained through screws actuated by handwheels. Both screws have graduated dials which aid in milling work accurately. The most convenient position for the operator is with one handwheel at his right and the other at his left. A proper sliding fit of the two slides is insured by the use of gibs, and both slides have ample bearing surfaces and narrow guides.

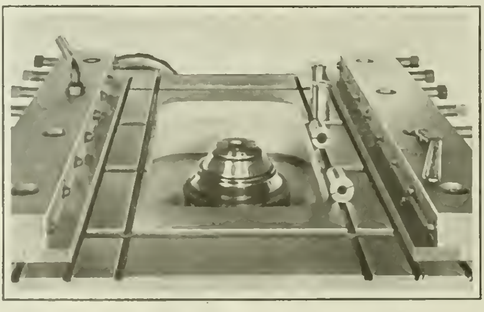


Fig. 3. View looking down on Top Slide and Its Clamping Parallels and the Spindle Nose

Four speed changes for the spindle are readily obtained by shifting the levers of a speed-change box. These levers may be seen in Fig. 1. The gears of the speed-change box are driven direct from the constant-speed pulley. The cutter is held in the spindle by a spring collet, the machine being regularly supplied with collets for holding 3/8-, 1/2-, 5/8-, 3/4-, and 1-inch cutters. The method of holding the cutter in the collet is such as to enable the die to be under-cut to any desired draft. Gripping or releasing of the cutter in the collet in inserting or removing it is effected by operating the upright hand-lever conveniently located on the speed-change-box cover. The spindle is mounted in ball bearings, and all power-driven rotating parts are similarly equipped. Particular care was taken in designing the machine to provide for ample lubrication of the spindle bearings and to insure disposal of chips.

Some of the specifications of the machine are as follows: Size of die that can be accommodated, 3 1/2 to 17 1/2 inches in width and up to any length; travel of longitudinal slide, 12 inches; travel of transverse slide, 4 1/4 inches; speed of cutter, 281, 421, 619, and 926 revolutions per minute; speed of driving pulley, 300 revolutions per minute; floor space occupied, 49 by 58 inches; and weight, approximately 2100 pounds.

* * *

THE AUTOMOBILE INDUSTRY

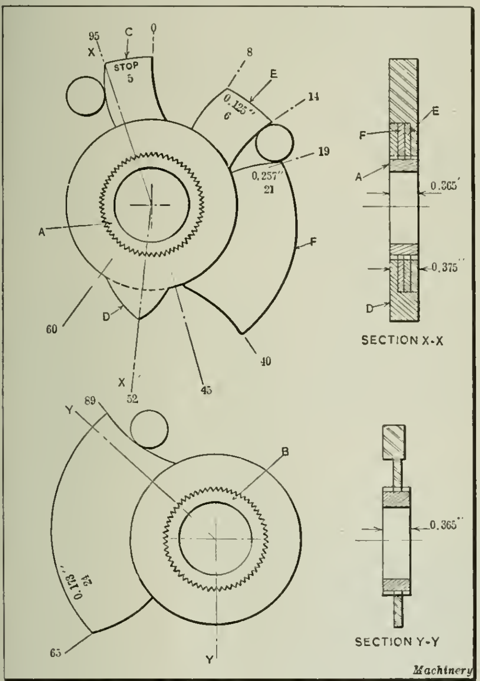
The automobile industry, as a whole, is in a better position today than it has been for the last year and a half. The shops of the leading manufacturers are well occupied, but owing to the readjustment that is taking place in the industry, many of the less well known cars find competition very keen, and it is expected that some of these will not survive. The production of passenger cars during the month of April was about equal to that during March—about 153,000 cars being produced each month. The plans for May called for about the same number of cars.

UNIVERSAL CAMS FOR AUTOMATIC SCREW MACHINES

By D. A. NEVIN, Chief Engineer, Watters Corporation, St. Louis, Mo.

A set of adjustable cams for use on a No. 00 Brown & Sharpe screw machine is shown in the accompanying illustration. These cams are designed to permit the use of various combinations of lobes, and to allow the lobes to be set at different positions on the cam hubs. The lead cam may be made up of four lobes, as shown in the upper view, or it may be made up with one, two, or three lobes, according to the requirements of the work. The nature of the work to be performed must, of course, be considered in selecting the lobes which make up a cam. Lobes that are suitable for drilling and turning operations are made interchangeable with those of the cross-slide cam shown in the lower view.

The hubs *A* and *B* of the lead cam and the cross-slide cam have 90-degree teeth of 1/16 inch pitch cut in their peripheries.



Adjustable Cams for Automatic Screw Machine

The hole in each cam lobe is broached to fit these toothed hubs. The cams are 3/32 inch thick where they come in contact with each other when assembled on a hub, so that the total thickness of four cams is 3/8 inch. The lobes are made of tool steel and are hardened and ground. The cross-sectional view of the lead cam is taken through the stop lobe *C* and the thread lobe *D*. For convenience the amount of throw and the number of hundredths of a complete circle occupied by the cam surface are stamped on the side of each cam lobe. For instance, the notations on lobe *E* show that it has a rise of 0.125 inch and that its cam surface occupies a space equivalent to six hundredths of a complete circle. The thickness of the hub *A* is 0.01 inch less than the combined thickness of the cams, so that the latter are clamped tightly on the camshaft when the clamping nut is tightened. The overlapping sections of the cams are accurately fitted in order to give strength.

The regular locating pin is not used on the No. 00 Brown & Sharpe machine when these cams are employed, as a sufficient grip on the cams is obtained by the clamping nut. If desired, the hub of the cam could be keyed to the camshaft. When combining less than four lobes on the lead cam, washers are used to increase the thickness of the central portion to 3/8 inch. The clamping collars on the camshafts are reduced 1/16 inch in thickness so that the cams will be located centrally. This change does not interfere with the use of the regular cams, which are 1/4 inch thick, as washers can be used to make up the difference in thickness. The cam-roll is made wide enough to allow for the increased thickness of the cams. Only a small variety of thread lobes is required to provide for all threading requirements on the No. 00 machine. The same system may be applied profitably to the No. 0 machine, but on the No. 2 machine the value is not as great.

* * *

INDUSTRIAL CONDITIONS IN FRANCE

By MACHINERY'S Special Correspondent

Paris, May 12

While there are no definite indications that any marked improvement will take place in the industrial situation in the immediate future, the results of the international fairs that have recently been held point to some resumption of industrial activity. The Brussels fair had more than 2000 exhibitors from twenty-four different nations. In 1920 only fourteen nations were represented, and in 1921, twenty nations. The business transacted at the fair appears to be as great as in former years. There were definite indications of reductions in machine tool prices. The machine tools exhibited were noted for simplicity in design and for good workmanship. The Paris fair, which is about to open, also promises to be a great success. The number of exhibitors will be larger than last year, and although it is held after the Brussels fair, it is believed that orders of considerable importance will be placed.

The economic situation in France is improving. Over 5,000,000 acres of land were devastated during the war, and of these nearly 4,000,000 acres have been reclaimed. France will probably be able to raise her entire wheat requirements this year, and as the live stock is increasing steadily, food imports will be still further reduced. Production in the coal mines is increasing, 16,000,000 metric tons of coal being exported in 1921. Pig iron and steel were also exported in large quantities. The increase in the value of the franc is doubtless due to these exports, and also to the efforts of the government to balance the budget.

A ruling has been made in regard to the valuation of imports on which tariff duties are paid ad valorem. The percentage of the ad valorem duties varies according to the country of origin of the imports. When a foreign shipment arrives, the wholesale value in the French market is first determined. Then the value on which the duty is applied is figured as equal to the sum which added to the minimum tariff on that sum would make the price of the goods equal to the wholesale price in the French market.

Take, as an example, a shipment of twist drills having a wholesale value in the French market of 10,000 francs. The value on which the duty would be applied would be a figure so determined that after the minimum tariff had been added to it, the sum would be equal to 10,000 francs. The minimum tariff on drills is 20 per cent, and the value placed on them for tariff purposes would be $\frac{10,000 \times 100}{120}$ or 8333 francs.

If the goods came from the United States, the minimum tariff would be applied to this figure, which would be 8333×20 per cent, or 1666 francs. However, if the drills came from Germany, the tariff of 80 per cent would be applied. This would mean a duty of 8333×80 per cent, or 6666 francs.

The importer is required to state the actual value of the goods, and also the sales price in France.

The Machine Tool Industry

FOR the first time in the last eighteen months, it is possible to report a definite improvement in the machine tool industry. There has been—for some months past—a marked improvement in the machine-building industries in general, but the machine tool field has been but slightly affected. Now, however, the records show a rise in the curve of machine tool business above the low level of the past year, and the average of sales of the whole industry has actually increased. While the operation of the shops is far from normal and some are still practically closed, facts clearly denoting improved business should be recorded. Many of the shops entirely closed during part of last year are now operating with small forces. Some of the larger plants that have been operating on extremely conservative schedules have put on increased forces, and others are getting ready to do the same. Some firms that operated at a loss all last year now are able to meet expenses, and some of the leaders in the industry look forward to a steadily improved business from this time on.

Stocks have been reduced in many instances to a point where it is considered advisable to begin building them up again. Compared with 1921, some firms state that their business, so far in 1922, is equal to the entire business of 1921, and in a few instances we are told that the first four months of this year amount to double the business of 1921. The number of firms doing a business more nearly approaching normal is also increasing. At least eight shops are averaging one-half of their capacity business, and, considering the fact that "normal" business in machine tools must be placed considerably below the expanded capacity of the shops, 50 per cent is perhaps not so very far from a normal output.

The activities in the radio field have affected the sale of small automatic screw machines in a marked degree. No automatics of the smaller sizes are available in the second-hand market, and the makers are not able to deliver from stock any longer, but are quoting from four to six weeks deliveries. The sale of small presses has also been favorably influenced by the radio activity.

Prices of machine tools have been reduced in some cases to a point where it is doubtful if even a normal business would make it possible to produce except at a loss, and it is likely that as soon as demand increases, prices in some lines at least will also have to be increased. In this respect the machine tool business will doubtless follow the procedure in the iron and steel business, where prices came down to a low level some months ago, but have since stiffened and have stabilized at a higher level than that to which they first receded. The buying in the machine tool field at present is done almost entirely on price, quality being disregarded in many instances. This condition, too, is likely to change as soon as business in general becomes more active, money is a little easier, and buyers feel they can afford to pay for the best. Nevertheless, even under present conditions, there are buyers who continue to insist upon quality, and are paying for quality in workmanship and materials, which in the long run will prove a wise investment. Some manufacturers have made good use of the time the business depression afforded to so organize their shops and perfect their manufacturing processes that they can maintain high quality without materially increasing the price. But it must not be forgotten that wages in the machine tool industry at present are very nearly double what they were in 1914, and the price of castings still remains practically double that of the pre-war period.

There is a great deal of activity in the development of new machinery. Many new designs have been shown in the mechanical journals during the last few months. Numerous other machines are being designed and developed to be brought out within the next year. These new developments will help stimulate business, as production costs will be brought down by their use. The automobile companies, particularly, are on the lookout for any improvements in the machine tool field, and while very conservative, they have, nevertheless, been among the most active buyers during the last few months. There has also been scattered buying of single machines throughout the entire machine shop field.

LODGE & SHIPLEY AND CARLTON MACHINE TOOL COMPANIES DENY MERGER

In view of the publicity given to a proposed merger in the machine tool field, J. Wallace Carrel, vice-president and general manager of the Lodge & Shipley Machine Tool Co., Cincinnati, Ohio, has authorized the following announcement:

"The Lodge & Shipley Machine Tool Co. is not in any merger or combination. There has been no change in ownership or management. The policy of the company remains the same, and the business will be conducted as it has been in the past."

It has also been announced that the Carlton Machine Tool Co. is not in any merger or combination of machine tool companies and that the ownership and management will remain as in the past.

The Tool Business

The tool shops are better employed at present than they have been for a long time. Most of the tool work comes from the automobile plants. Some die work has also been placed by the radio instrument shops. A growing appreciation of the work of shops specializing in tool design and construction is indicated by the increased buying of tool equipment from such shops by manufacturers who used to do their own tool work.

The demand for accessories in the metal-working field also indicates a general improvement in the business. The sales of abrasive paper and cloth, for example, increased nearly 25 per cent in March over the sales in February, and were almost double the sales of a year ago. The business in grinding wheels is improving, and the sales of wheel-dressers indicate increasing activity in the machine shops. There has been a growing demand for drills, and some of the twist drill manufacturers have increased production. The demand for sheet-metal machinery, including bending and corrugating machines, is good. The electrical tool business is considerably better than the standard machine tool business, and with few exceptions the plants specializing in electrical tools run from 35 to 75 per cent capacity. Some of the old customers have resumed buying, but, on the other hand, it is noted that the orders from the smaller shops have been falling off, doubtless due to financial difficulties. The automobile gear business is booming, and at least one of the shops devoted to the cutting of automobile gears has increased its equipment. The jobbing gear business is improving, but still leaves much to be desired. Were it not for the keen competition and the price-cutting in this field, even the jobbing gear business would show a fair improvement. On the whole, there is now a definite improvement in industry, and while it will be a long time before all adjustments are made to the new conditions, the future is viewed with greater confidence.

NEW MACHINERY AND TOOLS

THE COMPLETE MONTHLY RECORD OF NEW AMERICAN METAL-WORKING MACHINERY

Colburn Heavy-duty Vertical Boring and Turning Mill

ONE of several innovations in the design of vertical boring and turning mills which have been incorporated in a machine now being introduced to the trade by the Colburn Machine Tool Co., 1038 Ivanhoe Road, Cleveland, Ohio, is a patented single-lever control for all feeds and rapid traverses of the tool-heads and rams. Other important patented features include ratchets on the ram saddles which furnish a means of closely positioning the tool-heads relative to the work, spring counterweights for the rams, a reversing mechanism which provides for cutting threads, and a lubricating system which supplies oil to every bearing surface on the machine subject to wear. The machine is built in six sizes which range from 42 to 84 inches swing, inclusive.

The Colburn single-lever control for feeds and rapid traverse of the heads and rams is mounted under each end of the cross-rail, the two head units being separately controlled. The single-lever of the control is moved along cored openings in the cover plate of the control box. This lever is always operated in the direction of the desired movement, whether feed or rapid traverse. When the lever is moved to engage a feed, all traverse gears are automatically disengaged and vice versa.

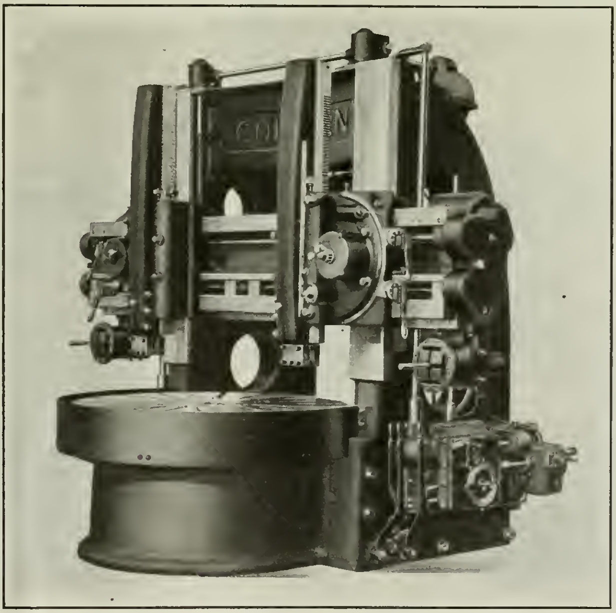


Fig. 1. Heavy-duty Vertical Boring and Turning Mill made by the Colburn Machine Tool Co.

In Fig. 3 the arrows indicate the direction in which the lever is operated to obtain the various feeds and traverse. If it is desired to feed the head at the right-hand end of the cross-rail toward the left, the lever is pushed to the top horizontal slot and then to the left-hand end of this slot. When the head is to be traversed back to the right, the lever is pushed to the extreme right-hand end of the same slot. To obtain vertical movements of the ram, the lever is operated in the vertical slots. In the illustration the lever is shown in the neutral position.

Sixteen feed changes for both horizontal and vertical movements, ranging in geometrical progression from 0.006 to 1 inch per revolution of table, are obtainable through a feed-box on each side of the machine; one feed-box is shown in Fig. 5 with the cover removed. The power rapid traverses allow the heads and rams to be moved at a rate of about 12 feet per minute, and these rapid movements may be secured with the table running or at rest. The rapid traverse mechanism is engaged through the action of a multiple disk clutch in each feed-box.

The cross-rail is raised and lowered by power independently of the table movement through a worm mechanism and gears in oil-tight cases on top of the housing, power being transmitted through a multiple-disk clutch. Raising or lowering of the cross-rail is accomplished by means of a lever on the inside of the right-hand housing. This lever may be seen in Fig. 2, which shows a rear view of the machine. Ball thrust bearings are furnished at the ends of the cross-feed screw and the vertical feed-worms to eliminate wear and reduce the power required to drive the feeding mechanism. The feed-rods and screws are unusually large in diameter.

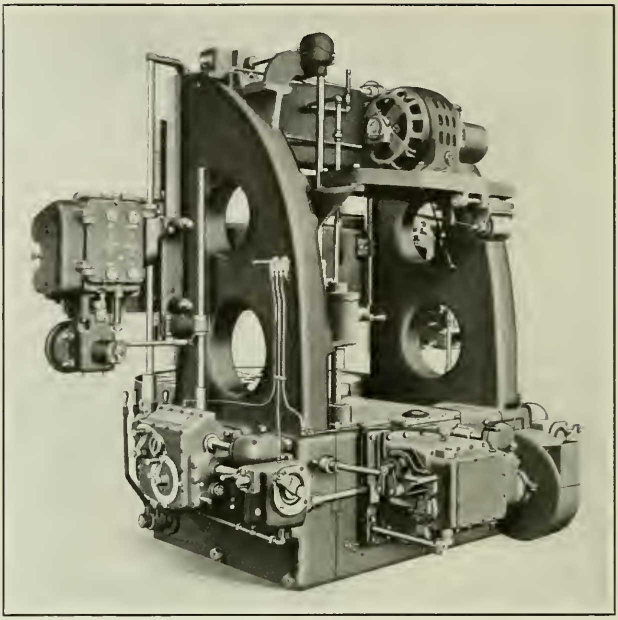


Fig. 2. Rear View of the Colburn Heavy-duty Boring and Turning Mill

The heads are independent in their movements, both as regards direction and rate of feed, and either head may be brought to the center of the cross-rail for boring. The exact central position is determined by a positive hardened stop. Close adjustment of the heads is possible by means of ratchets on the saddles, which have dials graduated to thousandths of an inch. The ratchet, being located on the saddle, is always close to the work, and may be conveniently used while the operator is observing the position of the tool relative to the work. Adjustable taper gibs on the saddles furnish a means of compensating for wear. The rams are also gibbed to the swivel members mounted on the saddles. Bolts are supplied for clamping the swivel members to the saddles when the rams are in the vertical position. A turret head which does not swivel is furnished when desired. This head is always mounted on the right-hand side of the machine and replaces the regular swivel head. The turret has five sides, each of which has tapped holes for attaching box-tools. The turret tilts to an angle of 8 degrees to allow ample clearance for large tools.

The rams have 4 high-carbon steel racks extending their entire length. The rack pinion is made from chrome-nickel steel. The rams may be raised in the swivels sufficiently to allow the bottom of the tool-holders to come flush with the swivels. It is possible to swivel the rams 45 degrees either side of a vertical position, graduations on the swivels indicating the exact setting. The swiveling is accomplished by means of a worm and segment operated through a ratchet lever on the front of each head. The worm and segment of this mechanism also serves as a safety lock to prevent the head from tipping when the clamping bolts are loosened. The rams are counterweighted by a spiral spring enclosed in a steel drum fitted into the front of the heads. This spring can be given any desired tension by operating the ratchet at the front of the drums (see Fig. 1).

Table and Driving Mechanism

The table is a solid casting without cored openings underneath, and has four sets of parallel T-slots planed to accommodate faceplate jaws. Eight radial slots supplement the parallel sets. The table-spindle has a self-centering angular bearing and two vertical bearings which resist all side

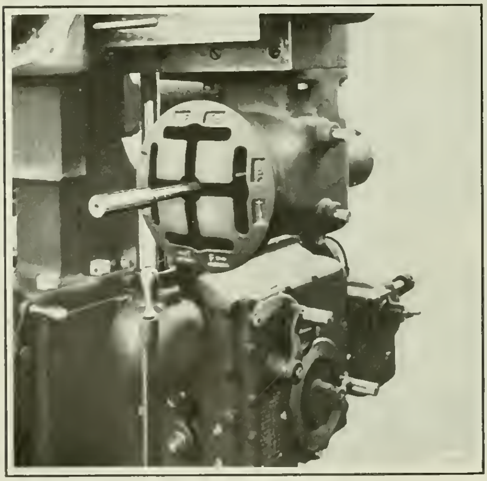


Fig. 3. Close-up View of the Colburn Single-lever Control for Head Feeds and Traverses

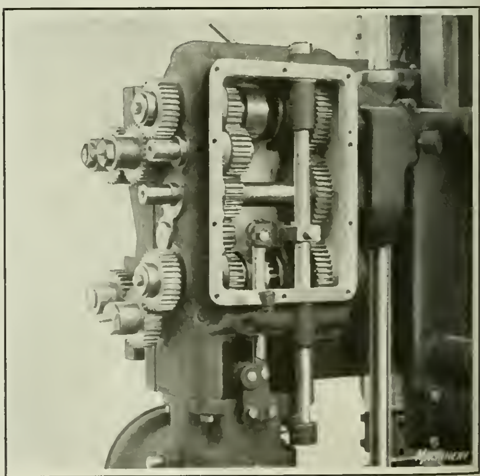


Fig. 4. Feed-clutch Gear-box with Covers removed to show Change-gears and Studs for Threading Gears

strains. A heavy guard protects the operator against injury from the revolving table. Twelve table speeds in geometrical progression are obtainable through sliding gears and positive clutches by shifting two levers at the right-hand side of the machine adjacent to the table. The inside lever operates the gears in a primary speed unit, and the outside lever operates the gears of a secondary speed unit.

The gears are shifted through a patented cam arrangement at the rear of the machine. The secondary speed unit is contained in a box in the main bed, which serves as a reservoir and should be kept supplied with about ten gallons of lubricating oil. The machine may be driven by a motor mounted on a bracket between the housings, through single pulleys and a large friction clutch, or by belt from a lineshaft through a single pulley. Hand-levers on each side of the machine at the front permit convenient starting and stopping. These levers automatically operate a brake, which enables the machine to be stopped instantly at a predetermined point.

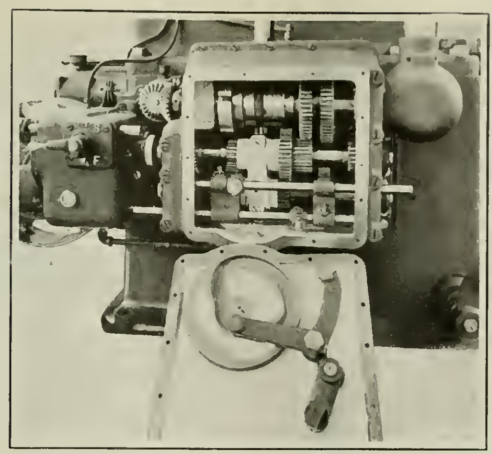


Fig. 5. Feed-multiplying Gear-box on Left-hand Side of Machine

Provisions for Lubricating

Care was taken in designing this machine to provide positive automatic lubrication throughout. The main driving gears and their bearings are lubricated by splash and spray from the oil reservoir previously referred to. Oil is also pumped to a cored reservoir in the top brace of the machine, whence it flows to the feed-boxes, primary table speed unit, table-spindle bearings, and cross-rail elevating mechanism. In each case, the oil passes through sight-feed oilers so that the operator can see whether or not the oil is flowing freely. The feed-clutch gear-boxes at the rear of each end of the cross-rail, one of which is illustrated in Fig. 4, are filled with oil to a certain level. Adequate oiling of the angular and vertical bearings of the table spindle is provided for. Oil is piped from the reservoir in the top brace to the edge of the angular bearing, and is then forced through the vertical bearings back to the reservoir in the bed. Overflow from the angular bearing keeps a supply of oil on the table gear and pinion, and also lubricates the pinion bearing.

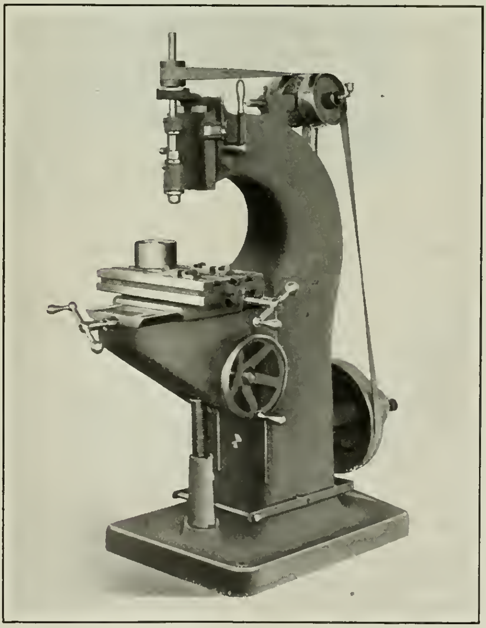
Thread-cutting and Other Attachments

Four, eight, and sixteen threads per inch can be chased without extra equipment, but when extra equipment is provided, standard threads from two to twenty-four per inch, including eleven and a half, can be cut. For cutting different threads, change-gears to suit the desired lead are mounted on the proper studs at the ends of the cross-rail, which may be seen in Fig. 4, and a lever on the feed-box is placed in the proper position. The machine may also be equipped with the following attachments: Revolving spindle center head, grinding spindles, cutting compound outfit, cross-taper and forming attachment, and pulley-crowning attachment.

The safety of the operator received due consideration in the designing of this machine. All moving parts on the ends of the cross-rail are enclosed, and the driving pulley and clutch are guarded. The various units are protected against overload.

BECKER HIGH-SPEED VERTICAL MILLING MACHINE

A demand for a vertical milling machine of the same size as the No. 2 machine built by the Becker Milling Machine Co., 677 Cambridge St., Worcester, Mass., but having higher spindle speeds, has led this concern to bring out the machine here illustrated, on which changes have been made that permit the use of speeds at least 50 per cent higher than on the former machine. It is practical to run the machine at a spindle speed of 6000 revolutions per minute, it being necessary, of course, to pay proper attention to oiling when running at such speed. With the maximum speed of 6000 revolutions per minute, two other speeds of 3240 and 1800 revolutions per minute are obtainable through the use of a three-inch spindle pulley, and three speeds of 3540, 1920, and 1060 revolutions per minute through a five-inch pulley. The necessary countershaft speed is 540 revolutions per minute.



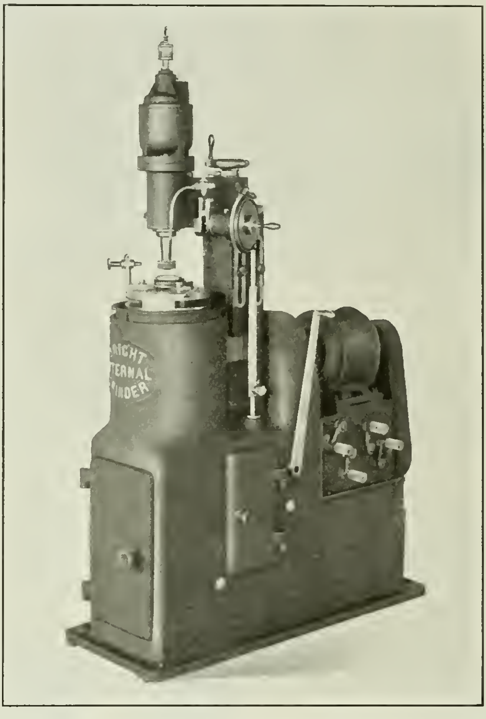
High-speed No. 2 Vertical Milling Machine brought out by the Becker Milling Machine Co.

The changing of the spindle pulleys is simple. It is merely necessary to lift the pulley on the machine by hand, away from the sleeve on which it is mounted, and substitute the other pulley. The belt slack is then taken up by means of the adjustable idler-pulley bracket. The machine is equipped with an auxiliary ball bearing to compensate for belt pull. Hardened steel thrust washers are provided for the spindle and the main bearing of this member is made of bronze and has a babbitt lining. The spindle is ground all over and carefully balanced. The spindle pulley and all rotating collars and nuts are also balanced so as to minimize vibration. Other improvements on the machine consist of a box knee and a steel chip-guard on the knee in front of the carriage, which protects the cross-feed screw.

BRIGHT INTERNAL GRINDING MACHINE

An internal grinding machine, on which the work is held in a chuck mounted at the top of a vertical spindle which both revolves and reciprocates in the same bearing, is being placed on the market by the Garvin Machine Co., Spring and Varick Sts., New York City. This machine is intended for grinding straight round holes in such parts as ball races and automobile transmission gears on a manufacturing basis. It is named after the inventor. The wheel-head swivels on an upright arm to bring the grinding wheel in contact with the surface to be ground and to permit a ready replacement of the work or measurement of the hole. The rated capacity of this machine is for holes up to 4 inches in diameter and 4 inches in length, and work up to 11 inches in swing.

The chuck spindle is supported at the lower end on a ball contained in a pocket at the upper end of the lift bar employed for reciprocating the spindle. The ball bears against hardened steel disks in both the spindle and the lift bar, and the pocket in which it is placed is sufficiently large to permit the ball to revolve freely and thus wear evenly. The spindle is driven through bevel gears from a shaft extending from the speed change-box at the rear of the machine. The gear which drives the spindle runs in a separate bearing and does not touch the spindle. It drives the latter through three sets of flexible keys made of spring steel, which slide in splines as the spindle travels up and down.



Bright Internal Grinding Machine which is manufactured by the Garvin Machine Co.

Driving by means of these keys eliminates any strains on the spindle, and because of this and the ball support, it is claimed that there is no pressure on this member, except that resulting from bringing the grinding wheel in contact with the work. This pressure is said to be negligible, and that a perfect film of oil is always maintained between the contact surface of the spindle and that of its bearing. The length of the spindle stroke is controlled by an adjustable crank arrangement in the base of the machine that is operated by means of a heart-shaped cam. The latter is driven through worm gearing by a second shaft extending from the speed-change box. The cam is designed to give the crank a straight-line action.

There are ten changes of stroke, ranging from 4 to 48 per minute, and five chuck-spindle speeds ranging from 100 to 385 revolutions per minute. The length of stroke may be adjusted while the machine is in operation. The load on the cam and gears is relieved by a counterweight. The chuck-spindle driving and reciprocating mechanisms are driven from a motor mounted on the speed-change box, power being transmitted through a silent chain, friction clutch and the speed-change box. Lubricant is automatically fed to the chuck spindle by a system which ceases to function when the machine is stopped.

The spindle of the grinding wheel is connected to the rotor of a vertical motor on top of the wheel-head. The rotor shaft has only one bearing which is located at its upper end. The lower end of the shaft is connected by a coupling to the grinding wheel spindle. This spindle runs in four ball bearings, which have an adjustment to compensate for wear. An extension for the wheel spindle adapts the machine to deep-hole grinding. The wheel spindle is driven at speeds ranging from 7500 to 12,000 revolutions per minute.

As previously mentioned, the wheel head is swiveled on an upright arm to bring the wheel in contact with the work. The wheel head is roughly set for a given job by means of a clamp bolt, and then fed to the work by rotating a feed screw held in a bracket attached to the housing in which the head arm slides. This feed screw has a total adjustment of ¾ inch. It contacts with a finished block on the side of the head, to which it is rigidly held to insure accurate feeding of the wheel. The feed screw is automatically advanced by means of a ratchet mechanism. The ratchet wheel has fine teeth about its periphery, each of which causes a 0.0001 inch advancement of the wheel, the wheel being fed forward at each end of the stroke. The height of the head is adjustable a distance of 6 inches by means of a vertical elevating screw operated through a handwheel.

When it is desired to remove or examine a piece of work, the machine is stopped almost instantly by pulling to the front, the long lever on the right side. Movement of this lever also raises the wheel-head arm and frees the head from its connection to the feed screw. The head may then be freely swung to the left through an arc of about 45 degrees. At the farthest position, it is held by means of a positive stop in direct line with the truing diamond, in which position the wheel may be conveniently dressed by operating the long lever backward and forward sufficiently to feed it up and down past the diamond. This truing device is always in a fixed position. A spring plunger relieves the head from any shocks in returning it into contact with the feed-screw. Water is pumped to the grinding wheel from a reservoir at the rear end of the housing. The machine is so designed that water or grit cannot be carried to bearings or working parts. The water is returned to the reservoir after serving its purpose. A guard may be raised to surround the chuck.

HORTON DIFFERENTIAL SCROLL CHUCK

Differential gearing incorporated in a wrenchless scroll chuck developed by the E. Horton & Son Co., Windsor Locks, Conn., for use in quantity production work on engine and turret lathes, permits speed of operation and a powerful grip on the work. This chuck may be operated by hand or by

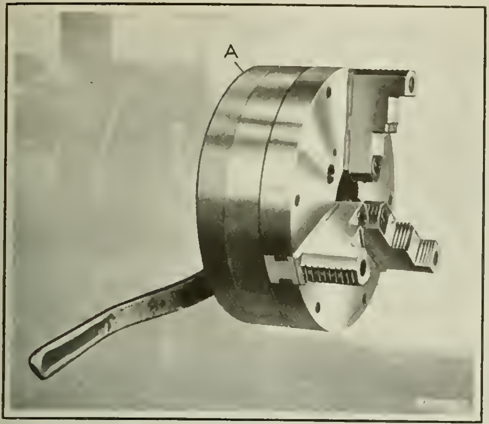


Fig. 1. Differential-geared Scroll Chuck designed by the E. Horton & Son Co.

power transmitted from the machine spindle during the revolution of the spindle before the tool begins to cut the work. The jaws are designed to grip work either on an outside or inside cylindrical surface, and are operated to and from the center of the chuck through five double spur pinions. A large ball bearing insures easy operation. The overhang is no greater than with scroll chucks of the usual design.

To operate the chuck, the knurled handwheel *A* in Fig. 1 is revolved until the jaws close on the work. Then the grip is tightened either by giving a quick push on the handwheel or by starting the machine and exerting a pressure on the lever. In opening the chuck, a quick pull on the handwheel releases the grip, after which the jaws can be run out to clear the work by giving a spin to the handwheel. The construction of the chuck will be understood by referring to Fig. 2. It will be seen that the handwheel carries the five double pinions previously referred to. These pinions mesh with a backing gear pinned to the chuck body and an internal gear on the reverse side of the scroll. The internal gear is different in pitch diameter from the backing gear. Therefore when the handwheel is revolved, the scroll is rotated by a powerful force on account of the differential action due to this difference in pitch diameters. One revolution of the handwheel causes the jaws to move approximately 1/32 inch radially, and opens the chuck 1/16 inch in diameter.

The arrangement for gripping and releasing the chuck by hand is an important feature. By providing for a slight rotation of the backing gear on the pins which hold it to the body, a small lost motion is imparted to the handwheel. This lost motion furnishes a hammer action that multiplies many times on the scroll, the actual pressure applied to the handwheel. The lever is bolted to the machine and carries a friction shoe which may be brought in contact with a surface on the inside of the handwheel. When it is desired to use power for gripping, the lever is employed to retard the handwheel while the chuck revolves. The chuck is now made in a 13-inch size, and 9- and 16-inch sizes are also to be made.

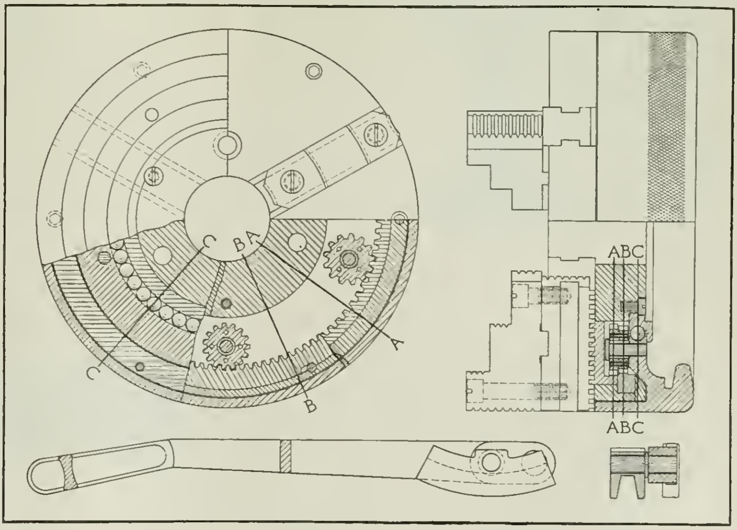


Fig. 2. Construction of the Horton Differential Scroll Chuck

"ETTCO" HIGH-SPEED TAPPING ATTACHMENT

The majority of taps that are broken in use break just after the hole has been tapped and the rotation of the tap has been reversed to withdraw it from the hole. Chips produced when a tap is fed into a hole stick to the wall of the hole, and when the tap is reversed, the heel of the flutes comes in contact with these chips. As these heels are not ground for cutting, the chips become clogged between the wall of the hole and the tap, and produce a strain sufficient to break small-sized taps. With a view to eliminating this source of trouble, the Eastern Tube & Tool Co., Inc., 594 Johnson Ave., Brooklyn, N. Y., has brought out a sensitive high-speed tapping attachment, as shown in Fig. 1, having a friction drive both for feeding and reversing the tap. A cross-sectional view of this attachment is illustrated in Fig. 2. The attachment has a capacity for tapping holes up to 3/16 inch diameter in steel, and up to ¼ inch diameter in cast iron and brass.

The shank of the tapping attachment is inserted in the spindle of a drilling machine, which may be run at any desired speed. In feeding the attachment, the chuck and the cone *A*, which is leather-faced on its inner and outer conical surfaces, remain stationary until the tap is brought into contact with the part to be tapped. An additional 1/16-inch movement of the machine spindle brings the cast-iron driving cone *B* into contact with the outer leather face of cone *A*. Cone *B* is fastened to the shank of the attachment, and causes cone *A* to drive the chuck spindle in the proper direction for tapping. The friction drive enables the speed of the tap to be regulated by varying the pressure applied to the feed-lever of the machine, which, of course, governs the amount of slippage between cones *A* and *B*.

Any undue resistance results in a complete slippage of the two cones, and so when the bottom of the hole is reached and the tap stops revolving, the operator readily observes that the tapping has been completed and raises the feed-lever of the machine. While this is being done, the chuck and cone *A* remain stationary until the machine spindle has been lifted 1/16 inch, which is sufficient to bring the cast-iron cone *C* into contact with the inner leather face of cone *A*. Cone *C* is driven through gearing from a ring gear on cone *B*, and revolves in the opposite direction to cone *B*. Therefore, the moment that cone *C* is brought into contact with cone *A*, the chuck spindle is revolved in the right direc-

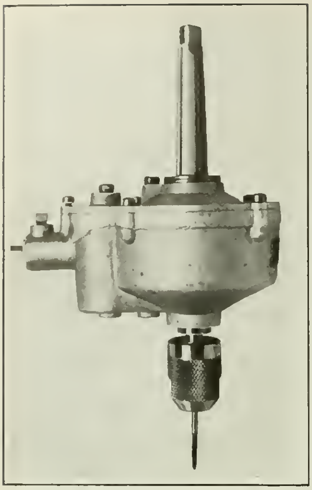


Fig. 1. Tapping Attachment made by the Eastern Tube & Tool Co., Inc.

tion for withdrawing the tap from the hole. In case chips cause the tap to stick during withdrawal, cone *A* will slip on cone *C* as previously mentioned, and the danger of tap breakage is averted.

Power is transmitted from cone *A* to the chuck spindle through an Oldham coupling *D*, which allows cone *A* to float sufficiently to insure a uniform contact at all times with the cast-iron cones. The reverse speed of the chuck spindle is twice the forward speed. The chuck is also manufactured by the Eastern Tube and Tool Co., Inc. It holds the taps by the square end and round shank with equal pressure, and has a slight float to allow a tap to follow the hole correctly. After the leather faces of cone *A* become glazed, the attachment is very sensitive and responds to any slight pressure, the cone slipping whenever the resistance to the tap is greater than normal. By making the housing from aluminum and the gears from a light alloy steel, the weight of the unit has been reduced to about 3¾ pounds. The distance

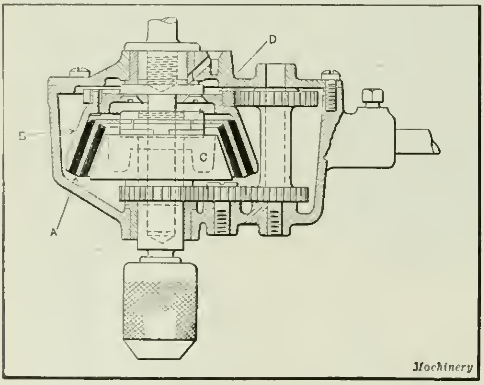


Fig. 2. Cross-sectional View, showing Construction of the "Ettco" Tapping Attachment

from the chuck nose to the end of the machine spindle is 5¼ inches. A rod inserted in a socket of the housing prevents the device from rotating during an operation.

VAN KEUREN MEASURING WIRE SETS

Sets of wires for measuring screw threads, profile gages, and angular surfaces, have been added to the line of precision measuring equipment manufactured by the Van Keuren Co., 362 Cambridge St., Allston, Boston, Mass. From the illustration it will be seen that wires of one size are contained in glass bottles, which protect them against rust and lessen the danger of breakage or loss. The wires are checked by light waves against standards certified by the Bureau of Standards. They are 1⅞ inches in length and lapped the full length to give a long life. Handles or suspension ends are not furnished unless desired.

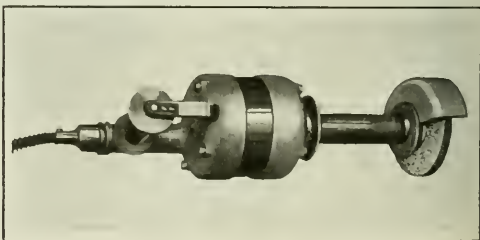
The wires furnished for thread measurement are known as "best size" wires, that is, they are of such diameter that they theoretically touch on the pitch line of a perfect thread. By using "best size" wires for each pitch of thread, the measurement of the pitch diameter is unaffected by any error of thread angle. This angle may be checked by taking a measurement with the next larger sized wire. Labels on the bottles give the wire diameter in hundred-thousandths inch.

Each label also gives the formula for determining the pitch diameter of a screw with wires of that bottle. To find the pitch diameter, subtract a given constant from the micrometer measurement over the wires in the thread. The set illustrated includes the common sizes of wires for threads from 6 to 36 pitch. It contains all the wires needed for the measurement of U. S. standard, S. A. E. and National coarse and fine threads, between these pitches. Additional sizes are made ranging from a ½-inch plug to wires 0.00641 inch in diameter for measuring 90-pitch threads.

Set of Measuring Wires introduced to the Trade by the Van Keuren Co.

FORBES & MYERS PORTABLE GRINDER

The motor supplied with the Model 35 portable electric grinder placed on the market by Forbes & Myers, 178 Union St., Worcester, Mass., is insulated with asbestos subjected to a patented treatment which binds its fibers into a tough but flexible mass that prevents the winding of the motor from burning out as a result of overload. The motor is of ¾ horsepower capacity, and resumes its normal speed quickly after having been slowed down by an overload. The bearings are self-lubricating, and may be quickly replaced when worn out. Electric shocks are avoided with this tool by grounding a wire to a water pipe or some other permanent

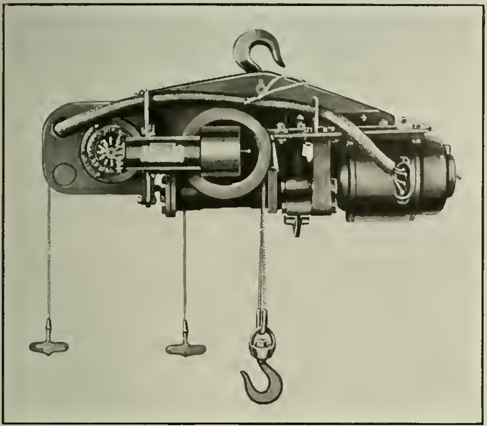


Model 35 Portable Electric Grinder produced by Forbes & Myers

ground. The controlling switch is located in the handle. Wheels 6 inches in diameter by 1 inch thick are standard for this tool, although thicker wheels may be used. The spindle speed is 3600 revolutions per minute.

"EVEREDY" ELECTRIC HOIST

A light-weight quick-speed electric hoist intended to replacing hand hoists in cases where speed is a factor has been added to the line of chain and electric hoists manufactured by the Reading Chain & Block Corporation, Reading, Pa. This hoist is known as the "Everedy" and is made in different sizes having capacities of from 500 pounds to 2 tons. It may be controlled either by a pendant cord or push-button switch, and may be provided either with a plain or geared

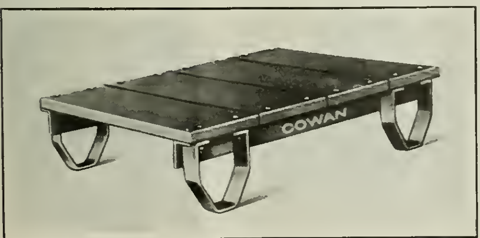


"Everedy" Electric Hoist which is a Product of the Reading Chain and Block Corporation

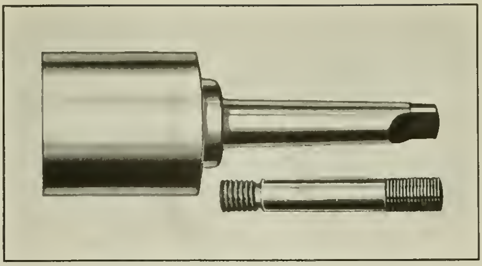
trolley or a hook suspension. The hoist has a motor-and-load brake which takes up its own ware. The rope drums have deep grooves that eliminate overloading and jamming. A special feature of the hoist is a patented positive up-and-down limit stop. All working parts are protected and arranged to run in heavy grease, to insure proper lubrication.

COWAN LIFT TRUCK SKID

For use with hand and electric lift trucks, the Cowan Truck Co., 16 Water St., Holyoke, Mass., has placed on the market a skid consisting of heavy pine planks bolted on two pieces of 2½ by 2 by 3/16-inch angle-iron, to which are attached four malleable iron legs. The construction of the skid is such that the platform cannot spread, sag, buckle or warp. The legs are both riveted and bolted to the angle-irons to insure a rigid connection. The skid is made in lengths from 24 to 80 inches, in widths from 24 to 48 inches, and in heights of 6½, 7½, and 9½ inches. Skids 40 to 80 inches long and 39 to 48 inches wide are also made 11½ inches high.



Hand and Power Lift Truck Skid made by the Cowan Truck Co.



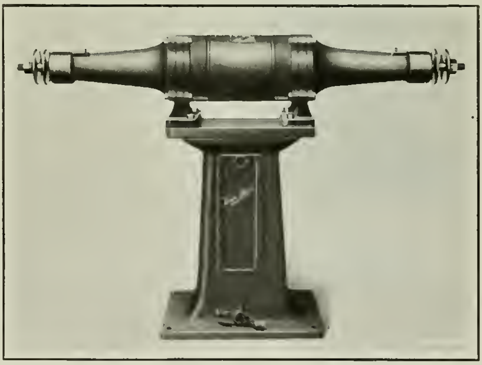
Jarvis Self-opening Stud Setter manufactured by the Geometric Tool Co.

JARVIS SELF-OPENING STUD-SETTER

The Jarvis self-opening stud-setter shown in the accompanying illustration is the latest addition to the line of small tools manufactured by the Geometric Tool Co., New Haven, Conn. This tool is simple in design and easy-working. A quick grip and ready release operate the jaws to and from the stud to be driven in place. This stud setter is regularly made in three sizes: The No. 1½ size has a capacity for studs up to ½ inch in diameter, and is regularly made with either a No. 2 or a 3 Morse taper shank; the No. 2 size has a capacity for studs up to 7/8 inch in diameter, and has a No. 3 or a No. 4 Morse taper shank; and the No. 3 size has a capacity for studs up to 1¼ inches in diameter, and has a No. 4 or a No. 5 Morse taper shank. Taper shanks other than those mentioned may also be furnished. Jaws of different size may be supplied for studs within the capacity of each setter.

VAN DORN HEAVY-DUTY BUFFING MACHINE

A heavy-duty buffing machine designed for large work requiring wheels or brushes twelve inches in diameter or over is the latest addition to the line of electrically driven ma-



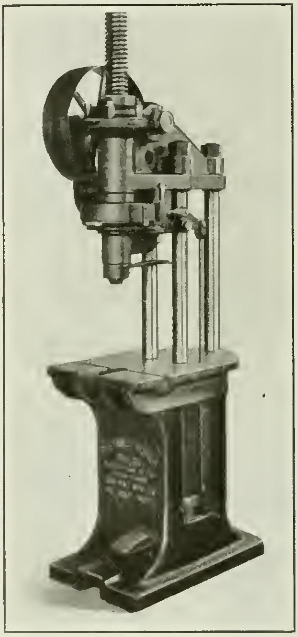
Six-horsepower Buffing Machine built by the Van Dorn Electric Tool Co.

chines manufactured by the Van Dorn Electric Tool Co., Cleveland, Ohio. There are extensions on both ends of the motor so that the brushes are about five feet apart; thus there is ample room for two operators. The buffing-wheel shafts are two inches in diameter inside the arm extensions where they are mounted in ball bearings. These bearings are enclosed in dustproof cages into which grease may be readily injected through four ports on top of the arms. Equalizing couplings are placed between the motor and the wheel shafts to correct any misalignment and thus eliminate vibration.

The motor is designed especially for this machine. It is of the polyphase induction type, and develops six horsepower under normal continuous operation, but has double that capacity under momentary overloads. The machine can be furnished for operation on two- or three-phase current having from 220 to 440 voltage. The current enters through a conduit hole in the rear of the pedestal, the fuses and switch being enclosed in the latter so that no electrical appliances are exposed. Starting and stopping of the machine is effected through the foot-pedal. Self-ventilation of the motor, which is ordinarily accomplished by a fan inside the motor, can be materially assisted in a dusty atmosphere by connecting the motor housing to a fresh-air supply pipe. This machine weighs approximately 700 pounds.

"FLEXIBLE" POWER PRESS

Flexibility or variation of the power applied on the work is the main feature of a power press developed by the General Mfg. Co., 255 Meldrum Ave., Detroit, Mich. The power may range from a few pounds to eight tons. This press is particularly adapted for straightening operations, pressing bushings in place, and assembling other parts having a press fit. The machine has a stroke of nine inches, and thus can also be used in push-broaching. The table has a fixed height of 30 inches. Three posts extend upward from the table, two of which are under tension and the third under compression.



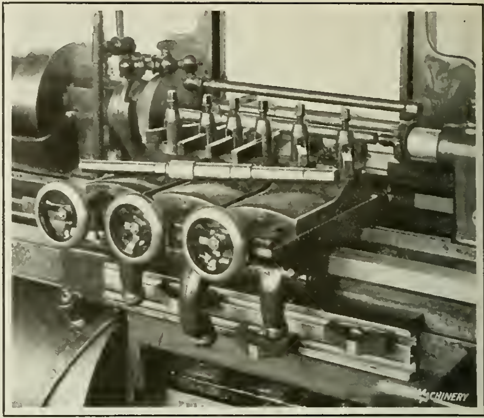
"Flexible" Power Press built by the General Mfg. Co.

The ram has a long-lead Acme thread and runs through a nut four inches long. Power is transmitted from the driving pulley to the ram through worm-gearing. The ram is driven at a constant speed in one direction, the nut turning with it until pressure is applied on the foot-pedal. Operation of this pedal closes an asbestos-lined brake-band on the nut. The ram then passes down through the nut until the pressure is released from the foot-pedal or until the pressure applied by the ram equalizes the pressure on the pedal. The return stroke is obtained through a spring at the top of the ram. The ram is raised immediately after an operation to the position in which the nut revolves about it.

The maximum height between the lower end of ram and table is 12 inches unless otherwise specified. The speed of the ram travel is 150 inches per minute with the pulley running at 300 revolutions per minute. End thrust of the ram is taken by a ball bearing placed between the nut and the main casting of the head.

PRATT & WHITNEY NECKING ATTACHMENT FOR AUTOMATIC LATHE

An automatic lathe with a magazine for feeding cylindrical parts to centers, between which they are held while being machined, was described in December, 1921, MACHINERY, shortly after the machine was developed by the Pratt & Whitney Co., Hartford, Conn. The accompanying illustration shows an attachment which has been brought out for use on this machine. This attachment is designed for squaring shoulders, necking turned surfaces prior to grinding, or for taking other cuts in which a cross-feed can be utilized.

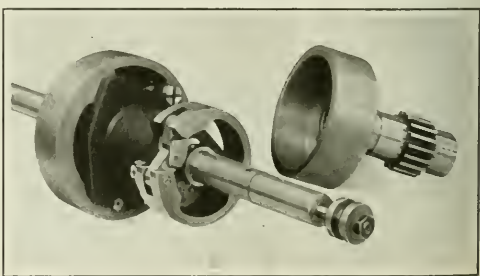


Pratt & Whitney Automatic Lathe fitted with Necking Attachment

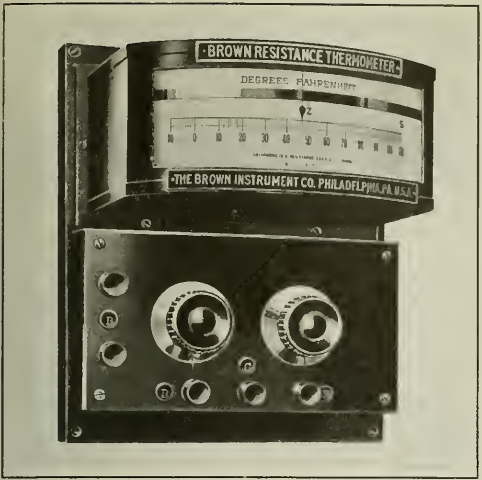
The attachment consists of several carriages which are substituted for the regular carriage. One, two, or three of the special carriages may be clamped in various positions to the front way of the bed. They carry tool-slides and may be provided with multiple toolposts. The cross-slides are actuated through the medium of rolls on arms attached to the carriages. These rolls come in contact with cams mounted on a carrier which is reciprocated longitudinally by the main feed-cam of the machine. The cams on this carrier can be adjusted to provide any sequence of cross movements, and it is possible to move all slides in unison. Adjustment for depth of cut is made on each carriage through its handwheel, which has a dial graduated to 0.001 inch. Suitable oil distribution is provided for all working parts. The different members of this equipment may be readily removed from the machine when the regular carriage is to be substituted.

GREAVES-KLUSMAN FRICTION CLUTCH

Geared-head lathes manufactured by the Greaves-Klusman Tool Co., Cincinnati, Ohio, are now equipped with an improved friction clutch in which the clutch ring is expanded on both sides instead of on only one side, as was the case with the clutch provided in the past. The expanders of the new clutch are located at the center of the ring, and apply a direct pressure. Eccentric studs of the levers provide for adjustment to maintain the same leverage at all times. This design eliminates twisting and springing of parts with the resulting wear. The driving hub is made in one piece, with a long bearing on the shaft and a long driving key. This clutch also has a wider face and is larger in diameter for some machine sizes than that previously made.



Greaves-Klusman Friction Clutch



Direct-reading Resistance Thermometer made by Brown Instrument Co.

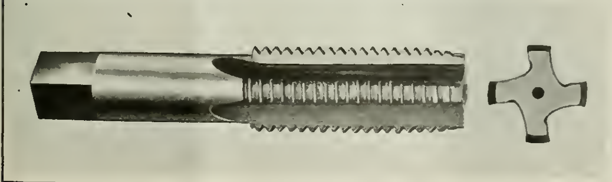
BROWN DIRECT-READING RESISTANCE THERMOMETER

In some heat-treating processes the temperature must be accurately known and maintained within close limits. For example, if the desired temperature is 820 degrees F., the low and high limits may be 750 and 900 degrees F., respectively. The accompanying illustration shows a direct-reading resistance thermometer brought out by the Brown Instrument Co., 4510 Wayne Ave., Philadelphia, Pa., to meet such conditions. The scale of this instrument could be graduated from 750 to 900 degrees F. for the example cited, in which case each division would be equivalent to 1 degree and afford accurate readings. The instrument may be furnished to cover a range of only 25 degrees F. The fundamental principle of the resistance thermometer is based on the well-known physical property of metals (with the exception of special resistance alloys) of change in resistance with change in temperature. This change in resistance can be accurately measured and a scale calibrated in temperature degrees. The bulb or coil of wire which changes in resistance is usually made of nickel for temperatures up to 300 degrees F., and of platinum for higher temperatures up to 1800 degrees F.

The left-hand knob of the instrument is turned to *Z* to check the zero reading, and to *S* to check the instrument with a standard resistance at the top graduation on the scale. The right-hand knob is used for adjusting the voltage. By means of a switch, the instrument can be connected to any number of resistance thermometer bulbs installed in different locations.

BATH "EASY-CUT" GROUND TAPS

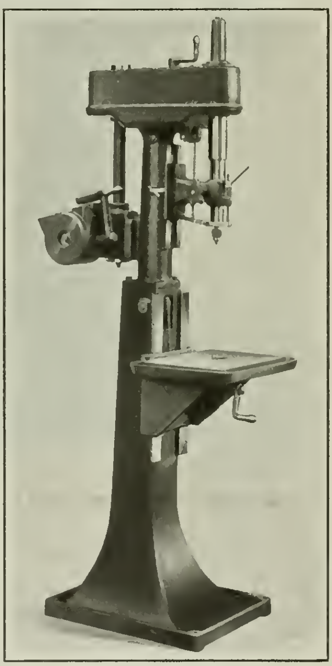
An improvement has been made in the line of "Easy-cut" ground taps manufactured by John Bath & Co., Inc., 8 Grafton St., Worcester, Mass., (described in May, 1921, MACHINERY) by changing the design of the flutes. This new design is known as the "sharpening face" flute. From the illustration it will be seen that each flute has a projecting face having an under-cut clearance that permits the tap to be resharpened without changing its size, until it is worn out. Another advantage is that the cutting face can be ground to any angle or concave to give the desired rake for the kind of material being tapped. The sharpening face is narrow and is the only part of the flute that is finished. The rear side of each flute has a hook for removing chips from the threads of the work when the tap is reversed. This eliminates danger of tooth breakage when the tap is being withdrawn from the hole. The new style flute has a standard width of land and sufficient chip room. Taps are made of both high-speed and carbon steel and may be driven by hand or power.



"Sharpening-face Flute" Tap made by John Bath & Co., Inc.

FOSDICK SENSITIVE DRILLING MACHINE

The principal feature of the new "Superspeed" drilling machine recently placed on the market by the Fosdick Machine Tool Co., Cincinnati, Ohio, is the speed-change arrangement. With this arrangement a single turn of a handle causes the tension on the driving belt to be automatically released and the belt to be shifted first from the larger step of one cone pulley to the next smaller step, and then from the smaller to the next larger step of the second cone pulley. Tension is then automatically applied to the belt. This machine is shown in the accompanying illustration. It is built in both bench and pedestal types in combinations having from one to eight spindles, and has a capacity for driving drills up to 1/4 inch in steel. With the driving pulley running at 1750 revolutions per minute, three spindle speeds of 5700, 8000, and 12,000 revolutions per minute, respectively, are available. However, other speeds may also be provided to meet conditions.



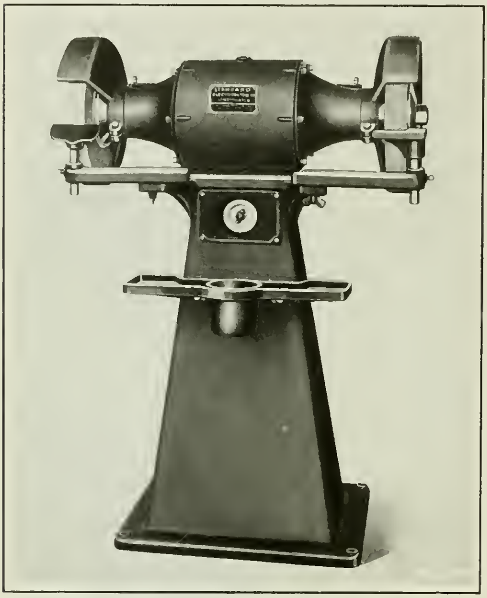
Fosdick "Superspeed" Drilling Machine

All revolving members are equipped with annular ball bearings and dustproof metal oil containers, the only revolving member exposed being the drill chuck. The drive is through spiral gears. The table on the pedestal machine is of the quick-acting counterbalanced type with a clamping handle at the front, and has a traverse of 10 inches. This table, as well as that of the bench machine, is surrounded with chip and lubricant channels. The head has a vertical traverse of 6 inches, and is counterbalanced to prevent it from dropping when unclamped. The spindle has a feed of 3 inches, and may be automatically stopped at any point within this range. An adjustable gravity counterbalance may be set to return the spindle automatically.

The position of the feed-lever may be adjusted to suit the convenience of the operator. Opposite the feed-lever is a quick-return handwheel. The belt guard is made of aluminum. Both the belt and shifter may be positioned to receive the driving belt at any angle. A ½-horsepower motor can be mounted on the machine for either a belted or a direct-connected drive. The spindle is provided with a No. 1-A Jacobs drill chuck. The bench-type machine weighs about 225 pounds, and the pedestal type, 465 pounds.

STANDARD ELECTRIC GRINDER

A two-horsepower alternating-current grinding machine, made in both bench and pedestal types for grinding light or heavy work, has recently been added to the line of products manufactured by the Standard Electric Tool Co., Cincinnati, Ohio. The machine is fitted with a tool tray, water pot and tool-rests, as illustrated. The controlling switch is within easy reach of the operator. One coarse and one fine wheel are furnished with each tool, the two wheels being 12 inches in diameter and 1½ inches face width, with a 1-inch bore. The wheels are located a sufficient distance from the body of the motor to facilitate the grinding of large or irregular parts. Both the bench and pedestal types are made for operation on either 110-, 220-, or 440-volt, two- or three-phase, 60-cycle, alternating current.



Grinding Machine made by the Standard Electric Tool Co.

GAMMONS-HOLMAN REAMER

An expansion hand reamer known as the "Parob" on which each cutting edge is followed and preceded by another which cuts at a different angle relative to the axis of the reamer has been placed on the market by the Gammons-Holman Co., Manchester, Conn. The design of the cutting edges eliminates chatter during an operation and enables holes having a keyway or oil-groove to be reamed satisfactorily. The reamer is expanded by means of a screw-driver, the expanding device being protected against accidental adjustment. It is so located within the pilot that a reamer may be ground on its own centers with the expanding device in place.

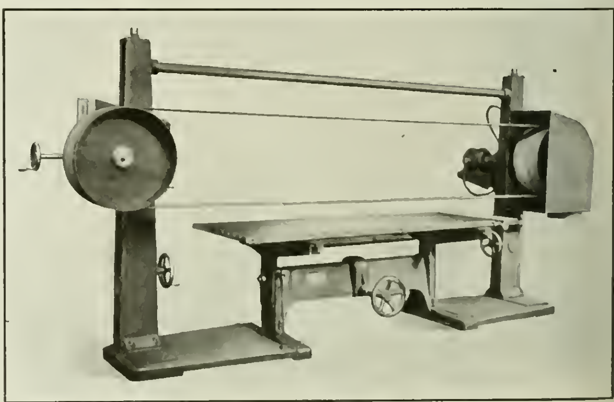
"Parob" Expansion Hand Reamer manufactured by the Gammons-Holman Co.

A special feature of this tool is an oil-hole that leads from the shank to the inside of the reamer and is connected with slots in the flutes. This provides a convenient means of delivering cutting lubricant to the work. The pilot is amply long for most jobs but pilots of special length may also be furnished. This reamer is particularly adapted for reaming wrist-pin bearings in automobile pistons. It is also made in multiple series for aligning bearings too far apart for standard reamers, or of different diameters. Each section of a multiple-series reamer has a separate adjustment. The reamer is regularly made in sizes from ½ to 1½ inches in diameter.

OLIVER BELT SANDER

The sanding or polishing of wooden pieces required in building large patterns may be conveniently accomplished on a No. 183 self-contained belt sander introduced to the trade by the Oliver Machinery Co., Grand Rapids, Mich. The machine may also be used for polishing metal surfaces. The arms of one pulley are guarded, and the other pulley is entirely enclosed by an exhaust hood. Both pulleys are rubber faced and run on ball bearings. The table top also runs on ball bearings. The table has a vertical adjustment of 14 inches on two uprights connected by a heavy brace, this adjustment being obtained through a screw, gears, and a rack. The horizontal travel of the table is 36 inches, and its working surface is 96 inches long by 32 inches wide.

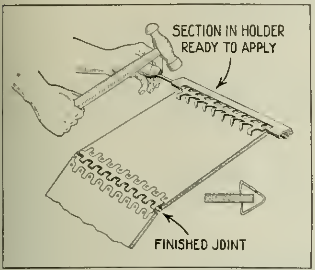
When the machine is motor-driven, a slow-running motor may be direct-connected to the driving shaft, whereas a high-speed motor would be geared to this shaft. The pulley should be run at a speed of about 600 revolutions per minute. Sanding belts about 31 feet long and up to 10 inches in width may be used.



No. 183 Self-contained Belt Sander brought out by the Oliver Machinery Co.

FLEXIBLE STEEL BELT LACING

Flexible steel lacing for tape, fabric, and light leather belts up to 5/32 inch in thickness is being manufactured by the Flexible Steel Lacing Co., 4622 Lexington St., Chicago, Ill. The method of fastening the ends of a belt together by this lacing may be seen in the accompanying illustration. In addition to smoothness of belt running and flexibility of the joint, the advantages that are claimed for this lacing are as follows: A separable connection, the possibility of running either or both sides of the belt in contact with pulleys, quick application, and the necessity of providing only half a joint when a belt must be shortened.

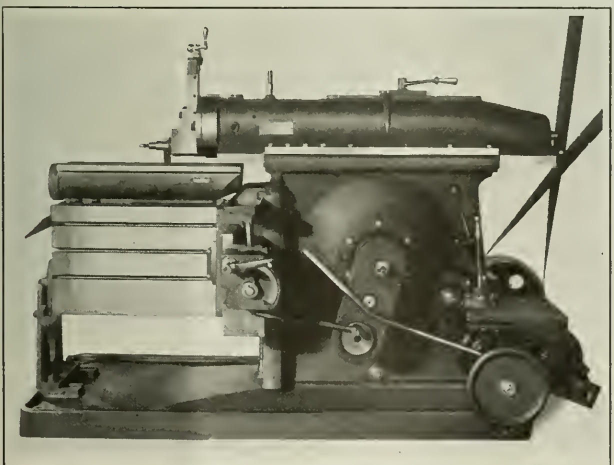


Belt Lacing made by the Flexible Steel Lacing Co.

KELLY HEAVY-DUTY CRANK SHAPER

A shaper designed for the heavy work handled in railroad and forge shops has been placed on the market by the R. A. Kelly Co., Xenia, Ohio. This machine is similar in many respects to a line of shapers made by the same company, which was described in June, 1920, MACHINERY. The new machine has a 32-inch stroke, a vertical table movement of 12½ inches, and a cross traverse of the table of 30 inches. The table is of the swivel type.

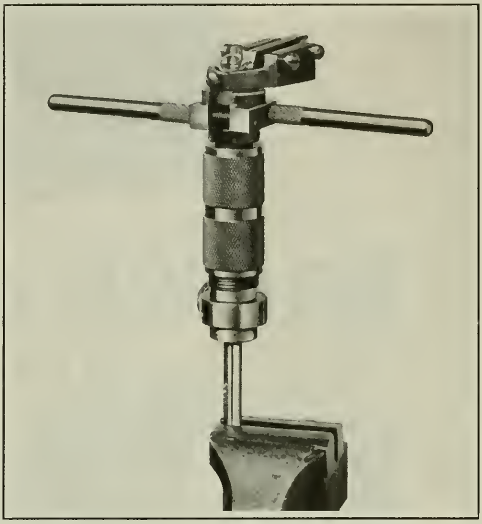
The cross-feeding mechanism is simple and entirely enclosed in a box. The direction of the feed is controlled by the straight knurled lever on top of the box, and the amount of feed by the lever on the side of the box. The feeding mechanism cannot be operated during the cutting stroke of the ram. No adjustment is necessary in order to raise or lower the cross-rail, except to loosen and retighten the clamping studs on the cross-rail. The gear-box is designed along the lines of an automobile transmission. It has four speed changes, which are engaged through a ball lever on top of the box. A clutch and brake are controlled by the long lever at the front of the machine. The ram may be brought to a stop at any desired point by the operation of this lever.


Railroad and Forge Shop Crank Shaper brought out by the R. A. Kelly Co.

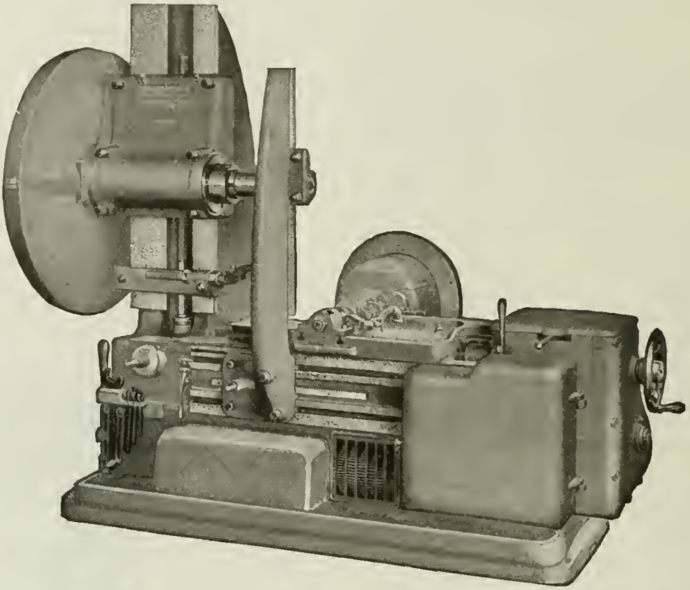
When equipped for a motor drive, a bracket is bolted to pads on the back of the shaper for supporting the motor, and a gear is mounted on the driving shaft instead of the pulley. All machines are built so that motor drive may be easily applied, and a gear-box may also be quickly installed on a cone-driven machine. All gears are helical and all slide surfaces are provided with felt wipers. A guard on the table prevents chips from falling on the bearing of the table support. A guard is also placed over the elevating gears, and on this guard are cast directions for elevating and lowering the table. The weight of the machine is about 6500 pounds.

RAMSDELL HAND-VISE "LATHE"

Repairmen in general will be interested in a portable device by means of which studs, set-screws, cap-screws, and special screws, and pins may be produced accurately from bar stock. Coil springs may also be wound to any desired pitch with this device. It is known as the hand-vise "lathe," and is made by the Campbell Mfg. Co., Slater Building, Worcester, Mass. In the illustration it is mounted on a piece of bar stock and provided with a turning tool which is turning down one end of the stock. The tool is fed by turning the knurled member. The body of the device is held in position on the work by a thumb-screw.


Hand-vise "Lathe" placed on the Market by the Campbell Mfg. Co.

In addition to the parts illustrated, the equipment furnished with this device includes knurling tool, spring-winding details, S. A. E. taps and dies, spacers, and centering bushings. The turning tool-holder is so constructed that the die for a threading operation may be fitted in the upper part of the holder and a centering bushing in the lower part. The width of the centering bushing is sufficient to hold the stock central with the die while being threaded, and prevent the cutting of the thread off center. Centering bushings from ¼ to 1 inch in diameter, varying in size by 1/16 inch, are furnished with the set. Bar stock up to 1 inch in diameter can be accommodated, which enables hexagon-head screws up to ⅝ inch to be made. All wearing parts are casehardened.



BROWN & SHARPE
AUTOMATIC
GEAR CUTTING MACHINES

For the Accurate Duplication of High-Grade Gears

The accuracy and precision of Brown & Sharpe Automatic Gear Cutting Machines are important factors in accurately duplicating high-grade gears. The high quality of these machines takes on an added importance with the introduction of the Ground-Form Gear Cutter mentioned on the opposite page. The full benefits of these Ground-Form Cutters are assured by using them on Brown & Sharpe Gear Cutting Machines whose highly accurate indexing mechanism gives the uniformity in spacing essential for the duplication of accurate gears.

The extremely accurate worm wheel used on these machines is of large diameter in proportion to the diameter of the work, insuring accurate spacing of the gear teeth. The indexing mechanism operates without shock, has a positive start and stop, and is securely locked for each tooth space.

These high grade machines are built by men whose one thought is to get things "right." Every detail of construction is subjected to rigid inspection and the machines leave our plant ready for a long life of accurate production.

Send for Catalog No. 137 describing these machines

Accuracy of Form
Duplication of Accuracy
Increased Production

—the three outstanding features of the new

BROWN & SHARPE GROUND-FORM GEAR CUTTERS

(from 1¾ to 12 pitch inclusive)

ACCURACY of form—the primary requirement in precision gear cutting—is assured by the grinding of the tooth form—correcting all hardening distortions.

DUPLICATION of accuracy in different cutters through this positive control of form gives the user of cutters further ability to duplicate this accuracy in the finished gears—this continued accuracy and uniformity which makers of gears strive to maintain.

INCREASED production, due to the freer cutting action and keener cutting edges of these cutters, has been proved by actual tests to be surprisingly great. The freer cutting action, which is largely responsible for this increased production, is due to each tooth doing its share of the cutting, for the grinding of the form has so corrected any hardening distortions that no single tooth or group of teeth can do the major part of the work—each must do its share. Consequently the finish is correspondingly improved and cutter wear greatly reduced.

As to cost, these ground-form cutters necessarily list somewhat higher than those with the unground form but their ability to produce more and better gears per sharpening of the cutter will affect a pronounced saving in ultimate cutter cost—they mean high cutter economy from all angles, both as to quality and quantity of the gears produced.

BROWN & SHARPE MFG. CO.

Providence, R. I., U. S. A.

CHESTERFIELD CUTTING-TOOL METAL

An alloy consisting mainly of nickel, cobalt, and tungsten, which is non-magnetic and non-corrosive, is now being introduced to the trade by the Chesterfield Metal Co., 261 St. Aubin Ave., Detroit, Mich. It is sold in square, flat, and round bars for cutting into tool bits. One feature of this alloy is its extreme hardness, which is retained even when the friction of a cut is so severe as to bring the tool to a red heat. Chesterfield metal derives its hardness from the alloying process by which it is produced, and so cannot be tempered or annealed. This eliminates the danger of burning the cutting edge in dressing a tool.

The metal is cast in molds into assorted standard sizes. It is too hard to cut except by grinding, and so the bars in which it is cast are first nicked with a grinding wheel and then broken to the desired length for use. Tool bits made from the metal may be used in various commercial tool-holders or they may be welded to a machine-steel shank. Blades may also be made from the metal for inserted-tooth milling cutters. In a demonstration, a cast-iron disk 15 inches in diameter was rotated at a peripheral speed of about 600 feet per minute, and a cut 1/8 inch deep taken by a tool made from the alloy at a feed of 1/32 inch per revolution. While the cut was being taken the chips came off red-hot and the tool point was also red-hot, but the tool was apparently as good as ever at the end of the cut.

* * *

NEW MACHINERY AND TOOLS NOTES

Portable Drill Stand: A. H. Peterson Mfg. Co., Milwaukee, Wis. A portable stand designed to hold rigidly at any angle, the "Hole Shooter" portable electric drill manufactured by this concern. When placed in a perpendicular position, the equipment is suitable for use as a bench drilling machine, and when placed in a horizontal position, it is especially adapted to grinding or buffing. Bristle wire brushes, rotary taper files, special buffers, and circular saws are also made for use with this drill.

Electric Etching Pencil Outfit: Luma Electric Equipment Co., 405 Spitzer Bldg., Toledo, Ohio. An electric etching outfit consisting of two major units—a magnetic table and a pencil. Its chief uses include etching or writing on hardened steel, demagnetizing steel, annealing, and soldering. Work which has been placed on a magnetic chuck is demagnetized by simply passing it across the table of the outfit while the current is turned on, and tools or bars may be magnetized in the same way. For annealing, the pencil point is replaced by one made of carbon, and the cord of the pencil is attached to a second connection. The carbon point is also used for soldering.

NUMBER OF EMPLOYES IN THE MACHINE TOOL INDUSTRY

According to a report of the Bureau of Census, there were approximately 61,700 persons engaged in the machine tool industry in 1919. Of this number 2333 were salaried officers, superintendents, and managers, 6186 clerks, etc., (including men and women), and 53,111 wage earners, the latter being an average number. The state of Ohio had 13,855 wage earners (average number) or 26.1 per cent of the total number in the United States. Rhode Island was next in rank with 7169 wage earners, or 13.5 per cent of the total. The accompanying table gives the average number of wage earners in twelve of the most important machine tool building states. This table shows how the total number in each state is divided in regard to the prevailing working hours. The hours for most wage earners in the machine tool industry (39 per cent of the total number) are between 48 and 54 hours per week. About 29 per cent work 48 hours per week, 19 per cent between 54 and 60 hours per week, 10 per cent 54 hours, 2 per cent between 44 and 48 hours, one-half of one per cent 44 hours or less, and one-fifth of one per cent 60 hours per week. The total number of establishments in the United States directly engaged in the production of machine tools during the year 1919 was 403, and the total value of the products, $212,400,000.

AVERAGE NUMBERS OF WAGE EARNERS IN THE MACHINE TOOL INDUSTRY DURING 1919, BY STATES AND BY PREVAILING HOURS OF LABOR PER WEEK

State	Wage Earners, Total Average Number	Per Cent of Total for U. S.	Numbers of Wage Earners according to Prevailing Hours of Labor							Number of Establishments
			44 Hours and less	44 to 48 Hours	48 Hours	48 to 54 Hours	54 Hours	54 to 60 Hours	60 Hours	
Ohio	13,855	26.1	1	169	7926	3241	473	2045	....	102
Rhode Island	7,169	13.5	....	....	....	7065	....	104	....	13
Massachusetts	6,471	12.2	....	....	643	3866	692	1270	....	46
Connecticut	5,472	10.3	13	....	1691	632	2062	1074	....	33
Pennsylvania	3671	6.9	....	....	1033	974	342	1208	114	32
Illinois	3,273	6.2	182	5	7	1671	78	1330	....	28
Michigan	3,196	6.0	....	....	144	1760	185	1107	....	31
Wisconsin	2,352	4.4	22	....	570	147	800	807	6	24
Vermont	2,024	3.8	....	....	1269	....	68	687	....	6
New Jersey	1,678	3.2	....	846	17	138	591	86	....	14
New York	1,590	3.0	13	4	1269	271	22	11	....	29
Indiana	1,228	2.3	....	....	25	762	56	385	....	15
All other states	1,132	2.1	8	....	719	222	38	145	....	30
United States	53,111	100.0	239	1024	15,313	20,749	5407	10,259	120	403

Machinery

* * *

INDUSTRIAL ADVERTISING CONFERENCE

In connection with the convention of the Associated Advertising Clubs of the World to be held in Milwaukee, Wis., June 11 to 15, an industrial advertising conference will be held which will deal entirely with this class of advertising. In connection with this conference, there will be an exhibition of industrial advertising, which will include complete campaigns of general advertising, business paper advertising, letters, broadsides, folders, and catalogues as well as single advertisements. Individual photographs, drawings, and paintings for advertising purposes will add to the attractiveness of the exhibition. Those interested in this part of the work of the conference should communicate with A. K. Birch, advertising manager, Allis-Chalmers Mfg. Co., Milwaukee, Wis. The program for the industrial sessions, of which Keith J. Evans, advertising manager of Joseph T. Ryerson & Son, Chicago, Ill., is chairman, will include a great many papers of interest to industrial advertisers.

* * *

MEETING OF THE AMERICAN SOCIETY FOR TESTING MATERIALS

The twenty-fifth annual meeting of the American Society for Testing Materials will be held in Atlantic City, N. J., during the week of June 26. There will be twelve business sessions, at which a number of interesting subjects will be considered, among which are the following: Metallography and corrosion of non-ferrous metals; wrought, cast, and malleable iron; steel; impact testing of materials; and methods of testing fatigue of metals.

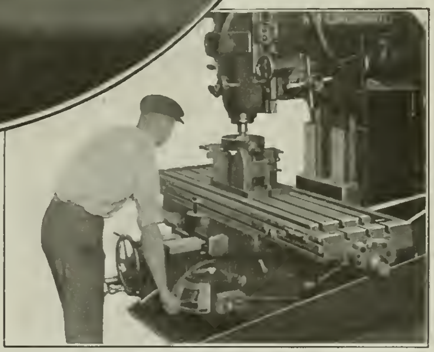
ONE LEVER—
ONE MOVEMENT—
ONE SECOND!

This Single Lever (Patented) Controls 16 Feed Changes in the Nos. 4 and 5

CINCINNATI MILLERS

ISN'T THIS THE ANSWER TO THE "CHEAPER MILLING" PROBLEM?

There are other exclusive features on these Millers it will pay you to know about—Write for Catalog.



The Feed Change Lever is Always at the Operators Finger Tips

The Cincinnati Milling Machine Co., Cincinnati, Ohio

OBITUARIES

William A. Greaves, president of the Greaves Machine Tool Co., Cincinnati, Ohio, died April 18, aged sixty years. Mr. Greaves was born in Cincinnati, Ohio. In 1889 he organized the firm of Greaves-Klusman & Co., in association with H. H. Klusman, to manufacture lathes. Later he retired from this firm, and with his three sons organized the Greaves Machine Tool Co. in Cincinnati. He is survived by his widow and three sons.

J. Ryan, for eighteen years manager of the Paris office of the Potter & Johnston Machine Co., of Pawtucket, R. I., died on the first of last May. Mr. Ryan was a man of great energy, a skilled mechanic, with a wide acquaintance among French engineers, including government officials, which enabled him to place enormous orders for Potter & Johnston machines during the war, that firm being generally credited with having made the largest sales in France of any one type of machine tool. Mr. Ryan had been in failing health for over a year, and his death will be a great loss to the company with which he was connected for so long a time.

LAROY S. STARRETT

Laroy S. Starrett, president of the L. S. Starrett Co., Athol, Mass., died of pneumonia at his winter home in St. Petersburg, Fla., on April 23. He lived to within two days of his eighty-sixth birthday. Mr. Starrett was born in China, Me., on April 25, 1836.

He was brought up on a farm and received his education in the country schools. His career was a remarkable one, starting among the hardest conditions of life and ending with marked success. At an early age he began to show a keen interest in the mechanical line, and was constantly busying himself with tools. When he was seventeen he left the farm and went to Newburyport, Mass., to work in a machine shop, and in 1866 he started his first machine shop in that town. In 1868 the Athol Machine Co. was established to manufacture his inventions. Mr. Starrett subsequently suffered reverses and lost control of that concern, but he was undaunted, and in 1880 began the manufacture of the well-known Starrett line of machinists' tools which has met with such marked success. He gradually built up a large business and later regained control of the Athol Machine Co. He also founded the Union Twist Drill Co. Mr. Starrett was a public-spirited man, and the prosperity of the town in which he lived was due, in a large measure, to his activities.

WILLIAM GLEASON

William Gleason, president of the Gleason Works, Rochester, N. Y., died at his home in Rochester, May 24. He was eighty-six years old, having been born in Tipperary County, Ireland, in 1836. He came to America at the age of fifteen, and served a machinist apprenticeship in Rochester. Later he went to Hartford, Conn., where he was employed in the Colt Armory during the Civil War. In 1865, Mr. Gleason returned to Rochester and opened a machine shop. Soon afterward he went into partnership with John Connell and James S. Graham under the name of Connell, Gleason & Graham, building machine tools and woodworking machinery. This partnership was dissolved in 1873 when Mr. Gleason went with the Kidd Iron Works, which he took over in 1875. Under the name of the Gleason Works the business has steadily grown from that time on, and wherever machine tools are used Mr. Gleason is known as the inventor of the bevel gear-cutting machines that bear his name. He was president of the Gleason Works up to the time of his death, although in his later years most of the business was administered by his sons, James E. and Andrew Gleason, who are vice-presidents. He is also survived by his wife and two daughters, Kate and Eleanor Gleason.

PERSONALS

Arthur Jenner, factory superintendent of the Noiseless Typewriter Co., Middletown, Conn., has resigned, and is planning to take a trip to Europe, returning about July 20.

Walter F. Rogers, of Southbridge, Mass., formerly with the Norton Co., Worcester, Mass., is now associated with the selling organization of the Reeves Pulley Co., Columbus, Ind.

Frank W. Adams, Jr., formerly western representative for C. E. Johansson, Inc., Poughkeepsie, N. Y., is now sales manager for the Steel Products Engineering Co., Springfield, Ohio.

John A. Johnson has been appointed works manager of the K. & F. Mfg. Co., 208 N. Wells St., Chicago, Ill., engineers and tool builders. Mr. Johnson has had a wide experience in the metal line.

L. S. Love, formerly vice-president and general manager of Barbour, Love & Woodward, New York City, has resigned his connection with that company. No announcement of Mr. Love's plans for the future has yet been made.

Malcolm Grant has joined the selling organization of the Black & Decker Mfg. Co., Towson Heights, Baltimore, Md., and will cover the state of Ohio, with the exception of the corner that takes in Cincinnati and Dayton. His headquarters will be at the Cleveland office, 2030 E. 22nd St.

Marvin E. Monk has been appointed assistant sales manager in charge of general sales of the U. S. Ball Bearing Mfg. Co., Chicago, Ill. Mr. Monk was formerly special sales engineer for Manning, Maxwell & Moore, Inc., of New York City. J. J. Torpey will continue as assistant sales manager in charge of bearing distributors.

R. M. Barwise who has been eastern representative of the Diamond Chain & Mfg. Co., Indianapolis, Ind., for the last twelve years, has opened an office and store-room at 18 Hudson St., near Reade, New York City. Mr. Barwise will act as distributor of Diamond chains, and of the gears and sprockets made by the Philadelphia Gear Works.

Carl G. Schluederberg, executive assistant to the manager of the supply department of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., has been elected president of the American Electro-Chemical Society. Mr. Schluederberg has been very active in American electro-chemical circles and has done considerable research work along these lines.

C. M. Hall, formerly in charge of the New York territory for the Dodge Transmission Co., has become associated with the Black & Decker Mfg. Co., Towson Heights, Baltimore, Md., and will have charge of the territory that includes Indiana, Kentucky, and that corner of Ohio that takes in Cincinnati and Dayton. Mr. Hall's headquarters will be in Indianapolis.

C. G. d'Ugglas, formerly assistant chief engineer with the Cleveland Machine & Mfg. Co., Cleveland, Ohio, is now associated with Williams, White & Co., Moline, Ill., in the capacity of assistant chief engineer in charge of the power press division. Mr. d'Ugglas is a mechanical engineer. He came to this country from Sweden about ten years ago, and has been connected most of the time since he has been here with the manufacture of power presses.

Joseph F. Keller, of Brooklyn, N. Y., was awarded the Edward Longstreth medal by the Franklin Institute at its April meeting, for his automatic die-cutting machine. This medal was also awarded to Samuel T. Freas, of Trenton, N. J., for an interlocking tooth saw, and to Charles F. Wallace and Martin F. Tiernan of the firm of Wallace & Tiernan, Newark, N. J., for their apparatus for the distribution of liquid chlorine for water purification.

J. Martin Duncan of the Detroit Steel Casting Co., Detroit, Mich., has been promoted to the position of general sales manager. Mr. Duncan's previous work has been that of following up every important shipment to its destination, to see how the castings were applied, and to ascertain whether more satisfactory results could be obtained by a closer cooperation between the management and the user. He is succeeded in this work by E. R. Young. Mr. Allen, formerly sales manager, is now assistant general manager.

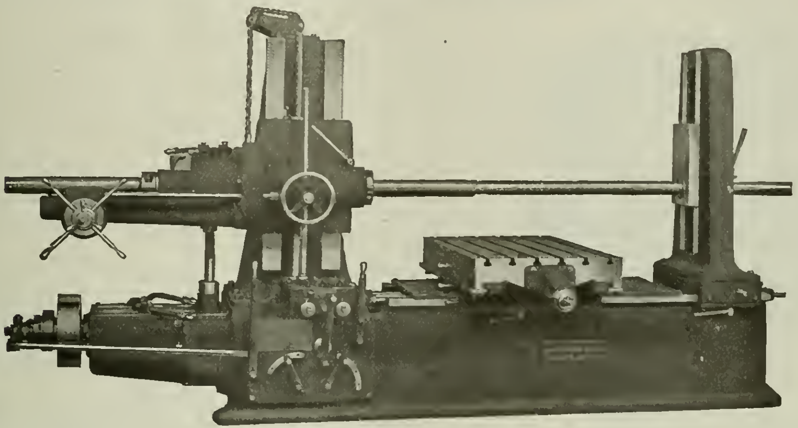
Ambrose Swasey, president of the Warner & Swasey Co., Cleveland, Ohio, was elected to membership in the National Academy of Sciences at the recent annual meeting in Washington. Members of the academy are grouped into committees of mathematics, astronomy, physics, engineering, chemistry, etc. The honor was conferred upon Mr. Swasey on account of his achievement and interest in the design and construction of great telescopes and other scientific instruments of precision. He established the Engineering Foundation and is an honorary member of a number of leading American and European scientific and engineering organizations, as well as an officer of the Legion of Honor of France. He is also a member of the National Research Council, which was organized in 1916 at the request of President Wilson, under the charter of the National Academy of Sciences.

Mr. MANAGER:

This is addressed to YOU.

A good many foremen and superintendents have told us that the men always prefer to use the

"Precision" BORING, DRILLING & Milling Machine



Why do the men prefer to use it? Because they want to *make a record,* and they can make it easier and quicker by using the *"Precision"*.

The reason that they want to make a record is that they want to make *more money* and they know that they must make a record first.

A record by the man is also a record for the foreman and the superintendent, and a record for the works.

A record for the works is a record for the *manager* and the manager doesn't object to more money either.

It is up to the manager to buy the kind of machines that will allow the record to be made—the *Precision* is *it*.

WE ALSO MAKE THE

LUCAS POWER

Forcing Press

LUCAS MACHINE TOOL CO. NOW AND ALWAYS OF **CLEVELAND, OHIO, U.S.A.**

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry. Societe Anonyme Belge, Alfred Herbert, Brussels. Aux Forges de Vulcain, Paris. Allied Machinery Company, Turin, Barcelona, Zurich. Benson Brothers, Sydney, Melbourne. V. Lowener, Copenhagen, Christiania, Stockholm. R. S. Stokvis & Zonen, Rotterdam. Andrews & George Company, Tokyo, Japan.

COMING EVENTS

June 5-9—Annual convention and exhibit of the American Foundrymen's Association and allied societies in Rochester, N. Y. Secretary C. E. Hoyt, Marquette Bldg., 140 S. Dearborn St. Chicago, Ill.

June 14-21—Annual meeting of the Mechanical Division of the American Railway Association in Atlantic City, N. J. Secretary V. R. Hawthorne, 431 S. Dearborn St., Chicago, Ill.

June 15-24—International exhibition of foundry equipment and materials in Birmingham, England, in connection with the annual convention of the Institution of British Foundrymen.

June 20-24—Summer meeting of the Society of Automotive Engineers at White Sulphur Springs, W. Va. Chairman of Meetings Committee, C. F. Scott, 29 W. 39th St., New York City.

June 26-30—Twenty-fifth annual meeting of the American Society for Testing Materials in Atlantic City, N. J.; headquarters, Chalfonte-Haddon Hall Hotel. Secretary C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

August 28-September 2—Annual Safety Congress of the National Safety Council in Detroit, Mich. Secretary S. J. Williams, 168 N. Michigan Ave., Chicago, Ill.

September 11-16—Eighth national exposition of chemical industries in the Grand Central Palace, New York City. Managers, Charles F. Roth and Fred W. Payne, Grand Central Palace, 46th St. and Lexington Ave., New York City.

December 7-13—National Exposition of Power and Mechanical Engineering at the Grand Central Palace, New York City. Charles F. Roth, manager, Grand Central Palace, 46th St., and Lexington Ave., New York.

SOCIETIES, SCHOOLS AND COLLEGES

University of Delaware, Newark, Del. Annual catalogue for 1921-1922, containing calendar, courses of study, and other related information.

Clarkson College of Technology, Potsdam, N. Y. Catalogue for 1922, containing calendar for 1921-1922, courses of study, and other information relative to the college.

Polytechnic Institute of Brooklyn, Brooklyn, N. Y. Catalogue of the College of Engineering for 1922-1923, containing calendar, requirements for admission, description of courses, and schedules for both day and evening departments.

Ohio State University, Columbus, Ohio. Educational Research Bulletin No. 9, containing announcement of summer quarter courses offered in the College of Education, the first term of which begins on June 19 and the second on July 27.

NEW BOOKS AND PAMPHLETS

Cutting Fluids. By Eugene C. Bingham. 76 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Technologic Paper No. 204 of the Bureau of Standards. Price, 15 cents.

An Investigation of the Properties of Chilled Iron Car Wheels. By J. M. Snodgrass and F. H. Guldner. 103 pages, 6 by 9 inches. Published by the Engineering Experiment Station of the University of Illinois, Urbana, Ill., as Bulletin No. 129.

Tensile Properties of Some Structural Alloy Steels at High Temperatures. By H. J. French. 92 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Technologic Paper No. 205 of the Bureau of Standards. Price, 5 cents.

Some Effects of the Distributed Capacity between Inductance Coils and the Ground. By Gregory Breit. 7 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Scientific Paper No. 427 of the Bureau of Standards. Price, 5 cents.

Manufacture and Properties of Steel Plates Containing Zirconium and other Elements. By George K. Burgess and Raymond W. Woodward. 54 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Technologic Paper No. 207 of the Bureau of Standards. Price, 20 cents.

Report of the Engineering Foundation for the Year Ended February 9, 1922. 92 pages, 7 by 10 inches. Published by the Engineering Foundation, Engineering Societies Building, 29 W. 39th St., New York City, as Publication No. 4.

In addition to the report for the year contained in this publication, there is also a report of a research on the fatigue of metals, which is given in full, including diagrams and tables.

Construction of Radiophone and Telegraph Receivers for Beginners. By M. B. Sleeper. 142 pages, 5¼ by 7½ inches. Published by the Norman W. Henley Publishing Co., 2 W. 45th St., New York City. Price, 75 cents.

The widespread interest in wireless telephony has created a demand for books on this subject, especially for those containing instructions for amateurs who are building their own equipment. This book which is written for the beginner, gives directions for the construction of radiophone and telegraph receivers. Special receivers, both crystal and audion, are shown in detail. The material is illustrated by halftones, diagrams, and working drawings, which have been especially prepared for this book. The information covers the erection of antennas, planning a station, and building all kinds of crystal, audion and regenerative receivers, with amplifiers and "loud speakers" for receiving radio telephone broadcasting and telegraph signals.

The Iron Man in Industry. By Arthur Pound. 230 pages, 5½ by 8 inches. Published by the Atlantic Monthly Press, 8 Arlington St., Boston, Mass. Price, $1.75.

This is an interesting contribution to the literature on industrial problems. It points out the social significance of the automatic machine, which the author calls the "iron man," and the labor problems that have followed in its wake. The author has worked in factory towns at a trade, and has been both employer and employe, reporter, editor, and printer, so that he has had an opportunity to look at the problem of social unrest from more than one point of view. He begins his book with a study of industrial and social conditions in Flint, Mich., showing the effect of the automatic machine in the manufacturing center of the automobile industry. He then goes on to consider the problem in its national aspects. He points out the need for adapting present-day education to the march of civilization exemplified in the use of automatic machinery, and makes a plea for a better use of the leisure which the "iron man" has brought to the world.

Human Factors in Industry. By Harry Tipper. 280 pages, 5 by 7½ inches. Published by the Ronald Press Co., 20 Vesey St., New York City. Price, $2.

This book contains an analysis of the present situation relating to capital and labor and discusses many of the experiments that are being made with a view to obtaining better industrial conditions. The first part of the book contains an outline of the history of labor unions for the past century and discusses their present tendencies and prospects. Manufacturers' associations and the influence on modern industrial problems of recent developments in industrial, economic and political theory are also considered. Particular attention is given to the influence of the modern tendency toward specialization. The second part of the book treats of various remedial changes which are being tried, discusses incentives in industry, the wage system, bonuses and profit-sharing, the employment and industrial relations departments, employe representation, and the open shop issue. The book is the result of many years of intimate observation by the author in actual work with labor and in supervising all kinds of labor.

Metal Cutting Tools. By A. L. DeLeeuw. 328 pages, 6 by 9 inches. Published by the McGraw-Hill Book Co., Inc., New York City. Price, $3.

The object of this book is to set forth the principles which must be applied in the selection, design, maintenance and use of metal-cutting tools. It is primarily intended for the young engineer, student, foreman, time-setter, and particularly for the ambitious mechanic who is desirous of basing his skill on knowledge. The principles underlying the cutting action of metal-cutting tools are not yet absolutely established, but the material presented is based on numerous observations of the author and others. There are eighteen chapters dealing with the following subjects: Formation of Chips—Elementary Considerations in the Construction of Simple Tools; Consideration of the Element of Feed—Analysis of the Round-nosed Tool—Effect of Fundamentals of Cutting on Design; Various Types of Planer Tools; Standard Lathe Tools and Boring Mill Tools; Boring Tools; Single and Multiple Boring Tools—Reamers; Milling Cutters—Gear Cutters and Hobs; Cutter Sharpening; Form Tools; Shear Tools; the Use of Liquids when Cutting Metals; Generating Tools; Thread-cutting Tools; Hollow Mills, and Special Tools.

American Travel and Hotel Directory. 2008 pages, 6 by 9 inches; numerous illustrations. Published by the American Travel and Hotel Directory Co., Inc., Baltimore, Md. Sold by The Industrial Press, 140-148 Lafayette St., New York City. Price $10.

The 1922 edition of this well-known directory contains a vast amount of information of great value to everyone who travels for business purposes. It contains a complete list of all hotels in the United States, indicating the class of hotel, rates, etc., and also gives the same information for hotels in Canada and Latin America. In addition, it contains tables giving railroad fares and Pullman berth rates between the principal cities in the United States. The arrangement of the information in the book is very convenient. All states are arranged alphabetically, and under each state the cities and towns are also arranged in alphabetical order. A general description of the various states and cities, particularly from an industrial point of view, is given in this connection, and a list of local holidays for each state is included. This is a book that, when properly consulted and used, will easily save its cost several times over in the office of any firm or corporation that has sales and traveling men needing exact information, carefully condensed and classified. It makes it possible to reserve accommodations in advance at stated rates, and to plan business trips intelligently beforehand. In addition to the hotel directory, there is a brief description in connection with each city giving altitude, population, location, transportation facilities, telegraph, banking and express facilities, etc., and an outline of the principal industries.

NEW CATALOGUES AND CIRCULARS

Goddard & Goddard Co., Detroit, Mich. Folder entitled "A Statement," relating to the development of curved-back tooth milling cutters, as made by the company.

Kurtz Equipment Co., 57 W. Houston St., New York City. Circular advertising Kurtz trucks, casters, barrel racks, tiering machines, and other indoor handling equipment.

Heine Boiler Co., (formerly Heine Safety Boiler Co.), St. Louis, Mo. Pamphlet entitled "Forty Years of Progress," announcing a change in name and several new developments in boiler design.

R. S. Whitney Mfg. Co., 74 Nichols St., Lewiston, Me. Circulars illustrating and describing Whitney standard garage equipment, including arbor presses, automobile jacks, etc., and Whitney valve refacing lathe.

Griscom-Russell Co., 90 West St., New York City. Bulletin 360, describing the application of evaporators to the purification of boiler feed water by distillation, and illustrating the Reilly self-scaling evaporator.

Van Dorn & Dutton Co., Cleveland, Ohio. Leaflet treating of Van Dorn gears, containing information relative to the materials used and illustrations showing views in the gear-cutting and heat-treating departments.

Spencer Lens Co., Buffalo, N. Y. Catalogue covering the Spencer products for commercial and industrial laboratories, which include projection apparatus, microscopes, photo-micrographic cameras, colorimeters, spectroscopes, photographic lenses, etc.

Nice Ball Bearing Co., Nicetown, Philadelphia, Pa. Catalogue giving dimensions and list prices of Nice annular type ball bearings, thrust bearings, and combination radial and thrust load ball bearings. Prices are also given for ball retainers and ball-bearing wheels.

Ingersoll-Rand Co., 11 Broadway, New York City. Bulletin 10004, descriptive of Type PO horizontal single-cylinder four-stroke cycle stationary oil engines. The features of construction are described in detail and data are given on fuel consumption, dimensions, etc.

N. A. Strand & Co., 625 W. Jackson Blvd., Chicago, Ill. Catalogue 22, covering the line of flexible shafts and equipment made by this concern. The equipment is applicable for grinding, polishing, sanding, drilling, reaming, tapping, tire-buffing, nut-setting, screw-driving, and many other operations.

Armstrong-Blum Mfg. Co., 343 N. Francisco Ave., Chicago, Ill. Catalogue 5, illustrating and describing the line of "Marvel" machines made by this concern, which includes high-speed sawing machines, hacksaws, band saws, punches and shears, drill press vises and combination punching, shearing, and bending machines.

Kearney & Trecker Corporation, Milwaukee, Wis. Circular illustrating Milwaukee milling machines and giving data on the saving in production costs effected in milling transmission cases, connecting-rods, cylinder blocks, and clutch adjusting rings, by the use of special attachments and fixtures designed for these machines.

Tide Water Oil Sales Corporation, 11 Broadway, New York City. Catalogue entitled "One Hundred and One Economies for the Motorist," containing information on the proper lubrication of all the different parts of automobiles. A diagram of a car is presented, on which is shown the location of every part that requires lubrication.

James Clark, Jr., Electric Co., Inc., Louisville, Ky., is issuing a monthly publication for the benefit of its selling agents and salesmen, known as the "Jaco Driller" which contains news relating to the activities and personnel of the firm, and information concerning its product, which comprises portable electric drills and other electrically driven tools.

Rochester Electric Products Corporation, Rochester, N. Y., has just issued the first of a series of pamphlets entitled "Little Motor Talks." Pamphlet 1 takes up the subject of brush mounting, and other features of motor design will be dealt with in subsequent issues. The company will be glad to place those interested in motors on its mailing list for the entire series.

Nilson-Miller Co., 1300 Hudson St., Hoboken, N. J. Card containing information on the gear-cutting service which this company is in a position to render, including the cutting of spur gears up to 66 inches in diameter, bevel gears up to 24 inches in diameter, helical gears up to 18 inches in diameter, internal gears up to 30 inches in diameter and worm-gear sprockets, intermittent gears, etc.

W. S. Rockwell Co., 50 Church St., New York City. Circular illustrating and describing Rockwell stationary and tilting crucible melting furnaces for aluminum, brass, bronze, copper, gold, monel metal, nickel, silver, and other non-ferrous

metals. These furnaces are operated with either oil or gas fuel. Dimensions are given covering the three sizes of stationary furnaces and the four sizes of tilting furnaces.

Turner Brass Works, Sycamore, Ill. Circular listing the principal points of construction in the Turner "Master" line of blow-torches, which may be used for burning either gasoline or kerosene. Particular attention has been given to safety features in the design of these torches. This line is an addition to the regular line of blow-torches made by this concern. List prices are given for the different sizes.

Scovell, Wellington & Co., Boston 9, Mass., accountants and engineers, have compiled a list of four hundred books on accountancy, industrial engineering, and related business topics. This list was prepared originally for the use of members of the company and clients, but is now being distributed without charge to those interested in buying business books on these subjects for their own use or for a commercial library.

Grindle Fuel Equipment Co., Harvey, Ill. General catalogue of Grindle powdered fuel equipment, pointing out the advantages of powdered fuel and the special features of the Grindle system. The catalogue contains many illustrations showing the Grindle powdered coal system, multiple-tube dryer, pneumatic conveying system, firing equipment, storage hoppers and tanks, etc. copies will be sent to those interested upon request.

General Tool & Equipment Co., 70 Monroe St., Chicago, Ill. Circular descriptive of the Sapihl portable electric grinder, which is especially adapted to valve grinding. The illustrations show some of the various uses of this tool in automobile shops and machine shops, for valve grinding, reamer and tool sharpening, surfacing, internal grinding, toolpost grinding, cotter grinding, and die work. Complete specifications for the tool are given.

Ingersoll Milling Machine Co., Rockford, Ill. Circular illustrating the use of the Ingersoll adjustable rotary milling machine in railroad shops for profile-milling such as, for example, milling the radius on the end of main rods, milling steel straps, side-rods, etc. The combination of the movements to the head, housing, table saddle and rotary table give the machine a wide range. Complete data for the various operations are given.

Newark Gear Cutting Machine Co., Newark, N. J. Catalogue 3, containing a detailed description of Newark spur gear cutting machines. The general description is followed by illustrations of the different types of machines and complete specifications, the specifications for each machine being given on the page opposite the illustration. The book concludes with tabular matter, relating to sizes and prices of involute gear cutters, instructions for sizing and cutting gears, and data on tooth parts.

W. J. Savage Co., Inc., Knoxville, Tenn. Circulars containing illustrations, descriptive material, and specifications covering the line of sheet-metal cutters made by this concern. These machines are made in four sizes—Nos. 0, 1, 2, and 3 for cutting stock up to 1/8, 3/16, 3/8, and 5/8 inch thick respectively. They are so designed that they will cut any shape out of sheets or plates and will finish inside angles, corners, or curves, in the same operation, thus eliminating torch-cutting, drilling, and hand work.

Condensite Co. of America, Bloomfield, N. J. Catalogue telling what condensite is and the many uses for which it is adapted. The illustrations show a variety of products made from this material. Catalogue entitled "Condensite in the Automotive Industry" showing the application of condensite to this particular field. On alternate pages are shown photographs of automobile parts made from this material, and on the opposite pages are brief statements pointing out the advantage of condensite for the parts shown.

Charles H. Besly & Co., 120-B N. Clinton St., Chicago, Ill. General catalogue of Besly grinding machines containing complete specifications and illustrations of the disk and ring-wheel single- and double-spindle grinders. These machines are of the ring-oiling type, and the construction of the ring-oiling spindle is illustrated and described in detail. All the single-spindle machines may be arranged for motor drive. Circular descriptive of the Besly "Titan Non-glaze" abrasive disks, which are made for use on Besly grinding machines.

Boston Gear Works, Norfolk Downs, Quincy, Mass. 1922 edition of general catalogue No. 40, covering 600,000 standardized Boston gears carried in stock in 1500 sizes. The latest addition of steel and iron internal gears for use with the company's new style pinions of less than twelve teeth are shown on pages 64 to 71. Complete data including dimensions, prices, etc., are given for brass, iron and steel bevel and spur gears, worm-gears, sprockets, etc. The catalogue also gives dimensions and prices of universal joints, ball bearings and thrust washers.

TRADE NOTES

J. Horstmann, dealer in machinery, tools, and steels, 81 Rue St. Maur, Paris, France, discontinued its New York office on May 15.

Acme Stamping & Machine Co., has reincorporated, and has changed its name to Acme Stamping & Mfg. Co. The firm is now located at 119 Sheldon St., Chicago, Ill.

Metal & Thermit Corporation, 120 Broadway, New York City, has removed its Pittsburg branch office from 1427 Western Ave. to 801 Hillsboro St., Corliss Station.

Alvord Reamer & Tool Co., Millersburg, Pa., manufacturer of reamers, milling cutters, twist drills, drop-forgings, punches and dies, and special tools, has moved its Philadelphia office to 228 Church St.

Reeves Pulley Co., Columbus, Ind., announces that the manufacture and sale of the Reeves centerless roll grinder will be carried on in the future from the office and factory of the company at Columbus, instead of through a sales agency as heretofore.

Sharon Pressed Steel Co., New York City, has moved its office from 66 Broadway to the company's new warehouse in the Dodge building, 47 West Broadway, corner of Murray St., where a complete line of trucks, trailers, skids, and other pressed steel products will be carried.

Arthur M. Watkins, dealer in machine tools, eastern agent for the Covington Machine Co., and New York agent for the American Tool Works Co.'s planers and the Ohio Machine Tool Co.'s shapers, has moved his offices from 165 Broadway to the Dodge Building, 53 Park Place, New York City.

General Tool & Equipment Co., 70 Monroe St., Chicago, Ill., has been appointed exclusive selling agent for the portable electric grinder made by the Sapihl Electric Tool Co., of Galesburg, Ill., in the states of Michigan, Ohio, Kentucky, Minnesota, North and South Dakota, Iowa, Indiana, Illinois and Pennsylvania.

Bristol Co., Waterbury, Conn., manufacturer of recording instruments, has opened a branch office at Philadelphia, in the Widener Bldg., Room 1311. C. C. Eagle, Jr., is in charge of the new office. Mr. Eagle has had wide experience, including laboratory training at the factory and sales training in the field. He was formerly in charge of the Detroit office.

Reeve-Fritts Co., 37 S. DesPlaines St., Chicago, Ill., has been formed for the purpose of dealing in new and second-hand machine tools. The officers of the company are J. E. Fritts, president and treasurer, and H. J. Reeve, vice-president and secretary. Both Mr. Fritts and Mr. Reeve were formerly associated with the Stocker-Rumely-Wachs Co. of Chicago.

Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., has recently erected a new building in Huntington, W. Va., at Second Ave. and Ninth St. The building is a three-story structure containing 30,000 square feet of floor space. The activities of the sales, service, and warehouse departments have been coordinated in the new building, and this, together with the better facilities provided, is expected to result in more effective service to customers.

Herberts Machinery & Supply Co., corner of Third and San Pedro Sts., Los Angeles, and 140 First St., San Francisco, Cal., dealer in machine tools and woodworking machinery, has been appointed exclusive representative for California, Arizona and Nevada for the Norton line of grinding machines, built by the Norton Co., Worcester, Mass. The Herberts Machinery & Supply Co. has placed an order for two carloads of grinding machines with the Norton Co. for stock purposes, which will enable them to take care of their trade by giving immediate delivery.

Oneonta Iron Works, Inc., Oneonta, N. Y., have recently opened the foundry previously operated by the Titchener Colver Iron Works, and will do a general jobbing business. A cupola with a capacity of from 6 to 7 tons has been installed. The officers of the concern are as follows: President, F. G. Schifferdecker; vice-president and general manager, R. S. Findlay. Mr. Findlay has been general foreman of the Hudson Coal Co.'s repair shops at Scranton, Pa., for the last four years, and previous to that time was engaged for a number of years on river harbor improvements for the United States Government.

Dodge Sales & Engineering Co., Mishawaka, Ind., manufacturer of power transmission appliances and heavy oil engines, has removed its New York City branch from 21 Murray St., to the Dodge Building at 53 Park Place, New York City. The new Dodge building is twelve stories high and is of steel and concrete construction. This company has maintained a branch and warehouse in New York City for over twenty-eight years, and in moving to its new location, which is convenient to shipping and railway facilities, will be in a position to handle more efficiently its local and export business.

Modern Machine Tool Co., Jackson, Mich., has taken over from the Sprague-Hayes Mfg. Co., of Detroit, Mich., the manufacture of a special combination table and vise for use on drilling machines. This device will now be manufactured by the Modern Machine Tool Co. on a royalty basis, under license from the inventor, George H. Cocks of Adrian, Mich. With the manufacturing rights, the Modern Machine Tool Co. acquired the tools, patterns, jigs, fixtures, etc., and also the stock of raw materials and finished table-vises which the Sprague-Hayes Mfg. Co. had on hand.

Arrow Tool & Mfg. Co., 200 Cannon St., Bridgeport Conn., has changed its name to the Forsberg Mfg. Co. This change was made because another company, which has been in business for a longer period of time, uses the word "Arrow" in its name and trademark. The Forsberg Mfg. Co. will continue to make tools and special machinery of all kinds. An up-to-date press room has been added to the plant, and the company is prepared to make stampings and sheet-metal specialties of steel, brass, aluminum, or other metals, in large quantities. In addition it is making a complete line of hacksaw frames. No change will be made either in the ownership or management.

General Electric Co., Syracuse, N. Y., announces a number of important changes in the directorate of the company: C. A. Coffin has retired as chairman of the board of directors and has been succeeded by Owen D. Young, who has been a vice-president of the company for many years. Gerard Swope, president of the International General Electric Co., has been elected president, succeeding E. W. Rice, Jr., who will devote his entire energy to the further upbuilding of the scientific, engineering, and technical phases of the company's work, and who will become honorary chairman of the board of directors. Anson W. Burchard, for many years vice-president of the company in charge of public utilities and foreign investment, was elected vice-chairman of the board. J. R. Lovejoy and G. F. Morrison were elected directors.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912

of MACHINERY, published monthly at New York, N. Y., for April 1, 1922.

State of New York } ss.
County of New York }

Before me, a Notary Public in and for the state and county aforesaid, personally appeared Matthew J. O'Neill, who, having been duly sworn according to law, deposes and says that he is the treasurer and general manager of the Industrial Press, Publishers of MACHINERY, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, The Industrial Press, 140-148 Lafayette St., New York; Editor, Erik Oberg, 140-148 Lafayette St., New York; Managing Editor, None; Business Managers, Alexander Luchars, President, 140-148 Lafayette St., New York, and Matthew J. O'Neill, Treasurer and General Manager, 140-148 Lafayette St., New York.

2. That the owners of 1 per cent or more of the total amount of stock are: The Industrial Press; Alexander Luchars; Alexander Luchars, Trustee for Helen L. Ketchum, Elizabeth Y. Urban, and Robert B. Luchars; Matthew J. O'Neill; Louis Pelletier; and Erik Oberg. The address of all the foregoing is 140-148 Lafayette St., New York.

3. That there are no bondholders, mortgagees, or other security holders.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

MATTHEW J. O'NEILL, General Manager

Sworn to and subscribed before me this 17th day of March, 1922.

(SEAL)

WILLIAM E. BACON,
Notary Public, Kings County No. 444
Kings Register No. 8109
New York County No. 79 New York Register No. 8047
(My commission expires March 30, 1923.)

MACHINERY

JULY, 1922

VOL. 28 NO. 11

Approved Methods of Grinding Such Important Parts as Pistons, Piston-rings, Piston-pins, Cylinders, Connecting-rods, Crankshafts, Camshafts, Gear Teeth and Spline Shafts

First Installment of a Series of Five Articles on Grinding in Different Industries, by the Engineering and Educational Departments of the Norton Company, of Worcester, Mass.

Grinding in the Automotive Industry

THE automotive and allied industries, including the manufacture of automobiles, motorcycles, trucks, airplanes, tractors, ball and roller bearings, universal joints, and transmissions, consume more grinding wheels than all other industries combined. In the automotive industry, interchangeable manufacture is of particular importance, and as small tolerances are allowed for most of the parts, grinding is the only economical method of producing them. Another reason for the extensive application of grinding in this field is that a large number of hardened steel parts are used. Hardened work can be machined commercially only by grinding. Almost every part is ground at some stage of its manufacture, and in many cases grinding is by far the most important operation.

There are many automotive parts that are simple cylindrical pieces ground on the ordinary type of cylindrical grinding machine, there being nothing unusual about the operation. This class includes such parts as push-rods, pump shafts, shackle bolts, pins, and bushings. Bushings are also ground internally on standard internal grinding machines, the operation being simple and not of special interest. There are, however, many grinding operations that are characteristic of the automotive industry, and that represent interesting examples of grinding practice, and these will be dealt with in this and in a second article to appear in August MACHINERY.

Fig. 1. Cylindrical Grinding Operation on Pistons

Pistons, such as are used in the automotive industry, are made from either cast iron or aluminum. The grinding of cast-iron pistons will be considered first. The important operation is cylindrical grinding (see Fig. 1). This follows a rough-turning operation in which the castings are turned to within about 0.025 inch of the finished size. The piston is held on a special fixture, which makes it possible to grind the entire length with one set-up of the machine. Three types of these special fixtures are illustrated in Fig. 2. The construction will be readily understood by referring to this illustration in connection with the description.

The grinding fixture shown at *A* has a conical-shaped part (made of cast iron), which is mounted on the hardened taper bearing of a dead center, and is revolved by the faceplate driving pin. This conical casting carries three equally spaced jaws which may be adjusted along dovetail slots to suit the diameter of the piston that is to be ground. Each jaw is split lengthwise, and has a taper screw which spreads it in the slot for locking in any position. A notch in each jaw provides clearance for the grinding wheel, as the illustration shows. The dead center which supports the conical-shaped chuck is inserted in the main spindle of the grinding machine.

The fixture shown at *B* is very simple; it consists of a steel disk-shaped part for supporting the open end of the piston, with a driving pin that engages one of the wrist-pin bosses, and another pin that engages the driving pin on the machine faceplate. In this case, as in the preceding one, the regular machine center is used for supporting the outer end of the piston.

A third design of fixture is shown at *C*. A loose pin is inserted in the wrist-pin holes so that it extends across the piston and through an elongated hole in the central arbor. After the back-plate is placed in the open end of the piston, the taper drift key is driven in, thus holding the parts firmly together. This simple method of holding a piston has proved very effective.

In grinding pistons, the "draw-in-cut" method is generally combined with the stroke method; that is, the wheel is fed in at one end to within 0.001 or 0.002 inch of the finished size, traversed once by hand the entire length of the piston, and then automatically traversed until the diameter is correct. Usually only one automatic traverse is needed, although in some cases several complete passes may be necessary.

Wheels Used for Piston Grinding

When the "draw-in-cut" method is used, the corner of the wheel removes practically all of the stock, and must therefore wear very slowly. This makes it necessary to use harder wheels than when the stroke method is used for the complete operation, as in the latter case the feed for each traverse is only 0.001 or 0.002 inch. Silicon carbide wheels of medium grade are in use in shops where the "draw-in-cut" method is followed, while in the case of the stroke method, wheels in the soft range are more common.

In many plants, roughing is done on one machine and finishing on another, two different grains and grades of wheels being used. In other plants, the piston is ground to the finish desired in one operation, in which case the corner of a hard wheel does the cutting, and the remainder of the face, being glazed, burnishes the surface of the work. The production is often as high as one piston per minute.

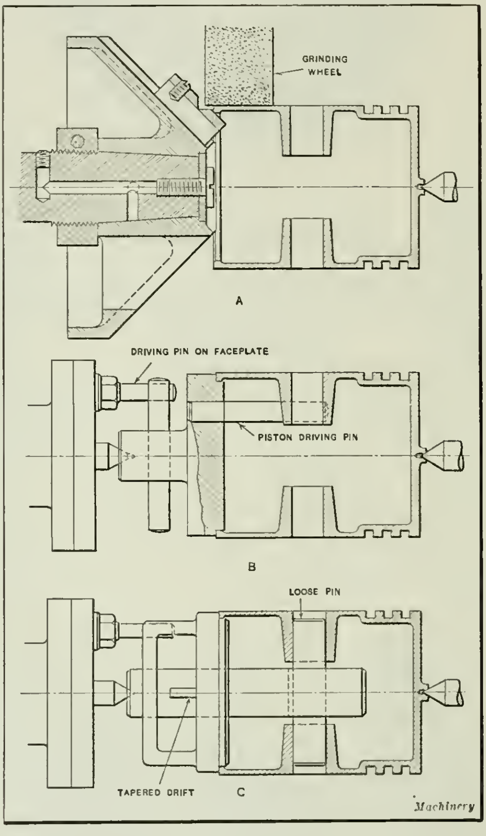


Fig. 2. Three Types of Fixtures or Arbors for holding Pistons while grinding

More care must be exercised when grinding aluminum than when grinding cast-iron pistons. Both aluminous and silicon carbide abrasive wheels are used for this work.

[Note: The silicon carbide abrasives represented by crystolon, carborundum, etc., differ materially from the aluminous abrasives such as alundum, aloxite, etc. The grains of the former are harder but are also more brittle due to the structure; the grains of the latter, while not as hard, are tougher and do not break apart as easily, thus being able to withstand a greater stress. In addition, the aluminous abrasives admit of a certain range of toughness in their manufacture. On account of the difference in physical characteristics of the two abrasives, a general rule has been established, namely, that aluminous abrasives are used for grinding materials of high tensile strength, and silicon carbide abrasives for those of lower tensile strength. While tensile strength alone is not the criterion, inasmuch as hardness and ductility influence the selection, experience has shown that, in general, the aluminous abrasives are particularly adapted for grinding materials of high tensile strength.]

It is very difficult to grind aluminum without producing scratches, unless the operator is very expert, because either a loaded wheel, or abrasive particles coming between the wheel and the piston result in objectionable scratches. The first difficulty is reduced to a minimum, or even obviated entirely, by using a wheel which breaks down easily, as, for instance, an aluminous abrasive elastic wheel, or by treating the wheel face in such a way that the metal particles cannot be forced into the voids between the grains. In the latter case, if silicon carbide vitrified wheels are used, beeswax or paraffin is often rubbed into the wheel face, which, in addition to reducing the loading tendency, helps to give the polished finish commonly desired. High work speeds and frequent truing with a diamond are helpful in reducing the loading.

To prevent the abrasive particles from flowing between the wheel and the piston, the tank should be kept clean and the lubricant renewed frequently. Often a fine-mesh cloth screen is attached to the tank end of the lubricant pipe. The common lubricants used on other grinding work do not give the best results on aluminum. Kerosene or a mixture of kerosene and lard oil are most commonly used.

In addition to the periphery, two other parts of the piston (whether made of cast iron or aluminum) are sometimes ground, namely, the relief around the pin-hole and also the top. For grinding around the pin-hole, the piston is held off center in a cylindrical grinding machine and the relief ground with a narrow wheel. Some manufacturers finish the top of the piston very carefully, because of the belief that any irregularity tends to facilitate the deposit of carbon. This work may be done (1) on a Blanchard type of grinding machine, (2) on a rotary surface grinding machine of the Heald type, or (3) on a disk grinding machine equipped with abrasive disks mounted on metal plates.

Piston-ring Grinding

Piston-rings are finished almost entirely by grinding. Castings are made either singly or in cylinder form, the latter being cast by the "pot" method. When single cast rings are used, the rough rings, as they come from the foundry, must be snagged in order to remove the sprues and fins. Silicon carbide wheels are preferable for this work. Following this operation the rings are either rough-ground cylindrically, being held in a fixture and rotated against the grinding wheel by hand, or are rough-turned. They are then rough-surfaced in any one of several different ways, the most common method being to use a rotary type of surface grinding machine. Abrasive disks and cylinder wheels are also used for this work in a few plants, the latter method being the more commonly used of the two.

A special type of machine for surface-grinding piston-rings has two cylinder wheels mounted with their faces close together, the distance between them being equal to the desired thickness of the rough-ground ring. The rings are held in a suitable fixture and pushed between the two wheels. Usually about 0.003 inch of stock is left on the ring for the finish-grinding operation. Production of the common types of rings is about 200 rings per hour on this machine.

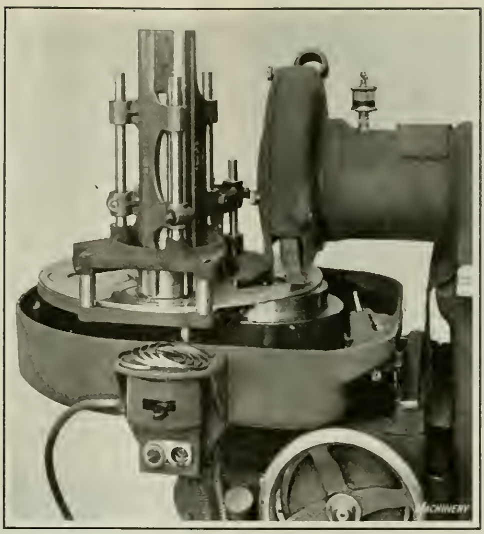


Fig. 3. Automatic Ring-grinding Machine

The finish surface grinding is always done on a rotary type of machine. This is one of the few grinding operations that can be done automatically. The Heald automatic ring grinding machine, shown in Fig. 3, has a magazine type of ring-feeding attachment, and is fully automatic. A feeding plate or carrier disk transfers the rings from the magazine to the grinding position. This disk has five holes to receive the rings, which may be bushed to take rings up to 5 inches in diameter. When the disk indexes, a ring is transferred from the magazine to the center of the magnetic chuck and then, after being ground, this ring is removed as another one slides around to the grinding position.

Current for the chuck is supplied through a rotating disk having an electrical contact. This disk is so timed with reference to the grinding operation that magnetizing the chuck to hold the ring for grinding, and demagnetizing both chuck and work to permit removal of the ground rings are automatically controlled. The wheel-slide of this machine is operated hydraulically, oil being used. A production of 1000 rings per hour may readily be attained.

Another type of attachment makes the surface grinding machine semi-automatic. In this case it is necessary for the operator to place the rings in the holder with one hand, and to remove the ground rings with the other hand, using a non-magnetic hook.

An interesting point in connection with the surfacing of piston-rings on the rotary type of surface grinding machine is the fact that aluminous instead of silicon carbide abrasive wheels are used. This practice is contrary to the general rule that materials of low tensile strength are best ground by silicon carbide wheels, and is probably followed because of the dressing action of the sharp corners of the rings, which makes it necessary to use a tougher abrasive in order to prevent excessive wheel wear.

After the surfacing operation, the rings are split and compressed to the required size, mounted in "gangs" on a special arbor and ground in a plain cylindrical grinding machine. This is merely an ordinary cylindrical grinding operation. Single cast rings are also ground internally, in some cases on a precision machine, but more frequently they are ground "off-hand," as it is not necessary to have the inside dimensions exact.

When rings are cast by the pot method, the castings are trued, bored, and then cut off into individual rings. As their thickness can be brought to size very accurately, only about 0.005 inch of stock being left for grinding, it is not necessary to rough surface-grind the rings. In this way one of the grinding operations which is necessary on single cast rings is eliminated. The other operations performed on rings that are cast by the pot method are exactly the same as in the manufacture of the single cast rings.

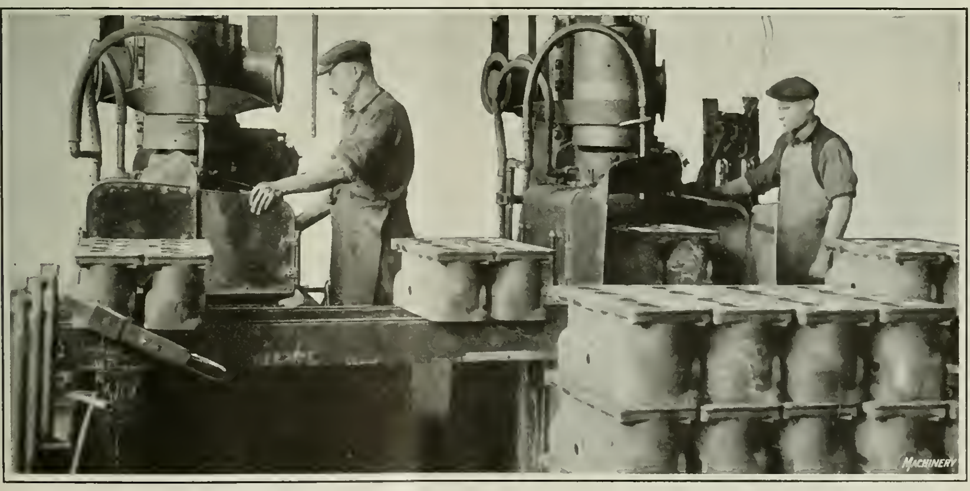


Fig. 4. Surface-grinding Operation on Cylinder Castings

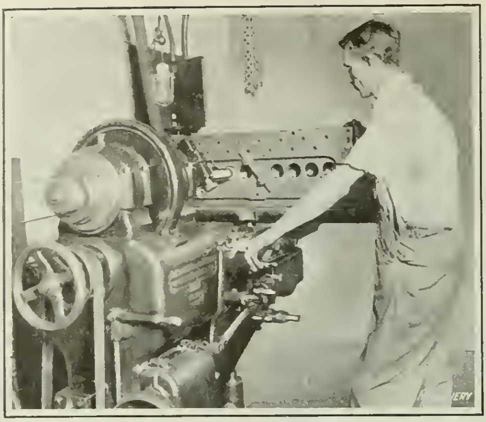


Fig. 5. Grinding Cylinder Bores

Piston-pins are plain cylindrical parts, but in spite of this, they are very difficult to manufacture. This is due to the fact that the pins are hollow, the walls being only about ⅛ inch thick, and also to the fact that in their manufacture they are usually held to the very close limit of from 0.0005 to 0.0002 inch. On this account great care must be exercised in order to produce perfectly cylindrical and uniformly hardened pins. The pins are formed on automatic screw machines, and after heat-treatment are ready for grinding.

Piston-pin Grinding on Cylindrical and Centerless Grinders

The grinding method used, whether it employs a narrow wheel with provision for traverse or a wheel slightly wider than the piston-pin, depends upon the practice of the individual shop. Two distinctly different types of cylindrical grinding machines are used. The older type is the plain cylindrical machine, in which the pins are mounted on arbors and ground like any cylindrical part of similar dimensions. If a wide wheel is used it is fed straight in, there being no traverse except for a slight hand movement of the table when the pin is ground nearly to the finished size. This slight traverse merely brings about somewhat of a dressing action, which helps to keep the wheel face straight. Grinding is done wet, and aluminous abrasive wheels are used which are usually of grain No. 36 combination or No. 46.

The newer type of machine used for this work is known as the "centerless" grinding machine. In the latest types of these machines, the work is held between the grinding wheel, a drive wheel, which is also an abrasive wheel, and a work shoe. The pieces to be ground are fed in at one side of the machine and the drive wheel, which is set at an angle, pulls the work past the grinding wheel. The greater the angle between the axis of the drive wheel spindle and that of the grinding wheel spindle, the faster the work travels. Grinding is done wet, and aluminous abrasive wheels are used. They must be finer than those used on the plain cylindrical grinding machine, and are usually of grain No. 46 or 60 for roughing and of grain No. 80 to 120 for finishing. With the first centerless machines it was difficult to produce round pins, but marked improvement has been made, although the quality is still inferior to that of pins ground on centers.

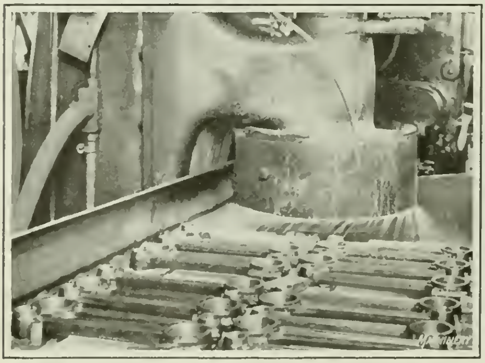


Fig. 6. Grinding the Side Faces of Connecting-rods

Surfacing Cylinder Castings

Cylinder castings are made of either cast iron or semisteel. The larger number at present are made of semisteel, which consists of about 20 per cent steel scrap added to the cast iron. This metal must be considered of low tensile strength, and it is most efficiently ground with silicon carbide wheels, the same as cast iron. The important result of adding the steel scrap is to refine the iron and make it finer grained, rather than to increase the tensile strength to a point where it would approach that of soft steel.

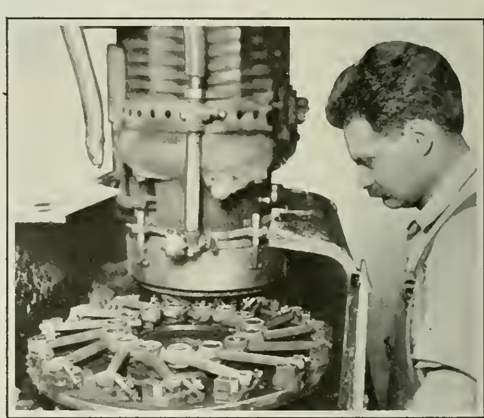


Fig. 7. Another Method of grinding the Side Faces of Connecting-rods

Cylinder castings are surfaced-ground, on a machine of the Blanchard, Pratt & Whitney, or Diamond type, for the purpose of making a commercially perfect joint with the crankcase and also (if the casting is of the open-head type) with the cylinder head. Fig. 4 shows Blanchard machines surface-grinding cylinder castings. The production secured by this operation, because of the rapid removal of stock, compares favorably with the results obtained by milling. The use of water in the grinding makes it possible to maintain high production.

Grinding Cylinder Bores

Before the development of the gasoline engine, cylinders such as are used in pumps and steam engines were usually machined by boring with a single-point tool, there being a sufficient amount of metal in the cylinder wall to resist the pressure exerted by the tool. The gasoline engine cylinder has such thin walls, however, that this method of boring would not give satisfactory results, because the walls would spring and the tool would slide over hard spots in the casting and gouge into soft spots, leaving an irregular surface. Grinding provides an accurate method of finishing cylinder bores, and most automobile engine cylinders are ground, although some manufacturers prefer reaming. (For a discussion of the two methods, see March, 1919, MACHINERY, page 615.) The eccentric-spindle type of cylinder grinding machine is used for automotive work.

Fig. 5 shows a Heald machine grinding the bores of an eight-cylinder engine. The grinding wheel is mounted on a spindle which, in addition to rotating about its own axis, also travels in a circular path concentric with the circumference of the cylinder hole, making it unnecessary to rotate the work. The cylinder casting is mounted on the machine table, which travels parallel with the axis of the grinding wheel spindle.

The holes are first rough-bored, leaving about 0.005 to 0.008 inch for grinding. This material can be removed easily in three complete passes of the work. The first two roughing cuts are made with the highest speed of table traverse and the lowest eccentric speed, and the finishing cut is made with the lowest table speed and highest eccentric speed. The production naturally depends upon the size of the hole and the amount of stock left for grinding. There are cases on record where as many as eighty holes were ground in an eight-hour day on a single grinding machine, the work being done at the rate of six minutes per hole.

Truing Wheel, Removing Chips, and Cooling Work

Before grinding a cylinder, the wheel must be carefully trued, which should always be done with a diamond. The corners should then be touched up with a silicon carbide abrasive stick or wheel stub, as the sharp corners sometimes

Fig. 8. Internal Grinding Operation on Large End of Connecting-rod

produce feed lines. It is possible in many cases to produce from twenty-five to thirty commercially finished cylinders after each truing, although if a very smooth surface is required, it may be necessary to true the wheel before finish-grinding each hole.

The grinding should always be done dry. Attempts have been made to cool the casting by letting water flow into the hole, but the cast-iron or semi-steel chips and grinding dust that collect at the bottom of the hole form a mud, into which the grinding wheel dips at each revolution of the eccentric. This mud fills up the wheel face and seriously impairs the cutting action. The dust and chips are preferably removed dry by a suction pipe placed at the end of the cylinder hole. This method has practically no cooling effect. A cool cutting wheel is therefore essential, although some of the heat can be carried away by letting water flow over the cylinder or through the water jacket or chambers. In some cases the holes are rough-ground and the casting set aside to cool before the final 0.001 or 0.002 inch of stock is removed. However, this method involves handling the castings twice, and is probably unnecessary, if care is used in cooling the casting as described.

Grinding Compared with Reaming

As a final finishing operation for cylinder holes, grinding is generally considered superior to reaming for the following reasons:

1. A fine finish can be obtained with a grinding wheel much more rapidly than with a reamer. While a good finish

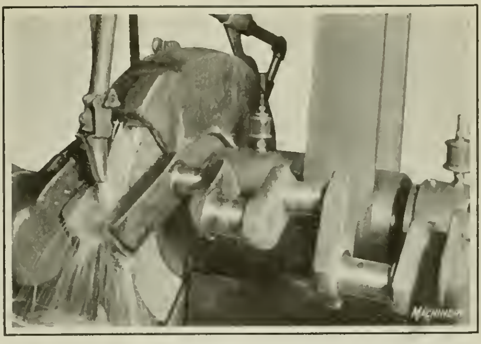


Fig. 9. Grinding Crankpins on a Double-head Type of Machine

may be obtained by taking very light cuts with the reamer, an excessive amount of time is consumed. Much depends, however, upon the reamer and the method of using it, and some automobile manufacturers contend that the finish obtained by a good reamer meets practical requirements, although most cylinders are ground, especially for cars of the better grade.

2. The hard and soft spots that frequently occur in a cylinder casting make it very difficult, and almost impossible in fact, to obtain an even, round hole with a steel tool. A grinding wheel grinds this hard material just as well as the soft sections.

3. There is a tendency for a steel tool to follow more or less the path of least resistance. If, therefore, the hole is not cored straight in the casting, it quite frequently happens that the bored and reamed hole is not at right angles to the crank end.

Grinding Operations on Connecting-rods

The grinding operations on connecting-rods are snagging, surface grinding, and internal grinding. The first operation is not of special interest; it consists merely of removing the stock rapidly by the use of a coarse, hard wheel. The bearing cap and connecting-rod, where they fit together, may be ground to a plane surface and accurate fit by the rim of a small cup-wheel. The side faces of the rods are surface-ground on a Pratt & Whitney or Blanchard type of vertical-spindle surface grinding machine, fifteen or twenty rods being mounted on the chuck of the machine and ground at one time, as shown in Figs. 6 and 7. The bearing cap is then put in place and the small and large holes are ground internally on machines of the Bryant or Heald type, after a rough-machining operation. A Bryant grinding machine is illustrated in Fig. 8, set up for grinding the large ends of the connecting-rods.

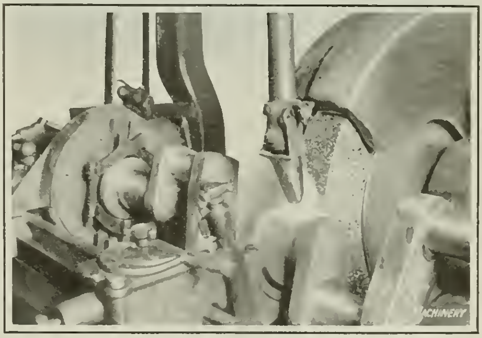


Fig. 10. Grinding Main Bearings of Crankshaft on Plain Cylindrical Machine

Grinding Crankshafts

A typical outline of the operations performed in grinding an automobile crankshaft is as follows: (1) Center the forging; (2) straighten; (3) rough-grind the bearings; (4) turn the flanges and ends; (5) restraighten; (6) rough-grind the pins (sometimes they are rough-turned instead); (7) finish-grind the pins; (8) finish-grind the bearings and outside diameter of the flanges.

Two classes of machines are used—the double-head crank-pin grinding machine, Fig. 9, and the ordinary cylindrical machines, in which the crankshaft is mounted in end-blocks or "throw-blocks," which bring the pins successively into alignment with the headstock and footstock centers. In both cases the wheels are as wide as the pins, and the corners are trued radially in order to form fillets. Wheels slightly over size in thickness are furnished to the operator to allow for truing to the exact width required.

When production warrants the use of more than one machine, it is customary to set up batteries of machines, each performing a single operation. A plain cylindrical grinding machine, equipped with special steadyrests and perhaps a wider wheel than is standard for that size of machine grinds the main bearings, as shown in Fig. 10. A double-head pin-grinding machine grinds the first and fourth pins of a four-throw crankshaft, and another double-head machine grinds the second and third pins. Similarly three machines are used for grinding the pins of a six-throw crankshaft.

A cylindrical grinding machine, which is to be used solely for crankshaft work, is ordinarily equipped with a two-speed hand traverse for convenience in truing the wheel and in locating the work rapidly in position for grinding. Steadyrests of ample width are most essential, and in no class of grinding is the manipulation of the rest more important or capable of greater influence on the quality of work produced. The general principles of cylindrical grinding apply to crankshaft work. For roughing, aluminous abrasive wheels of grain No. 30 or 36 and of hard grade are used. For finishing, aluminous abrasive wheels of medium grade and finer grain give the best results.

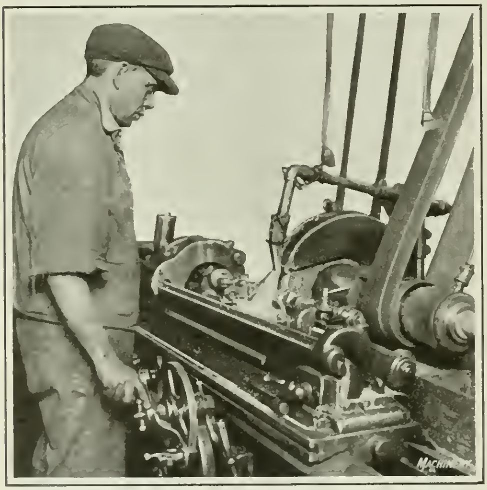


Fig. 11. Grinding Cams to the Correct Contour after hardening

Cam Grinding

Cams are usually rough-ground from the black forging, and considerable material must be removed at a very rapid rate. This is practically a semi-precision snagging operation, and it is accomplished by the use of hard, coarse wheels. After the rough-grinding operation, the cams are hardened. In some shops two grinding wheels are used after hardening, one for semi-finishing and the other for final finishing. In most cases, however, the two operations are performed with the same wheel. Either vitrified or elastic wheels are used.

Cam grinding calls for a high grade of workmanship and great accuracy, as compared with other grinding operations in automobile manufacture. The machine must be operated by a careful workman, who knows thoroughly the art of grinding and applies that knowledge continually. The cam-shaft is revolved at a constant rate, and the proper shape of the cam is developed by a swinging frame controlled by a cam roller following a master cam. The result of this motion is that the camshaft moves toward and away from the grinding wheel, depending on the part of the cam that is being ground.

Fig. 12. Rear View of Grinding Machine showing Mechanism which controls the Cam-grinding Operation

Front and rear views of machines arranged for cam grinding are shown in Figs. 11 and 12. The master cams are located at *A*, Fig. 12, there being one master cam for each cam on the shaft. Cam roller *B* is mounted on a fixed shaft and is set opposite first one master cam and then another. The master cams and the camshaft are carried by a member that is free to oscillate; consequently when a master cam is in contact with roller *B*, the camshaft not only rotates but also moves in and out relative to the grinding wheel, so that cams of the required shape are ground.

This operation calls for much attention on the operator's part on account of the irregular shape of the cam. Although the camshaft is rotated at a constant number of revolutions per minute, the peripheral speed and the nature of the contact varies from one part of the cam to another. On this account it is necessary to adapt the wheel to constantly changing conditions. The operator must be especially careful of the finish, which is closely linked up with the surface speed of the work. Careful truing of the wheel with a diamond, in order to make it cylindrical and to make the wheel face smooth, is essential if perfect work is to be produced.

Effect of Wheel Wear on Accuracy of Cams

The effect of wheel wear on the accuracy of the cam being ground is a peculiarity met with in cam grinding. An error will always exist, regardless of the type of machine or the attachment being used, whenever the periphery of the wheel is used in the grinding operation. This error can be reduced to a minimum, but cannot be entirely eliminated, by regulating the swing of the attachment, so that it approaches more nearly the straight line which passes through the center of the camshaft and the center of the wheel.

If a wheel could be made that would not wear away as a result of the grinding action, there would be no change in the product of such a wheel, provided the diameter of the wheel were exactly the same as that of the one used in generating the master cams. It is not possible to make such a wheel, however, and the slightest amount worn from

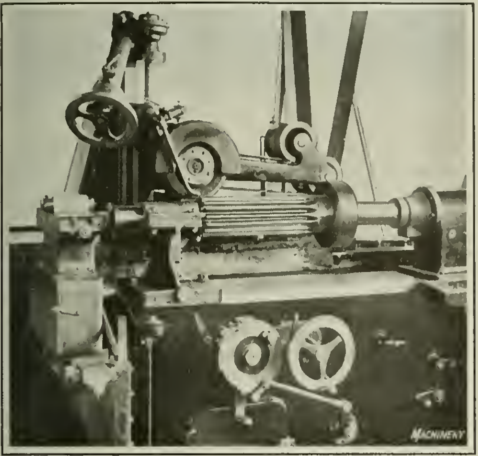


Fig. 13. Gear-tooth Grinding Machine of the Formed-wheel Type

the true theoretical diameter produces a corresponding change in the work. In normal cases with average requirements, the effect of wheel wear does not become evident until one inch or more is worn from the diameter of the wheel, and in many cases the wheel can be reduced as much as four inches in diameter before the error in the cam becomes so great that it will not pass the inspection limits. The foregoing applies to finish-grinding only. When roughing, this error is just as noticeable but is not considered, as finish-grinding is depended upon to correct the error introduced in roughing. For finishing, therefore, a wheel of the proper diameter should always be used, and it should not be allowed to wear to such an extent that the accuracy of the cams will not be within the established limits.

The reason for this peculiarity of cam grinding is obvious. In common types of cam-grinding attachments, the work oscillates in front of the grinding wheel and also revolves about a fixed center. The center holes are concentric with the heel of the cam, while points along the contour and on the toe of the cam are farther away from the center than points on the heel. As the camshaft revolves, the heel of the cam comes in contact with the wheel at a point on the horizontal line drawn from the center of the wheel to the center of the camshaft. Each point on the side of the cam, however, comes in contact with the wheel at a certain distance below this line, and continues in contact with the wheel until it reaches a point the same distance above the line.

It is evident, therefore, that this is quite different from the grinding of cylindrical work, where each point on the periphery of the work revolves at a uniform speed, and immediately recedes from the grinding wheel after having passed the point of contact. As the diameter of the wheel changes, each point on the cam comes in contact with the wheel at a different time, as compared with when the wheel is full size, and furthermore, remains in contact for a shorter or a longer period according to whether the wheel is smaller or larger than the proper size. There are two points that must be considered when finish-grinding is done, if accurate cams are to be produced: The wheels must be soft so that they will cut freely under light pressure, and the work speed must be low, about fifteen or twenty revolutions per minute being the proper speed.

Grinding Operations on Valves

There are usually three and sometimes four grinding operations on a tappet valve. The valve stem is ground in the ordinary type of cylindrical machine, and the valve seat is ground in a special machine or by using an attachment. A typical example illustrating the use of an attachment is shown in Fig. 15. The valve is held at the required angle relative to the wheel, and is revolved by the small belt seen in the illustration. The ends of the stems are ground in various ways, either by surface or disk grinding, or on the face of a cup-wheel, simple fixtures being used to hold the stems. The fourth grinding operation is illustrated in Fig. 16, which shows the valve head being ground by the use of a special attachment. This is not typical of all valve manufacture, but is an added operation performed by many makers.

Methods of Grinding Spur Gears

When the sides of gears are surface-ground, the ordinary type of horizontal spindle rotary surface grinding machine is commonly used. The production, as in all grinding operations in the automotive shops, is rapid. The appearance of the ground surface is pleasing to the eye, because all grinding lines are concentric with the periphery of the gear.

The holes in gears are ground internally, and the wheels ordinarily used for the internal grinding of hardened steel

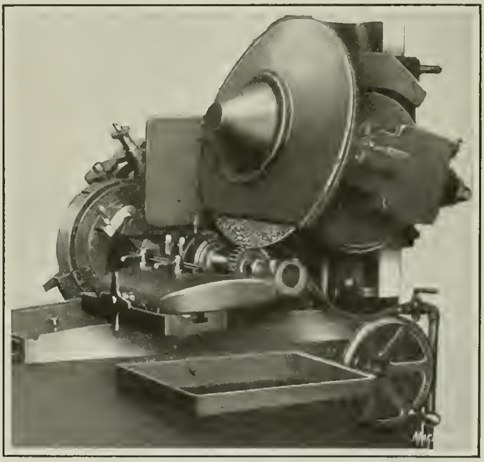


Fig. 14. Gear-tooth Grinding Machine of the Generating Type

give good resuts. If the holes are splined, relatively harder wheels must be used, as otherwise the dressing action of the sharp corners of the spline will cause excessive wheel wear. The larger the number of splines or keyways, the harder the grinding wheel must be to stand up properly.

Gear teeth are sometimes ground to the proper contour after the gears are hardened in order to correct distortions due to heat-treatment, and to obtain accurate tooth forms. This operation requires a special machine. Two general types of machines are used for this purpose, one employing a formed wheel, and the other operating with a generating action. The formed-wheel type of machine, Fig. 13, of the Gear Grinding Machine Co., of Detroit, is so arranged that the grinding wheel is formed to the shape of the gear tooth by means of a diamond held in a truing device, it being possible to obtain any desired shape, depending upon the master form used. The gears are clamped on the machine table and traversed under the wheel, each tooth being ground singly. The number of gears that can be ground at one time depends on their size.

The gear tooth grinder of the Lees-Bradner Co. is a generating type, so designed that the gear rolls bodily past the wheel to obtain the involute tooth profiles. The grinding wheel (see Fig. 14) is set to the pressure angle of the gear, the straight or flat side which does the grinding representing the side of a rack tooth. The combined sliding and rolling action imparted to the work is obtained from a circular segment in conjunction with steel tapes or bands. The segment corresponds to the pitch diameter of the gear to be ground, and is located on the work-spindle. A diamond mounted on a ball socket container, which can be swiveled to any angle, is used to true the face of the grinding wheel. This machine may be used for grinding involute spur gears having pressure angles varying from 14½ to 24 degrees.

Grinding Worm-gears and Spline Shafts

Although there are several grinding operations in making the rear axle (drive shaft, housing, and differential), the grinding of the worm-gears is the only one of special interest. One type of machine used is made by the Reed-Prentice Co. The grinding wheel is mounted at an angle which is governed by the helix angle of the worm thread, and the travel of the work-table is controlled by a cam in the base of the machine. The cam used must correspond with the lead of the worm, the machine being intended for plants where large numbers of duplicate worms are ground. Another cam controls the cross action of the wheel-head for relieving the wheel during the return stroke and advancing it to the cutting position for the grinding stroke. An index device permits the grinding of single- or multiple-thread worms. A formed wheel is used in conjunction with a wheel-forming device. The wheels employed are about the same grade as those used for spline grinding, but the grain size is a little coarser—generally not finer than No. 36.

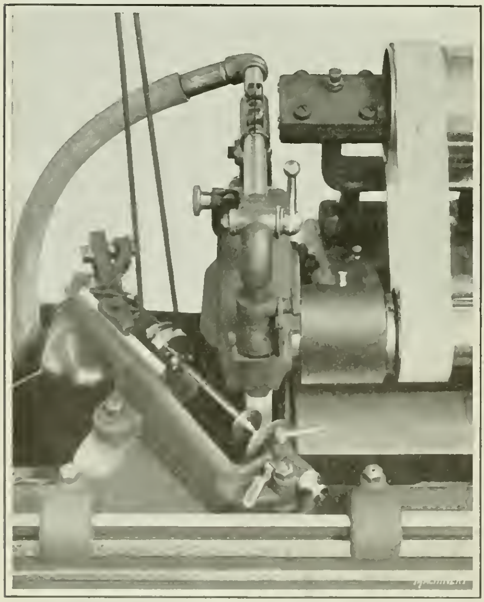


Fig. 15. Attachment for grinding Valve Faces; the Valve is held at the Required Angle and is revolved on Dead Centers

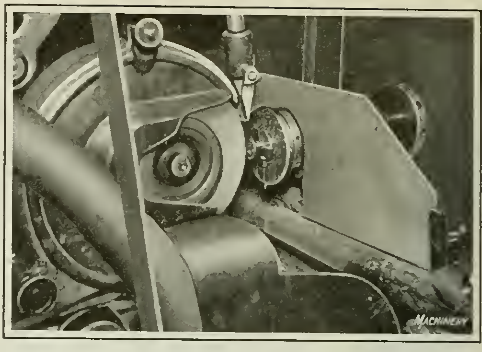


Fig. 16. One Method of grinding Top Surfaces of Valves

The cylindrical grinding operation on spline shafts is no different from that on any of the common pieces ground on a plain cylindrical grinding machine, except that the wheels may have to be somewhat harder to withstand the dressing action caused by the splines. Grinding the splines is a form-grinding operation, the face of the grinding wheel being formed to the correct contour. The multiple-key shaft grinding machine of the Universal Grinding Machine Co. is the type commonly used. The shaft is held in an index work-head, the number of divisions on the dial being determined by the number of keys on the shaft to be ground.

The grinding wheel is formed by two diamonds, one of which forms the periphery and the other the sides. The truing device must necessarily be very accurate. The spline is ground by traversing the shaft back and forth under the wheel, the operation being in reality form surface grinding. The wheel is in contact with the whole contour of the groove between two splines during the grinding, and the corners of the wheel must hold their shape. This operation requires a medium grade aluminous abrasive wheel, the limiting factor being the hardness of the shaft. The grain size is usually about No. 46.

Surface Grinding with Abrasive Disks

Rough surface grinding is finding increased application in the automotive shops, the grinding being done on disk grinders having abrasive disks glued to metal plates. Such parts as pump cases, exhaust connections, gear-cases and covers, cylinder heads, and crankcases are ground in this way. There are two types of machines used, one having a horizontal and the other a vertical spindle. When grinding on horizontal-spindle machines a special work-holder is often used. The part being ground is traversed across the face of the disk, and at the same time is forced against the disk by a hand-lever. This kind of grinding is done dry.

The vertical-spindle machines carry disks as large as 53 inches in diameter, and the parts to be ground are laid on the revolving wheel. When the weight of the work is equal to three or four pounds per square inch of area to be finished, no external pressure is required; but when it is less, weights are laid on the pieces being ground. An exhaust system is provided to remove the dust, the openings being directly beneath the outer edge of the wheel on which a disk is mounted.

Abrasive disks for heavy work such as this are made of artificial abrasives held on canvas or heavy paper backs by means of glue, shellac, or other materials having similar properties. The exact compositions of the binding materials used by the different concerns manufacturing these disks are the result of constant experimental work and are held as trade secrets. The disks are attached to the metal plates by glue, shellac, silicate of soda or a similar material.

Another article on grinding in the automotive industry will be published in the August number.

COMPETITION IN THE FRENCH MACHINE TOOL TRADE

By W. P. MITCHELL *

The French machine tool trade is entering upon a stage of very active competition. French manufacturers have made remarkable progress in machine tool development, and are successfully competing, in point of price, with many lines of American and British machines, and in some cases with German machines as well. For special and high-duty machinery, France must still look abroad, as the comparatively small demand in France for machinery of this type would not warrant the French manufacturers entering these fields.

The drop in the value of the mark, as compared with the franc, has caused German manufacturers to increase their catalogue prices in a marked degree, so that many German-made machines are now higher in price than similar machines of French manufacture. This, of course, is partly due to the fact that German machine tools over 2200 pounds in weight pay a duty of 64 francs per 220 pounds, while similar machines from America and England pay a duty of only 16 francs per 220 pounds.

The average lathe or grinder of German manufacture in the French market is selling in Paris at from 20 to 30 per cent less than the American product of similar type, but the French áre now making machines that sell for from 20 to 30 per cent less than the German machines. Hence French machine tools are prominent in the market at present, although American milling machines and grinding machines are preferred to any French machines, even though the French prices are from 40 to 50 per cent less.

Prices of Machine Tools in France

It is evident that the adverse exchange rates, the French tariff, and the high freight rates are the main causes for the difference in prices of French and American machines. This has aided French builders to capture a very considerable part of their home market. A few comparative prices of American and French machine tools of similar type may prove of interest. A French turret lathe selling at 9500 francs competes with an American lathe selling in Paris at 12,220 francs. A French 40-inch planer with a 10-foot bed is sold for 25,000 francs, while an American 36-inch planer with the same length of bed costs 40,700 francs. A French 4-foot radial drilling machine sells for 25,000 francs, as compared with 38,900 francs for the American product. In general, these comparative prices are for first-class machines in both cases, but French manufacturers have also placed on the market less expensive grades of machine tools of a type that was formerly imported from Germany. The German machine tools at present are priced higher than the French but lower than the American, as already mentioned.

In the following are given additional prices of French machine tools. American manufacturers may make comparisons for themselves with American prices:

14-inch lathe, medium grade	7500 francs
3½-foot radial drilling machine	15,000 francs
15-inch shaper	5000 francs
25-inch shaper	9500 francs
30-inch planer with 6-foot bed	15,000 francs

Prospects for American Machine Tools

Under present economic conditions in France, it does not seem possible to create a better position for American machine tools. The only opportunity that is now apparent is in the case of high-duty machines or special machines that are not being built in France. But American manufacturers in most lines have ever been specialists, pioneers, and improvers, and this will give them strength in the world's markets in all those countries where progress is the watchword; and if France is to hold her own as an industrial country, she must adopt a progressive policy. If France makes proper use of her ore resources and metal industries, no other European country will be able to surpass her in quantity of output.

There is little opportunity of being able to bring American prices in France down to the French level, because it will be a long time before exchange will return to pre-war figures. The French tariff is also a matter to be considered. Manufacturers in all lines in France are asking for further protection. Another possible item in favor of the French manufacturer is the adoption of more efficient production methods. There is continual progress in this respect, which is chiefly manifest in two or three automobile plants. If the eight-hour day law is repealed and there is generally increased production, prices for machinery manufactured in France may come down still further. The same will be the case if the piece-work system is more highly developed. It is true that all of these possibilities are contrary to French routine and tradition, but it might be said that even in France "the old order changeth." In the future, capital in France will have to be content with a smaller return, and the workman will have to be paid more, or living costs will have to come down. A few people in France see this. That is why there is a general transformation of old-time French business methods, or an attempt to make such changes.

French Industrial Fair

The seventeenth industrial fair recently opened in Paris. During the last three years the number of exhibitors has tripled, the number this year being over 4500. Some of the large concerns like the Creuzot and Saint Chamond steel works occupied their own special buildings. This Paris fair (or "Foire de Paris") is destined to become an important part of French industrial life. The exhibitors are either French or of French affiliation. The various metal industries occupied, perhaps, the most important position.

Small electrical tools, drills, brushes, grinders, and polishing machines are now being made in quantities. This equipment is along the general lines of American products. Further development in the manufacture of these small tools depends upon a more general adoption of electricity, and the manufacture of such specialties in France is still in its infancy. Electrical lifting magnets and other elevating and lifting apparatus are being manufactured in France on an increasing scale which is also true of polishing machines of the belt type. It is noted with respect to this latter specialty, as with many others, that the greatest demand is for small tools and other shop equipment (formerly purchased abroad) which may readily be manufactured in small French plants.

One of the most imposing exhibits of heavy machine tools is that of the H. Ernault Co. The exhibit includes engine and turret lathes of large capacity, one lathe having a swing of nearly five feet. A grinding machine made by this firm and having a range of six feet between centers sells for 28,000 francs (about $2500 at the present exchange rate). The Metallurgic Co. of Persan-Beaumont is exhibiting an engine lathe having a swing of 18 centimeters (about 7 inches) and a maximum distance between centers of 1.30 meters (4 feet 3 inches). The price is approximately $650.)

A "Somua" radial drilling machine, capable of boring a hole 7 centimeters in diameter (2¾ inches) sells for 45,000 francs (approximately $4000) delivered in Paris where it is manufactured. The weight of the machine is 11,500 kilograms (25,300 pounds) which an American authority considers inordinately heavy. Another heavy-duty machine of the same make, capable of boring a hole 8.5 centimeters in diameter (3 11/32 inches) sells for approximately $6000. Electrical and autogenous welding machines of French manufacture are appearing in increasing numbers.

A large demand for electrical machinery and accessories is anticipated, following the rapid development of electrical power generation along the Rhone river and the streams of the French Alps and Pyrenees. The southern French railways are planning for extensive electrification within the next five years, and surplus power will be available for industrial enterprises along the route.

Piston Pump Manufacturing Methods

THE double-acting piston pump made by the Goulds Mfg. Co., Seneca Falls, N. Y., which is known by the trade name "Pyramid," consists of a gear-operated cross-head and piston, the stroke of which must be exactly at right angles to the parallel shafts on which the driving gears and pinions are mounted. The cross-head travels on guide-rods extending from holes *A*, Fig. 1, in the main cylinder casting, and the gear and pinion shafts are carried in bearings *B* and *C*, respectively, which are babbitted. The cylinder casting shown is for the 6- by 12-inch pump—the largest size in this style of pump that is manufactured. The piston travels in the brass-lined cylinder bore *D*, and the cylinder head is fitted to surface *E* and carries the stuffing-box. The pitmans are attached to each side of the cross-head, one connecting with a crankpin on an arm of the gear at one side of the pump, and the other with a similar pin in a crank-plate at the opposite side of the pump. The gear and crank-plate are assembled to opposite ends of the driving shaft.

The operations described are those that are performed to establish an even piston stroke at right angles to the gear and pinion shafts. This condition is of vital importance to the satisfactory operation of the pump. After face-milling the base of the casting on a horizontal milling machine, the work is transferred to the machine shown in Fig. 2. This illustration shows two drilling machine units mounted on a common platen, for convenience in machining the cylinder bore, the counterbored surface for fitting the stuffing-box, the guide-rod holes and the cylinder-head bolt holes.

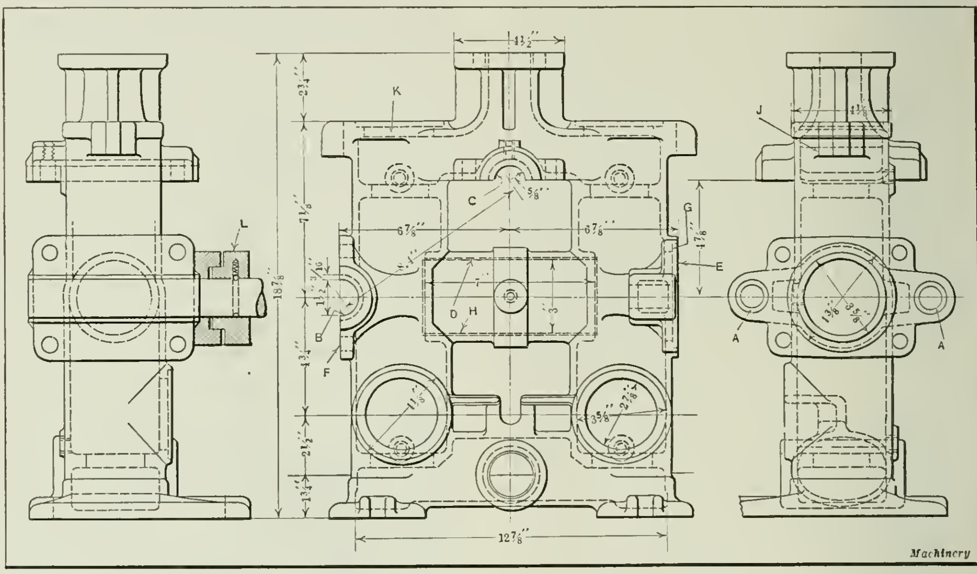


Fig. 1. Detailed Views of Cylinder Casting for Double-acting Pump

Boring and Counterboring Operations

The casting is located on a bridge iron fixture on which it rests on four shims placed under each corner of the rough surface *F*, Fig. 1. Inserted-blade boring heads are used to rough- and finish-bore cylinder *D* and to counterbore *G*. The bars on which these heads are carried are driven by a key in the machine spindle, and are fastened by a hollow-head set-screw, so that they may be quickly replaced. The counterbore has a piloted end that enters the cylinder bore, thus insuring concentricity with the counterbored surface.

Assembling Brass Liner in Cylinder Bore

After counterboring, a No. 16 gage brass liner *H*, Fig. 1, is forced into the cylinder bore. This is assembled by means of a pestle-shaped press arbor *A*, Fig. 2, which has a turned shoulder that seats in the end of the tube, and a shank to enter the machine spindle. The liner is forced into position by the spindle handwheel, after which it is anchored in place by setting over the ends of the liner with a hammer. A special tool having three rolls is used to roll the brass liner snugly against the cylinder bore. This tool is carried in the machine spindle and fed by power. The rolls may be adjusted radially by means of a spindle with a tapered nose, which causes the roll-carriers to expand when the adjusting collar is turned. To contract the rolls, for the smaller diameters of liners, the collar is turned in the opposite direction, and the roll-carriers are forced radially inward by means of springs.

The work is next shifted to the second spindle, where the four bolt holes for the cylinder head and the two guide-rod holes are drilled and reamed, and the guide-rod holes are also counterbored. For this work a jig plate with a cut-out section that straddles the lug *J*, Fig. 1, is employed. The plate is thus located on the casting, and is anchored by a long eyebolt that passes into the casting far enough so that a bar placed in the discharge hole *K* will also pass through the eye of the bolt. As the nut at the plate end of the bolt is tightened, the eyebolt is brought up against this cross-bar and the jig plate secured in place.

Babbitting Fixture

A special fixture is used for babbitting the gear and pinion shaft bearings *B* and *C*, Fig. 1. This fixture is shown in

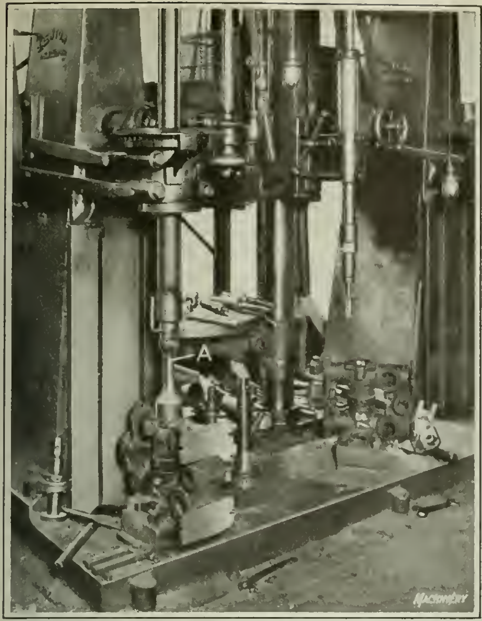


Fig. 2. Drilling Machine on which the Cylinder is bored and the Cylinder Head Bolting Surface machined

place in Fig. 3 with the bearing caps assembled, cardboard packing being used. With this fixture the correct gear center distances are obtained, and the bearings are held parallel with each other and at right angles to the cylinder bore. The side supports of the fixture are T-shaped, and they are attached at the back to a plate by means of which the fixture is fastened to the cylinder-head bolting surface *E*, Fig. 1. It is located by two posts that engage the guide-rod holes at this end of the casting. This plate is shown at *A*, Fig. 3; one of the guide-rod holes used to locate the fixture may also be seen in this illustration.

The side supports or arms have elongated slots by means of which they are bolted to the plate so that they may be placed in the correct position to bring the two arbors central with the cored holes to be babbitted. The center distance of the arbors, which for this size pump is 8.4 inches, is fixed, so that the use of the fixture insures correct relative positions of the gear and pinion shafts. After the caps have been assembled and the fixture has been properly adjusted, the ends of the bearings are closed by special collars. These collars are shown in position on the arbors, and their construction and use is clearly shown in Fig 1 at *L*. There is a pair of collars for each bearing end, one collar of each pair having a spring-snap, which locates it by engagement with a circular groove on the arbor. This collar has a shoulder over which another collar fits so that it may be slid to bear against the end of the bearing. It should be observed that the inner collar is shaped to give the babbitt bearing a built-out surface to receive the hub of the gear or pinion.

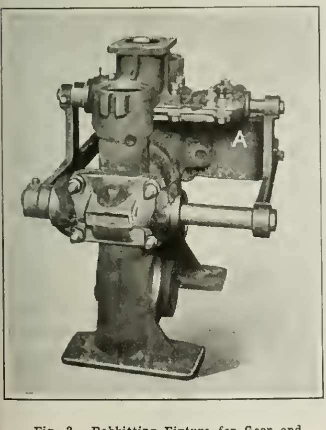


Fig. 3. Babbitting Fixture for Gear and Pinion Shaft Bearings

For luting the joints and for packing in between the slip and loose collars, etc., a composition of ground asbestos and oil is used. This has proved to be more satisfactory as a sealing material than clay, and it is easily prepared and does not harden so as to become unworkable, as is often the case with other luting materials. In the illustration Fig. 3, it will be seen that everything is in readiness for pouring the bearings, including the closing of the joints with the ground asbestos luting material. After the bearings have been poured and the fixture has been removed, no further work is required to obtain the desired relationship of these bearings with the cylinder bore. The amount of machining which is saved, as compared with the use of bronze bearings (when the casting must also be machined) should be readily realized, as well as the accuracy which is obtained.

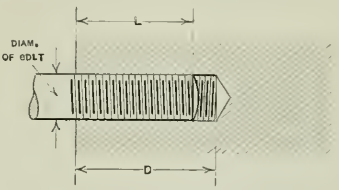
* * *

TAPPED HOLES FOR STUD BOLTS

By A. ERICSEN

There seems to be no established practice or rules for determining the correct depths of tapped holes for stud bolts. To insure satisfactory results, this matter should be given more serious consideration than is usually accorded it by engineers, draftsmen, and shop foremen. The accompanying table was prepared by the writer and gives a factor of safety that has proved satisfactory. This table has been used to advantage in making lay-outs, and has been adopted as standard practice in several engineering departments. It is suitable for use in all machine design work, and can be safely employed for high-pressure fittings with standard threads.

TABLE OF THREAD LENGTHS AND TAPPED HOLE DEPTHS*



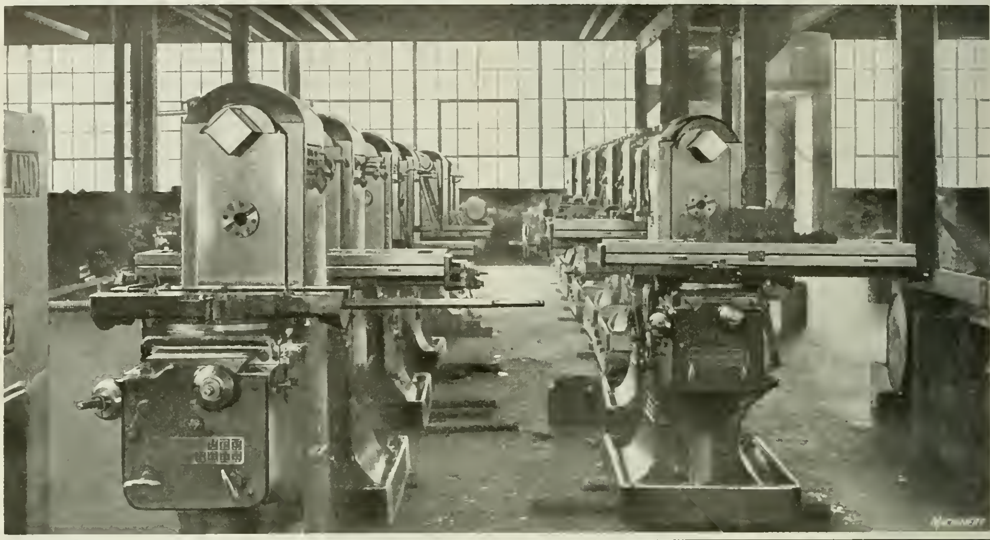
Diameter of Bolt	Cast Steel		Cast Iron		Diameter of Bolt	Cast Steel		Cast Iron	
	L	D	L	D		L	D	L	D
⅛	¼	⅜	¼	⅜	1⅝	2⅛	2⅝	2½	3
¼	⅜	½	⅜	½	1¾	2¼	2¾	2⅝	3⅛
⅜	½	⅝	⅝	¾	1⅞	2⅜	2⅞	2⅞	3⅜
½	⅝	¾	¾	⅞	2	2½	3¼	3	3¾
⅝	⅞	1⅛	1	1¼	2⅛	2¾	3½	3¼	4
¾	1	1¼	1⅛	1⅜	2¼	2⅞	3⅝	3⅜	4⅛
⅞	1⅛	1⅜	1⅜	1⅝	2⅜	3	3¾	3⅝	4⅜
1	1¼	1½	1½	1¾	2½	3⅛	3⅞	3¾	4½
1⅛	1½	2	1¾	2¼	2⅝	3⅜	4⅛	4	4¾
1¼	1⅝	2⅛	1⅞	2⅜	2¾	3½	4¼	4⅛	4⅞
1⅜	1¾	2¼	2⅛	2⅝	2⅞	3⅝	4⅜	4⅜	5⅛
1½	1⅞	2⅜	2¼	2¾	3	3¾	4½	4½	5¼

Machinery

*For wrought iron and cast bronze, use values given for cast steel, and for aluminum and brass, use those given for cast iron.

Broken taps and stripped threads result from incorrectly specified tapped hole depths. For instance, if a ¼-inch stud hole is tapped 1 inch deep or more, it simply means that time is wasted and unnecessary expense involved. When holes for stud bolts are drilled and tapped to a greater depth than necessary, it follows that either a large cavity will be left under the stud bolt, or the threaded part of the bolt will be greater than is required to insure the full holding power.

Aligning and Inspecting Milling Machines



> The accuracy required in the manufacture, assembly, and inspection of high-grade machine tools is generally appreciated. To attain the necessary degree of accuracy, great care must, of course, be taken in the final assembling and fitting operations. The practice outlined in this article is that adopted by the Clark-Mesker Co., Cleveland, Ohio, in building the Cleveland milling machine. The article deals with the final aligning methods and the inspection of this machine.

THE methods employed in the final alignment and inspection of the Cleveland milling machine are described in the following. This machine consists of four main castings—the column to which the knee is accurately fitted; the knee, which carries the saddle, scraped and gibbed to a tongue and groove fit; the saddle (either plain or universal), in the scraped groove of which the table has its bearing; and the table. In establishing a working surface for the table that is level and parallel with the horizontal center line of the spindle and over-arm, as well as at right angles to the vertical bearing on the column, each fitted surface must be held within very close limits of accuracy.

Fitting the Column and Knee

The columns of the machines (and in fact, all castings on which considerable machining is performed) are first planed to produce a suitable surface from which to locate the castings in a fixture, in which position they are not only completely planed, but also bored. The bronze bushings for the gear shafts and main spindle bearings are assembled before the columns are delivered to the assembling floor. The first attention that is given to these castings is to inspect thoroughly the oil troughs and passages for the free flow of oil. This is of paramount importance, because the splash oil system is used in this milling machine. The inside walls of the castings are then scoured and cleaned to remove all molding sand, and a coat of binding material, such as shellac, is applied to these surfaces. The knee castings are subjected to practically the same treatment as the column before any fitting of these two units is done.

The machined castings are left lying on the floor to become seasoned, so that when the bearing surfaces are subsequently scraped in, a permanent set of the fitted bearings will be obtained. The columns are blocked up in the manner indicated in Fig. 1, and the long vertical knee tongue bearing scraped to a master jig. The illustration shows one of these jigs in position on a column and another of similar design resting on the wooden horses at the right. In this operation, the top of the tongue is not scraped, because this surface is not a fitting surface, and between it and the knee groove there is a clearance of from 0.003 to 0.005 inch. The groove of this jig is slightly wider than the tongue on the column so that the jig may be pushed over to form a bearing on one side while scraping, and then to the other side.

In order to maintain parallelism of the scraped surfaces on both sides of the tongue, an adjustable gage consisting of two angular blocks is used. This gage is shown lying on the bearing surface of the second column, from which it will be seen that the two blocks may be set as required by the width of the tongue and that the angular and horizontal surfaces of the blocks are parallel. In rubbing down the surfaces to determine whether there are any high spots, a coating of red lead is applied.

The tongue of the knee casting on which the saddle of the machine has its bearing is scraped to a master jig in the manner just described. This tongue may be seen in Fig. 3 at *A*, but this illustration does not show the scraping operation. The knee is next scraped to the column bearing, a special overhanging angle-plate type fixture being employed by this operation. The fixture is attached to the saddle bearing of the knee as indicated in Fig. 2. This angle-type fixture consists of two cast-iron plates *A* and *B*, set at right angles on a grooved bear-

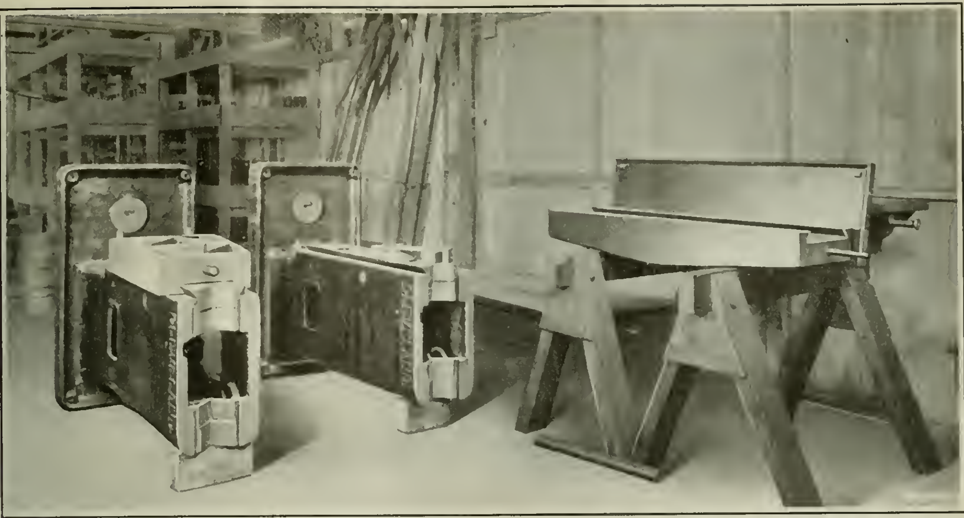


Fig. 1. Milling Machine Columns blocked up in Readiness for Scraping

ing by means of which the fixture is secured to the saddle tongue. It extends twice the ordinary length of the usable part of the column bearing, so that in using an indicator at the extremity of the plates to test the relationship of the saddle bearing and the knee bearing on the column, a greater degree of accuracy can be obtained than if the plates were not thus extended.

In fitting these two castings it is required that the saddle bearing be perpendicular with the column bearing of the knee within a limit of 0.001 inch, and in checking this relationship an angular block carrying a Starrett dial indicator is used. The horizontal plate *B* of the angle fixture has its vertical side accurately scraped and adjusted to be parallel with the tongue on the column. The vertical plate *A* has its under side made parallel with the flat bearing surface of the column. In using the indicator, these surfaces are employed to check the alignment at one side of the column only, as shown in the illustration. When the desired condition has been obtained, a taper gib is fitted between the column tongue and knee groove at the opposite side. If this operation in carefully done and the knee is kept bearing against the tongue of the column at one side, the gib may be fitted with the assurance that the required limit between the saddle bearing on the knee and the column bearing is obtained. The close limits specified in fitting the knee to the column are of vital importance to the perfect alignment of all parts supported on the knee with the machine spindle.

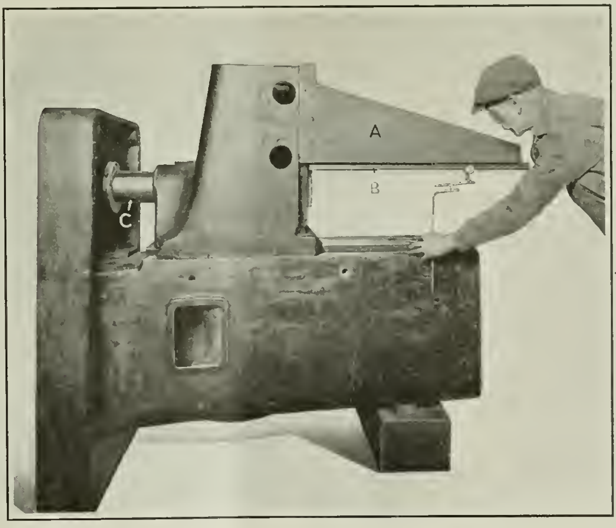


Fig. 2. Fixture for inspecting Assembled Column and Knee

The final operation in fitting the knee is scraping the under side of the flange on the knee guide post *C*, to form an even bearing on the faced boss in the base of the column to which this flange is bolted. This also is an important operation, because the elevating screw for the knee passes through a nut assembled in this post, and it is vital that no cramming of this elevating screw occur. The guide post is then bolted in place.

Fitting the Spindle and Over-arm Bearings

With the column set upright, the spindle bearings and over-arm bearings in the column are aligned relative to the saddle bearings of the knee. The method of testing the relationship of these bearings is illustrated in Fig. 3. The spindle of the machine runs in taper bearings, one at the front and one at the rear of the column. These bearings are scraped to alignment and parallel with the knee, Prussian blue being used in this operation to detect the high spots. A long test bar is then placed in the spindle bearings and a sliding block and dial indicator are used in the manner illustrated, on the left-hand side of the tongue. The allowable limit of parallelism between the spindle bearings and the knee bearings is 0.001 inch.

The planed V-bearings in which the square-section over-arm of the machine is fitted are then scraped to parallelism with the spindle bearings. The equipment used for testing the accuracy of these operations is also illustrated in Fig. 3. The over-arm is

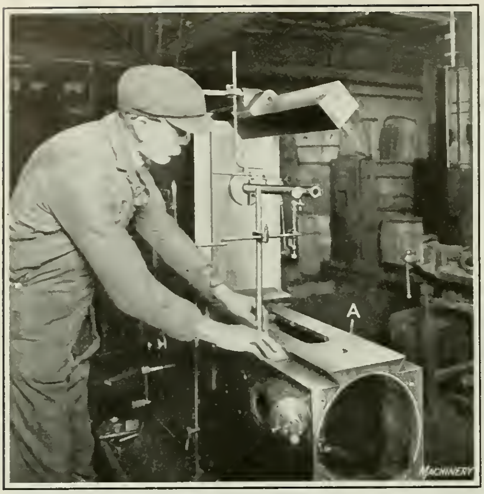


Fig. 3. Test Bar and Indicators used in testing the Spindle Bearings and the Over-arm Bearings in Relation to the Knee Bearings

placed in position and on its top surface an angular slide is seated to which the indicator arm is attached. The same limit of accuracy is maintained on this operation as is required in assembling the spindle bearings, that is, 0.001 inch. It will be understood that this angular slide is moved back and forth on the over-arm with the indicator point in contact with the test bar, before the over-arm cap is assembled. Assembling the cap is the next operation, the only requirement in this case being that the over-arm shall slide freely.

Fitting the Saddle and Table

The machine may be equipped either with a plain or a universal table. In scraping the saddle of the plain milling machine, the top and bottom surfaces are scraped parallel on the bench, a Brown & Sharpe surface plate and red lead being used. The table is next scraped to its bearings in the saddle, an adjustable gage of the type illustrated in Fig. 1 being used to maintain parallelism, and the taper gib is then fitted in place. This work is all performed on the bench.

The left-hand side of the tongue and groove by which the saddle and knee are fitted, is then scraped to a bearing and the tapered gib *A*, Fig. 4, fitted on the right-hand side as shown. In inspecting the accuracy of the fitted bearing of the saddle and knee, the long table furnishes a surface from which the spindle bearings are tested. The gib has been temporarily fitted only, so that in squaring up the table and saddle with the spindle bearings, the saddle may be readily removed as required to correct any inaccuracies that may have been detected in this test.

A long sweep or arm on the test bar in the spindle carries the indicator which is swung from one end to the other of the table, the indicator bearing on the rear vertical planed surface. The table is 50 inches long, and the parallelism between the knee bearings for the saddle and the spindle is thus inspected and held to a limit of 0.002 inch in a length of 50 inches. Since the table surface is planed at the same setting as the saddle bearing surfaces underneath the table, it is possible to use this surface to indicate from without danger of errors due to inaccuracies in machining.

It may be interesting to note that the table castings are seasoned in the open for several months before being machined. They are then rough-planed all over and allowed to set in this semi-finished condition until it is necessary to finish up a quantity to fill an order. As the thoroughly seasoned castings have several surfaces machined at one time by the use of multiple tools, set to a master gage so that the relation between all the surfaces is kept uniform, a high degree of accuracy is obtained.

When the milling machine is to be equipped with a universal saddle (see the heading illustration) in which the table rotates on a swivel, the swivel is first graduated and the zero graduation marked on the universal saddle after the assembled saddle and table have been first set square with the spindle bearings. In setting the saddle and table of a universal milling machine, equipment similar to that illustrated in Fig. 4 is employed, which was described in connection with the scraping-in of the saddle bearings for a plain machine.

Boring Over-arm Pendants—Gear Testing

The over-arm pendant, which supports the cutter-arbor, is bored for the outboard support of the arbor with the set-up illustrated in Fig. 5. The boring-bar *A* is of the fly-cutter type, and is carried in the regular spindle bearings. The over-arm is fed to the cutter by a hand-operated device which is attached to the column of the machine in the manner indicated. This assures absolute parallelism between the arbor support and the spindle bearing.

The speed gears, which are of the sliding type and controlled by an automobile shift lever handle, are carried in the column of the machine, and the feed gears are located in a box at the front of the knee. Both sets are inspected for backlash and running qualities by means of a master gage which is a replica of the gears used in the particular train being tested. The gage illustrated in Fig. 6 is for testing the speed gears. It is used by simply placing the various gears on their respective shafts, which rest in open bearings on the master gage, and revolving them by hand. By this simple but effective means the action of the entire gear train can be clearly observed.

Running-in Test and Final Inspection

After the machine has been completely assembled and is ready for operation, it is given a running-in test at all speeds without load. During this trial run the inspector is required to make observations of every part of the machine that it is possible for him to inspect, and enter a notation opposite every question on a special report sheet. For example, in inspecting the column he must report, among other things, on the following items: Supply of oil in the column; adjustment of starting friction clutch; operation of gear-shifting bars by means of the ball lever, sockets, etc.; operation of the speed reverse mechanism; alignment of the

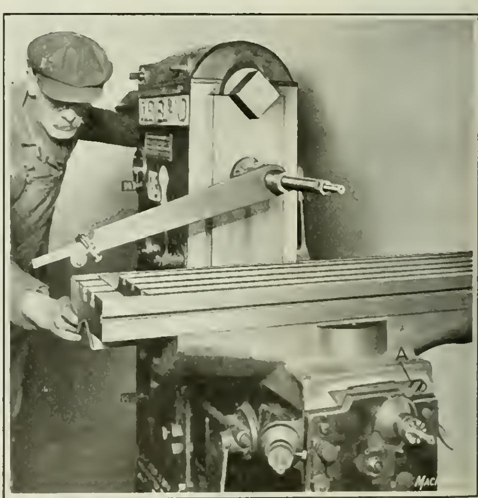


Fig. 4. Arm and Indicator used in squaring up the Table with the Spindle

spindle hole by means of a taper gage (here the diameter and taper of the spindle bearings must be noted); and amount spindle runs out at the mouth and at the end of a 15-inch test bar.

The inspector must also note whether or not the spindle bearings become overheated after a run of thirty minutes and must state if the machine has been run five minutes on each speed. The quiet running qualities of the gears when running idle and when under load must be stated on this report, as well as the correct rotative speed for the driving pulley. There must be no leakage of oil at any place in the column and the cutter lubricant pipes and valves must be a good fit at the joints. A tolerance of 0.002 inch is allowable in lining up the hole in the pendant for the arbor support with the center of the spindle. The distance the spindle nose extends beyond the face of the column must not be more than 0.032 inch under the nominal length. The inspector must furnish a definite answer concerning both these details and he must also check the diameter of the spindle nose to within limits of plus 0.000 and minus 0.0005 inch. The points mentioned only partly cover the complete questionnaire which has to be filled out by the inspector for every machine built.

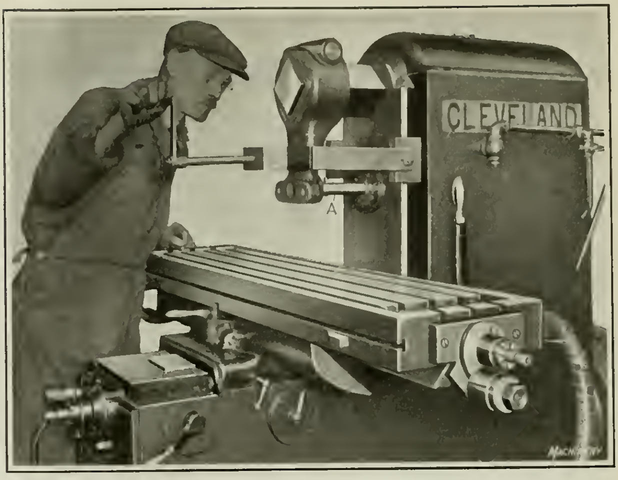


Fig. 5. Boring the Arbor Support Hole in the Over-arm Pendant

Inspection of Knee, Saddle, and Table

A few of the questions contained in the inspector's report relative to the knee, saddle, and table are:

Is knee gib adjusted properly?

Does knee operate smoothly and at uniform resistance throughout its full travel?

Is saddle gib properly adjusted?

Does saddle operate smoothly and with uniform resistance throughout its travel?

Does cross-feed screw work smoothly and with uniform resistance throughout its travel?

Have graduations on saddle been correctly stamped?

Does table screw handwheel run true?

Does table quick-return bracket work smoothly?

Are slots in table correct to gage?

A similar set of questions pertains to the gearing and operation of the gears in the feed-box, and each of these questions must be answered in full. The following details regarding alignment should receive the inspector's attention, and where deviation from true alignment is noted, the amount of this deviation must be reported, as, for example, when testing the alignment of the spindle with the top of the ways on the knee, with the side of the ways on the knee, with the top of the over-arm, and with the side of the over-arm, on each of which there is a limit of 0.002 inch. In inspecting the top of the knee relative to the face of the column and to the ways of the column, the amount of error in 15 inches width must be noted. Similarly, the top of the table must be checked for parallelism with the top of the knee, and the variation in a length of 24 inches entered on the report. For checking the top of the table relative to the spindle and the T-slots of the table relative to the spindle, diagrammatic sketches are contained on the report so that the corner of the table which is high or low may be indicated.

Horsepower Tests

The inspector must further report the range of hand and power feeds for the longitudinal, cross, and vertical feeds for the table. All data regarding horsepower tests, both with and without load, such as the spindle revolutions per minute, kilowatts, voltage, and horsepower transmitted must be furnished. When working under load, a description of the material used in the test is required, as well as the cutter diameter, amount of stock removed, feed in inches per minute, speed of cutter in feet per minute, etc.

After the machine has passed these exhaustive tests and before it is ready for crating, special care must be given by the inspector to the tools and attachments to be included in the consignment, and the condition of these, as well as the provision for attaching them to the machine, must be noted. The entire list should be carefully checked with the shipping list and any deficiencies or improper parts reported. The machine is tested for appearance, with respect to painting, polishing, condition of screw-heads and nuts, and the rustproofing of parts so treated. Final provision is made on the report for the inspectors to furnish a summarized statement or to make notes regarding special points not fully covered in the report form. The inspector then signs and dates the reports, and these form a complete reference in case any question relative to the operation of the machine should be raised after it has been put into regular use.

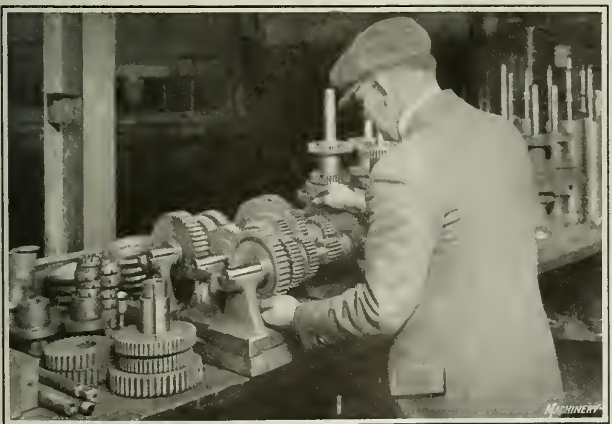


Fig. 6. Master Gage for testing the Running Qualities of the Speed Gear Train

Opportunities in the Machine Tool Industry

By FRED A. GEIER, President, Cincinnati Milling Machine Co., Cincinnati, Ohio

WHAT are the opportunities in the machine tool industry for young men about to choose their life work? This question is debated in the mind of many a young man today, and naturally so, because of the depression through which the machine tool industry has passed.

The main point that should be considered is the fact that the machine tool industry is the foundation upon which all other machine-building industries are built. It may have periodic depressions, but it also has periods of prosperity, and even during the depressions the men who have made a place for themselves in this industry as capable engineers or shop executives have retained their place. At the present moment some of the large firms in the field are looking for capable designers; and except for the unusual but somewhat uncertain opportunities that may be offered by some industry that has a sudden boom when it first looms up on the industrial horizon, it is doubtful if any other engineering industry offers a better field for earnest efforts, initiative, and ability than the machine tool industry.

The Type of Man who will Succeed

The conditions created by the war had a far-reaching effect upon men's minds. The tendency toward less seriousness of purpose is apparent everywhere, and the young men just starting life have been especially affected. The ease with which some fortunes were made during the war, either through pure speculation or through advantage being taken of the abnormal demand for goods of all kinds, created an impression that it will take many years to eradicate. Many seem to believe that it is possible to obtain a comfortable living, and even wealth, without a great deal of effort. The desire for pleasure and entertainment is greater than ever. The spare time of the younger generation is spent almost exclusively in the pursuit of pleasure, rather than in preparing for greater responsibilities in a successful business or engineering career. There is much less inclination to devote spare hours to study than in the years preceding the war, and the tendency to avoid serious effort is marked.

These tendencies of the times, however, create even greater opportunities for those whose minds are capable of serious endeavor, because there is actually less competition for the important places in the industrial field. The man who applies himself with earnest effort to his work stands out more definitely and will gain recognition more easily than in past years when such effort was more general. But it must be remembered that in the years to come, the ease of the war period will cease, and no success can be earned without hard and persistent work, any more than it could be attained without effort and application previous to the war. To the young man with a serious purpose, the machine tool industry offers at the present time an opportunity for usefulness and development at fair compensation.

Stability the Keynote in the Machine Tool Field

After all, the machine tool industry is one of the most stable of industries. Taking the established concerns in this field, the number of failures over a period of years has been exceedingly small. But it is not a "get-rich-quick" industry. It is not a speculative industry like the oil and mining business. There are no opportunities for gambling chances, but the young man choosing his life career should remember that for one gusher that may give wealth and easy riches, there are a hundred dry oil wells. For one lead of ore that furnishes profits to the mine operator, there are a hundred dead leads. There is an uncertainty that is not present in the machine industry. The speculative fields offer opportunities for a few men who are lucky. The stable industries—like the machine tool industry—offer steady employment with fair compensation to those who make good, and they need not take the gambling chances that are taken by those who look for "get-rich-quick" opportunities. In addition, the man engaged in the machine tool industry has the satisfaction of feeling that his work is necessary and useful to the world, because this industry is the basis upon which the entire civilization is built in a machine-made world like ours.

This satisfaction can never become part of the life of the speculator or the man engaged in enterprises the main purposes of which are to provide profits for the promotors. Even when these enterprises are not entirely dishonest in purpose, they are frequently entirely useless as far as the world at large is concerned, and are often intended to serve no other purpose than to provide an easy living for those who are able to influence the minds and pocketbooks of credulous investors and buyers.

The machine tool industry, on the other hand, is based on the one fundamental fact that it receives nothing except for value delivered. It must make good from month to month and from year to year. It must continue to produce machinery and appliances that will save money in production in other shops, and it can be based on no other qualities than honesty, integrity, and initiative.

The Needs of the Machine Tool Industry

Because of the purpose and position of the machine tool industry in the industrial structure, it constantly needs young men of a serious frame of mind, determination, ability, and progressive ideas. It is an industry that can never stand still. It therefore offers unusual and constant opportunities for the development of new ideas, and it places no limitations on the display of initiative.

We have just begun to develop machine tools along high productive lines. Only a few of the machine-building industries are as yet using machine tools to the best advantage, but as other industries become more and more specialized, the demand for machine tools that will produce more rapidly and more accurately will increase. In spite of the tremendous advance that has been made in machine tool design and construction during the last twenty or thirty years, perfection has by no means been reached in present designs. The years to come will doubtless see a great improvement in the capacity of machine tools. To carry this work forward, men are needed who have imagination coupled with a serious purpose. They must be able to conceive of new ideas; they must have the ability to do research work and to determine by experiments and analyses the lines along which the development of machine tool design must be carried on in the future.

The places of those men who are now the leaders in the field and who have brought the machine tool industry to its present point of development must be taken by a younger generation with new ideas and new enthusiasms. For men of the right type the machine tool industry offers an opportunity for a steady, honest, and useful life-work, with the satisfaction that comes from having filled a needed place in the world. As the industry grows and develops, the opportunities for greater usefulness and greater success will also grow.

Opportunities in the Machine Tool Industry

By J. B. DOAN, President, American Tool Works Co., Cincinnati, Ohio

THE question has been asked whether I consider the machine tool industry a worth-while field for young men to enter. Does it offer an opportunity to young men about to choose their life work?

To one who has been engaged in this industry for thirty years, this seems at first thought almost an unnecessary question, because there can be only one answer. But on further thought it will be realized that it is a natural question for a young man to ask, because if he has seen the industry only in the present depression, he may hesitate to become identified with it, even though his inclinations and abilities would fit him unusually well for this field. It is a peculiar trait of human nature to think, during a period of prosperity, that prosperous conditions will last forever; and on the other hand, in times of depression, it is natural to believe that business will remain in that state forever. In view of this, a few words from one who has been identified with the machine tool industry for many years may be helpful to younger men.

Fluctuations in the Industry

Practically every business has its high spots and low spots. This fluctuating condition is more pronounced in those industries whose products are not quickly consumed, and it is well known that machine tools have a comparatively long life—longer in fact than they should have for really economical production. Hence, the fluctuations are greater than in a business where the product is such that it is consumed practically as soon as it is produced, like agricultural products and clothing. As a general rule, the further an industry is removed from the ultimate consumer, the more marked are its fluctuations, and the building of machine tools being the basic industry—the beginning, so to speak, of all production in the manufacturing field—is therefore subject to more marked periods of prosperity and more definite and prolonged depressions than most other lines of manufacturing activity.

Constant Development in the Mechanical Field Requires Machine Tool Equipment

Anybody who knows anything about mechanics and mechanical devices realizes that they are becoming more and more an essential part of civilization; and they will probably become even more a part of everyday life in the future. New mechanical devices are constantly being developed to perform manufacturing operations formerly done by hand; to provide pleasure and entertainment, like the automobile, the phonograph, and the radio telephone; or for greater convenience like the many electrical devices for household use which have been placed on the market during the last few years. Machine tools are required for making all these devices. The future of the machine tool industry therefore is assured, because the demand for machine tools is as fundamental as the demand for agricultural products, clothing, or any of the prime necessities of life. The only difference is that the demands for the latter are constant, whereas the demand for machine tools is fluctuating.

The Need for High-grade Men in the Machine Tool Industry

The machine tool business is a difficult one. It requires a high grade of mechanical, executive, and business ability, and the men holding responsible positions in it must be capable of looking forward into the future. Because of the extremely high cost of designs, drawings, patterns, jigs, fixtures, time studies, etc., mistakes are very costly. This industry, therefore, requires the best type of brains—a type which should be well paid.

Both on the commercial side and on the engineering side the requirements are high. Men are needed who are capable of designing correctly the kind of machines for which there is a demand, and which will perform and produce in the customers' shops in such a way that a future demand is assured. Men are also required who are capable of manufacturing these machines in an economical manner, so that they can be sold at a price that will return a large enough profit for accumulating a sufficient surplus in good business years to tide the industry over the dull periods. This field also requires the highest type of selling ability, so that a properly designed and economically manufactured product may be sold in sufficient quantities to produce sufficient returns. All this requires a type of brains that can demand a satisfactory return for services rendered.

Service of this Industry to Other Industries

The abilities of the men engaged in the machine tool industry must also be such as to counteract the influences that are tending to break down the high standards of the industry in times of depression. At present the machine tool industry is passing through a discouraging period, because purchasers, instead of encouraging the development of better machines by being willing to pay a fair price, are doing just the opposite, and by attempting to beat down the price are hampering the development of better and more productive machines.

If this policy were pursued for a sufficient length of time, it would bankrupt the entire machine tool industry, and the principal sufferers in the long run would be the users of machine tools who must have them in order to produce economically and in sufficient quantities the goods which they sell. It requires great ability to counteract these influences that are tending—unintentional though it may be—to wreck the industry. Buyers of machine tools must be informed of the truth of the situation in such a manner that they are able to see that the welfare of the industries in which they themselves are engaged depends upon the welfare of the machine tool industry. To carry on this work among machine tool buyers requires a type of man of unusual abilities who must be well paid.

To sum up the whole situation, the machine tool industry unquestionably offers inducements to young men who have the proper qualifications. Because of the many difficult problems that confront this industry, there is plenty of room in it for men who have foresight, courage, stamina, and integrity. This type of man, in whatever industry he is engaged, must be well paid, and because the opportunities to display ability are greater in the machine tool industry than in many other fields, the possibilities for success are also greater. Gradually the industry is becoming more and more aware of the fact that, with proper management, it can bridge over the periods of depression by foresight and conservative action during the prosperous years. The machine tool industry should be judged, not by its periodic booms and depressions, but by its constant development and progress over a long period of years. The development of the machine tool industry in the United States during the last thirty years is proof of the possibilities, the stability, the usefulness and the permanency of this industry.

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HOOVER ON COOPERATION

In his address before the executives and secretaries of trade associations at the recent Washington conference, Secretary Hoover referred to the cooperation of his Department with several organizations that have appointed special committees to give "direction and strategy to the agencies of the Department of Commerce abroad on behalf of the whole industry," thereby facilitating closer cooperation between the Department and the automobile and rubber industries, as well as others.

Secretary Hoover is not trying to force this kind of cooperation upon the industries. He is offering a service that has never yet been performed by our Government, although before the war similar services were rendered by the German Government to its manufacturers, which helped the wonderful extension of their foreign trade—that in machine tools alone having increased over 1000 per cent between 1904 and 1914. Cooperation cannot be effected by one party to the effort alone, and American manufacturers who are interested in foreign trade must show their active interest in this work, or it will amount to little.

The machine tool building industries represented in the Department of Commerce by the Industrial Machinery Division have not formed a special committee to cooperate, although apparently it would be of considerable advantage to them, and especially to those engaged in the metal-working machinery field. The larger manufacturers may be able, through special representatives, to investigate foreign markets sufficiently for their needs, but the great number of small manufacturers in the metal-working machinery field cannot afford to undertake such work, nor to maintain an information service that keeps them in touch with foreign developments affecting them.

If the smaller manufacturers are to be kept informed about the possibilities in foreign markets, a cooperative arrangement with the Department of Commerce is of great importance. A special committee to keep in close touch with the Department, and especially with the Industrial Machinery Division can greatly help the latter in its work, by pointing out specifically the lines of inquiry along which the Department can be of the greatest service. Several of the leading trade associations and societies in the mechanical engineering fields, such as the National Machine Tool Builders' Association and the American Society of Mechanical Engineers, might well unite in forming such a committee, the members from the latter society representing manufacturers of industrial machinery and equipment other than machine tools. This effort should especially appeal to all manufacturers who are interested in exports, and the mounting values of foreign exchange mark the present as the time when such an effort should be initiated.

* * *

BUILDING UP GOOD WILL

Good will is worth millions to many great enterprises, and is a substantial part of the assets of many small ones. This factor of value is based almost entirely upon the confidence of the buyer in the manufacturer or dealer, and every machine tool builder knows well that the closing of a sale is often only the beginning of his relations with the buyer. The machine sold must make good in the customer's shop. It must prove to be the kind of machine best suited for his work, and if it develops unexpected defects, the seller must make good or lose the buyer's confidence.

In building up good will in the machinery field no factor is more important than the suitability of the machine to the customer's needs. If it is too heavy or too light, or in any other way unfitted for the work it was bought for, it is a poor sale and the manufacturer may eventually lose more than his profit, because the customer will soon learn that he made a mistake which he could have avoided if the seller had cared to give him honest advice as to the kind of equipment best suited to his needs.

The truisms mentioned above apply also to a variety of products. The manufacturer of leather belting, who is familiar with the conditions under which his product is to be used, can give advice that will save his customer money. If the manufacturer of gearing is familiar with the kind of service the gears are required to render, he may be able to advise his customer on a selection of gears that will be better for the work than those the buyer originally intended to get. Sometimes for this reason the sale may be smaller and the profits less; but the profit chargeable to good will cannot be estimated in dollars and cents, for the customer who has been given honest advice will return with more business. Some far-sighted manufacturers refuse to make sales of their product for uses in which they are unlikely to make good.

* * *

THE VALUE OF APPRENTICESHIPS

What are the chances of success for the boy who completes a regular apprenticeship, as compared with one who simply goes to work in a shop as an operator and expects to pick up some knowledge of the trade while earning a regular operator's wage? Voluminous statistics would be necessary to answer this question accurately; but the experience in a few plants where records have been kept of apprentices shows the great value of systematic training in shop work. In a comparatively small shop in Michigan, the proprietor made it a rule to take in a certain number of apprentices every year. He put them through a rather strenuous course of training and many of the boys dropped out, partly because the work was hard and partly because they could earn more as machine operators in other shops; but the success of those who completed their apprentice course proved that they did not pay too high a price for their training. All but one of those who finished their apprenticeships of four years are today either superintendents or foremen, and five of them own their own shops.

Another manufacturer states that about 50 per cent of the apprentices taken into his plant completed their apprenticeship, and of those who did so the majority are today either superintendents or foremen, or hold other positions of responsibility. A Cleveland machine tool manufacturer who has maintained an apprenticeship system for forty years, has kept a record of those who have learned their trade in his shop, and the list includes several well-known manufacturers and shop superintendents, as well as a large number of successful salesmen and foremen.

The National Metal Trades Association is working successfully to interest its members in a systematic plan for establishing apprenticeships which doubtless will prove of practical value, both to the young men who take up this training and to the industry generally. This plan should have the support of all manufacturers.

Selling Machine Tools by Demonstration

By OGDEN R. ADAMS, Rochester, N. Y.

DURING the past a great deal of effort has been made to sell machine tools by letters, catalogues, and circular matter, but little or no attempt has been made to demonstrate to the prospective customer what can actually be done with the machine tools on the market. The only way in which a customer can be thoroughly convinced as to the superior qualities of a machine is by an actual demonstration of its work. This sales method has been almost entirely neglected in the United States.

The entire mechanical field has been advancing rapidly during the last few years, and the machine tool manufacturer, representing a basic industry, has had to step lively in order to keep ahead of the procession. He has been able to do this, however, and there are a great many machines on the market today that are far superior to those that were available, say, ten years ago—or even five years ago. In consequence of this, hundreds of men who have been running shops that were well equipped with modern machines several years ago, and who have settled down to what they consider to be approved methods of production, are not familiar with the improved types of machines which the machine tool manufacturers have placed on the market during the last few years. These new machines in some cases are improvements on former types; in other cases they have been developed from the ground up, representing entirely original ideas, and are placed on the market as competitors of other types of machines that were formerly used for doing the same kind of work.

Modern Method of showing, by Actual Demonstration, what Results can be obtained from Different Types of Machine Tools

The Value of Dealers' Demonstrations of Machine Tools

A few years ago I conceived the idea of inviting the manufacturers from various parts of the country to my showrooms in Rochester in order to give them an opportunity to see newly developed machines, operated by expert demonstrators, performing actual work. My experience has taught me that this method is a valuable one, and that by following some such practice it is possible to create a great deal of interest, not only among the local and nearby manufacturers but among their employes as well. These men have gone to considerable trouble to come to the annual demonstrations, which now seem to take the form of an annual reunion of the men. Some come in intending to stay a few minutes only, but when they see the value of the demonstration, they remain for hours. This bringing together of men from different factories also gives them an opportunity to exchange views and ideas along mechanical lines, which in many cases has proved mutually helpful.

General Principles of Machine Tool Demonstrations

When a machine tool demonstration is arranged for in the show-rooms of a machine tool dealer, it should be planned with considerable care. Experienced mechanical men do not wish to see a standard machine tool being operated. It is of no particular interest to them to see an ordinary lathe producing an ordinary chip. What they wish to learn is how rapidly good work can be produced on different types of machine tools or how accurately work can be produced by an average operator. They want to know about the newest types of machines for producing work of a certain quality in the quickest possible time. They are interested in the safety devices for the protection of the operator, and in all kinds of improvements in design for the rapid and convenient handling of work. Furthermore, they are interested in the conservation of floor space, a point that can be very effectively demonstrated in the exhibition rooms of a machine tool dealer.

All these various things have been successfully demonstrated and it is not a mere theory that such demonstrations can be made successful. The machine tool manufacturers naturally are enthusiastic over the opportunity to have their machines exhibited, and generally they are glad to supply demonstrators and experts to explain thoroughly the operation of the machines and the new ideas that have been incorporated in their design. Another advantage of this local demonstration is that it is possible for the dealer to obtain local work for demonstration purposes. He can then show by actual performance how it can be done to better advantage on the machines in operation in the show-room than it is at present in the prospective customer's shop.

Taking Care of the Human Side

In making a success of a machine tool demonstration in the show-rooms of a dealer, it is necessary, in order to sustain the interest, to furnish not only serious food for thought to the visitors, but also to appeal to their sense of humor and to provide for the "inner man." Educational features should be introduced in the nature of talks by authorities, and these should be illustrated, if possible, by stereoptican views. In the demonstrations held in the writer's showrooms in Rochester, an opportunity has also been provided for testing the manual skill of the visitors, or their quick brain action in overcoming some difficult problem, and to stimulate interest prizes have been awarded for the performance of some particular kind of operation.

It is important, if these demonstrations are started, that they must not be considered as a single effort held only once, but they should be made an annual function of the machine tool dealer's business, and should be conducted in a dignified, constructive, and instructive manner. In Europe machine tools have been sold by demonstration for years, and in a great many of the European show-rooms machines are under belt at all times, and expert operators are employed who can start and operate any machine when a customer calls.

Such methods would be of great value in the United States as well. At first, however, it might be necessary to limit the efforts to annual demonstrations, while later on permanent demonstrating rooms could be maintained. A few of the manufacturers of machine tools now maintain demonstrating rooms in their factories, but I believe, as the pioneer in this country in the adoption of a dealer's demonstration, that I have struck the right keynote for the most effective advertising covering a limited territory, and the right method in which to instruct prospective customers in regard to the machine tools handled. The results obtained thus far have thoroughly proved the accuracy of our opinions and the success of our endeavors.

By carefully planned demonstrations, it is possible to make every city of any size in the machine shop centers of the country an attractive center for machine tool buyers. By such efforts local dealers would be able to obtain a stronger grip upon the local machine tool trade, and they would come into closer contact with their customers.

* * *

GERMAN MACHINE TOOL PRICES

By MACHINERY'S Special Correspondent

Berlin, June 10

The German machine shops are fully occupied, but there are complaints about a scarcity of coal, a falling off in export orders, an increasing scarcity of credits, and slow collections. Many plants are working over-time. Sales are made at sliding prices only, and the domestic prices in many cases exceed those offered foreign buyers. As an example may be mentioned aluminum goods, which have become too expensive for domestic buyers.

The demand for locomotives is brisk. Several orders for bridges for South America have been booked, as well as orders for railway equipment; but Belgian competition is becoming keener, and a large Belgian iron works has underbid German firms in many cases. One bid on rails for Bulgaria shows the Belgian price as 14 per cent below the German. On bids for railway car wheel tires, pipes, metal ties and plates, German prices in recent bids have been from 16 to 34 per cent above Belgian prices.

The price per pound of machine tools, as expressed in marks, is constantly rising. In many instances it is now from 28 to 32 marks per pound. Some examples of prices current in the month of April are given in the following:

Prices of Stock Machines

18-inch engine gap lathes (with feed-rod), distance between centers 60 inches, weight 3740 pounds, 70,000 marks (present exchange, about $235).

Bolt-cutting machines, height of centers 8 inches, distance between centers 50 inches, weight 2000 pounds, 43,000 marks (present exchange, $145). The same type with height of centers 6¼ inches, distance between centers 24 inches, weight 1540 pounds, 38,500 marks (present exchange, $130).

Planers, working length of table 60 inches, width 36 inches, working height 30 inches, weight 9900 pounds, 210,000 marks (present exchange, $700).

Shapers, stroke of ram 22 inches, weight 3300 pounds, 75,300 marks (present exchange, $250).

Oil-grooving machines with single-pulley drive, weight 2530 pounds, 50,000 marks (present exchange, $165).

Prices of Machines Made to Order

Small thread-cutting machines for cutting brass threads up to 0.20 inch in diameter, 3600 marks (present exchange, $12); up to 0.80 inch in diameter, 10,200 marks (present exchange, $34).

14-inch production lathe, distance between centers 36 inches, weight 2090 pounds, 48,400 marks (present exchange, $160).

24-inch engine lathe, distance between centers 50 inches, weight 8360 pounds, 190,300 marks (present exchange, $635).

18-inch engine lathe (Wohlenberg), distance between centers 60 inches, weight, 3475 pounds, 68,100 marks (present exchange, $225).

Radial drilling machines (high-duty), with motor drive, working radius 72 inches, working height 80 inches, weight 15,840 pounds, 440,000 marks, not including electrical equipment (present exchange, $1465).

Radial drilling machines, with motor drive, capable of drilling holes up to 2.6 inches in diameter, working radius 70 inches, working height 64 inches, weight 10,780 pounds, including electrical equipment, but without table and foundation plate, 308,250 marks (present exchange, $1025).

Radial drilling machines for drilling holes up to 2 inches in diameter, working radius 88 inches, working height 56 inches, weight 6775 pounds, 145,150 marks (present exchange, $485).

Plate-straightening machines for rough plates, ¼ inch to ¾ inch thick, 106 inches wide, 1,203,000 marks (present exchange, $4000).

Duplex nut milling machine, table surface 10 inches wide by 44 inches long, weight 4350 pounds, 98,500 marks (present exchange, $330).

Circular plate shears capable of handling plates 0.120 inch thick and 40 inches in diameter, weight 814 pounds, 22,000 marks (present exchange, $73).

Planer, working length of table 100 inches, width 60 inches, and working height 50 inches, weight 26,400 pounds, 560,000 marks (present exchange, $1865).

Cold saw (heaviest pattern), diameter of saw 48 inches, weight 18,525 pounds, 285,300 marks (present exchange, $950).

Lathe chuck (Cushman type), diameter 2¾ inches, 600 marks (present exchange, $2); diameter 10⅝ inches, 2100 marks ($7); diameter 18⅞ inches, 7500 marks ($25).

* * *

In a recent number of the Journal of the Franklin Institute, mention is made of the application of what has been termed the "ultra-micrometer" to the measurement of small increments of temperature. This is an electrical device so sensitive that it is said to be possible to detect a change in temperature of one-sixteen thousandth of a degree Centigrade or a change in length of one two-hundred millionth of an inch. By this arrangement the expansion coefficient of copper can be measured by raising the temperature a single degree.

* * *

VALUE OF MACHINE TOOLS AND METAL-WORKING MACHINERY EXPORTED TO ITALY, 1912-1921

Year*	Lathes	Sharpening and Grinding Machines	Other Machine Tools	Total of Machine Tools	All Other Metal-working Machinery	Total of Machine Tools and Metal-working Machinery
1912	......	......	......	......	......	$278,344
1913	......	......	......	......	......	437,910
1914	......	......	......	......	......	421,603
1915	......	......	......	......	......	511,134
1916	......	......	......	......	......	4,779,178
1917	......	......	......	......	......	8,771,496
1918	$1,103,629	$518,606	$1,246,257	$2,868,492	$2,208,386	5,076,878
1919	73,331	138,668	600,877	812,876	1,079,194	1,892,070
1920	152,034	106,218	641,488	899,740	589,078	1,488,818
1921	2,972	11,575	65,151	79,698	159,572	239,270

Machinery

*Amounts given are for fiscal years, up to and including 1918, and for calendar years thereafter. The Department of Commerce statistics did not give machine tool exports separately previous to 1918.

Making Radio Parts

By FRED R. DANIELS

The Use of Lathes and Other Machine Tools in Radio Shops

PERHAPS the most general use of lathes in radio manufacture is for winding tuning coils, rheostat coils, etc. The winding of a tuning coil, as done in the plant of the DeForest Radio Telephone & Telegraph Co., is shown in Fig. 1. These coils are wound on uncolored bakelite tubes. The uncolored material is used because it has been found that a better current inductance is obtained from tubes made of material that contains no coloring matter. The coils are wound with No. 26 gage enameled wire, which is run from a reel at the front of the lathe, and guided by the operator as shown. The tube fits over a cylindrical wooden block attached to the lathe, and the wire is passed through holes drilled in the end of the tube and is extended to permit suitable connections to be made in the circuit. This operation is performed on a Seneca Falls tool-room lathe. After the winding operation has been completed, the wire is severed and threaded through corresponding holes at the opposite end of the tube in order to anchor it.

The DeForest rheostat consists of a molded bakelite base to which a resistance coil, wound on a strip of fiber, is attached. The fiber core of the resistance coil is shown in the upper part of Fig. 3, and the special winding fixture in Fig. 2. The fiber is 1/16 inch thick by 5 9/32 inches long, and it was found necessary to employ a special fixture to prevent it from twisting and buckling during the winding operation. There are 117 turns of No. 23 B & S gage nickel-plated resistance wire wound with twenty-six right-hand turns per inch. The length of the wire is 10½ feet. The fixture used was designed by Mr. Reber, the chief toolmaker of the DeForest company.

The spindle of the lathe carries a pinion which drives, through suitable gearing, two ½-inch lead-screws having thirteen threads per inch, on which the carriage *A* of the fixture travels during the winding operation. The fiber is prevented from twisting by driving the chucks that hold both ends of the strip positively, the drive for the tail-end chuck *B* being from a pinion within the carriage, carried on the splined shaft *C*. This construction permits the pinion on shaft *C* to slide along with the carriage as the coil is being wound and to drive the chuck *B* at the same rate of speed as the chuck *D* at the head end. It will be seen that with twenty-six turns per inch and a lead-screw having thirteen threads per inch, a gearing ratio of two to one is required to give the proper rate of carriage traverse.

The fiber strip is tightened in the head-end chuck by the hollow set-screw wrench *E*. The hole in the set-screw in the chuck goes clear through, so the wire may be passed through it and through a hole in the fiber, before starting the coiling operation. Previous to this the two lead-screw nuts *F* are released by the thumb-screws which hold the two halves together, and the carriage is advanced to the head end, preparatory to starting the operation. A flat strip attached to the top of the carriage helps to support it, and carries a mark to indicate when the correct number of turns have been wound. The wire is passed over two buttons on the side of the carriage, which guide it and maintain the proper tension. When the winding is finished the operator cuts off the wire with a pair of pliers, releases the lead-screw nuts and the head-end chuck, and slides the carriage to the right far enough to remove the coil. The coil is then replaced by another fiber strip and the carriage moved to the head end. The fiber, which is now extending through the foot-

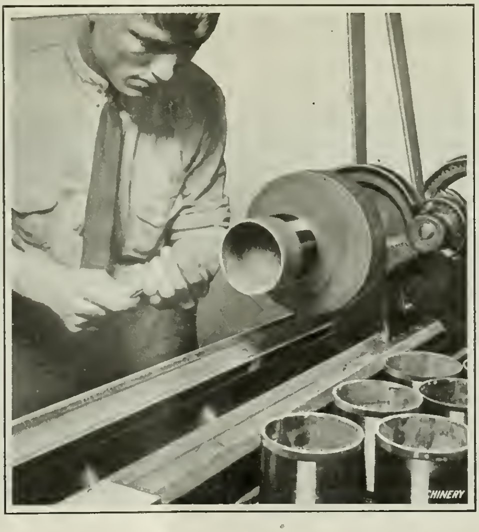


Fig. 1. Winding a Tuning Coil in a Lathe

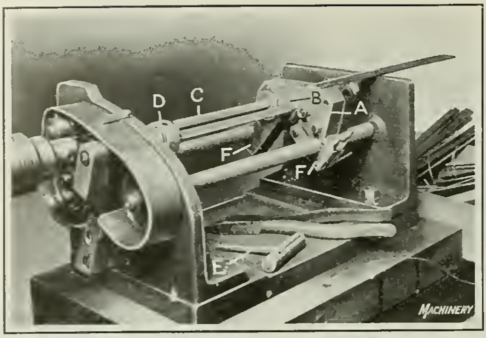


Fig. 2. Winding Fixture used on a Lathe for making Rheostat Coils

end chuck or slotted bushing on the right-hand side of the carriage, is tightened in the head-end chuck and the wire threaded through, as before.

Some Uses of Bench Lathes

The winding of variometers, which are used in regenerative circuit radio receiving sets, is done at the Adams-Morgan plant in a bench lathe. The exterior winding on the rotor member of the instrument is performed with no special means of guiding the wire other than the judgment of the operator. The interior windings of the stator member of the variometer require a special guide on the bench lathe for the wire, and this guide extends within the hollow stator, the interior surface of which is coated with shellac in which the windings are embedded. Aside from the means for reaching in to guide the wire, no other special provision is made for doing this work.

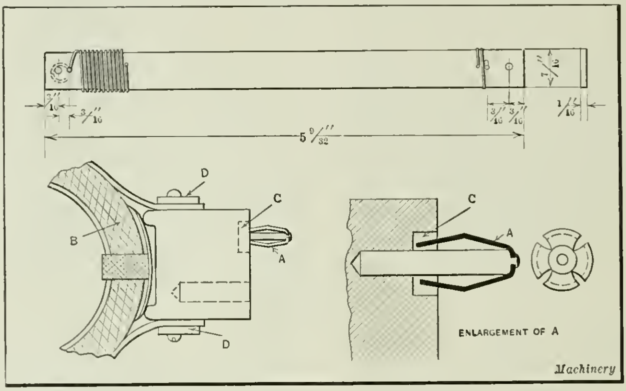


Fig. 3. (Above) Fiber Strip for Rheostat Coil Winding; (Below) Honeycomb Coil and Enlargement of its Spring Contact "Plug-in"

A number of the rotors may be seen in Fig. 4, where the operator is shown straightening the rotor shafts, with hand tools, two anvils being used to support the work. This illustration shows the character of the windings. Incidentally, attention is directed to the receiving set which is shown directly in front of the operator. The unit at the extreme right is a vario-coupler. It consists of a primary and a secondary winding, the primary coil being mounted at a 45-degree angle within the secondary, so that the windings may be variably coupled by turning the drum on which the primary coil is wound. Next to the vario-coupler is a plate condenser which, though not absolutely necessary in regenerative sets, is used to sharpen the tone. The unit at the left is a variometer; this view shows the mounting of the stator and indicates how the rotor is operated within it. The primary winding, in this case, is on the outer member, or stator.

The use of bench lathes as auxiliary equipment for finishing screw machine products is quite general in the radio manufacturing field. Indicator arms and switch points that are assembled by spinning to brass bushings molded in nonmetallic knobs, may be conveniently cleared of the burr produced in the bushing hole, by the use of a bench lathe. Small hand tapping jobs, of which there are a large variety, are also suitable bench lathe radio jobs. Other typical bench lathe work commonly found in radio shops includes smoothing the heads of brass screws with a small emery-faced wooden disk, burring and beveling shoulder screws, and countersinking holes. Fig. 5 shows a battery of Sloan & Chace bench lathes used in the DeForest plant for a wide variety of work of the class to which reference has just been made.

Lathes for Spinning Horns

Horns of various types are employed for use in connection with an amplifier, the sound being delivered from the receiver of the instrument and thrown out so as to be heard without the use of head-phones. The type of "loud speaker" manufactured by the Radio Service & Mfg. Co. is known as an "amplitron." This is not of the familiar graphaphone horn type, but is slightly different in construction from those in common use.

The "amplitron" is cone-shaped, and this cone is fastened to a suitable stand by means of which it is supported in an upright position. The open end of the horn has a flange to which three radial strips are fastened which support a cup at the center, into which an ordinary telephone receiver may be screwed. The instrument is shown on the ways of the lathe in Fig. 6. Leading from the rear of this receiver cup, there is a small horn through which the sound is carried back to the apex of the cone, where it is reflected and amplified. The wide angle of the cone is designed to eliminate distortion of sound. The cone is 10 inches in diameter and 7 inches deep, and it is made from No. 23 gage sheet copper.

Four distinct operations are required in spinning this copper cone; that is, four different spinning chucks are used. The shaping of the cone is not completed until after the third operation, when the work is annealed preparatory to the finish-spinning operation, which is shown in Fig. 6. The chuck or form

Fig. 4. Straightening the Shaft of a Variometer Rotor

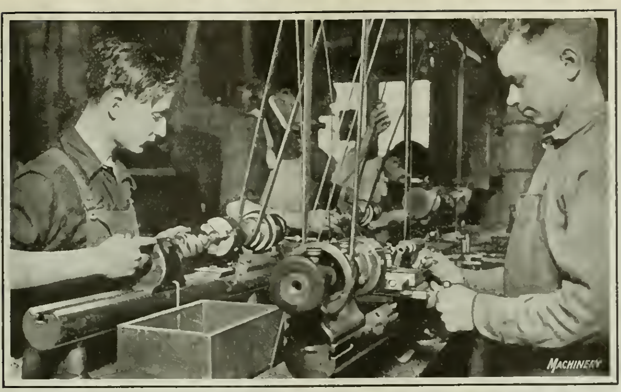


Fig. 5. Battery of Bench Lathes on which Numerous Minor Operations are performed

is made from hard maple, polished nicely, and the operation is performed on an 18-inch lathe, the tailstock of which is equipped with a ball bearing center. After greasing the wood form with albany grease, the shell is placed over it so as to run true. Four tools are used in the operation; the first has a rounded end like the bowl of a spoon, and is called a point-and-ball. This is the regular finishing tool, but it is used first to shape the apex and to work the metal back for a distance of about one inch from the apex. A small hard wood center is used between the apex

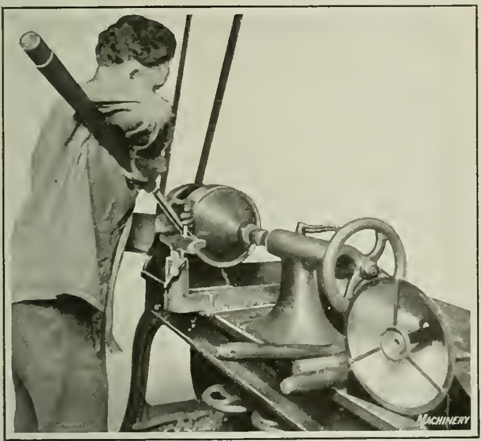


Fig. 6. Spinning a "Loud Speaker" Horn

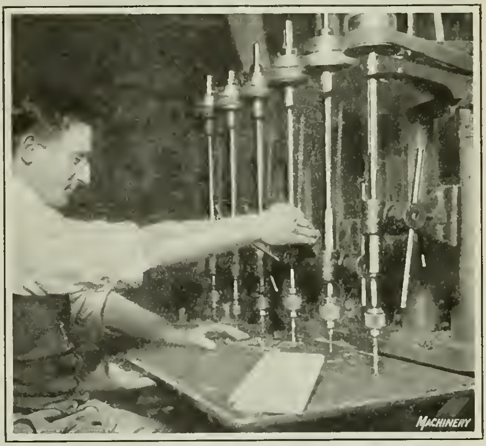


Fig. 7. Drilling Panels for Receiving Sets

and ball-bearing center during this step, but it is discarded afterward for a larger one which is employed during the remainder of the spinning operations.

The next tool is the one shown in use in the illustration; this has a blunt point on the end and a very long handle to provide the proper amount of leverage. During this operation the position of the tool on the T-rest is changed as the work progresses by transferring the fulcrum pin from hole to hole in the rest, so that the desired leverage for the tool is obtained. By the time the operator has reached the large end of the shell near the flange the diameter has increased to such an extent that he has to work in an extremely limited space, necessitating a somewhat cramped working position. This tool is brought up to the flange and across it, and then the smoothing tool is used again, this time to go over the same surfaces. Before this tool is used, the shell is greased. Lubricating the shell reduces the friction between tool and work. The corners of the flange are then trimmed with a square-edged tool, preparatory to forming the bead at the edge.

Fig. 8. Two Different Tapping Operations required on Radio Parts

In curling the edge of the flange, a pair of hook pliers is used, supported on the T-rest by a piece of wood held in one hand while the spinner uses the pliers in the other to turn the edge. The turned edge is then beaded with a tool which carries a roll at the end. After the bead has been formed, the hard wood center is removed and the smoothing tool used to finish the apex of the shell which has now been exposed by the removal of the wood plug. It will be understood that in using each of these tools any one of several holes in the T-rest may be employed for the leverage pin. to suit the convenience of the operator.

Work on Drilling and Tapping Machines

The examples of the use of drilling and tapping machines on radio work here illustrated were obtained at the plant of the DeForest Radio Telephone & Telegraph Co. The first is the drilling of thirty-three holes in the wooden panels used in the receiving sets of this company's manufacture. The panels are made of walnut and are used on crystal detector sets. They are located in a flat plate-type jig, and the operation is performed on a six-spindle Prentice drilling machine, as shown in Fig. 7. There are thirteen No. 51 drill holes, seven No. 31, four No. 27, five No. 18, two F size, and two 5/16-inch holes drilled in this sized panel.

The use of a three-spindle Allen drilling machine is shown in Fig. 9; in this view the two end spindles are being used on two different spinning operations. The contact spring *A*, Fig. 3, used in the DeForest honeycomb coil *B* and in its mounting, is assembled to a stud molded in the bakelite plugs by spinning. This operation is being performed under the first spindle, in which a roll spinning tool is used. The hole in the center of the thimble-shaped spring is slipped over a teat on the end of the stud molded in the bakelite plug, and is then secured by a spinning operation. The material surrounding the base of this stud over which the contact spring is spun, has a molded recess *C*, Fig. 3, to receive the ends of the spring and prevent them from spreading or becoming misshaped due to being repeatedly plugged into the coil mounting.

The operation being performed under the farther spindle of the machine illustrated in Fig. 9 is the spinning of brass bushings, molded in control knobs, as a means of securing phosphor-bronze indicator pointers to the knobs. The knobs are molded from bakelite, and the inserts have a shoulder at the end over which the indicator pointer seats.

The clips *D*, Fig. 3, by means of which the fiber strips are bound to the honeycomb plugs, are secured in place by machine screws, and the plugs are tapped to receive these screws on Rickert-Shafer tapping machines. This operation is shown at the left in Fig. 8. The holes have a 6–32 thread, and the material is molded condensite. The other tapping machine of the same type shown in this illustration is engaged in tapping a hole in the shanks of bakelite knobs. A wide variety of knobs of this general type are used in radio apparatus, some of which are attached by machine screws, while others are molded with inserts and have pointers assembled by spinning, as previously mentioned.

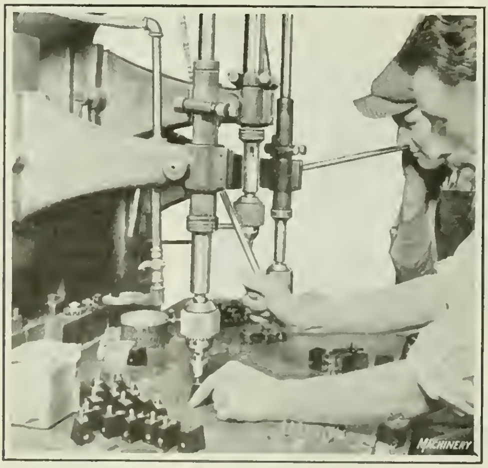


Fig. 9. Two Spindles of a Three-spindle Drilling Machine used for Spinning Operations

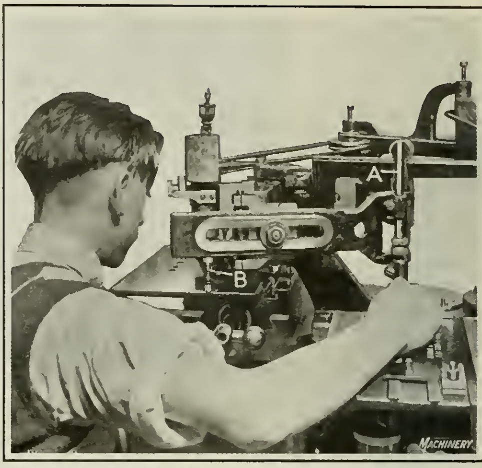


Fig. 10. Engraving Bakelite Tuner Panels on Pantograph Engraving Machine

Use of Pantograph Engraving Machines for Radio Work

Fig. 10 shows a pantograph engraving machine engaged in engraving DeForest long-wave tuner panels. These panels are sheet bakelite, and are engraved with the maker's name and various other notations regarding the type of instrument, the function of the different control knobs and switch contact points, etc. The stylus point is carried in spindle *A* and is moved by the right hand of the operator along the letters in the master plate which is attached to the table. The engraving tool is shown at *B*. The panel which is being engraved is attached to a table by clamps in the regular manner. Some of the machines used are built by the George Gorton Machine Co., and some are of German manufacture.

* * *

NATIONAL INDUSTRIAL ADVERTISING ASSOCIATION

During the annual convention of the Associated Advertising Clubs of the World held in Milwaukee June 11–15, an organization known as the National Industrial Advertising Association was formed. The following officers were elected: Keith J. Evans, Joseph T. Ryerson & Son, Chicago, president; P. C. Gunion, Hyatt Roller Bearing Co., New York City, vice-president; H. N. Baum, Celite Products Co., Chicago, secretary; A. K. Birch, Allis-Chalmers Mfg. Co., Milwaukee, treasurer. The following board of directors was elected: Julius Holl, Link-Belt Co., Chicago; L. F. Hamilton, Walworth Mfg. Co., Boston; W. A. Wolff, of the Western Electric Co., New York City; P. A. Powers, Benjamin Electric Mfg. Co., Chicago; H. J. Downs, American Locomotive Co., New York City; E. W. Clark, Clark Equipment Co., Chicago; H. L. Delander, Crane Co., Chicago; Bennett Chapple, American Rolling Mills Co., Middletown, Ohio; and J. C. McQuiston, of the Westinghouse Electric & Mfg. Co., Pittsburg.

The object of the new organization is to hold a conference in connection with every annual convention of the Associated Advertising Clubs of the World, the purpose being to gather together the leaders in industrial advertising for consideration of methods to improve the standards of advertising those products which are sold by one manufacturing plant to another. The problems involved in handling such publicity are necessarily different from those which arise in other classes of advertising. It is believed that the development of an organization for the free exchange of ideas on this subject will prove of great mutual benefit to those who participate.

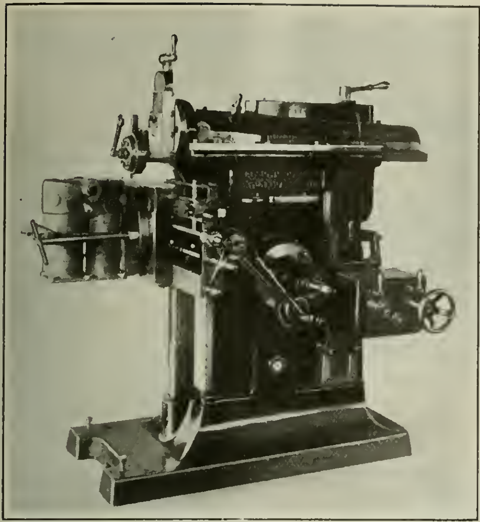


Fig. 1. Equipment used for machining the End of an Automobile Cylinder Block on a Shaper

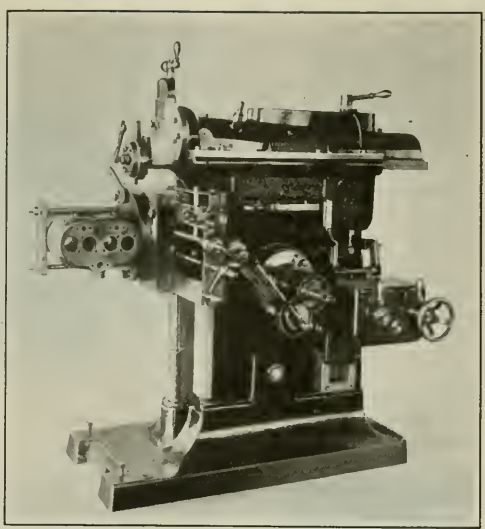


Fig. 2. Using the Equipment shown in Fig. 1 for shaping a Side of the Cylinder Block

The Shaper as a Manufacturing Machine

THERE are some classes of work on which the shaper may be used profitably as a manufacturing machine. Examples of such work are shown in this article. Most of the work illustrated was performed in the plant of the Smith & Mills Co., Cincinnati, Ohio, and all was done on shapers built by that company. Brief references only are made to the methods of performing the work, as the illustrations are self-explanatory, showing clearly both the method of holding the work and the tooling arrangement employed in each case. These examples will doubtless suggest similar applications in other plants.

Figs. 1 and 2 show a shaper engaged in machining automobile cylinders. This work was formerly done on a milling machine, but it was found more economical in this case to use a shaper, because of the saving of a double set of milling cutters. The holding fixture used on the shaper is the same as that which was formerly used on the milling machine. This is an indexing fixture, with a plunger-pin for

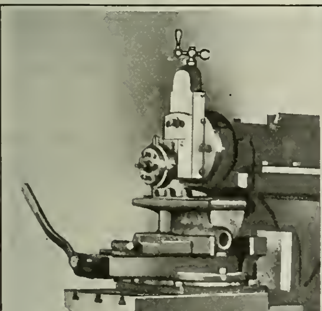


Fig. 3. Shaping the Top Casting of a Tailstock

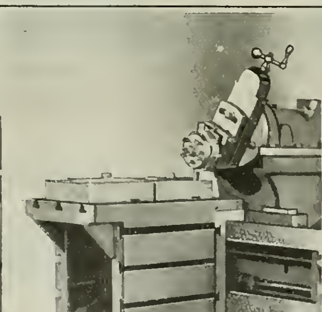


Fig. 4. Operation on a Lower Tailstock Casting

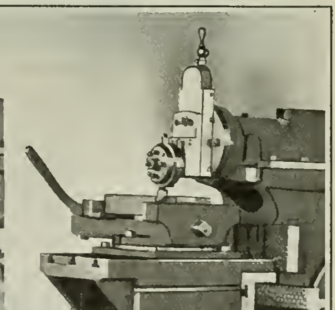


Fig. 5. Second Operation on the Part shown in Fig. 4

indexing so that the cylinder can be turned to the four positions necessary for machining both the ends and the sides of the work. The tools are held in a turret toolpost which has four positions to accommodate tools for four different operations. The cylinders are strapped to the top of the swivel plate of the fixture, so that either one of the two ends or either of the sides can be brought into position for shaping.

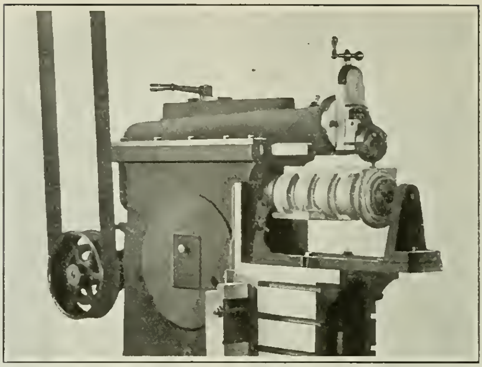


Fig. 6. Set-up for machining an Automobile Crankcase

Fig. 6 shows an automobile crankcase, which was also formerly machined on a milling machine. The job required the use of milling cutters 10 inches in diameter with inserted high-speed steel blades. It was found that this work could be done on a shaper in the same time as on a milling machine, with a saving in the first cost of tooling equipment. Furthermore, the shaper produced a straight but somewhat serrated surface which accommodated the gasket in a more satisfactory manner than the milled surface, which was wavy on account of the rota·y motion of the cutter. A turret toolpost is used in this case also, and it carries one roughing and one finishing cutter. The crankcase is machined on three sides, and the fixture can be indexed to turn the work around 90 and 180 degrees. It is clamped tightly in the fixture for the performance of the shaping operation.

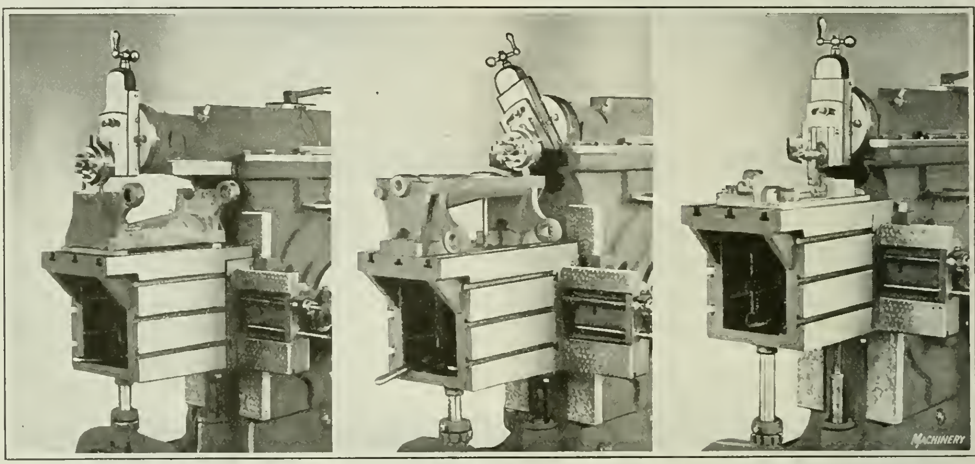


Fig. 7. First Operation on a Lathe Headstock Fig. 8. Second Operation on the Headstock Fig. 9. Trimming Bosses on Lathe Apron

Some time ago the Smith & Mills Co. had occasion to machine parts for lathes, and it was found that by rigging up shapers for planing most of the flat surfaces, the work could be done profitably at a low cost as regards both the machine tool equipment and the tools, as well as at a minimum cost for power. In the particular case under consideration, an advantage was gained by being able to machine a few parts quickly so that subsequent operations and the assembling work could be started. If, on the other hand, machine tools requiring an expensive equipment for planing a large number of these parts at a time had been used, it would have been necessary to wait longer before the subsequent operations could have been started, and while the total time consumed for each operation might have been less, the entire time consumed before some of the machines were completed would have been greater.

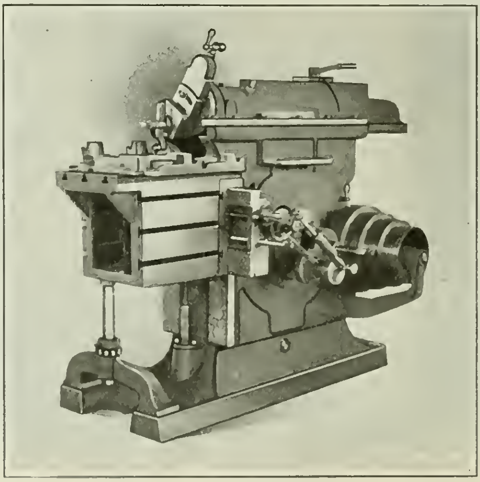


Fig. 10. Shaping out the Slot for the Split Nut on a Lathe Apron

Fig. 3 shows the top casting of the lathe tailstock being shaped on its bottom surface The casting is held in a vise and set with a surface gage, so as to insure that the hole will clean up in a subsequent boring operation, when this surface is used for locating purposes. Fig. 4 shows the lower casting of the tailstock being finished on the bottom, while Fig. 5 shows the same casting being shaped on the top. The turret toolpost is used in each instance, and is equipped with both roughing and finishing tools.

Fig. 7 shows the headstock casting mounted on the table of the shaper for the first operation. The casting is held to the table by a bolt passing through the cored hole in the center. Fig. 8 shows the

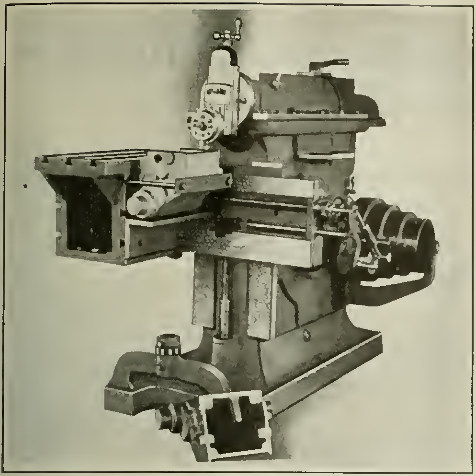


Fig. 11. Shaper equipped for machining a Lathe Feed-box

second operation—shaping off the bottom of the headstock. For this operation the work is located on setting blocks, as shown, which fit the surfaces shaped in the first operation. There is an angular way on one side and a flat surface on the other. The toolpost turret holds four tools, one for roughing and one for finishing the flat way, and one for roughing and one for finishing the angular way.

The first operation on the lathe apron is to shape off the top side and each edge. This operation is not illustrated. Fig. 9 shows the second operation, in which all the bosses are trimmed off on the inner side of the apron to an equal height, and Fig. 10 shows the shaping out of the slot for the split nut. At the end of these three shaping operations finished planed aprons were ready for further operations, such as drilling or vise work, and it was not necessary to wait until an entire lot had been finished in a multiple fixture on a planer before the work could be proceeded with.

Fig. 11 shows the lathe feed-box which was easily set up on the shaper with the use of a simple angle-plate and a strap with two bolts. In this operation the tongue and flat surfaces on the side of the feed-box by which it is attached to the lathe were machined. Four tools are used in the turret toolpost, two for roughing and two for finishing.

* * *

SHOULD FOREMEN DO DETAIL WORK?

By F. H. SWEET

The writer has known foremen who would set up every job, who would go to the tool-room and get all the tools and who would go out of their way to do various odd jobs, and yet their departments would not be efficient. They would spend so much time getting a job started right that they would have no time to superintend the work. They had no time to go over their orders, but would pick them out haphazardly or they would be picked out for them of necessity. They had no time to plan their work, to judge their men, or to watch their product, yet they would work themselves into nervous exhaustion and fail in health.

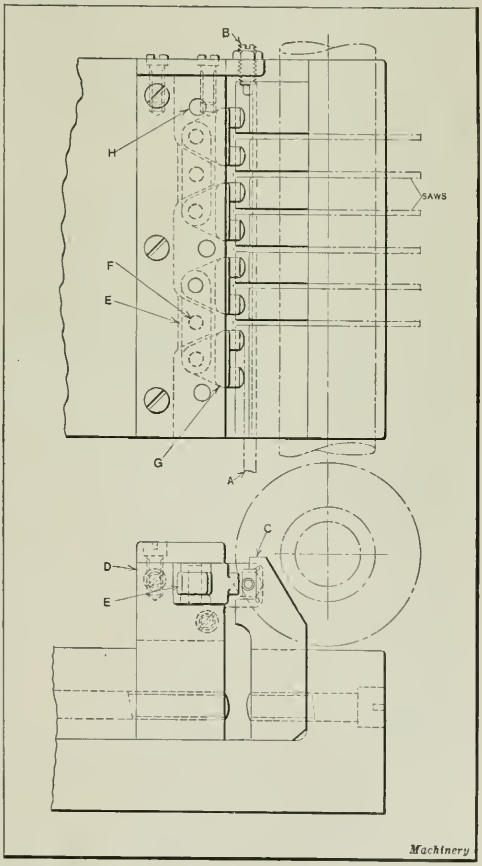
They were too busy looking after details to keep in sight the larger and more important things. They were so occupied that they had no time for conferences or interviews. They fooled themselves into thinking that the details they were doing could not possibly be done by anyone else. "One of the hardest things I have had to learn, is when to cease doing a detail and delegate it to someone," said one manager. This is especially difficult when it involves things that one can do very well, or things that one likes to do.

FIXTURE FOR MULTIPLE CUTTING OFF

By D. A. NEVIN

In the manufacture of firearms, typewriters, adding machines, and various classes of light machinery, there are many small parts that must be made from pieces sawed off from flat bar stock, because the thickness is too great to permit blanking them from flat sheet metal. In many cases the material is hard steel, which makes it difficult to obtain satisfactory results by cutting off in an automatic screw machine. For this reason these parts are often cut off in a milling machine, using a standard manufacturing vise to hold the stock. The illustration shows a pair of special vise jaws which were designed for use in sawing off six parts simultaneously, by employing six gang saws mounted on a milling machine spindle. The stock was $\frac{3}{8}$-inch by $\frac{1}{4}$-inch hard steel and is shown by dot-and-dash lines at *A*. The work is located against an adjustable stop-screw *B*, which is secured by a lock-nut. The saws are 1/16 inch thick.

The stock is supported by the rigid jaw *C* and clamped by the movable jaw *D* fitted with compound equalizers which provide for clamping all parts rigidly in place, thus allowing a maximum feed of the saws. The equalizing parts consist of the links *E* retained in the slotted jaw *D* by the pins *F* and carrying on each end the equalizing clamps *G*. Three pins *H* are provided to prevent the equalizing clamps from getting out of position. The parts are cut to a length of 0.494 inch plus or minus 0.0002 inch, and the jaws are mounted in a No. 3 Brown & Sharpe vise.



Vise Jaws for Multiple Cutting-off Operations

Cost Recording and Production Control in Drop-forging Plants

By H. F. OSLER

FORGING STEEL STOCK RECORD														
ORDERED					RECEIVED					SOURCE			LOT NO.	
DATE	PRODUCTION REQ. NO.	PURCHASE ORDER NO.	QUANTITY	SOURCE	DATE	PRODUCTION REQ. NO.	PURCHASE ORDER NO.	QUANTITY	SOURCE					
										HEAT NO.			S.A.E.	
										MINIMUM			SIZE	
										CAR NO. AND INITIAL			ANALYSIS NO.	
USED					USED					APPORTIONED				
DATE	SALES ORDER NO.	DIE NUMBER	QUANTITY	ACTUAL BALANCE ON HAND	DATE	SALES ORDER NO.	DIE NUMBER	QUANTITY	ACTUAL BALANCE ON HAND	SALES ORDER NO.	DIE NUMBER	PART SYMBOL	QUANTITY	UNAPPORTIONED BALANCE ON HAND
														Machinery

Fig. 4. Sheet on which a Record is kept of the Stock on Hand

In the first installment of this article, published in June MACHINERY, the general need for more efficient cost-recording systems was emphasized, and some of the difficulties encountered in developing cost-recording systems in drop-forging plants were dealt with. Following this consideration of the cost-recording problem, an outline of a system of management which has proved very satisfactory in two large drop-forging plants was given. In the present installment the actual operation of the system will be described in detail.

In order to make clear the operation of the system, the progress of an order will be followed from the time that it is received by the sales department until the finished forgings are shipped. When an order is received by the sales department a set of sales orders is immediately made out on blank forms like that shown in Fig. 7. This order gives all the information available that will be of assistance to the executives who are responsible for the proper execution of the work. It will be noted that all items required in figuring costs are included on this order slip, so that there should be no cause for error or delay in obtaining the costs. A copy of this order is sent to the cost, the billing, and the production departments.

When the sales order is received by

TOOL NO. — DIE DEP'T JOB TICKET — CARD NO.

OPERATION CONSISTS OF ______

TIME ALLOWED ______ TIME USED ______

DIE NUMBER ______ SERIAL ______
PART SYMBOL ______
OUR ORDER NO. ______ THEIR NO. ______

OFFSET ______ LEAD WANTED ______
CUT-OFF ______ " SENT ______
EDGER ______ " SENT ______
FULLER ______ " APPROVED ______
IMPRESSIONS ______ DIES READY ______

BLOCK NO. ______ SIZE ______
KIND ______
BLOCK NO. ______ SIZE ______
KIND ______

HARDENED ______
BY ______
TEMPER ______ HARDNESS ______

ESTIMATED TO MAKE ______ FORGINGS
MADE ______ FORGINGS HAMMER NO. ______

TRIMMER
TIME ALLOWED ______ TIME USED ______
HOT ___ COLD ___ LOOSE ___ STATIONARY ______
SIZE TRIMMER STOCK ______
KIND ______
SIZE PUNCH STOCK ______
KIND ______
SPECIAL CHAIR OR STANDARD ______
SPECIAL PUNCH-HOLDER OR STANDARD ______

EMP. NO. ISSUED ______
BY ______

ACCUMULATIVE TIME JOB CARD

DATE	HOURS	TOTAL	DATE	HOURS	TOTAL
			FORWARD		

ADDED TOTALS TO BE KEPT UP BY WORKMAN AND CARD RETURNED WHEN JOB IS FINISHED TO FOREMAN AND FOREMAN TO PROD. DEPT.

______ WORKMAN ______ FOREMAN

Fig. 5. Front and Back of Die Order Blank

ISSUED ______ CARD NO.
BY ______ STEEL RECEIVING CARD

YARDMASTER AND CHIEF INSPECTOR
DELIVER TO LABORATORY FOR ANALYSIS ______ SAMPLES FROM HEAT NO. ______
CONSISTING OF ______ BARS FROM ______
IN CAR ______ ON OUR P.O.NO. ______ FOR LOT NO. ______
BARS RECEIVED ______ CAR NET ______
CAR RECEIVED ______ CAR TARE ______
CAR UNLOADED ______ CAR GROSS ______
______ YARDMASTER
______ PROD. DEP'T.

INSPECTOR NOTIFIED ______ INSPECTOR ______ 19__
SURFACE INSP. APPROVED ______ INSPECTOR ______ 19__
ANALYSIS APPROVED ______ CHEMIST ______ 19__
STEEL NOW AVAILABLE ______ INSPECTOR ______ 19__

SIZE	STEEL ANALYSIS CARD											LOT NO.
S.A.E.	CAR INITIAL & NO.				SOURCE							CARD NO.
MILL ANALYSIS	HEAT NO.		C	MN	SI	S	P	NI	CR	VA	W	
SAMPLE NO.	ANALYSIS MADE BY	DATE	C	MN	SI	S	P	NI	CR	VA	W	
												Machinery

Fig. 6. Front and Back of Steel Receiving and Analysis Recording Card

the production department, the information board is consulted to determine the condition of the dies and trimmers. If a new die is required, an order is made out on a form, the front and back of which are shown in Fig. 5. If the die simply requires repairing, an order is made out on a form provided for that purpose. These orders give all the information required, including the time allowed. Copies of these orders go to the die-room and cost department.

Ordering Materials

From the steel or stock record, made out on the form shown in Fig. 4, it is next ascertained if the steel required in making the forgings is available. If the stock is on hand, the allotment of the required amount is noted on the record, and a requisition is sent to the purchasing department, calling for an amount of steel sufficient to replace the allotment. This requisition is made out on the form shown in Fig. 8. If the record sheet shows that the steel is not available, the same procedure is followed so that all the records will be complete and up-to date. Complete information in regard to the quality and kind of steel needed is placed on the requisition slip.

When the purchasing department orders the steel, a copy of the order is sent to the production department, which then follows the order until shipment is made. All information regarding the ordering of steel, the condition of dies, etc., is posted on the information board by inserting tacks of the proper shape, color, or color combination. For instance, referring to Fig. 2 in the first installment of this article, the tack at *d*, which is black with a white cross in the center, indicates that the steel is available and an allotment has been made. A triangular green tack *e* shows that the trimme:s have been inspected and found ready for use. A square red tack at *f* shows that the lead cast of the forging has been approved, and a square green tack at *g* indicates that the dies are ready for use.

ISSUED
DY
FORM P6 11-20-1M

DROP FORGE DEPARTMENT
SALES ORDER

PART SYMBOL
DIE NUMBER
ORDER No.

Part Name ... Quantity
Customers Order No. ... Date
Customer
Address
Ship to
Address
Routing
Use Hammer No. ... Fires ... Helpers
Size Material ... Cut ... For ... Forgings
Gross Weight Ea. ... Net Weight Ea. ... Heat Treat
Specifications S.A.E. ... C ... MN ... SI ... S ... P ... NI ... CR ... VA
Dies Billed at ... F.O.B.
Terms
Price Each ... F.O.B.
Terms
Estimate No.
Average No. Pcs. to be Forged Per ... Hr. Day
Average No. Pcs. to be Trimmed Per ... Hr. Day
Hours Allowed to Make Dies
Hours Allowed to Make Trimmers
Approved by ... Date

Operation Numbers for Dies
Operation Numbers for Trimmers
Operation Numbers for Forgings

CUSTOMERS SCHEDULE and REMARKS

Fig. 7. Sales Order Blank, which is filled out by the Sales Department

The system for receiving and inspecting the stock is as outlined in the following: At the time an order of steel is received, a receiving and analysis card, the front and back of which are shown in Fig. 6, is made out in the production department. When a shipping manifest of steel is received by the production department, a lot number is assigned to every size according to its specifications. If more than one heat of each size is included in the order, a letter is added to the lot number, and in unloading, care is taken to see that each size and lot are placed in separate piles and properly marked. Two copies of the receiving and analysis card are sent to the yardmaster, one copy to the inspection department, and one to the laboratory. When the car carrying the steel arrives, the yardmaster notifies the inspection department by sending it one of the copies of the steel receiving and analysis card, after which he weighs the car.

PRODUCTION DEP'T REQUISITION ON PURCHASING DEP'T

PLEASE PURCHASE FOR DROP-FORGE DIVISION THE FOLLOWING STEEL

POUNDS	SIZE	S.A.E. SPECIFICATION	BAR LENGTHS	C	MN	SI	S	P	NI	CR	VA

TO BE DELIVERED AS FOLLOWS:

FOR SALES ORDER NO.	PART SYMBOL	DIE NUMBER	LOT NO.	PURCHASE ORDER NO.	DATE	SOURCE

APPROVED BY ____ REQUISITIONER ____
DATE ____ DATE ____

Fig. 8. Requisition sent to the Purchasing Department

The inspection department makes a surface inspection of the steel, and takes one sample, by lot numbers, from each ten bars for analysis. Then there is placed on each lot the inspectors "hold card" on which is printed in large type "Hold—do not use this material. It has not been passed by the inspection department." The samples are next sent with the yardmaster's notification slip to the laboratory. The steel is inspected during the unloading operation, at the end of which the car is weighed light, and the weight entered on the receiving and analysis card, as shown in Fig. 6.

When the steel analysis has been completed at the laboratory, the inspection

FORM P7 11-20 25 BOOKS

LEAD APPROVAL

To Die Foreman ... 19...

Have Approved Lead Cast For Die No. ... Serial No.
Part Symbol ... Part
Have Die and Trimmer Ready For Production On ... 19...
Hammer No. ... Press No.

... Production Dept.

Dies Were Ready For Production On ... 19...
Trimmers Were Ready For Production On ... 19...

... Foreman

Billing Price of Dies $
Costomer
Dies Billed By ... 19...

Fig. 9. Lead Approval Slip made out when the Customer approves the Lead Cast

analysis slip is sent from that department to the inspection department and the "hold card" is removed from the steel. This steel is then available, and the inspection analysis slip is sent to the production department. At the time the car is unloaded, the yardmaster sends his second copy of the receiving analysis slip to the purchasing department, as a receiving slip. Each step in the receiving, testing, and storing of the steel is recorded on the information board.

Approval of Lead Cast

As soon as the lead cast is ready for the customer's approval, the die-room forwards it to the inspection department. After it has been approved by the inspectors, it is sent to the production department, and from there to the customer. When the customer approves the lead cast, the production department makes out a set of lead cast approval slips on the form Fig. 9. Three copies of this approval slip are sent to the die-room and one to the billing department. When the dies and trimmers are ready for use, the die-room forwards one copy to the production department and one to the cost department. This progress is also posted on the information board.

FORM P6 11-20 25 BOOKS

DIE and TRIMMER RELEASE

..................19..........

TO HAMMER / TRIM SHOP FOREMAN

Die No.................Seria .... Symbol .... Part ......

Is Released To HAMMER NO. / PRESS NO. .... At .... M .... 19..........

To FORGE / TRIM ....Pieces on Order No. ....

Lead Cast Was Approved By Customer .... 19 ....

The Rate On This Part Will Be ....

On This Work There Will Be Allowed.......... Fires.......... Helpers..........

Size Steel Will Be.................. Cut............. To Make.............. Forgings ....

Operation Numbers Are..........

Steel Lot No...................

Production Department

Taken Out........ ....M.................19........Account Of..........

This Die Must Be Repaired Resunk Or Will Be Able To Forge ....Pcs. More

This Trimmer Must Be Repaired A New One Made Or Will Trim ....Pcs. More

Foreman

Fig. 10. Die and Trimmer Release Order

DROP-FORGE DIVISION

INSPECTOR'S DAILY INDIVIDUAL HAMMER REPORT

HAMMER NO.________

FORGER NO. ________ DATE ________

PART NO. ________ DIE NO. ________

RAW MATERIAL TODAY

AT START SIZE ________ PCS. ________ WEIGHT ________

DELIVERED SIZE ________ PCS. ________ WEIGHT ________

AT FINISH SIZE ________ PCS. ________ WEIGHT ________

USED SIZE ________ PCS. ________ WEIGHT ________

GROSS WEIGHT OF FORGINGS MADE TODAY ________

FORGINGS MADE TODAY

HEAT NO.	GOOD	REJECTS	CAUSE OF REJECTION

FORGINGS REPAIRED TODAY

PRODUCTIVE HOURS ________ NON-PRODUCTIVE HOURS ________

REASON FOR DOWN TIME ________

SIGNED BY ________ INSPECTOR

Fig. 11. (A) Individual Hammer Report

DEFECTIVE MATERIAL

DATE	NO.
PART SYMBOL	DIE NO. AND SERIAL
MADE ON ORDER NO.	REPAIR NUMBER
NUMBER PCS. DEFECTIVE	NO. PCS. SAVED
LAST OPERATION	NEXT OPERATION
NATURE OF DEFECT	
DISPOSITION	
INSPECTOR REJECTING	
CHARGE COST OF MAKING GOOD TO	
INSPECTOR ACCEPTING	

DATE	NO.
PART SYMBOL	DIE NO. AND SERIAL
MADE ON ORDER NO	REPAIR NUMBER
NUMBER PCS. DEFECTIVE	
NATURE OF DEFECT	
LAST OPERATION	
DISPOSITION	
INSPECTOR REJECTING	
NEXT OPERATION	
CHARGE COST OF MAKING GOOD TO	

DEFECTIVE MATERIAL

(B) Defective Material Tag

MOVE ORDER NO.________

DATE ________ SHIFT ________

MOVE FROM ________ TO ________

________ PCS. PART NO. ________

DIE NO ________ SERIAL ________ S.O. NO ________

OPERATIONS TO PERFORM IN MAKING THESE FORGINGS

COMPLETED OPERATIONS ________

NEXT OPERATION ________

PRODUCTION DEP'T

WHEN MOVE HAS BEEN MADE, SIGN AND RETURN TO PROD. DEPT.

DATE ________ MOVER ________

MOVE RECEIPT NO.________

DATE ________ SHIFT ________

RECEIVED FROM ________

________ PCS. PART NO. ________

DIE NO. ________ SERIAL ________ S.O. NO. ________

TO PERFORM OPERATION ________

LAST OPERATION PERFORMED ________

NEXT OPERATION TO PERFORM ________

COUNTER FOREMAN

WHEN RECEIVED CHECK SIGN AND RETURN TO PROD. DEPT.

(C) Work Transfer Order Blank

FORM P8 11-20-25 BOOKS NO.

RAW MATERIAL DELIVERY NOTICE

From Lot No. .... Heat

I Delivered .... Pcs. of

Cut .... Lg. Which Will Make .... Pcs. Ea.

For Die No. .... Serial..

Part Symbol..

To Hammer No. .... At .... M 19

Actual Weight in Pounds

.... 19

Yardmaster

.... 19

Production Dept.

Weight .... @ .... per lb.

.... 19

Cost Dept.

Pieces at Start Today

Pieces Delivered Today

Total Pieces at Hammer.

Gross Forgings Made

Pieces Left at Close

Forge Order No.

REMARKS

Fig. 12. Raw Material Delivery Notice

FORM P7 11-20 10 BOOKS NO. ....

RAW MATERIAL TRANSFER NOTICE

From Hammer No. .... At .... M .... 19 ...

I Transfered .... Pcs. of ....

Lot No. .... Heat No. ....

Cut .... Long. To Stock ....

Actual Weight in Pounds ....

For Die No. .... Part ....

Reason ....

Date ....

Yardmaster

Date ....

Production Dept.

Weight .... Lbs. @ .... $

Date ....

Cost Dept.

Forge Order No....

REMARKS

Fig. 13. Raw Material Transfer Notice

Delivery of Steel at Forging Hammer

About five hours before a hammer completes the job on which it is at work, the production department makes out a set of release slips of the form shown in Fig. 10. Copies of this slip are sent to the die-room foreman, hammer-shop foreman, steel-room foreman, timekeeper, and cost department. When the steel-room foreman receives his copy, he immediately prepares to transfer the steel from the store-room to the hammer, so that no delay will occur.

FORM P3. 11-20-2M

DROP FORGE DEPARTMENT

DAILY PRODUCTION REPORT

SHIFT .... DATE ....

Hammer Number	Die No.	Die Serial	Part Symbol	CUSTOMER	Emp. No.	PRODUCTION Gross	Net	Scrap	Welds	Restrikes	Pieces Restruck	Pieces To Run	Next Die	Steel Lot No.	Prod. Hrs.	Fires	Helpers	Cause for Delay

Weight of steel used today
Weight of steel used to date
Weight of finished forgings today
Weight of finished forgings to date
Weight of rejections today
Weight of rejections to date
Weight of scrap today
Weight of scrap to date
Percent actual running time
No. employees today No. absent

Weight shipped today
Weight shipped to date
Weight shipped last period
Weight shipped to date last year
Value forgings produced today
Value forgings produced to date
Value forgings produced to date last period
Value forgings produced to date last year
Payroll today Hours today
Payroll to date

Fig. 14. Daily Production Report Sheet made out from the Individual Hammer Reports

When the steel-room foreman delivers the steel to the hammer he makes out a steel delivery slip on the form shown in Fig. 12, and if at any time he removes steel from the hammer he makes out a transfer slip on the form shown in Fig. 13. At the close of each shift, one copy each of these slips is handed to the production and cost departments. The steel-room foreman has the amount of steel at the hammers checked at the beginning and end of each shift, and the amounts recorded on the slips. The production department then checks the amounts on these slips against the forgings made, and deducts from or adds to the steel record the amounts shown on these slips.

As work on the order progresses, the floor inspector makes out at the end of each shift an individual hammer report on the form shown at *A* in Fig. 11. These reports are sent to the production department at the end of each shift. As these slips give the amount of steel for each hammer at the beginning and close of each shift, the number of net rejects and scrap forgings made, the number of productive hours spent, and the reasons for any delay or

PART NAME ....
HAMMER ....
ESTIMATE NO ....

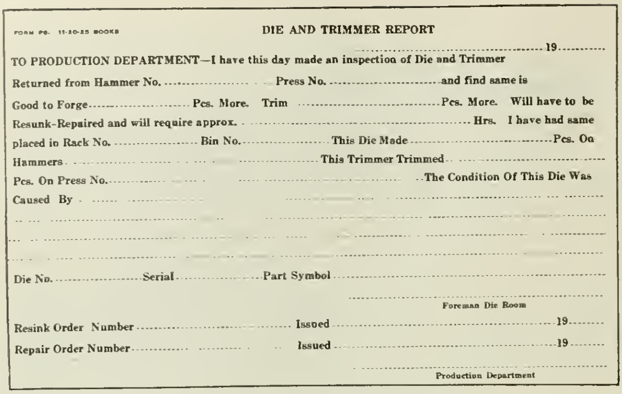
DROP FORGE DEPARTMENT

PRODUCTION RECORD

CUSTOMER .... SHEET ◯ OF ◯

CUSTOMERS REQUIREMENTS	HAMMER NO.	DATE	SHIFT	PRODUCTION GROSS	TOTAL GROSS	FINISHED	TOTAL FINISHED	BALANCE TO RUN	BLOCKED	RESTRUCK	TRIMMED	SHOP REJECTS Scrap	SHOP REJECTS Repair	TRIM Scrap	TRIM Repair	FINAL INSPECTION Scrap	FINAL INSPECTION Repair	RETURNS BY CUSTOMER Scrap	RETURNS BY CUSTOMER Repair	SHIPMENTS DATE	PACKING SLIP NO.	QUANTITY	TOTAL SHIPMENT	BALANCE TO SHIP	VIA	ORDER NO ....
OPERATION NUMBERS																										DIE NO Part Symbol Customers Order No. Date Cust. Order Date Entered Size Material Steel Specifications Length to Cut Steel Length Makes Pcs. Gross Wgt. ea. Net Wgt. ea. Quantity On Order Quantity Steel Needed Quantity Steel in Stock Steel Lot No. Quantity Steel Ord. Steel Mill Steel Order No. Steel Promised Average Per Day Ship Via Lead Cast Sent Lead Cast Approved Fires Helpers Heat Treat

Fig. 15. Production Record Sheet filled out from Daily Production Report



FORM PG. 11-10-25 BOOKS

DIE AND TRIMMER REPORT

TO PRODUCTION DEPARTMENT—I have this day made an inspection of Die and Trimmer .... 19..........

Returned from Hammer No. .... Press No. .... and find same is

Good to Forge.................. Pcs. More. Trim .... Pcs. More. Will have to be

Resunk-Repaired and will require approx. .... Hrs. I have had same

placed in Rack No. .... Bin No. .... This Die Made .... Pcs. On

Hammers .... This Trimmer Trimmed ....

Pcs. On Press No. .... The Condition Of This Die Was

Caused By ....

Die No. .... Serial .... Part Symbol ....

Foreman Die Room

Resink Order Number .... Issued .... 19..........

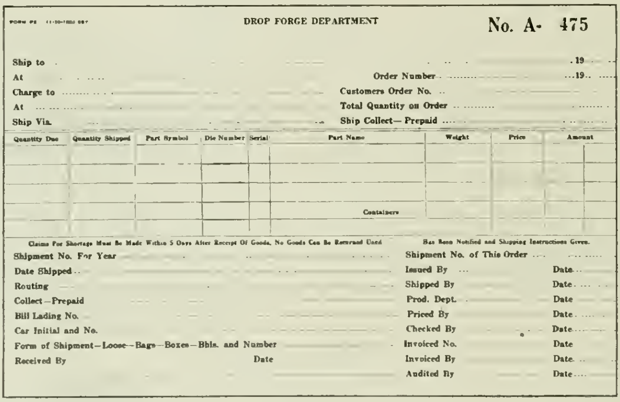
Repair Order Number .... Issued .... 19..........

Production Department

Fig. 16. Die and Trimmer Report Blank

failure to meet the production schedule, it is an easy matter for the production department to record all progress on the production board.

From these slips and the shipping report, the production department makes out the daily production report on the form shown in Fig. 14. The production record is made out from this production report on the form shown in Fig. 15. If the floor inspectors find defective forgings that can be repaired, they place a defective ticket such as shown at *B*, Fig. 11, on them, and send the stub or lower part of the ticket to the production department with the individual hammer reports. When the pieces are repaired and passed by the inspector, the remainder of the ticket is turned in to the production department also. Whenever forgings are moved from one place to another for different operations, a "move ticket," such as shown at *C*, is made out.



FORM PE 11-20-1000 007

DROP FORGE DEPARTMENT

No. A- 475

Ship to .... 19......

At .... Order Number .... 19......

Charge to .... Customers Order No. ....

At .... Total Quantity on Order ....

Ship Via .... Ship Collect— Prepaid ....

Quantity Due	Quantity Shipped	Part Symbol	Die Number	Serial	Part Name	Weight	Price	Amount
					Containers			

Claims For Shortage Must Be Made Within 5 Days After Receipt Of Goods. No Goods Can Be Returned Used — Has Been Notified and Shipping Instructions Given.

Shipment No. For Year .... Shipment No. of This Order ....

Date Shipped .... Issued By .... Date ....

Routing .... Shipped By .... Date ....

Collect—Prepaid .... Prod. Dept. .... Date ....

Bill Lading No. .... Priced By .... Date ....

Car Initial and No. .... Checked By .... Date ....

Form of Shipment—Loose—Bags—Boxes—Bbls. and Number .... Invoiced No. .... Date ....

Received By .... Date .... Invoiced By .... Date ....

Audited By .... Date ....

Fig. 17. Shipping Order Blank

When a job is completed, the dies are removed from the hammer and sent at once to the die-room. The hammer-shop foreman fills in the remainder of the release order and sends it to the production department. Upon receipt of the dies and trimmers, the die foreman makes out an inspection report on the form shown in Fig. 16, and sends it to the production department. This information is recorded on the information board.

Shipping Statements

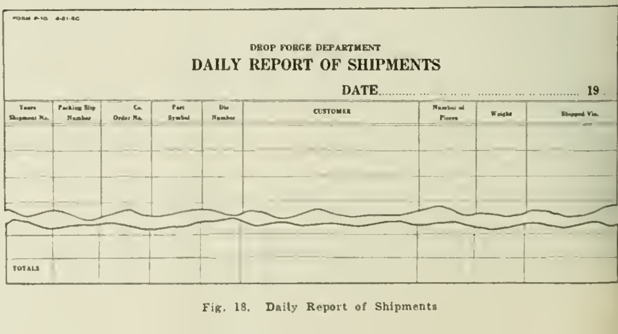
When a hammer release slip is made out by the production department, a set of shipping statements are made out on the form shown in Fig. 17. One copy of these statements is kept as a tracer, one forwarded to the billing department, also as a tracer, and four copies are sent to the shipping department. Two of the copies are sent to the shipping department when the goods are shipped to the customer, one to be signed by the customer and returned, and one to be retained by him. One copy goes directly to the cost department and the other to the production department. From the copy received by the production department is posted the production record, after which this copy is sent to the billing department from which it is sent to the cost department. At the end of each day the shipping department sends one copy each of the daily shipment reports, Fig. 18, to the production, billing, and cost departments.

When shipping instructions are given to a customer for the return of goods, the production department makes out a set of receiving inspection reports on the form shown in Fig. 19, and sends them to the receiving department. When the forgings arrive, this set of reports is sent to the inspection department, where the goods are inspected. Three copies of the inspection report are then sent to the production department, which, in turn, forwards one copy to the billing department and one to the cost department. The inspection department attaches a ticket to these forgings like the one used for shop rejects, and from then on they are handled in the same manner as shop rejects, except that they bear a repair order number instead of a sales order number.

A system such as the one described in the two installments of this article makes it possible for an effective control to be exercised over production in a drop-forging plant and for an accurate record to be kept of the costs of production, which, of course, are vital requirements in any manufacturing organization. The various forms illustrated will be of suggestive value to other plants engaged on the same or similar classes of work, who wish to install a system that will enable them to determine definitely whether their work is being done at the lowest possible cost. These forms would, of course, be modified to suit the conditions peculiar to different plants.

* * *

According to *Safety Engineering*, 75,500 lives were lost and 2,000,000 people seriously injured in the United States by accidents last year. Of this number 11,000 persons were killed in automobile accidents alone.



FORM P-10. 4-21-5C

DROP FORGE DEPARTMENT

DAILY REPORT OF SHIPMENTS

DATE.................. 19..

Years Shipment No.	Packing Slip Number	Co. Order No.	Part Symbol	Die Number	CUSTOMER	Number of Pieces	Weight	Shipped Via
TOTALS								

Fig. 18. Daily Report of Shipments

HELPING EMPLOYES TO SAVE

At the plant of the Dodge Mfg. Co. in Mishawaka, Ind., it was realized some years ago that the failure of employes to save any part of their wages was preventing them from getting the success and satisfaction out of life that their work and efforts entitled them to. Not that conditions were any worse in this factory than elsewhere; it was simply that the management of this concern noted an obstacle in the path of men in the company's employ. The fact was borne home with unusual strength during the early part of 1915 when industrial wages were reaching a new high level.

At that time C. E. Lukenbach, employment manager of the Dodge Mfg. Co., came before the directors of the firm with a plan designed to instruct employes in the practice of thrift. He claimed that factory workers could be taught to save a definite amount of their weekly wages, and offered to interview the men in the factory personally and get them to join a Thrift Club. According to the plan, no inducement was to be offered beyond that of calling attention to the failing common to all classes of men of spending their entire income.

The preliminary canvass for members of the Dodge Thrift Club was started in May, 1915, and during the first week pledges of weekly deposits were received amounting to $79.50. Every man had to be "sold" personally on this proposition; but the results are shown by the fact that from May, 1915, to January, 1916—a period of seven months—the deposits had increased to $6000, and on January 1, 1917, this amount had grown to $20,000. From that time on the progress of this Thrift Club has been almost phenomenal. During 1919 the amount deposited was $82,000, and for 1920 the deposits totaled $130,000.

In order to bring the benefits of the Thrift Club within the reach of all factory employes, it was decided to accept deposits in amounts of 25 cents a week up, in any multiple of the minimum deposit. All those who join the Thrift Club are expected to continue making deposits for at least thirteen weeks, and after twenty-six weeks, interest is paid on the average balance at the rate of 5 per cent. Every depositor is urged to start low and to increase his rate of deposit as he is able to. At the present time deposits range from 25 cents up to $30 a week. There are three men who deposit their entire wages and then take advantage of the checking privilege which goes with membership in the club. A depositor may withdraw any sum on such checks up to the amount of his entire deposit. To do so he goes to the office and fills in a special withdrawal notice. This notice is sent to the treasurer's office, and a bank check is drawn against the account of the Thrift Club in favor of the member who wishes a check for the payment of some current bill.

The measure of success of this Thrift Club is best shown by the fact that many men who formerly spent every cent they earned have now formed a habit of setting aside something for the proverbial "rainy day." At the time the club was started many of the men had been in debt for years—not, perhaps, for a large amount, but nevertheless in debt.

To show the results that the Thrift Club is accomplishing, it will be of interest to cite one or two specific examples. Not long ago a man came to the office of the employment manager and asked for a blank on which he ordered the withdrawal of $21 from his account in the Thrift Club. That man's wife had been sick and the rent money had been used to pay the doctor. It certainly made things easier to have a surplus for the landlord on the first of the month. Another man who had been most difficult to get into the Thrift Club accumulated a surplus of $86, and then used the money to clear up a number of debts; he stated that during fourteen years of married life he had never been out of debt.

Insurance Privileges of the Mutual Relief Association

In addition to the Thrift Club, the Dodge Mutual Relief Association maintains a fund from which payments are made to the members for time lost through sickness and also to the beneficiary of the insured upon death. There are six different plans of insurance to which subscription may be made, and these carry various benefits for disability or death. At present there are 750 members of the office and shop force who are carrying this protection, and as it is obtained on the mutual basis, that is, without yielding any profit to stock-holders, the rate is very low.

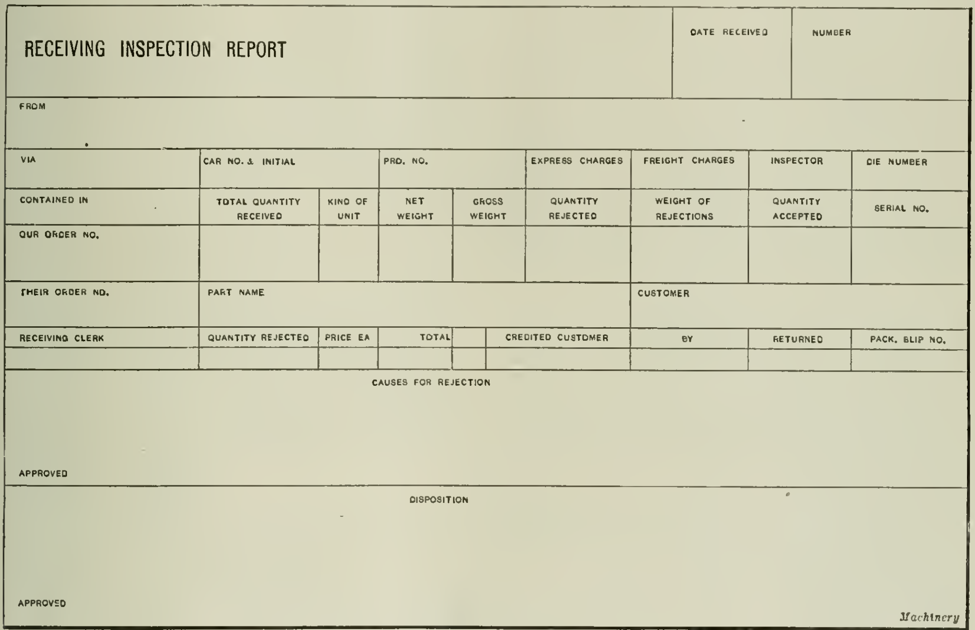
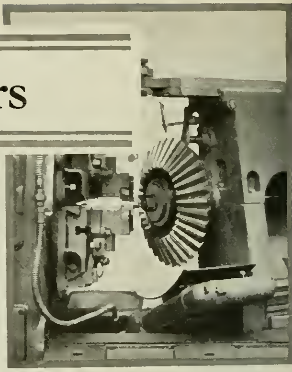

RECEIVING INSPECTION REPORT
DATE RECEIVED
NUMBER
FROM
VIA
CAR NO. & INITIAL
PRO. NO.
EXPRESS CHARGES
FREIGHT CHARGES
INSPECTOR
DIE NUMBER
CONTAINED IN
TOTAL QUANTITY RECEIVED
KIND OF UNIT
NET WEIGHT
GROSS WEIGHT
QUANTITY REJECTED
WEIGHT OF REJECTIONS
QUANTITY ACCEPTED
SERIAL NO.
OUR ORDER NO.
THEIR ORDER NO.
PART NAME
CUSTOMER
RECEIVING CLERK
QUANTITY REJECTED
PRICE EA
TOTAL
CREDITED CUSTOMER
BY
RETURNED
PACK. SLIP NO.
CAUSES FOR REJECTION
APPROVED
DISPOSITION
APPROVED
Machinery

Fig. 19. Receiving and Inspection Report Blank for Goods that have been returned by the Customer

Cutting Bevel Gears



Principles Governing Operation of Generating Planers and General Methods of Setting up and Adjusting Bilgram Machine for Cutting Bevel Gears—First Installment

By FRANKLIN D. JONES

CUTTING bevel gears is not so simple as cutting spur gears, because the teeth have a converging form. A correctly formed bevel gear tooth has the same sectional shape throughout its length but on a diminishing scale from the large to the small end. This accounts for the fact that a bevel gear cannot be cut properly by using a formed milling cutter which simply reproduces its shape, because if this cutter were of the exact curvature required at the large end of the tooth, it would not be correct for any other part, and the error would be considerable at the small end of the tooth. Consequently, accurate bevel gears are cut by a generating process, since that is the only way to give the tooth the proper curvature on a diminishing scale, the tooth tapering toward the apex of its pitch cone.

Principle of Generating Process as Applied to Bevel Gears

In connection with the cutting of spur gears by generating methods, it was explained that the straight-sided rack of involute gearing is represented either directly by the cutter used, or indirectly as when a circular form of cutter is generated from the rack. Now the relation between a rack and spur gear is similar to that of a crown gear to a bevel gear; thus the pitch surface of a rack and also of a crown gear coincides with a plane. The teeth of a crown gear are also straight sided like those of a rack, although of converging form, and the inclination of each side corresponds to the pressure angle. The cutting tools of bevel gear generators, therefore, represent the crown gear and when a bevel gear is being cut the tooth curves are derived by imparting to the work and to the cutting tool the same relative motion that would be obtained if the gear being cut were rotating in mesh with the crown gear. In addition to this generating motion, provision must be made in a practical design of machine for giving the tool or tools a reciprocating motion for cutting, and an indexing movement to the work in order to cut equally spaced teeth around the entire gear.

The generating motion on some machines is obtained by rolling the gear being cut, relative to the cutting tool (representing a crown gear tooth) just as though this gear were finished and rolling around a stationary crown gear. Thus all the generating motion is applied to the work; the cutting tool is simply given a reciprocating motion for planing. This method of generating is illustrated by the diagram Fig. 1. The gear to be cut, which is usually roughed out before finishing the teeth on a generator, is rolled about axis x of an imaginary crown gear while the planing tool is at work. One side of this tool or cutter is in the same position as the side of a crown gear tooth, and the point of the cutter moves along line x—y. The cutter forms one side of the tooth while the gear is slowly rolling from the position indicated by the full lines to the position shown by the dotted lines.

This rolling motion must be sufficient to roll the entire side of a tooth along the straight cutting edge of the tool. This straight cutting edge produces a smooth curved surface, because the rolling movement is very slight for each cutter stroke; hence, a number of strokes are required to finish the side of a tooth. Means must be provided to positively and accurately control this rolling motion of the gear. Suppose that the work-spindle carried at the outer end a master gear or a segment gear extending over a large enough arc to provide for all the rolling motion that is required; and assume that this master gear segment has the same pitch cone angle and pitch as the gear to be cut and is in mesh with a fixed crown gear segment. Then the rolling action can be properly controlled. The Bilgram machine, which is one type to be considered, operates on this general principle, although instead of actually using master and crown gear segments having teeth, a segment of the pitch cone with a smooth conical sur-

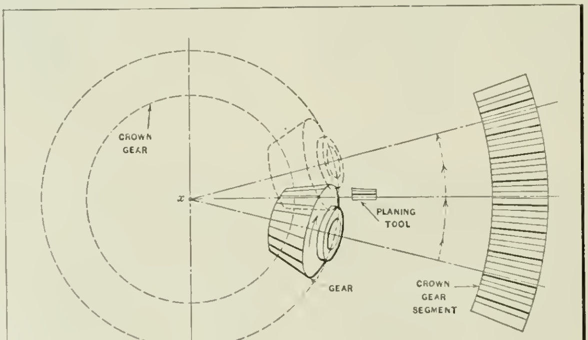


Fig. 1. Diagram illustrating Action of Bevel Gear Generator when all of the Generating Motion is applied to the Gear

face rolls on a flat surface as explained later. In the diagram Fig. 1, no provision is made for indexing the gear to present different teeth to the cutting tool. This part of the mechanism will be considered in connection with commercial types of machines.

Action when Generating Motion is Applied to Both Gear and Planing Tool

A common type of bevel gear generator is so designed that the generating action is applied to both the work and to the cutting tools. In this case the action is similar to that of a crown gear rotating in mesh with the gear being cut, each gear revolving about a fixed axis. Fig. 2 represents this generating motion in diagrammatic form. While each gear tooth is being planed, the gear turns part of a revolution about a fixed axis x—x, just as though the imaginary crown gear were turning with it. The planing tool also swings around with the gear as though it were one of the crown gear teeth. Only one tool is shown on the diagram to simplify it, although two are used on the Gleason machines which represent a commercial application of the generating motion illustrated by this diagram. Because of the converging form of the space between two teeth, it is impossible to cut more than one side at a time with a single tool or cutting edge, although it is not only feasible but desirable to use two tools which operate on both sides of a tooth.

On some machines the generating action indicated by Fig. 2 is controlled by a crown gear, which, as indicated by the diagram, swings with the toolslide, and is in mesh with a master gear segment connecting with the work-spindle. Such an arrangement causes the crown gear segment and the tools to move through an arc represented by the full and dotted lines, while at the same time the master gear rolls in mesh with the crown gear and causes the gear blank to turn in unison with the tools. Another method of regulating and controlling this generating motion is by using suitable combinations of change-gears instead of the crown and master gear segments. Thus, by selecting gearing of the proper ratio, the relative motion between the tools and work is the same as though a crown and master gear segment were employed.

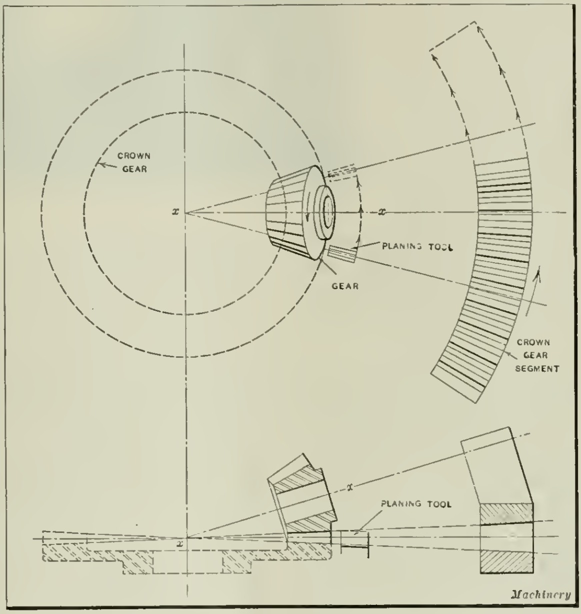


Fig. 2. Diagram representing Action when Generating Motion is applied to Both Gear and Tool

Planing Bevel Gears on Bilgram Machines

The Bilgram bevel gear generator made by the Bilgram Machine Works, Philadelphia, Pa., operates on the principle illustrated by the diagram Fig. 1, of imparting to the gear to be cut, a rolling motion corresponding to the rotation of a finished gear rolling on a crown gear. This generating motion might be derived from a master gear rolling on a crown gear as previously explained, but in the practical application of this principle to the Bilgram machine, a segment of the pitch cone is used instead of a master gear, and as this segment rolls on a flat surface representing the pitch surface of the crown gear, the blank being cut receives the required generating motion.

The action of this machine and its adjustment for cutting bevel gears will be described in connection with Figs. 3 and 4. While these views are not of the same machine, they show the mechanism from opposite sides. The part of the machine to the right, as seen in Fig. 3, is the shaper or planing mechanism, and at the left of the gear being cut is the generating mechanism from which the rolling motion is derived. When the machine is at work, the tool is lifted to clear the blank during the return stroke, but it does not have a lateral feeding motion like the Bilgram spur and spiral gear generator. During each return stroke of the tool, the gear blank indexes to bring the following tooth space into the cutting position. In conjunction with this indexing movement the progressive rolling action of the gear occurs. The vertical axis of the imaginary crown gear about which the gear being cut rolls, is at the left of this gear, and the action of the gear is the same as though it were rolling on a crown gear having teeth on the under side.

The planing tool (representing a crown gear tooth) takes successive cuts from tooth spaces around the entire gear as the latter is indexed after each cutting stroke; consequently, when rough-planing a gear from the solid blank, all of the teeth are roughed out while the gear is slowly rolled from the beginning to the end of its generating movement. When finishing a gear after roughing, all of the teeth are first finished on one side and then, after making a slight adjustment and inserting another tool, the remaining sides of the teeth are formed.

The cutting of gears directly from solid blanks is common practice in connection with jobbing work; if a quantity of duplicate gears is required, the teeth may be roughed out on another type of machine adapted for this work and the generator used only for finishing. The stroke of the tool is regulated by an adjustable crank, and the means for automatically lifting the tool during the return stroke is part of the shaper mechanism.

Operation of the Spacing and Generating Mechanism

The mechanism which serves to index the gear and impart a rolling motion to it is connected with the driving end of the machine by two shafts A and B, Fig. 4. The motion for indexing or spacing is derived from shaft A, which is splined and drives through spiral gears so arranged as to permit the generating head to move in any direction. The indexing mechanism has an intermittent or Geneva wheel motion and change-gears which are in action during the return stroke of the tool. When the tool is cutting, a pawl engages a spacing wheel which is so located as to insure accurate indexing, irrespective of lost motion in the change-gears.

The rolling motion is derived from shaft B, which is revolved at whatever speed is required to obtain a suitable rate of feed, depending upon the pitch, number of teeth, and material to be cut. A circular design of geared feed-box is located at the left-hand end of shaft B, beyond the range of this particular illustration. The cross-shaft C, driven by B, carries a worm which meshes with a worm-wheel segment attached to the base connecting with the main work-spindle. The vertical axis of this worm-wheel segment coincides with the axis of the imaginary crown gear previously referred to and represented by axis x in Fig. 1. The cone segment D corresponds, at least approximately, to the pitch cone angle of the gear to be cut, and rolls on a horizontal surface as the worm-wheel segment turns slowly about its vertical axis. This cone segment is attached to segment-shaped bars E by clamps at F, the latter providing means of adjustment according to the angle at which the work-spindle is set. (The arrangement of the cone segment and supporting bars is shown more clearly in Fig. 3, as the machine happens to be equipped with a cone segment of larger radius.)

The rolling motion is controlled by two steel bands G, Fig. 4, which are attached at one end to the cone segment and at the other end to the horizontal bar. With this arrangement, when the worm on shaft C revolves the worm-wheel segment, the cone segment D rolls along on its horizontal surface, representing the pitch surface of the crown gear; consequently, the work-spindle has a rotary motion about its axis, and at the same time swings bodily about the axis of the imaginary crown gear. The result is that the gear being cut is given a correct generating motion relative to the planing tool. The machine is equipped with a series of cone segments of different angles which are selected in accordance with the pitch cone angle of the gear that is to be cut.

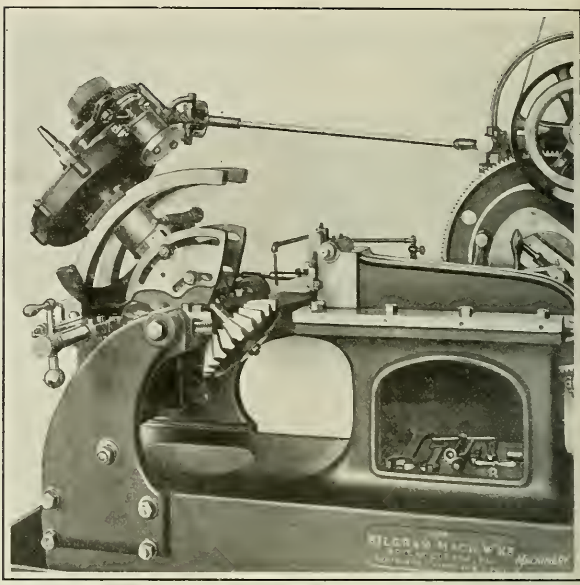


Fig. 3. Bilgram Bevel Gear Generator

General Method of Adjusting the Machine

When setting up a machine, the work-spindle is first adjusted according to the pitch cone angle of the gear to be cut. The segment and worm for making this adjustment are shown at H, Fig. 4. A pitch cone segment is selected which is nearest to the pitch cone angle of the gear. If the latter angle is about midway between two segment angles, preference is given to the smaller angle. The pitch cone segment is attached to bars E, as mentioned previously, and steel bands leading from each end of the segment to opposite ends of the horizontal "cone bar" are attached and stretched moderately tight. The change-gears and anchor wheel of the indexing mechanism are selected according to the number of teeth in the gear. These change-gears are located at N on the outside of the spacer housing.

As the planing tool must travel parallel with the bottom of the tooth space, it is necessary to make an adjustment equal to the dedendum angle. This is done by adjusting the entire generating mechanism, which is supported on each side by trunnions J. A screw connected with handwheel K is used, and the angle of adjustment is determined by graduations on scale L in conjunction with graduations on a bevel surface of the handwheel.

When the blank is properly set, the apex of its pitch cone coincides with the axis of trunnions J of the generating mechanism, which axis also intersects the vertical axis of the imaginary crown gear. The gear to be cut is adjusted axially, or in the direction of the work spindle, in order to locate the apex of the pitch cone in the right position. Small gears may be clamped to a mandrel which is adjusted longitudinally, but larger gears should be clamped against the lower end of the spindle with bushings between to get the proper adjustment. While adjustable collars may be used, solid collars faced to the required thickness are preferred. After the gear blank is clamped, its location is checked by a height gage set to the height of the tooth. Thus the gear blank is raised or lowered until this gage, when turned down into contact with the edge of the blank, gives a reading equal to the required tooth height. The accuracy of the blank is then checked by allowing the blank to make about one-quarter turn and repeating the height gage test three times.

As a final check, a distance piece, in conjunction with a gage bar of the machine, is used to determine the apex distance of the gear. While this measurement is being made, the generator should be in its central or zero position as regards the feeding motion. While the apex distance, to be strictly correct, should be measured when the generator is set horizontally or with the addendum

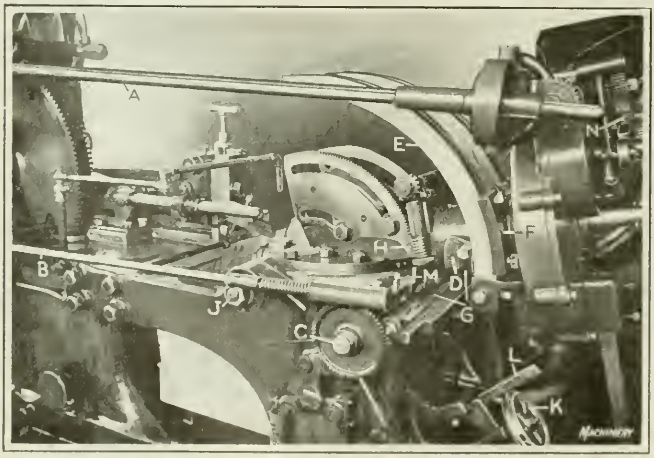


Fig. 4. Detail View of Another Bilgram Generator

angle at zero, this discrepancy can do no harm if the apex distance actually measured is noted and the mating gear is afterward set to the same distance.

Tools Used on the Bilgram Machine

There are three tools in a set. One is for stocking out, and there are right- and left-hand side-cutting tools for finishing opposite sides of the teeth. These tools may be ground on a surface grinder by using a holder supplied for this purpose. When a gear is to be roughed out on a machine, the stocking tool is set in a central position. A mark on the tool-slide shows when the tool is in the center. Thin packing strips are used with the smaller 6-inch machine. When using the side-finishing tools, the tool is set so that

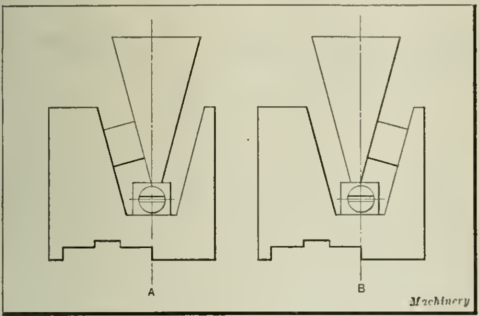


Fig. 5. Diagram showing Method of setting Tools on Bilgram Generator

the point or corner of the cutting edge is in the central position, as illustrated in Fig. 5, which shows the right- and left-hand tools.

Only one side of the teeth can be generated at a time, because of the forging form of the tooth spaces. The finishing tool must be set so that the lowest point of the cutting edge moves in a direct line toward the apex of the pitch cone or the center of the generator. The proper adjustments are obtained by a tool gage and gage-block illustrated in Fig. 5. The side-cutting tools have side slope or rake to give a better cutting action, whereas the stocking out tool is ground square across the end. When cutting some gears, such as soft bronze, for example, the tools with side rake may tend to gouge into the teeth and then the stocking out tool may be used for the side finishing cuts. When taking these finishing cuts, the lower edge of the tool should clear the bottom of the tooth space, as such contact sometimes causes chattering.

Angular Adjustment of Blank to Obtain Convergent Form of Tooth Space

The opposite sides of tooth spaces must be cut at slightly different angles, because both sides converge toward a common apex. For this reason, after the teeth are finished on one side, the gear is given an angular adjustment called the "shift." The master pinion engaging the master indexing or spacing gear, is so held that its position can be changed independently of the anchor wheel and change-gears. This movement is measured by a vernier scale. It is advisable to set the scale at zero when stocking out gears, and when finishing the sides of the teeth one-half of the amount of shift prescribed on the blueprint or shop order should be allowed on each side of the zero position. It is not necessary that the total shift be divided into equal parts, so long as this total amount is obtained when shifting from one side of the teeth to the other.

The feeding mechanism through which shaft *B* Fig. 4 is rotated, is set, not only with reference to the pitch of the teeth and the material, but also for roughing and finishing cuts. Thus, for finishing, a considerably higher rate is usually permissible than for roughing cuts. The feed may also be increased when stocking out, during the time the tool is approaching and after it has passed the middle position where the cutting is heaviest. Provision is made for reversing the direction of this feeding motion. The stop-pin *M* is placed on one side or the other according to the direction of feed, and fixed stops are also provided to insure stopping the machine if the operator should neglect to insert the adjustable stop-pin.

General Method of Operating Machine

After all adjustments have been made, the generating head is moved by hand for locating the blank in the proper position preparatory to starting the cut. The handle used for this adjustment is on the opposite end of feed-screw *C* (see Figs. 3 and 4). The feed mechanism is disengaged for this hand adjustment by loosening a knob in the front of the handle. The blank is first rolled away from the operator far enough for the tool to clear it; then, after starting the machine, the blank is brought back to a point where the tool begins to cut. Then the automatic feed is engaged. The direction of the feeding movement is controlled by a reversing knob on the feed box. The shift vernier should be set at zero for the stocking out cut, assuming that the gear is roughed out on the same machine used for finishing.

The first finishing cut is taken with that tool which cuts on the side farthest from the operator. This is the right-hand tool, and it is set so that the lower corner is in the central position as shown at *A*, Fig. 5. The shift vernier which has plus and minus graduations, is set on the plus side an amount equal to one-half of the shift required. After the blank has again been rolled away from the operator by the hand adjustment, and the geared feed-box is set for a coarser feeding movement, the finishing cut on one side of the teeth is taken. This cut is sometimes repeated to eliminate any inaccuracies due to springing action. Before taking the finishing cut with a left-hand tool, the shift vernier is set by the minus scale to one-half the shift required, and the feeding motion is reversed.

* * *

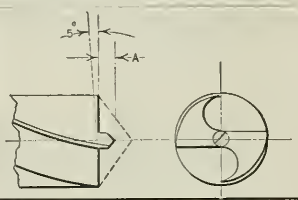
DRILL DIMENSIONS FOR TIN-PLATE DRILLING

By A. A. MARGIN

Holes larger than 5/16 inch in diameter cannot be drilled satisfactorily in tin plate with drills ground in the usual way. Even when a small lead-drill is used first and then followed up with a larger drill, the hole produced is likely to be over size, out of round, off center, and in some instances badly shattered. These defects may also result from the use of a combination centering drill.

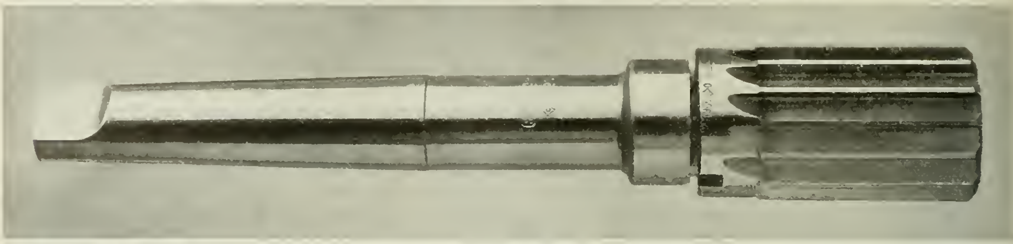
The writer has found that such difficulties may be avoided by grinding the drills in accordance with the data given in

Size of Drill, Inches	Dimension A, Inch
5/16 to 5/8	1/8
5/8 to 1 1/8	3/16
Over 1 1/8	1/4



the accompanying table. This table has been used to advantage in the tool-room when drilling tin-plate templets for laying out purposes. This work frequently requires the drilling of a large number of holes of different sizes, each of which must be round and accurately positioned.

A good example of the kind of work for which these specially ground drills proved satisfactory was a 12- by 12-inch plate, 1/16 inch thick, requiring ten accurately spaced holes ranging in size from 5/16 to 1½ inches in diameter.



Standardizing Shell Reamers and Arbors

Standard Dimensions Governing the Fits, and Gages Used for Inspection

By H. S. KARTSHER, Mechanical Engineer, The Cleveland Twist Drill Co., Cleveland, Ohio

CONSIDERABLE trouble has been experienced in the past with shell reamers and shell drills not fitting properly on the arbors used for driving them. This was due to the fact that different manufacturers had their own standards, and not more than two or three of the dozens were alike. Consequently, the reamers bought from one manufacturer would not fit the arbors of another. To eliminate this difficulty, the Drill and Reamer Association has specified that the reamer holes be made to a taper of ⅛ inch per foot on the diameter, that the arbors be tapered to correspond, and that the driving slots in the end of reamers and the lugs on arbors be made in accordance with the dimensions given in Table 1.

The various letters in this table refer to the dimensions indicated by the same reference letters in Fig. 1, where the taper of the arbor and reamer hole is shown considerably exaggerated for the sake of clearness. All tools made to these dimensions are to be stamped with a block letter S to distinguish them from tools made to old standards. The Cleveland Twist Drill Co. has set certain allowances and tolerances on these dimensions, and in the following a resumé of these fits will be given, together with a description of the gages used for inspecting the tools to see that they are machined to the correct size. It is only by adhering to a uniform system of tolerances in gaging of this kind that true interchangeability and satisfactory service to customers can be obtained.

Allowances and Tolerances for Fits on Taper Surfaces

In order to insure a good fit on the taper surfaces, an allowance *E*, Fig. 1, is made between the face of the reamer, when seated on the arbor, and the face of the arbor collar. Tolerances are placed on the large diameter of the hole in the reamer and on the diameter of the arbor (disregarding the recess near the collar) at a point located a distance *E* from the collar face, the basic diameter given for *H* being the minimum diameter in the case of the reamer, and the maximum in the case of the arbor. These tolerances are expressed in terms of length with respect to the taper surface, and permit each member to absorb 25 per cent of the basic allowance between the reamer face and the face of the arbor collar, so that should the reamer hole be made to the maximum diameter and the arbor surface to the minimum, there would still be left 50 per cent of the allowance to provide for wear. The limits on the diameter of the hole in the reamer at the large end and the diameter of the arbor at the gaging point, and the tolerance on these diameters, are given in Table 2.

On account of the fact that it is impossible to machine the driving lugs of the arbor in absolute alignment with the center of the reamer hole, a tolerance *X* is established to meet this condition. The formula for this tolerance is:

$$X = \frac{0.40\ (C - A)}{2}$$

in which

X = amount each member may be off center in either direction;

C = minimum (basic) width of slots in reamer; and

A = maximum (basic) width of lugs on arbor.

The difference between a minimum width slot and a maximum width lug is 1/64 inch in all cases, and so the solution resolves itself into

$$X = \frac{0.40 \times 0.015625}{2} = 0.003125 \text{ or } 0.003 \text{ inch}$$

for every size of reamer.

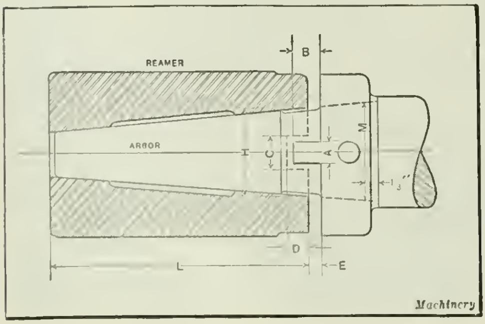


Fig. 1. Illustration showing on an Exaggerated Scale the Fit of a Shell Reamer on its Arbor

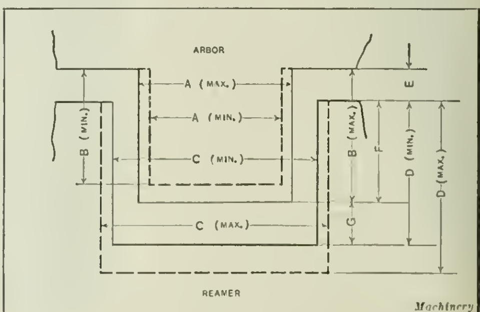


Fig. 2. Diagram showing Limits on Driving Lugs and Slots of Reamers and Arbors

It will be seen that in allowing the slots in the reamer and the lugs on the arbor to be off center an amount equal to 40 per cent of the smallest clearance, there still remains 20 per cent of that clearance even though both members should be out of true the maximum amount in opposite directions. Table 3 gives the maximum and minimum limits both for arbor lugs and reamer slots, as well as the driving length *F*, Fig. 2, and the clearances *E* and *G*.

The Master Gages

Before starting the manufacture of reamers and arbors, it was necessary to establish a sequence of operations and a system of gaging, the first gages required being three master gages. That known as the "master reamer" is shown in Fig. 3. The hole and the slots are made to very small tolerances, and correspond as nearly as possible to the dimensions of a reamer having a minimum diameter hole and size of slots, and any arbor which fits this gage will fit any reamer passing the inspection gages. The driving lugs and the taper surface of the master arbor illustrated at *V*, Fig. 7, are made to very small tolerances, and correspond to the dimensions of a maximum size arbor. Consequently a reamer which fits this gage will also fit any arbor passing the inspection gages.

Testing the Taper of Master Taper Plug Gages

The master taper plug gage shown at *W* is used in the manufacture of the other gages, the correct taper being determined within very close limits by setting up a pair of parallels with two different sizes of B. & S. ground disks spaced the proper distance apart by means of standard gage-blocks, as shown in Fig. 4. The middle line *H*, Fig. 7, of the three etched lines on the gage is located at a point where the tapered part is equal in diameter to the basic gage dimension *H* in Table 1, and the other two lines are located at points where the tapered part is equal in diameter to certain of the inspection gages ground to this master. All the gages considered in this article have a flat surface to provide a space for identification marks, such as the tool number, basic diameter, number of hole, trademark, and the block letter S previously mentioned. Master gages are also stamped with a letter M to distinguish them from inspection gages, which are stamped with the letter I.

TABLE 1. REAMER AND ARBOR DIMENSIONS ADOPTED BY THE DRILL AND REAMER ASSOCIATION*

Arbor No.	Diam. of Reamer Hole, Large End, Inches	Arbor Lugs		Driving Slots		Reamer Length, Inches
		Width, Inches	Depth, Inches	Width, Inches	Depth, Inches	
	H	A	B	C	D	L
3	0.250	7/64	1/8	1/8	5/32	2
4	0.375	9/64	5/32	5/32	3/16	2 1/4
5	0.500	11/64	7/32	3/16	1/4	2 1/2
6	0.625	11/64	7/32	3/16	1/4	2 3/4
7	0.750	15/64	9/32	1/4	5/16	3
8	1.000	15/64	9/32	1/4	5/16	3 1/2
9	1.250	19/64	11/32	5/16	3/8	3 3/4
10	1.500	19/64	11/32	5/16	3/8	4
11	1.750	23/64	13/32	3/8	7/16	4 1/2
12	2.000	31/64	15/32	1/2	1/2	5
13	2.250	31/64	15/32	1/2	1/2	5 1/2
14	2.500	39/64	9/16	5/8	5/8	6
15	2.750	39/64	9/16	5/8	5/8	6 1/2

Machinery

*See Fig. 1 for the notation in this table.

Manufacturing the Reamers and Arbors

As this article deals with the fit of shell reamers and their arbors, only such points in their manufacture as affect the fit will be considered here. The first operation on a reamer consists of reaming the hole to fit the plug gage shown at *X* in Fig. 7. Line *H* of this gage should be about 1/2 inch from the large end of the reamer to allow about 0.005 inch of stock in the hole for grinding after hardening. After that operation the gage must go into the reamer hole to line *H* at which point the diameter is the basic dimension given in Table 1. An axial tolerance *K*, equal to that specified in Table 2 for the proper size of arbor, is permitted.

Previous to hardening the reamer, the driving slots are milled to the limit plug gage shown at *X* in Fig. 5. On this, the "Go" and "Not Go" gaging surfaces are made to the minimum and maximum dimension *C* given in Table 3. As the depth of the slots has a tolerance of 1/64 inch, a scale measurement is considered sufficient in determining this dimension. After milling the slots, their alignment with the center of the hole is tested by means of the gage shown at *Z*, Fig. 7. A sliding sleeve on this gage carries a lug of a width *R* which is equal to the width of the minimum slot on a mating reamer, as given in Table 3, minus 0.006 inch to allow the slots to be off center 0.003 inch in either direction. After hardening the reamer and grinding the hole, this gage is again used to ascertain whether the slot width has changed in hardening; if this is the case, the interference must be ground away.

By again referring to Fig. 1, it will be seen that an arbor consists of two parts, a collar being driven on the arbor proper and pinned to it. The arbor proper is first turned to suit the gage shown at *X* in Fig. 6, on which diameter *M* corresponds to diameter *M* in Fig. 1; this dimension is 0.010 inch larger than the finished diameter of the tapered part carried to a point 1/8 inch from the shoulder provided on the arbor for seating the collar. The short pin projecting from the face of this gage is intended to come flush with the shoulder on the arbor or not reach it, while the large plug must reach the shoulder. The long pin is 0.400 inch longer than the short one and allows from 0.010 to 0.014 inch of stock on the diameter for subsequent grinding. The arbor

TABLE 2. LIMITS AND TOLERANCES FOR THE FITS OF SHELL REAMERS ON THEIR ARBORS*

Arbor No.	Arbor			Reamer			Allowance E	
	H (Min.) Inches	H (Max.) Inches	Tolerance K, Inches	H (Min.) Inches	H (Max.) Inches	Tolerance K, Inches	Min. Reamer and Max. Arbor, Inches	Max. Reamer and Min. Arbor, Inches
3	0.2498	0.250	0.0156	0.250	0.2502	0.0156	0.0625	0.0312
4	0.3748	0.375	0.0156	0.375	0.3752	0.0156	0.0625	0.0312
5	0.4997	0.500	0.0234	0.500	0.5003	0.0234	0.0937	0.0469
6	0.6247	0.625	0.0234	0.625	0.6253	0.0234	0.0937	0.0469
7	0.7497	0.750	0.0234	0.750	0.7503	0.0234	0.0937	0.0469
8	0.9997	1.000	0.0312	1.000	1.0003	0.0312	0.1250	0.0625
9	1.2497	1.250	0.0312	1.250	1.2503	0.0312	0.1250	0.0625
10	1.4997	1.500	0.0312	1.500	1.5003	0.0312	0.1250	0.0625
11	1.7495	1.750	0.0469	1.750	1.7505	0.0469	0.1875	0.0937
12	1.9995	2.000	0.0469	2.000	2.0005	0.0469	0.1875	0.0937
13	2.2495	2.250	0.0469	2.250	2.2505	0.0469	0.1875	0.0937
14	2.4993	2.500	0.0625	2.500	2.5007	0.0625	0.2500	0.1250
15	2.7493	2.750	0.0625	2.750	2.7507	0.0625	0.2500	0.1250

Machinery

*See Figs. 1, 6, and 7 for the notations in this table.

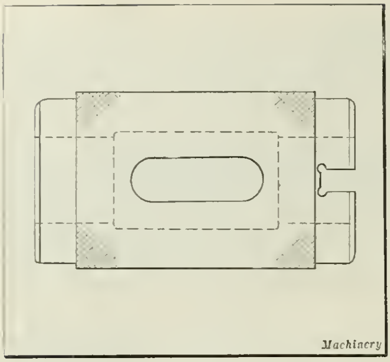


Fig. 3. Master Reamer made to Minimum Reamer Dimensions

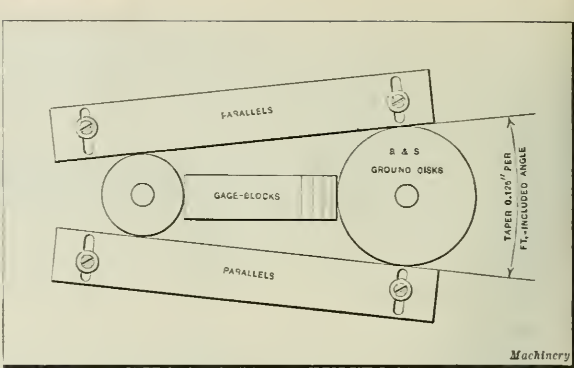


Fig. 4. Set-up of Parallels, Disks, and Gage-blocks to test the Taper of the Gage shown at W, Fig. 7

is finally recessed, as illustrated in Fig. 1, in order to facilitate the grinding of the taper surfaces after the collar is pressed on.

The arbor collar is first reamed to suit the requirements of the plug gage shown at Y, Fig. 7, on which the larger diameter of the etched band is the same as diameter *M* on the gage at *X* in Fig. 6. Thus should a maximum size collar and a minimum size arbor be assembled, there would be an axial allowance of 1/8 inch for a driving fit. If this allowance is exceeded, the collar must be reamed again until it rests 1/8 inch from the shoulder of the arbor. By this method there is always sure to be sufficient stock for a driving fit.

The lugs on the collar are next milled to the correct widths, as determined by the gage shown at *Y* in Fig. 5, the gaging surfaces of which are made to the maximum and minimum dimensions *A* in Table 3. As a tolerance of 1/64 inch is allowed on the length of the lugs, scale measurement is considered sufficient for determining this dimension. The

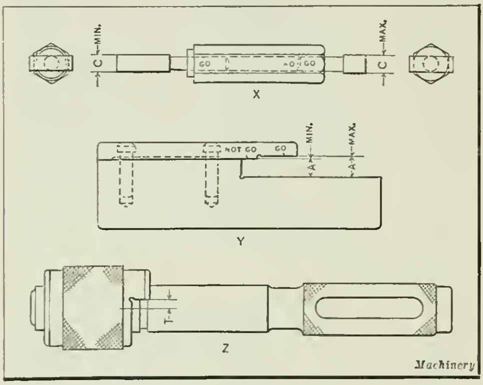


Fig. 5. (X) Gage for inspecting Width of Reamer Slots; (Y) Gage for determining Width of Arbor Lugs; (Z) Gage for testing Alignment of Lugs on Collar

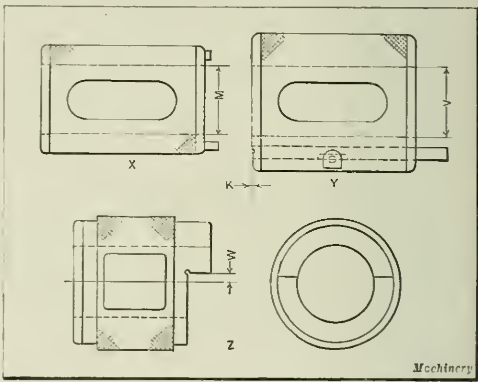


Fig. 6. (X) Gage to which Taper of Arbor is turned; (Y) Flush-pin Gage for Final Inspection of Taper of Arbor; (Z) Gage for testing Alignment of Lugs after Assembly

TABLE 3. LIMITS OF REAMER SLOTS AND ARBOR LUGS*

Arbor No.	Lug Limits, Inches				Slot Limits, Inches				Clearance and Driving Contact (Basic), Inches		
	Width A		Depth B		Width C		Depth D				
	Max. (Basic)	Min.	Max. (Basic)	Min.	Max.	Min. (Basic)	Max.	Min. (Basic)	E	F	G
3	0.1094	0.1044	0.1250	0.1094	0.1300	0.1250	0.1719	0.1563	1/16	1/16	3/32
4	0.1406	0.1356	0.1563	0.1407	0.1613	0.1563	0.2031	0.1875	1/16	3/32	3/32
5	0.1719	0.1669	0.2188	0.2032	0.1925	0.1875	0.2656	0.2500	3/32	1/8	1/8
6	0.1719	0.1669	0.2188	0.2032	0.1925	0.1875	0.2656	0.2500	3/32	1/8	1/8
7	0.2344	0.2284	0.2813	0.2657	0.2560	0.2500	0.3281	0.3125	3/32	3/16	1/8
8	0.2344	0.2284	0.2813	0.2657	0.2560	0.2500	0.3281	0.3125	1/8	5/32	5/32
9	0.2969	0.2909	0.3438	0.3282	0.3185	0.3125	0.3906	0.3750	1/8	7/32	5/32
10	0.2969	0.2909	0.3438	0.3282	0.3185	0.3125	0.3906	0.3750	1/8	7/32	5/32
11	0.3594	0.3534	0.4063	0.3907	0.3810	0.3750	0.4531	0.4375	3/16	7/32	7/32
12	0.4844	0.4784	0.4688	0.4532	0.5060	0.5000	0.5156	0.5000	3/16	9/32	7/32
13	0.4844	0.4784	0.4688	0.4532	0.5060	0.5000	0.5156	0.5000	3/16	9/32	7/32
14	0.6094	0.6034	0.5625	0.5469	0.6310	0.6250	0.6406	0.6250	1/4	5/16	1/4
15	0.6094	0.6034	0.5625	0.5469	0.6310	0.6250	0.6406	0.6250	1/4	5/16	5/16

Machinery

*See Fig. 2 for the notation in this table.

alignment of the lugs with the center of the hole is tested by means of the gage *Z*, Fig. 5, on which dimension *T* equals one-half the maximum dimension *A*, Table 3, plus 0.003 inch to allow a maximum lug to be off center 0.003 inch. It will be obvious that a minimum width lug can be off center more than a maximum width lug.

After milling these driving lugs, the collar is fitted, pressed on the arbor and pinned in place. It is then turned down flush with the arbor shank, and the taper surface of the arbor ground to the flush-pin gage shown at *Y* in Fig. 6. The large end *V* of the hole in this gage is ground to a diameter which, on a finish-ground maximum size arbor, causes the face of the gage to rest 1/8 inch from the lugs on the arbor collar. In this position if one end of the sliding pin is placed against the face of the collar, the other end will be flush with the lower step on the rear end of the gage. On a minimum size arbor, the gage will rest closer to the lug and the rear end of the sliding pin will be flush with the high step.

The last gage used in the inspection of an assembled arbor and collar is that shown at *Z*, Fig. 6. This is used to make a final test of the alignment of the driving lugs with the center of the arbor. Dimension *W* is equal to one-half of the maximum dimension *A* as given in Table 3, plus 0.003 inch, and if an arbor passes this gage, it is pronounced satisfactory. It will be apparent that this gage is used for testing both sides of the lugs. In the tables arbors Nos. 1 and 2 are not considered, as they are special sizes and seldom used.

* * *

ACTIVITY IN THE RAILWAY FIELD

While the railroads have not as yet placed large orders for machine tools, they have started a buying campaign which doubtless will be extended to the tool equipment field. The net operating income of the railroads has steadily increased, and their financial position today is better than it has been for many years past. Up to May first 52,000 freight cars had been ordered—a larger number than has been ordered in any year since 1918. It is evident that the railroad managers are looking forward to heavy freight traffic. The increased activity in railroad buying has favorably affected the sales of electric furnace equipment as reported by one of the electric furnace companies. These furnaces are used for manganese steel castings for railroad purposes.

DULLNESS IN FRENCH MACHINE TOOL MARKET DUE TO UNCERTAINTY

A well-known representative in France of an American manufacturer of metal-working machinery states that the stagnation of the French market in machinery of this type is due to the inability of the consumer to foretell the financial situation with any certainty, and the manufacturer who would bring his plant up-to-date with modern equipment is unable to do so, because he cannot determine whether or not there will be any returns on the investment. The manufacturer who finds that he can buy a machine tool of either French or German make very much cheaper than an American machine, naturally will turn either to the home industry or to the German market—sometimes without a thought as to whether the machine that he buys will actually serve his purpose as well as the more expensive American product.

As a matter of fact, he does not know definitely what the relative values of the machines are, because he has nothing upon which to base his judgment but the enthusiasm of the parties most interested—the French distributor of the American machine on the one hand, and the French or German manufacturer on the other. Furthermore, he often fears that it would be difficult to obtain repair parts in case the American machine is not one that is well known and generally used in France. He had the same idea about Ford cars and Kodak cameras, but he has changed his mind because these big-scale American producers have realized that they had a big market, and they were able to cultivate it until they ultimately found that they had a better field to till than they had expected.

Is there any way out for the American machine tool manufacturer? The larger ones possibly could manufacture, or at least assemble, in France. This would be one way, and perhaps the only way, in which to overcome present difficulties. In that case association with the right kind of French industrial enterprises might be desirable. The idea may be impracticable, but it would be worth while investigating.

* * *

The improvement in the iron and steel field is encouraging. Structural steel particularly is in great demand. Orders for fabricated structural steel placed during April were almost equal to the capacity of the fabricating firms.

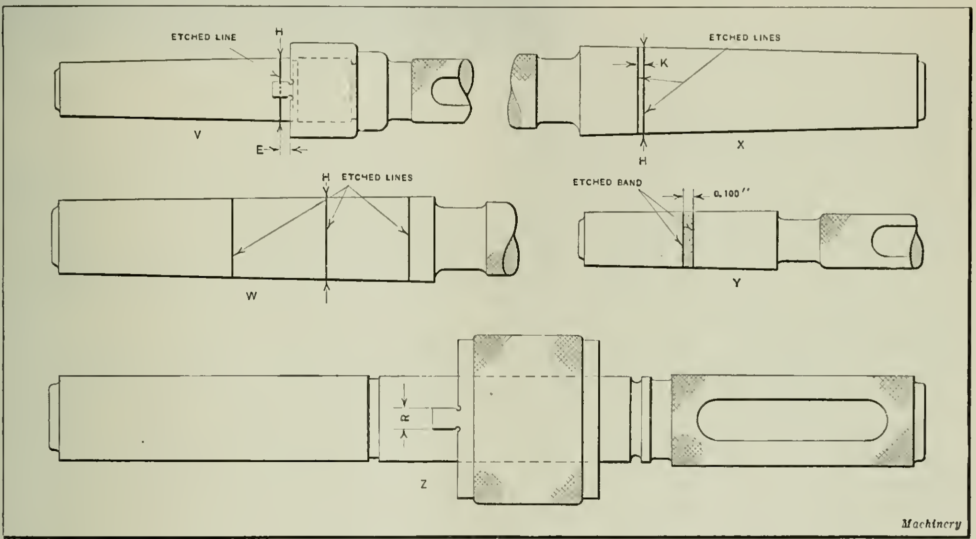


Fig. 7. Plug Gages used in manufacturing Standard Reamers and Arbor Collars

Tool Supply and Stock-carrying Methods

A Description of a Tool Supply System in a Contract Plant and a Discussion of the Inspection and Repair of Equipment and the Carrying of Adequate Stock

By GEORGE H. SHEPARD
Professor of Industrial Engineering and Management, Purdue University

TOOL issue rooms or tool cribs, as they are commonly called, are found in almost every machine shop. Here tools are taken care of and issued to the workmen without delay, and records are kept of the men to whom the tools are lent. In large shops, it is usual for each department to have a tool issue room, and in such cases it is a good plan to have a central tool store-room in which reserve stocks of standard tools are kept and supplied to the issue rooms as required. The tool supply system should be so organized as to render the best possible service to the shop, and in order to attain this end, the tool store-room and all issue rooms should be under the authority of one foreman responsible to the general foreman. The tool foreman should turn over all routine work to subordinates so that his time may be devoted to supervising the force and attending to the more important matters that arise. Every other man in charge of a section of the tool supply system should be held strictly accountable for the condition of tools or records under his care and for the quality of service rendered by his section.

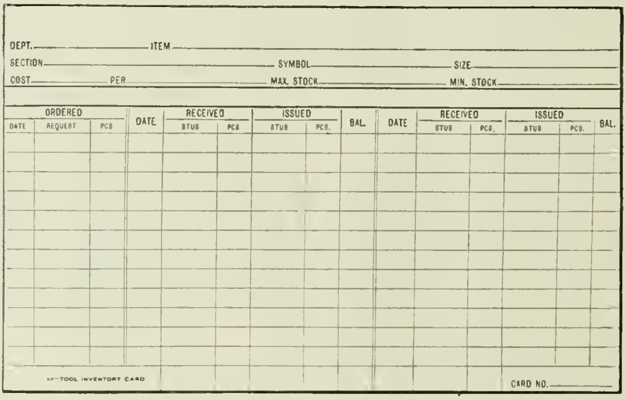
The equipment of the tool store and issue rooms consists primarily of facilities for stowing tools in the most accessible manner. Open shelves should be used whenever possible, and bins or pockets may be employed when it is necessary to prevent the stock from rolling on the floor. Drawers should be used only as a last resort, because they hamper inspection and encourage careless stowing. Revolving racks and other special equipment are sometimes necessary to facilitate stowing or handling. The heading illustration shows a tool issue room in which the tools are stored in an ideal manner. The stock that is on hand of each particular tool should be large enough to meet all reasonable demands of the shop, but care should be taken not to overstock.

In the following some of the duties of the members of a tool supply system are outlined.

Duties of the Tool Store and Issue Room Forces

Tool Foreman—The tool foreman is in complete charge of the tool store-room and the tool issue rooms, and is directly responsible to the general foreman. He should personally attend to the following duties, or see that they are definitely assigned to competent assistants: Assigning all new tools to the proper inventory class, depending upon whether they are standard, odd sizes, or special; examining all damaged tools and arranging for their prompt disposal; rendering a decision on any question as to the serviceability of such tools as short taps and badly worn dies; conferring with the technical advisor concerning special tools for new machines and procuring those necessary; issuing requests for new tools after reviewing the reports of the tool storekeeper and making a careful study of the tool inventory; and arranging for a periodic checking of the tool inventory, so the total inventory will be checked at least once a year.

Tool Store-keeper—The tool store-keeper should be next to the tool foreman in charge of the tool store-room, and should be responsible for keeping the records, including cards and damage reports. Three special inventories should be kept, one each for standard, odd-sized, and special tools. The inventory of all standard tools in the tool store-room, the tool issue rooms, and the forging shop for redressing, may be kept on a form such as illustrated in Fig. 1. The back of this card is identical with the front so as to permit the use of both sides. The balances on these cards should control the ordering of new tools. All cases of shortage and demands for new tools should be reported to the tool foreman. Whenever tools are requested, the date, requisition

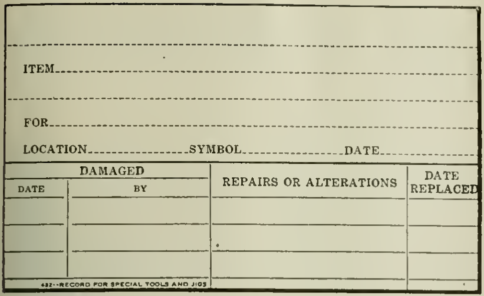


DEPT. ——— ITEM ———
SECTION ——— SYMBOL ——— SIZE ———
COST ——— PER ——— MAX. STOCK ——— MIN. STOCK ———

ORDERED			DATE	RECEIVED		ISSUED		BAL.	DATE	RECEIVED		ISSUED		BAL.
DATE	REQUEST	PCS		STUB	PCS	STUB	PCS			STUB	PCS	STUB	PCS	

TOOL INVENTORY CARD — CARD NO. ———

Fig. 1. Inventory Form for keeping Record of Stock on Hand of Standard Tools in General Use in the Shop


ITEM

FOR

LOCATION SYMBOL DATE

DAMAGED		REPAIRS OR ALTERATIONS	DATE REPLACED
DATE	BY		

432—RECORD FOR SPECIAL TOOLS AND JIGS

Fig. 2. Form used for keeping an Inventory of Odd-sized and Special Tools

number, and number of tools desired should be entered on the inventory cards under the heading "Ordered," and this entry should be checked off when the lot is received.

The inventory of odd-sized tools may be kept on the form shown in Fig. 2, the back of which is the same as the lower part of the front. Odd-sized tools should be handled in the same manner as standard tools, except that no reserve stock should be carried. They should be replaced or repaired as they become damaged, proper entries being made on the card. The inventory of special tools may also be kept on the form shown in Fig. 2. This class of tools should be handled in the same manner as standard tools, except that no reserve stock should be carried and they should not be replaced when damaged. When a special tool is discarded, the fact should be noted on the inventory card, and the latter removed from the file. The tool store-keeper should receive all new tools, and record them in the inventory file according to the classification assigned them by the tool foreman, and he should take care of reports and records of tools lost or damaged.

Supervisors of Issue Rooms—Each issue room or section of the tool store-room should be under the charge of a supervisor responsible to the tool foreman for the condition of tools under his care. The supervisor should frequently inspect all tools ready for immediate use and dispose at once of damaged or partly worn tools that may get into the racks. Doubtful questions as to serviceability should be referred to the tool foreman, as previously mentioned. He should also see that tools and receipt checks are in their proper places. As far as possible, tools should be stored according to their class; for example, lathe and planer tools should be placed in one section, taps and dies in another, and milling cutters and slitting saws in a third. Odd-sized tools should be kept with standard tools of the same kind, but special tools should be kept in an entirely different section. Standard tools of any one kind should be arranged according to their principal dimensions.

Caring for Precision Instruments

All precision instruments, such as micrometers, gages, straightedges, and vernier calipers should be returned to the tool issue rooms at the close of each working shift. These instruments should be kept separate from other tools, and before being placed in racks for re-issuing, they should be compared with working standards. The latter should never be issued or handled by anyone except the supervisor of the tool issue room. It is also well to remove any scratches or other blemishes from micrometers and gages before storing them for re-issue.

If the results are to be strictly reliable, there must be a routine system for adequate checking of the working standards. In a plant of considerable size there would probably be a precision laboratory, in which the working standards would be periodically checked against plant standards. At long intervals the plant standards themselves should be checked by the Bureau of Standards in Washington.

Inspection and Repair of Equipment

An anticipative inspection and preventive repair system is applicable to contract as well as manufacturing plants. Under this system, the equipment is listed and a definite interval is set for the inspection of each piece. At the appointed time, the equipment is examined by an inspector of the maintenance department, all work necessary to keep the equipment in working order is noted, and the work is done as soon as possible. The only peculiarity of this system as applied to the contract plant is that the inspection intervals are more difficult to set than when a plant is operated on a manufacturing basis, because of the irregular use of many of the machines. However, it has been found practicable to carry out this system so as to increase materially the reliability of the equipment and the chance of its being available when wanted. In a contract plant this factor is especially important, because there is often a sudden demand for the use of some equipment, and the need is likely to be an urgent one.

Before the installation of a system of this kind, supervisors generally are accustomed to calling for repairs to their equipment as they see necessary. They should continue to do this under the new system and should not place an overdependence on the system, or wait for the maintenance department to learn of the need of repairs in its routine inspection. The arrival of the time for this inspection does not justify the inoperation of equipment urgently needed; if necessary, the inspection should be delayed until a more convenient time. When an inspection of a piece of equipment is to be made, the inspector should interview the workmen and supervisors who operate the equipment and obtain a statement of their experience with it since the last inspection. By means of this information and such an examination of the equipment as may be possible during its regular operation, it may often be decided that a disassembly of the equipment is unnecessary.

Clamps, bolts, steadyrests, and other auxiliary equipment of machines should also be inspected regularly. It will often be found that the stock of such equipment is seriously depleted, in which case a replacement must be made. Such of this equipment as serves several machines is best kept in the tool-room when not in use, but articles that serve one machine only are often most conveniently located near that machine, provided arrangements are made to insure that the parts will not be carried away by unauthorized persons. In Fig. 3 is shown a method of locking wrenches to a machine to prevent losing them. Fig. 4 shows a lathe having a number of pieces of auxiliary equipment, including a tool box on the floor, a stand for collets and instruments, a portable light, and a crane for assisting in mounting or dismounting the chuck.

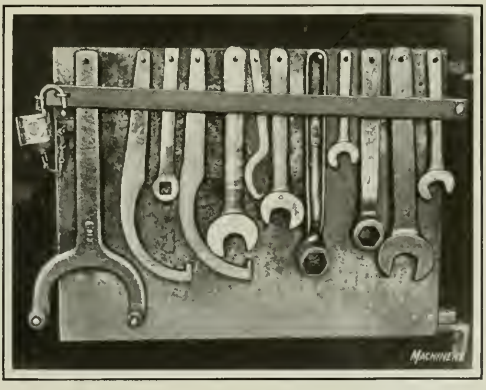


Fig. 3. Method of locking Wrenches to a Machine to prevent them from being lost or removed by Unauthorized Workmen

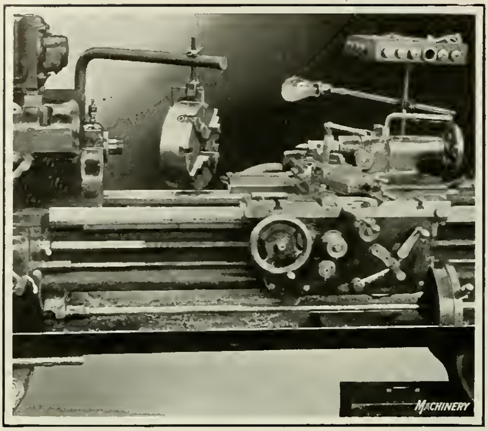


Fig. 4. Engine Lathe provided with such Auxiliary Equipment as a Chuck Crane, a Collet and Instrument Stand, and a Tool Box

Stock of Raw Materials and Completed Parts

The carrying of a reasonable stock of raw materials and completed parts is essential to the prompt filling of emergency and rush orders which are so common in contract or jobbing plants. Carrying a stock of completed parts also enables a plant to produce in quantities great enough for efficient operation, instead of wastefully making driblet orders of parts to customers' orders. However, with the continual change of work in these plants there is always a risk that any stock except that most essential will lie indefinitely in the store-room and perhaps never be used. The files of instruction cards of former work shown in the article "Planning in Large Contract Plants" in March MACHINERY, furnish the best data from which to decide what raw materials and completed parts should be carried in stock and between what limits. In the absence of such data, it is necessary to rely on the estimates of persons whose work brings them in touch with the subject. Experience has shown the great superiority of actual records. The estimates of such persons are of great value in correcting the figures of the past for the probable changes of the future, a matter which the jobbing plant least of all can afford to overlook.

In order to get the full benefit of the system of carrying stock, the planners must be kept fully informed of the stock on hand, as otherwise instead of drawing parts from stock, they will order them made in small quantities to suit a customer's order. To give planners adequate information along these lines, it is necessary to furnish them with an up-to-date stock catalogue. The difficulty of providing such data indicates that the decision as to drawing parts from stock or making them to order, should be made by the central planning office, because a small force of specially expert material men can be maintained there for this particular purpose.

One of the problems of keeping stores is to save materials left over. In a foundry having many emergency orders, where an excess allowance is molded and poured equal to a reasonable estimate of scrap loss, some castings are often left over. In a smith shop, also, ends of billets are left over, and in boiler shops, there is an excess of tube ends and plate clippings. Any shop will leave over broken packages of small articles usually bought outside. A convenient means of saving such materials is to establish a store-room in the shop, especially for left-over parts. Unless this is done, these parts are likely to lie about the shop indefinitely, contributing to the disorder of the shop and frequently resulting in a dead loss. The shops in a contract plant are often more or less inaccessible to the general store-room, and when much outside repair work is done it may be necessary to have small semi-detached shops on barges or railway cars. The degree of accessibility to the general storeroom determines the amount of supplies which should be carried in their stores.

Salvaging Scrap and Discarded Parts

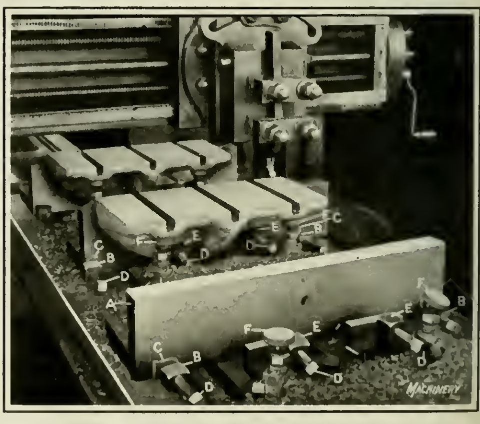
A repair shop, on account of the nature of its business, rapidly accumulates considerable scrap. The method of handling this material may make it a source either of expense or of considerable revenue. If the latter is to be the case, such materials must be handled by a competent salvage department. The first requisite for the efficient salvaging of this material is that it should be well sorted. This requires considerable room, but buildings of the cheapest construction, or even open bins, suffice. After it has been classified and sorted, the disposal of the material to the best advantage depends upon the skill of the salvage department, either in using it in the plant or selling it.

* * *

FIXTURE FOR PLANING ANGLE-PLATES

The accompanying illustration shows a Woodward & Powell planer set up for planing the top surface of an angle-plate for a Pratt & Whitney 6-inch vertical shaper. Before the operation is performed, the surface at the back of the work is finished, and this is used as a locating point for clamping the casting against an angle-plate fixture. A string of these castings is set up for planing. The arrangement of the clamping bolts, jacks, etc., may be clearly seen in the foreground, where one of the fixtures is shown with the casting removed. Provision must be made in this operation for supporting the end thrust of the tool, and this is accomplished by having stops *B* set in the table T-slots, which carry bolts engaging the front face of the fixture *A*.

In order to avoid damaging the finished surfaces of the fixtures, a sheet-metal shim *C* is placed between each clamping bolt and the fixture. It will be seen that there is a thin wall on each casting, the back face of which has already been planed, and this face is clamped against the fixture by two bolts *D* which are carried by stops *E*. The work is supported against the vertical pressure of the tool by means of two jacks *F*, the upper members of which are furnished with a ball and socket connection so that they will automatically adjust themselves for slight irregularities in the castings, and afford a uniform support. On this job the depth of cut is 1/8 inch, with a feed of 1/4 inch per table stroke and a cutting speed of 20 feet per minute, the material being cast-iron.



Planer equipped for planing the Tops of Angle-plates for Vertical Shaper

Building Special Machines for Can-Seaming

By ARTHUR MUMPER

MACHINE work of an interesting nature and calling for a high degree of accuracy is frequently met with in shops devoted to the construction of special machinery. The building of special machines, such as the can-seaming machine shown in Fig. 1, always has an interest for the machinist, and the shop doing this class of work usually experiences less difficulty from labor turnover than that engaged in general contract or repair work. In the plant of the Ackermann Mfg. Co., Wheeling, W. Va., where the Wheeling No. 100-A double-seamer shown in Fig. 1 is built, the work is done on a production basis, yet the management takes care not to advocate stereotyped high-production methods to the extent of lessening the men's interest in their work and killing any incentive for them to develop original methods of increasing production.

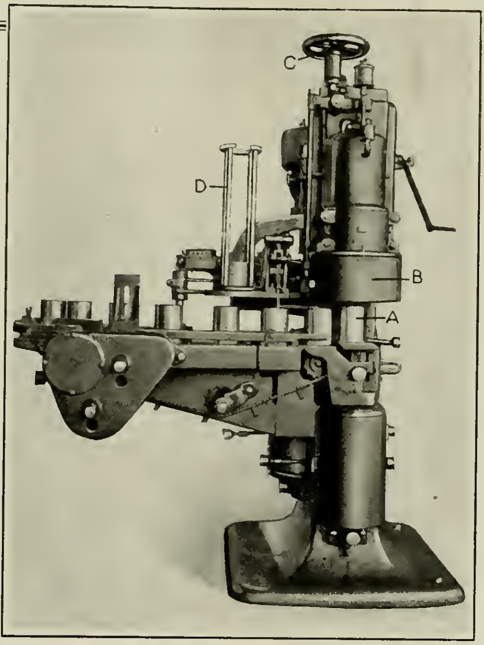


Fig. 1. Automatic Can-seaming Machine

A general line of machine tools is usually required in the manufacture of special machines like the double-seamer, or "can-closing machine," as it is also called. The machine work required in building the can-closing machine, like that required in building many other special automatic machines, includes gear-cutting and cam-cutting operations such as are seldom met with in repair shop work. The making of improvements on special machines taxes the ingenuity of the machinist in devising adequate means of machining new parts and thus increases interest in the work.

The can-closing machine represents a highly developed type of a strictly single-purpose machine. This machine is used to close the ends of cylindrical tin containers or cans after they have been filled at the packing plant. It is a patented machine, and it is claimed that it has a smaller number of working parts than any similar machine that is employed for the same purpose.

Operation of Can-closing Machine

The empty cans are placed in a trackway, and roll by gravity to an automatic filling machine. After being filled, they pass on to an endless belt which conveys them to the closing machine or double-seamer. The double-seamer handles the filled cans at the rate of sixty a minute without spilling the contents. It also straightens the cans, which are not perfectly round, before seaming the tops to the bottoms. The cans are not handled by the operator from the time they are first placed in the trackway until after they are packed and the ends seamed tight. After this seaming operation the cans will stand a pressure of from 40 to 45 pounds per square inch without leaking.

The curled edge of the can-end is rolled in under the flanged end of the can body which is thus made air-tight. This is done in two operations; the principle is practically the same as that involved in the construction of other can-closing machines, the can body being carried into the machine where it is held firmly in a stationary position while the seaming-head is forced in against the edge of the lid or can cover and revolved at a high rate of speed. The seaming head carries two seam-rollers of tool steel which are hardened and ground and mounted on roller bearings.

In the finishing machine, Fig. 1, a can is shown at *A* under the chuck. This can is being held up against the seaming chuck by the plunger-plate which is corrugated to prevent the can from turning. Directly above the third can from the right is the marking device. This attachment can be set with type to mark the ends with any impression desired. Just above the fourth can from the right is the magazine, which holds a stack of can ends. These ends are separated by the can as it passes through the can-guides and engages with an index-lever. The can-end passes along with, but just above, the can body until after the end comes from the marker, when it drops down in its place on the can.

Construction of Machine

The cans are carried from the filling machine on an endless belt, and are placed on a revolving table at the left-hand end of the seaming machine. This table moves them along until the dogs on the chain shown just under the table carry them under the plunger-plate, ready for the seaming operation. The seaming head is composed of an inner sleeve, which is a running fit in an outer sleeve. The outer sleeve runs on two tapered roller bearings. The inner sleeve is bored out to clear the chuck shaft which passes through the entire seaming head, and it has a bearing on the chuck shaft at one end. The chuck shaft is bored to clear the cam-operated knock-out, which forces the can from the chuck after the completion of the seaming operation.

Fig. 2. Cams used in Machine shown in Fig. 1

The cam that operates the knock-out is shown at *A* Fig. 2. The plunger-plate is also forced up by a grooved cam which is shown at *B*. At *C* is shown the topper cam, which is similar in design to the plunger cam. The seaming is done by a cast-iron cam *D*, which is provided with a hardened and ground tool-steel center. This cam is contained in the seaming head *B*, Fig. 1. The handwheel shown at *C* provides means of making vertical adjustments. The mold-carrier cam, which actuates the mechanism by means of which the can body is placed on the plunger-plate, is shown at *E*, Fig. 2. It will be noted that this cam is provided with gear teeth on its periphery. The making of this cam, as well as the others in Fig. 2, calls for fine machine work.

A different size magazine is required for each size of can handled by the machine. The machine is belt-driven, and power is transmitted through a large steel worm-gear. By the extensive use of jigs and fixtures in the manufacture of the various parts entering into the construction of this machine, the element of inaccuracy is reduced to a minimum. Special care is taken in the design and construction of the jigs and fixtures to provide for means of facilitating the handling and setting up of the work for the different machining operations. All parts that must be counted on to retain their shape are seasoned after the roughing cuts are taken. Particular care is taken in seasoning the casting of the cover feed-plate shown at *F*, as this part is required to be very accurate.

* * *

A lighting code for factories, mills, and other working places, based upon earlier codes issued by the Illuminating Engineering Society, and recently revised by a sectional committee under the sponsorship of this society, has been officially approved as standard by the American Engineering Standards Committee. The code is very brief, consisting of a few rules covering methods of avoiding glare, and the minimum requirements, from the point of view of safety, for exit and emergency lighting. Supplementary to the code are numerous suggestions relative to illumination for different classes of work and an outline of the advantages of good lighting.

GRINDING TRIMMING DIES USED IN SHOVEL MANUFACTURE

By C. F. GEORGE

The dies used in trimming round-point shovel blanks are usually made in two parts. The cutting members or blades are made from 3- by 3/4-inch shear steel, and they are fastened to cast-iron bolsters in the manner indicated in the enlarged sectional view in the lower right-hand corner of Fig. 1. This construction permits the bolster to be fitted to the bolster-plate *A* or to the upper die-plate *B* to suit the size of shovel to be trimmed. The shovels are usually made with a uniform variation of 1/2 inch between sizes on the width and length, unless otherwise specified, and the radius of curvature of the die blades for all shovel sizes is the same. By drilling a series of holes in the bolster-plate and upper die-plate, spaced to agree with the size of shovel being trimmed, adjustment for width will enable one set of die blades to be used on all standard sizes of shovels. The blades, which are forged to shape, are fastened by dowels and bolts to the bolster, as previously stated, and when assembled to their respective plates, have the general arrangement indicated in the sectional view *D*.

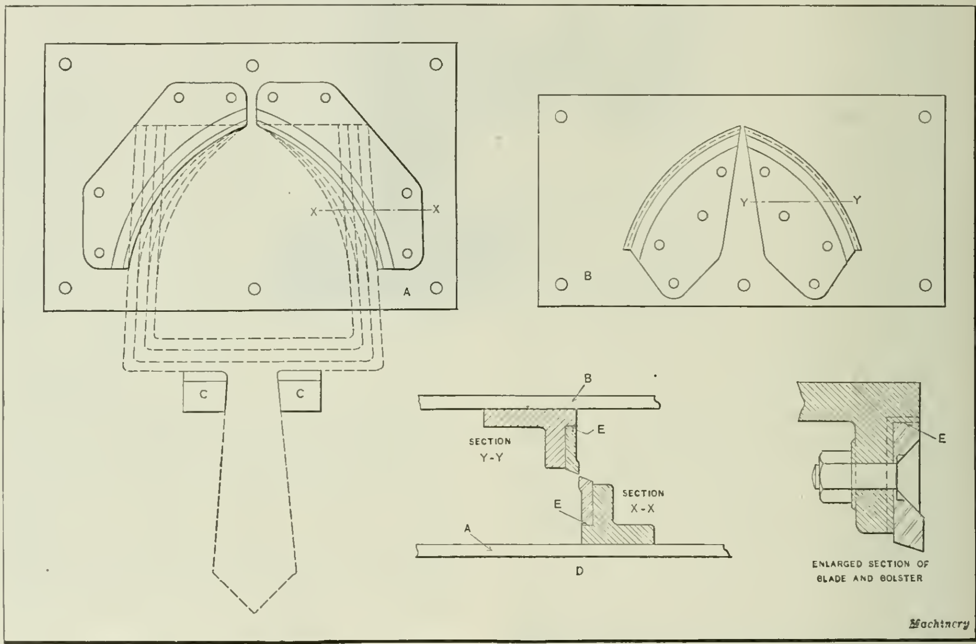


Fig. 1. Arrangement of Blades of Trimming Dies used in the Manufacture of Shovels

In assembling the bolsters to plates *A* and *B*, they are first ground to form a seat and then holes are drilled for the bolts by means of which they are attached to the plates. Surface *E* is also ground to form a seat for the blade, and bosses are cast on the plates for the bolt holes. These bosses are carefully filed to gage height, and provide an even support for the blades. This is an economical way of obtaining the desired fit, as it obviates finishing the entire bearing surface. The bottom dies are shown in the left-hand part of Fig. 1; in this view the relative contour of shovels of different sizes and the position which the blanks occupy during the trimming operation are indicated by dotted lines. It will be seen that the blanks are brought up against two stops *C*, the transverse adjustment for the bolster plate being obtained by means of the T-slots in the bed of the press. The upper die-plate *B* is attached to the ram, and it is in

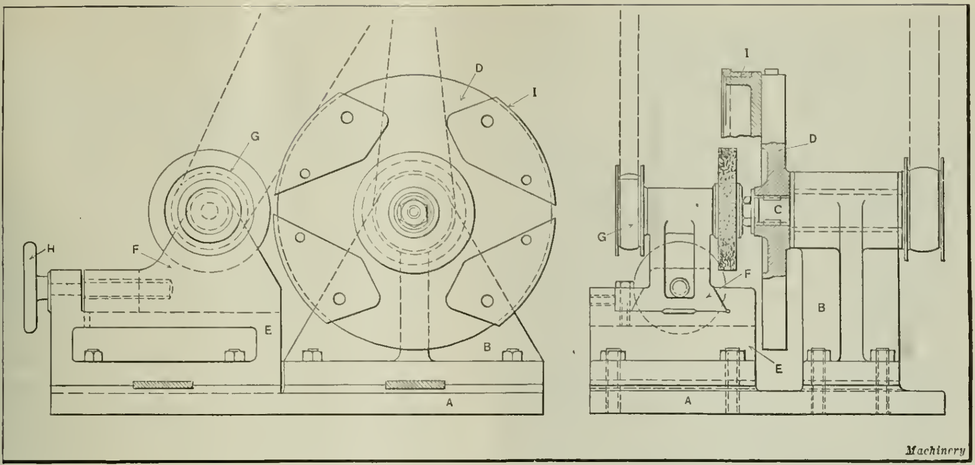


Fig. 2. Fixture for grinding Cutting Edges of Upper Die Blades

relation to the upper dies that the lower die-plate *A* is adjusted. After the upper and lower dies have been located on their respective plates by the holes for the particular size shovel to be trimmed, they are bolted down and tested on a bench, before being put into use. All the shear is put on the upper set of die blades which perform the trimming, the lower dies not being provided with shear.

Before being used, the bolsters and assembled blades are ground with the special grinding equipment shown in Figs. 2 and 3. The fixture for grinding the cutting edges of the upper die blades is illustrated in Fig. 2. This consists of a cast-iron base *A* to which is bolted the spindle bearing stand *B*. The upper part of this stand is the bearing box for the spindle *C* which carries the flanged driving pulley and the faceplate *D*. On the cast-iron base is also mounted the grinding wheel head, which consists of a cast-iron support *E*, in which the wheel-slide *F* is carried.

The slide casting contains the bearings for the short shaft that supports the pulley *G* at one end and the grinding wheel at the other. The blades *I* are bolted to the faceplate *D* by means of the bolsters to which they are fitted, slightly elongated bolt holes being used to allow for angular adjustment. After the bolsters and blades have been properly adjusted, the grinding wheel is traversed up to the face of the blades by operating the handwheel *H*. The uniform curvature of the cutting edges of the blades can thus be readily established and checked by the use of calipers. The grinding wheel is operated at a speed of 3000 revolutions per minute and the faceplate at 60 revolutions per minute in the opposite direction, both the wheel and the faceplate being driven by belts from the lineshaft.

The grinding fixture used in grinding the lower die blades is of equally simple construction, as shown in Fig. 3. It consists of a cast-iron base *A* to which the driving shaft bearing *B* is bolted. The driving shaft carries a flanged pulley by means of which the faceplate *C* is driven. The grinding wheel shaft is supported in roller bearings, mounted at each side of the driving pulley *D*, these bearings being housed in the top slide *E*. Slide *E* may be adjusted in the bottom slide *F* by means of a handwheel and traverse screw, a similar construction also being provided for the crosswise movement of slide *F*. Adjustable guide strips *G* are provided for the top slide, and a tapered gib *H* compensates for wear on the lower slide. The radial adjustment of the grinding wheel to obtain the correct curvature of the cutting edges of the blades is accomplished by operating handwheel *J*.

As in the method of attaching the top blades, elongated holes in the faceplate allow for making angular adjustment when

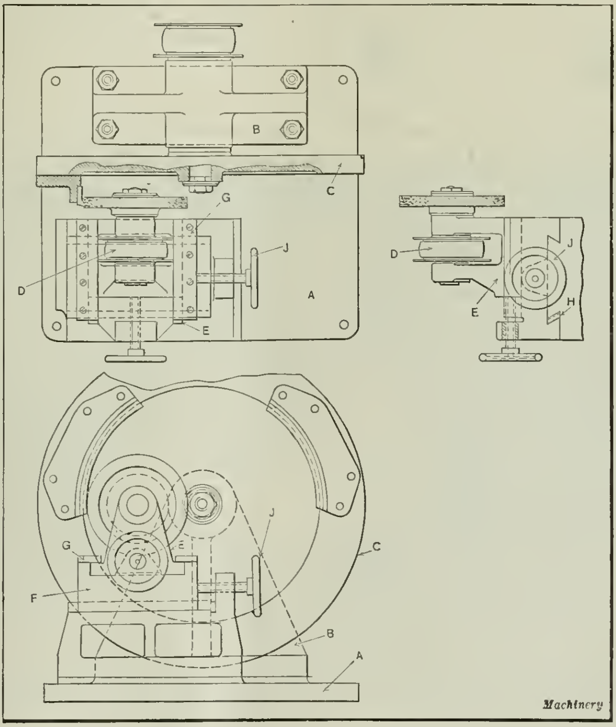


Fig. 3. Design of Fixture in which the Lower Die Blades are ground

attaching the bolsters and blades to the faceplate. This slight elongation is not shown in either Figs. 2 or 3. The inside diameter of the cutting edges of the bottom blades, when assembled to the faceplate, should be 0.010 inch greater than the outside diameter of the upper blades. This provides the necessary clearance between the dies when in use. The grinding wheel and the faceplate are driven from the line-shaft, and the same rotative speeds are used as are employed when grinding the upper blades. One set of trimming dies has produced 12,000 blanks before being reground. For average conditions it requires about one-half hour to set up and grind a pair of blades.

* * *

PATTERNS FOR CHECKED FLOOR-PLATE CASTINGS

By M. E. DUGGAN

Cast-iron stair treads and floor-plates are easy to keep clean and are very strong when properly supported. They are therefore used to a considerable extent in shops and factories. Pattern material for producing the checked surfaces that are required to prevent workmen from slipping on them can be obtained from companies that deal in patternmakers' supplies. Material of this kind usually has diamond-shaped checks cut in one side, although other designs are sometimes employed.

This stock is ordinarily obtainable in thicknesses ranging from ½ to ¾ inch. In some cases patternmakers are required to cut and shape the diamond checks in patterns for stair treads or floor-plates. This is a slow and tedious job, however, and is seldom attempted when it is possible to obtain stock already provided with checks of the required size and shape. The following method of constructing a pattern for molding four checked floor-plates, *A*, *B*, *C*, and *D*, of the dimensions shown in Fig. 1 was recently observed by the writer in a jobbing shop.

Skeleton frames conforming to the outlines of plates *A* and *B*, and one frame for plates *C* and *D*, were made from 1- by 1¼-inch pine stock. One of these frames is shown at *E*, Fig. 2. In making the mold, the frame and drag flask are first placed in position on the bottom board. The space within the frame is filled in with boards 1 inch thick, or the thickness of the plate. These filler boards are furnished with the pattern and can be made from scrap lumber. It is not absolutely necessary that they be fitted tightly; all that is required is that they be flat and of uniform thickness. Sand is next filled in up to the top of the flask, and the mold made in the usual manner. The drag is then rolled over, the cope flask placed on it, and the cope mold completed, after which the cope flask is lifted off.

By placing the loose pieces within the frame, the latter is practically converted into a one-piece pattern so that no digging out or disturbing of the mold is necessary. A better casting is produced from a mold made in this way than would be the case if no filler boards were used and the "digging-out" method employed. After the cope has been lifted out the filler pieces are removed, leaving the frame in the mold. The diamond checks are then made in the bottom face of the mold. First a block of wood *F*, Fig. 2, is cut and finished to a convenient size (in this case 6 by 12 by 1⅛ inches). Diamond checks are then cut in one face of this block. The block is next fastened to the gage-board *G*. The ends of this board are made long enough to overlap the drag flask in order to allow the block to be shifted back and forth over the frame. In the illustration the gage-board *G*, with the block *F* attached to it, is shown in position for making the first impression of the diamond checks in the face of the mold. A few taps with a hammer on the gage-board is sufficient to make the required impression. The block is next moved to the opposite side within the frame and another impression made. This process is continued until the whole face of the mold within the frame has been given the impression of the diamond checks.

Only one frame is required for plates *C* and *D*, as it is only necessary to reverse the position of the frame on the bottom board when making the mold for a plate of the opposite hand. Before moving the diamond-checked block ahead, a mark is made on the frame and the opposite edge of the gage-board then brought flush with this mark. If the work is properly carried out, the face of the casting will appear as if made from a full pattern. This method, of course, adds to the work of molding, but results in a saving in material and time, as it does not require the making of a full pattern. Another advantage is that there is no large plate pattern to be handled or stored away in the pattern loft where it is likely to become warped and twisted. It may be mentioned that the thickness of the frame is the same as the thickness of the cast plate minus the depth of the diamond checks. In this case the cast plate is 1⅛ inches thick, the diamond checks ⅛ inch deep, and the frame 1 inch thick.

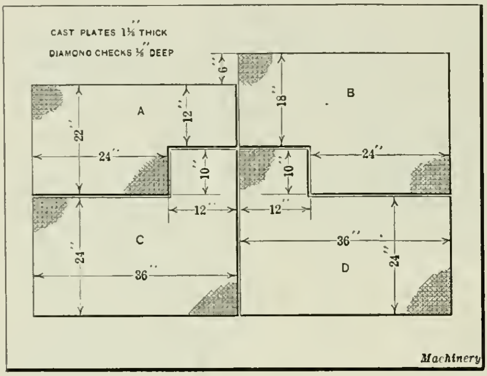


Fig. 1. Diamond-checked Floor-plates

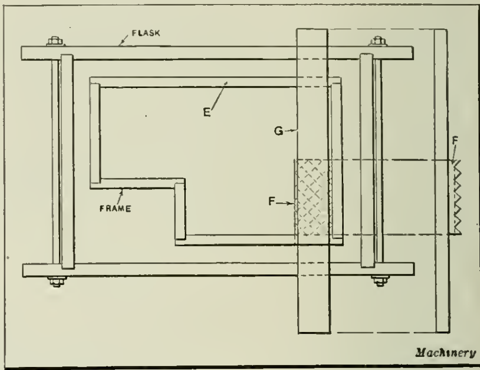


Fig. 2. Patterns for Floor-plate Mold

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THE COST OF BUILDING

The Bureau of Labor Statistics, Washington, D. C., has published a chart and a tabulated statement showing the increases in wages in the building trades and in the price of building materials since 1913. This statement shows that at the present time the average wages in all of the building trades combined are almost exactly double what they were in 1913, and the average of all building materials shows an increase of about 55 per cent over the 1913 figures. Brick has been reduced the least from the peak prices, prices of common brick being still double the 1913 prices. The average price of lumber is 65 per cent above the 1913 figure.

Checking the Accuracy of Lead-Screws

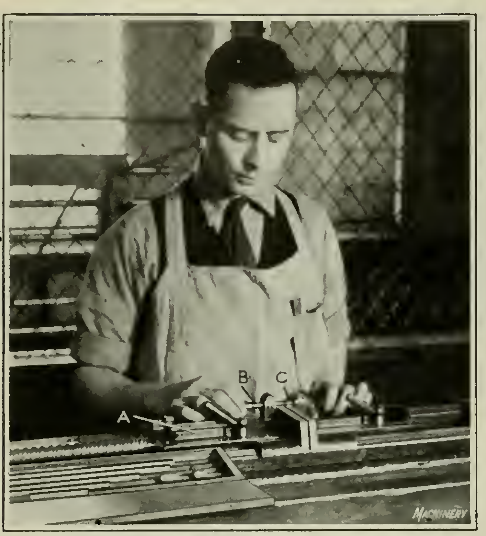

Fig. 1. Adjustment of Micrometer Spindle and Anvil Preparatory to checking Lead-screw for Lead Errors

When lead-screws are checked for accuracy at the plant of the Pratt & Whitney Co., Hartford, Conn., the test is based on the action of a nut relative to the screw, or the distance that the nut moves for a given rotation of the screw, as compared with the movement that would be obtained if the screw were perfect in lead. This simple method of using a nut and basing tests upon its movements is employed instead of attempting to determine the accuracy by a series of local tests along the screw itself, because, after all, it is the movement imparted to the nut that is important when the screw is applied to a lathe or other machine.

The testing fixture used for lathe lead-screws is very simple, as Figs. 1 and 2 indicate. There is a rigid bed long enough for any of the screws manufactured. This bed has accurate ways, and a block *A* which is free to slide along the ways and which carries a nut conforming to the diameter and pitch of the lead-screw to be tested. The nut can be replaced readily by others of different size and pitch when lead-screws of different sizes are to be tested. The sliding block carrying the nut also carries a micrometer head *B* which is opposite an anvil *C* held in another block mounted on the ways. The latter block may be shifted along the bed to whatever section of the lead-screw is being tested, but it is clamped in position for taking measurements. At one end of the lead-screw there is an index-plate *D* (Fig. 2) which provides for turning the screw exactly one revolution, or any whole number of revolutions.

In checking the accuracy of an ordinary lead-screw, the errors per foot are determined by the following method: The fixed anvil and the adjustable micrometer head are placed at one end of the lead-screw, and the micrometer spindle is adjusted to make contact with the anvil, as shown in Fig. 1. Next the lead-screw is revolved as many times as is necessary to move the engaging nut one foot, the number of turns depending, of course, upon the lead of the thread. The distance that the micrometer spindle has moved from the fixed anvil is then checked by using a standard end-measuring gage, as shown in Fig. 2. Whatever error there may be is readily determined by means of the micrometer. To secure greater refinement, as when checking the accuracy of screws that are more nearly in the precision class than ordinary lead-screws, standard gage-blocks are used in conjunction with a dial indicator, for taking the measure-

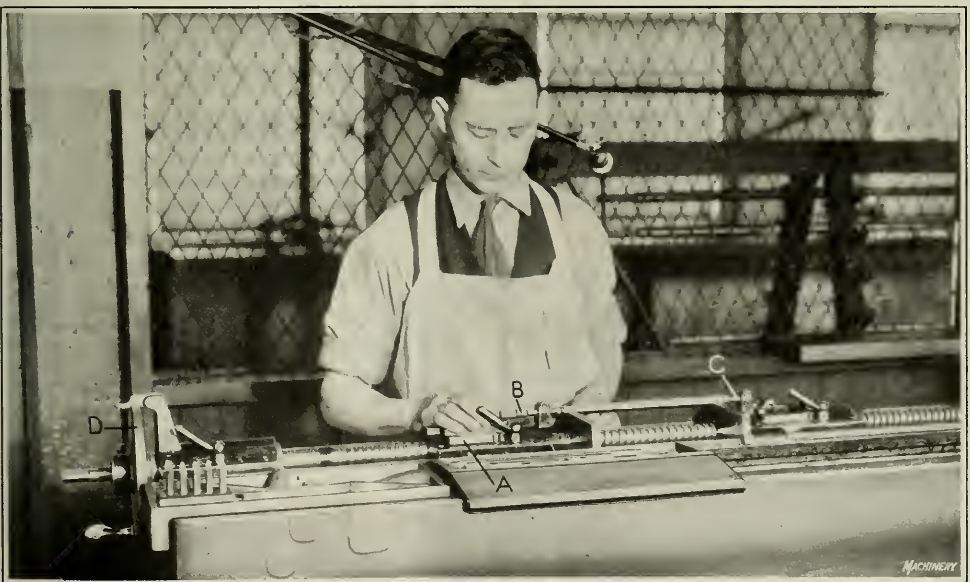

Fig. 2. Standard End-measuring Gage inserted between Anvil and Micrometer Spindle to show Lead Errors

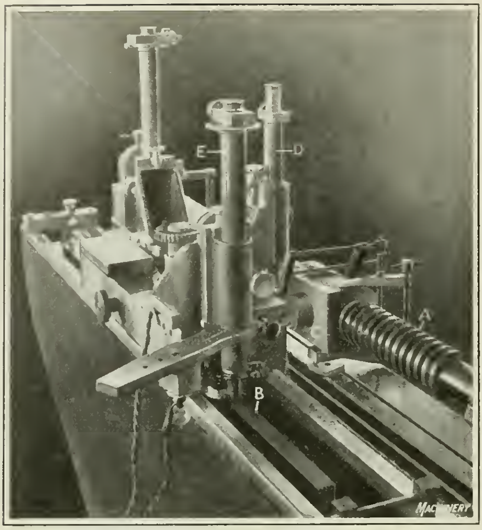

Fig. 3. Arrangement for testing Precision Screw by Direct Comparison with the Standard Bar of a Measuring Machine

ments, instead of an ordinary micrometer head and end-measuring gage.

Another method that has been employed when a very precise test is required is to check the accuracy of the screw by comparison with the standard bar of a precision graduating machine. Fig. 3 shows the machine equipped for this purpose. While this is a makeshift arrangement, any slight lead error in the screw may be readily determined in this way. The precision screw at *A* is compared with the standard bar at *B*. A small angle-plate carrying a polished plug, on which there is a very fine line, is clamped to the nut *C*. This plug is just beneath the microscope *D*, and it is a duplicate of the plugs inserted in measuring bar *B*. An index-plate is mounted on the end of the screw *A* to be tested. After adjusting nut *C* very carefully until it is square with the machine, microscope *D* is located over the plug attached to the nut, and microscope *E* is brought into position over one of the plugs in the measuring bar. The screw is then rotated a predetermined amount, after which the nut is again set square. The carriage carrying microscope *D* is also moved until the microscope is in alignment with the plug on the nut. Microscope *E* should then be in alignment with a plug on the measuring bar. If it is not, the difference is measured by the slide in the microscope, and this difference represents the error in the part of the screw that has been tested.

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SETTING LATHE FOR TURNING TAPERS

By DUNCAN CAMPBELL

The method of setting a lathe for taper-turning operations described in the following has been used by the writer for several years. It has proved especially useful in boring the tapered holes in propellers and in turning the tapers on tail-shafts when fitting them to propellers. As an example of the application of this method, assume that it is required to bore out a tapered hole in a propeller and turn up the taper on a tail-shaft to fit the tapered hole in the propeller, the taper being 1 inch to the foot.

To set the compound rest to the proper angle for boring the tapered hole in the propeller, first scribe a circle on the face of the chuck or faceplate having a diameter of, say, 2 inches. Next scribe another circle with a diameter equal to that of the first circle plus one-half the taper per foot desired—or in this case, $2 + \frac{1}{2} = 2\frac{1}{2}$ inches. Two lines are next scribed on the upper and lower slide members of the compound rest at points *A* and *B*, as shown in the illustration. Now if it is simply a problem of boring a tapered hole in the propeller and turning the taper on the shaft to fit the hole, we can make the distance *C* between the two scribed lines *A* and *B* equal to 6 inches. However, if it is required that the taper be exactly 1 inch to the foot, it is necessary (theoretically at least) to make this dimension slightly greater than 6 inches. To be exact, the distance should be:

$$C = \sqrt{0.25^2 + 6^2} = 6.0052 \text{ inches}$$

It will be seen from this formula that for practical purposes dimension *C* in this instance can be taken as 6 inches. However, if the method is used for very steep tapers or if it is necessary that the taper be exact, it will be necessary to calculate *C* by the formula

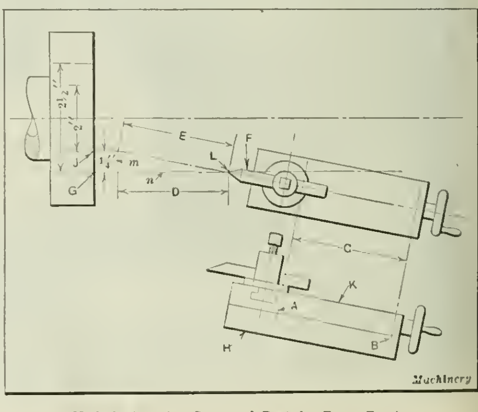
$$C = \sqrt{m^2 + n^2}$$

in which *m* equals one-half the difference between the diameters of the scribed circles on the faceplate and *n* equals 6 inches. The diameter of the larger circle scribed on the faceplate must, of course, equal the diameter of the smaller circle plus one-half the taper per foot desired, as previously stated.

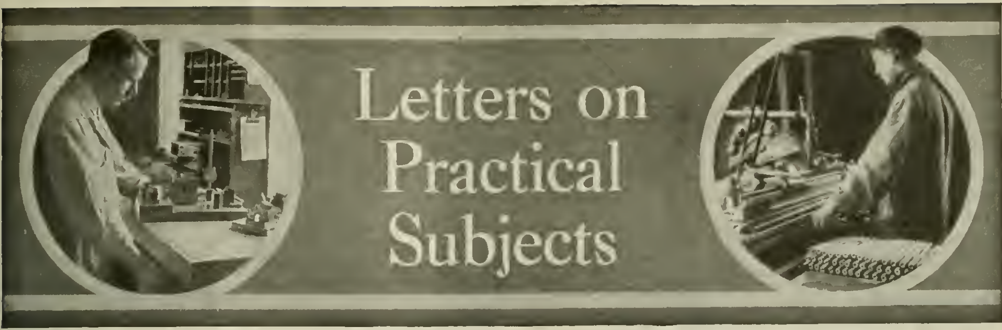
Next set the compound rest as nearly as possible to the proper angle for turning the required taper, and advance the carriage of the lathe until the point of a file or some other pointed instrument *F* comes in contact with the 2-inch circle at *J*. It is obvious that the point of *F* and the cutting point of the boring tool must be so set as to be at the same height as the center of the chuck or faceplate. Next adjust the upper slide member of the compound rest so that line *A* on the slide will be in line with line *B* on the lower member or slide base *H*. If the carriage is now brought forward and the point of *F* makes contact with the $2\frac{1}{2}$-inch circle at *G* it is evident that the slide is set at the proper angle for boring the hole. If this condition should not obtain, the angular position of the compound slide should be changed slightly until the required setting has been obtained.

Referring to the illustration, it will be clear that if *D* equals 6 inches and one-half the difference of the scribed circles equals $\frac{1}{4}$ inch, in order to turn a taper of 1 inch to the foot, slide *K* must advance a distance equal to dimension *E* from point *L* to make contact with the faceplate at *J* when the carriage is advanced. It is also clear that dimension *E* equals $\sqrt{m^2 \times n^2}$.

In turning the taper on the tail-shaft a 12-inch scale is clamped to the tailstock at right angles to the tailstock spindle and the graduations on the scale are used in the same manner as the circles scribed on the faceplate to determine the proper angular setting of the compound slide.



Method of setting Compound Rest for Taper Turning



CONVENIENT STOCK RECORDER

Inside every automobile speedometer there are two mileage registering units, one with three rows of figures and one with six. Speedometers are usually discarded because of some failure in the transmitting member, while the instrument itself is good for the life of several cars. The discarded speedometers may be obtained at garages and from junk dealers for a trifle and turned into useful shop appliances.

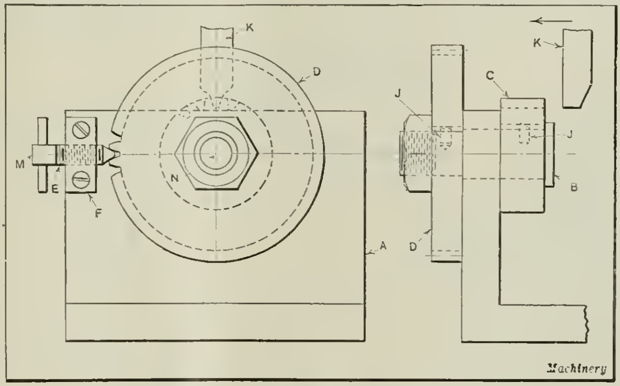
Records of incoming supplies, shipments going out, stock bins on which a perpetual inventory is kept, and inventory work in general all require the addition or subtraction of small numbers. When cards are used for this purpose, they become soiled and illegible. The mileage registering units from speedometers afford a convenient method of meeting these inventory requirements. The dials can be quickly turned to any number without becoming smirched by greasy fingers, and it is not necessary for the workman to use pencil and paper. It is a fundamental of tool design to reduce the number of "loose pieces" to a minimum; as applied to a stock bin with a perpetual inventory, this would mean that a registering unit should be attached to each bin.

There are, of course, various counters on the market (all operating the same as the mileage recording units of the speedometer) but they are larger and more expensive. The small or "trip" recording unit from a speedometer is particularly well suited for stock recording, and is so designed that it can readily be attached to any convenient post or to the wall.

Middletown, N. Y. DONALD A. HAMPSON

CUTTING GEARS WITH A SHAPER

A small pinion was required for a quick-repair job, and as there was no milling machine or gear-cutting machine available, it became necessary to provide some means of cutting the pinion teeth on a shaper. The way in which this was accomplished is described in the following. An angle-plate *A* was bored to receive the stud or shaft *B* on which the pinion blank *C* was mounted. A 40-tooth gear *D* belonging to a set of lathe change-gears was employed as an index-plate, and mounted on one end of shaft *B* as shown.



Fixture used in cutting Pinion Teeth on a Shaper

The end of index-pin *E* was turned to a conical shape and threaded to fit nut *F* at one setting in a lathe chuck. Nut *F* was attached to angle-plate *A* in such a position that it brought pin *E* into alignment with the center of shaft *B* on the line *MN*.

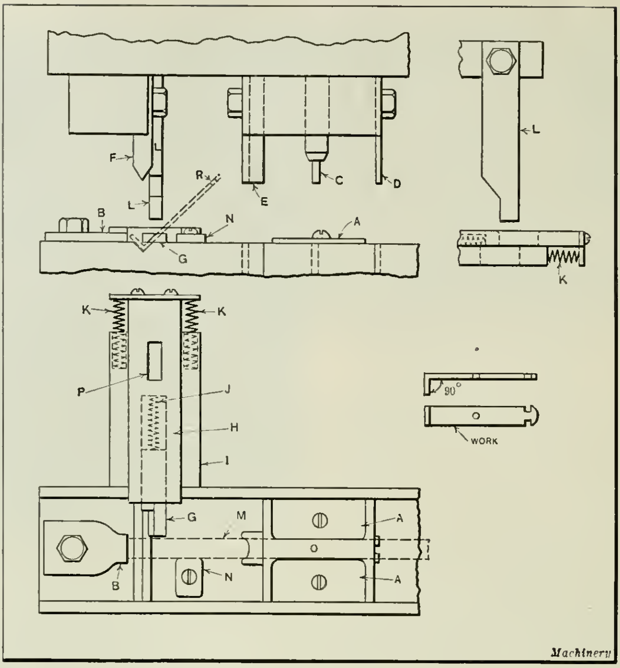
Gear *D* was indexed two teeth after each tooth space had been cut to depth, in order to obtain the correct spacing for the 20-tooth pinion being cut. The pins *J* in shaft *B* kept gear *D* and the pinion blank *C* in alignment. These pins were made a tight fit in the keyseats cut in the members that they held in alignment. The profile of tool *K* was ground to the correct form by using the teeth in the unbroken part of the original pinion as a gage or templet. The teeth were roughed nearly to size with a narrow tool before using the formed tool *K* for the finishing cut. The depth of the cut was determined by means of the graduated collar on the vertical feed-screw. The direction of the cutting stroke is indicated in the illustration by an arrow. A device similar to the one described was later used successfully in cutting ratchet teeth.

Algona, Iowa GEORGE WILSON

KNOCK-OUT FOR PUNCH-PRESS DIE

The accompanying illustration shows the construction of a punch-press die equipped with a knock-out mechanism. In the upper left-hand corner is shown a front elevation of the punch and die, while directly below is a plan view of the die. A side view of bar *L* which actuates the knock-out mechanism is shown in the upper right-hand corner. The work is formed from soft iron stock 0.250 inch wide by 0.060 inch thick. The stock is fed from the right-hand side of the die, between the guide plates *A* and against the stop *B*. When the ram descends, the stock is pierced by the punches *C* and *D* and cut off by the punch *E* while the 90-degree bend is formed by the punch *F*. As the ram ascends, the work is thrown out by the knock-out plunger *G*.

The interesting point in this die is the knock-out mechanism, which is shown with the ram in its extreme upper position. The knock-out plunger *G* slides in another plunger *H*. Plunger *H*, in turn, slides in a groove in an angle-piece *I* which is carried on the back of the die-bolster.



Punch-press Die equipped with a Knock-out Mechanism

Plunger *G* is held in its extreme forward position by the spring *J*, while plunger *H* is held in its extreme backward position by the springs *K*. Each of these plungers carries a stop-pin (not shown) which limits its motion. The bar *L* has a cam action on the downward stroke, imparting the necessary motion to plunger *H* by passing through the oblong hole *P*. The dotted lines at *M* show the position of the stock when the punch begins its descent. It will be seen by referring to the illustration that plunger *G* is so located that it just clears the edge of the stock.

When the ram has descended until the forming punch *F* comes into contact with the stock *M*, the punches *E*, *C*, and *D* will have just passed through the stock. The cam surface of the bar *L*, in its downward travel engages the forward edge of the oblong hole in the plunger *H*, causing it to move forward a distance equal to the throw of the cam surface. As plunger *G* is also carried on plunger *H*, it also has a tendency to move forward, but is prevented from doing so by coming into contact with the edge of the stock *M*, as shown.

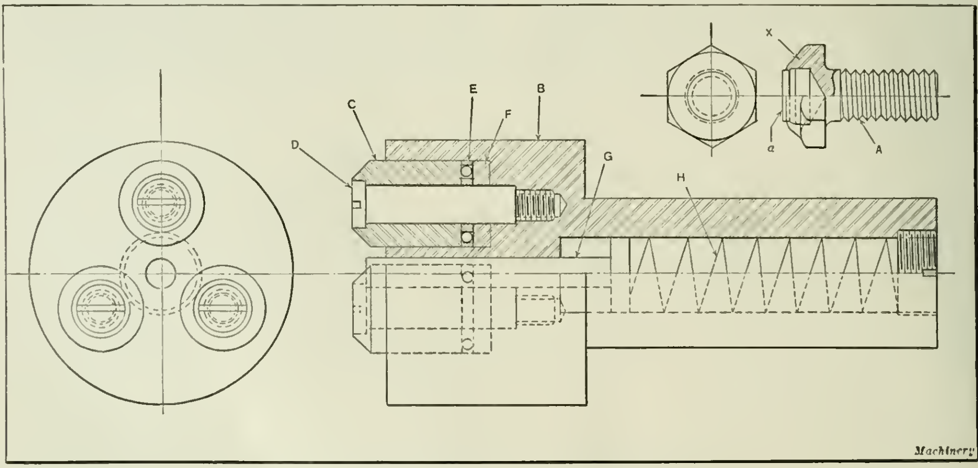
The stock *M* is held in position by the guide plates *A* and the stop *N*. In this position, the spring *J* is compressed, and pressure is exerted on the stock through the plunger *G*. Continued downward travel of the ram brings the forming punch *F* into operation, with the result that the stock is raised on one end so that it clears the stop *N*, as shown by the dotted lines at *R*, and is bent to the shape indicated. The pressure of the forming punch *F* on the stock is sufficient to overcome the action of the spring plunger *G* on the edge of the stock.

As soon as the ram starts on its return stroke, the pressure of the punch *F* on the stock is released, and the spring *J* actuates the plunger *G*, throwing the work clear of the die. The springs *K* then return the plunger *H* to its original position. When the press is running at a speed of 150 revolutions per minute, which is the speed regularly employed with this die, the work is thrown clear of the press bed, and into a hopper placed in a convenient position to receive it.

Philadelphia, Pa. R. H. Kasper

ROLLING TOOL FOR ASSEMBLING PLUG IN SCREW HEAD

The valve thrust screw shown at *A* has a hardened steel tapered plug *a* inserted in a drilled hole in its head, where it is held in place by peening or riveting over the edge *X* of the screw. This riveting operation was originally accomplished by means of a rivet-set and hammer, but the heavy blows necessary cracked many of the hardened plugs, thus causing the entire piece to be scrapped. To overcome this



Tool used in assembling Hardened Plug in Head of Valve Thrust Screw difficulty, the tool shown was devised which rolls the metal instead of striking it.

The tool consists of a machine steel body B, turned to fit the machine at one end and bored to receive the three hardened tool steel rollers C in the other end. The rollers C are held in place by screws D, and the feed thrust on the rollers is taken care of by three small ball thrust bearings E which, in turn, transmit the thrust to the hardened washers F. A plunger G, actuated by spring H, holds the valve thrust plug a in place while rolling over the edge X.

The tool operates as follows: After the valve thrust screw and plug are chucked, the machine is started and the tool fed down on the screw. The plunger G strikes the plug and holds it in position before the rollers C begin to operate. As the tool is fed farther the rollers strike the edge X, and roll it down, thus completing the operation. The chamfer on the ends of the rollers C in this case was made 45 degrees.

Chicago, Ill. HAROLD A. PETERS

INDEXING FIXTURES FOR HAND MILLING MACHINE

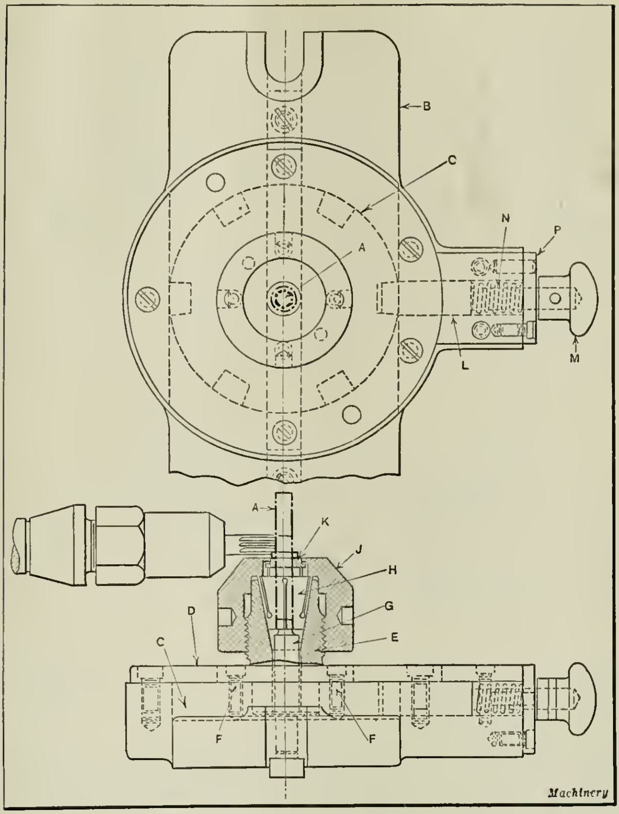


Fig. 1. Indexing Fixture for milling Hexagonal Section

An indexing fixture for use on a hand milling machine is shown in Fig. 1. This fixture is provided with a vertical chuck designed to hold the work shown by dot-and-dash lines at A, which is required to have flats milled on six sides to form a hexagonal section as illustrated in the plan view.

The base B of the fixture carries the index-plate C which is retained by the plate D. The spindle nose E is a separate piece and is fastened to the index-plate C by means of screws F. The spindle nose carries the work-locating stop-pin G. The spring collet H clamps the work in place when cap J is screwed down on the washer K. The indexing plunger L is provided with a knob M and is forced into the slightly tapered indexing slots by the action of spring N. Spring N is retained in place by a plate P which is fastened to the plunger base as illustrated.

The indexing fixture shown in Fig. 2 is for milling cross-slots in the head of the bolt shown by heavy dot-and-dash lines at A. This fixture is similar in design to the one illustrated in Fig. 1. The index-plunger in this case, however, enters indexing holes in the spindle, and therefore requires no additional index-plate.

Waynesboro, Pa. D. A. NEVIN

FORMING DIE AND ANGULAR SHEARING PUNCH

A die of rather unusual construction containing a forming punch and die, in combination with a shear punch, and mechanism for operating it is shown in Fig. 1. This die is used on a press having a so-called "double action," inasmuch

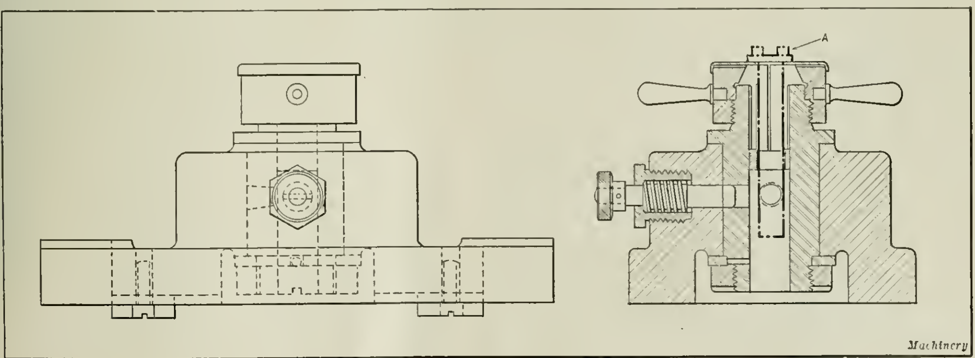


Fig. 2. Fixture used in milling Cross-slots in Bolt Head

as the forming punch must come down and form the work, after which it dwells while the shearing punch is operated. A detail view of the work is shown at the left. Fig. 2 shows some of the details used in the construction of this die; the same reference letters are used for these parts as in Fig. 1.

Referring to Fig. 1, the forming punch *A* is held in place in holder *B* by set-screw *C*. A screw *D* with a brass shoe in front of it prevents screw *C* from working loose under the continual jar of the press. At *E* is an adjustable punch against which the formed part is sheared when the die is in the closed position. This punch is backed up by the screw shown at *F*. The die over which the work is formed is contained in a cast-iron die bed *G*, the formed die being illustrated at *H*, and the shearing punch at *J*. Screws hold the formed die in place as shown. At *K* is a steel block held in place by two screws *L*. On the top of this block is a stripper plate, the stock from which the work is made being fed through a cut-out or slot in this plate. The stock is cut by the punch *M* as it descends, being sheared at point *X*.

As the forming punch descends the work is bent over the forming die and is held there while shearing punch *J*, through the medium of plunger *P* is forced out by the rocker *Q*. Rocker *Q* is pushed down by a lever at the side of the press, which is operated by an eccentric. In this connection it should be borne in mind that the press is of the cam-operated type, which allows the forming punch to dwell a short time while the shearing punch is operated by the eccentric. The spring *R* keeps the shearing punch back by acting against the collar *S* which is pinned to the punch. The spring *T* keeps the rocker and intermediate piece in contact with the operating lever which has but a slight action and is guided in block *U*.

This die proved an economical means of handling the work, as the diagonal shearing is an operation which would take much time if performed separately. F. SERVER

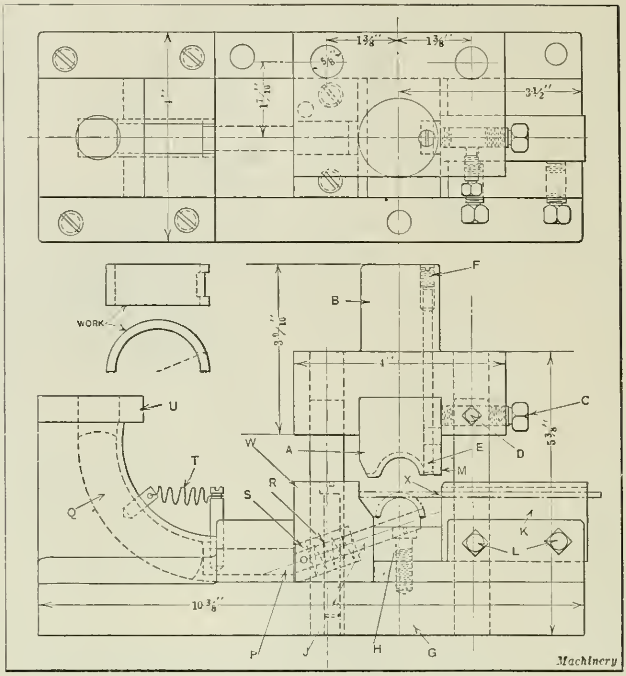


Fig. 1. Forming Die equipped with Angular Shearing Punch

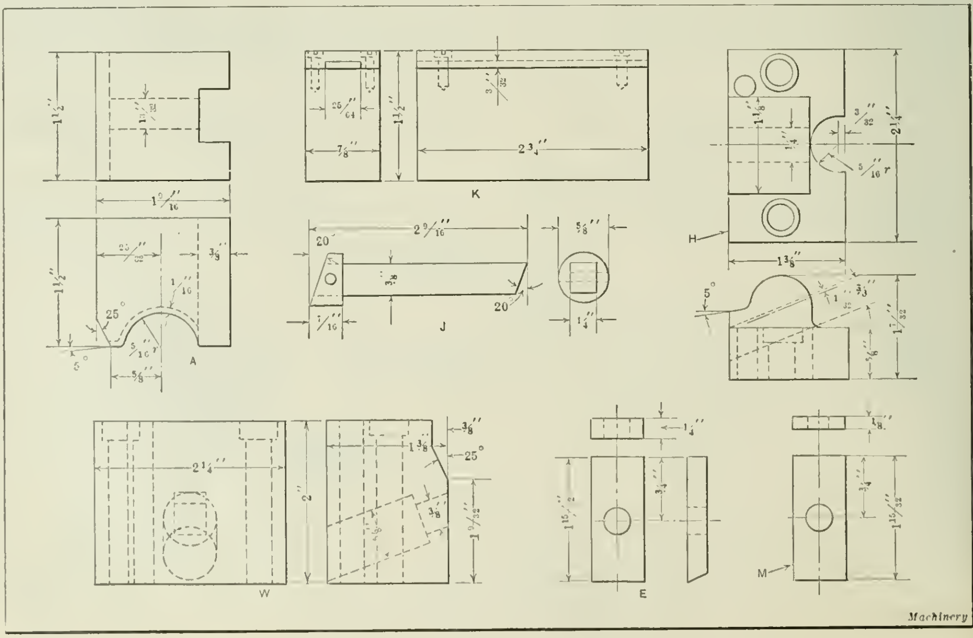


Fig. 2. Details of the Shearing Punch illustrated in Fig. 1

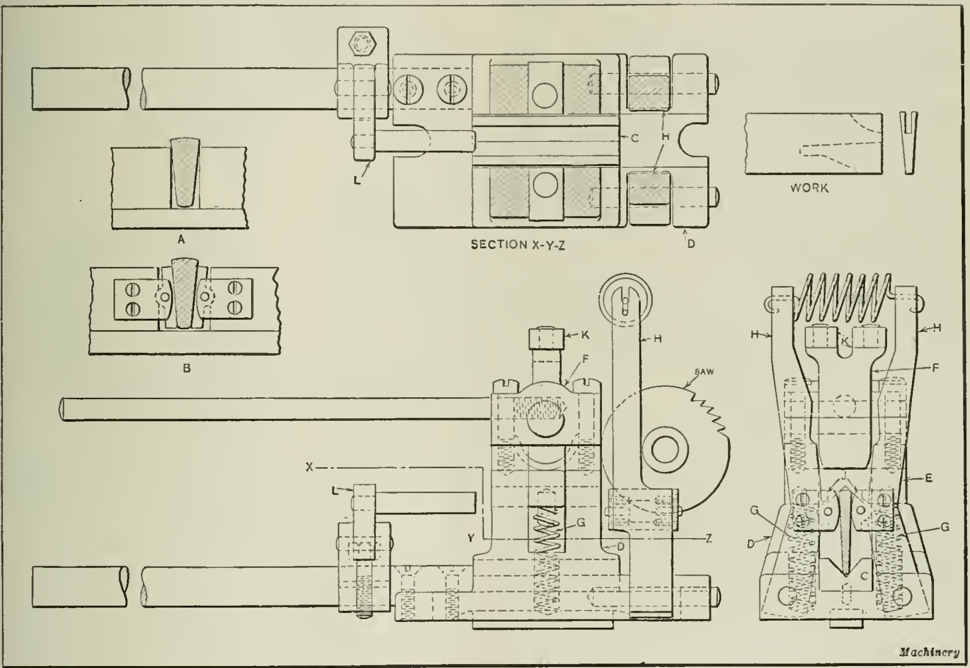
SLOTTING FIXTURE FOR COMMUTATOR SEGMENTS

The copper bars or segments in a commutator are slotted at one end to accommodate the leads used in soldering the armature windings. The detail view in the upper right-hand corner of the accompanying illustration clearly shows the construction. Ordinary milling machine vises are usually employed for holding the work while slotting, but these require a lot of adjustment to suit the great variety of widths and sectional shapes that have to be handled.

The varying angularity of these wedge-shaped sections makes it inadvisable to construct tapered vise jaws to conform to each change in shape, and so ordinary straight jaws are extensively used. These jaws pinch the bars in the manner indicated at *A*, causing them to be indented. An excessive amount of pressure is required to keep the bars in place by the use of jaws of this type, so that often the vises break or the threads in the nuts are stripped from the continuous tightening of the crank-handle. Not only is this means of holding unsatisfactory, but it is also a laborious task to perform the work by the use of a vise of this kind. Adjustable jaws like those illustrated at *B* may be used on milling machine vises, but these have a tendency to pinch the work and cause the sides of the slot to bind on the saw.

Owing to the objections to the use of milling machine vises equipped with either standard or adjustable jaws, a special fixture was designed for clamping these segments, the construction of which is shown in the illustration. This consists of a cast-iron base *D* which is attached to the table of a bench milling machine, and which carries the clamping arrangement. Its advantage is that it can accommodate various sizes of segments and that it is quick-acting. The position of the work is indicated in section in the end view, from which it will be seen that the bars are located vertically and clamped between two V-blocks, *C* at the bottom and *E* at the top. Block *C* is a stationary member located in a slot in the base, while the upper V-block *E* exerts pressure on the top of the work through an eccentric cam *F*, which is operated by a long lever. The base has a wide slot to accommodate this cam, and it is supported by trunnions and held in place by bearing caps.

The under side of V-block *E* carries two pins, which anchor the top ends of the two coil springs *G*, located in the base of the fixture. The purpose of these two springs is to exert pressure against the top V-block, keeping it in contact with the cam. Provision is made in this clamping device for exerting a light pressure on the work while the slot is being cut, thus preventing the walls from spreading, which is quite likely to occur, especially on thin bars. For this purpose two levers *H* carry a pair of swivel jaws *J* at their lower ends. The pressure of these jaws on the work is removed as soon as the clamping mechanism is released, by means of the same cam *F* used for clamping. In releasing the upper V-block by means of the long lever, cam *F* is revolved so that the rollers *K* operate against the lower surfaces of the levers *H* and force them apart. These rollers are integral parts of the cam.



Quick-acting Clamping Device for Holding Commutator Bars

The weight of the long lever by means of which the cam is operated is sufficient to exert clamping pressure enough to hold the bars rigidly during the slotting process. Segments of various sizes can be handled in this fixture without requiring adjustment and with the assurance that they will be located centrally and vertically. When heavy bars are being slotted, the compression spring connecting the side levers *H*, by means of which the pressure is exerted against the bars, may be removed and the levers omitted. When bars of varying widths are to be slotted, V-block *C* may be shimmed up if necessary. An adjustable stop with a pivot arm *L* is employed to suit varying lengths of bars. This arm may be easily swung back so that the bars can be inserted without interference. This device has been in constant use for two years, and as a result of the speed with which it can be operated the cost of machining the segments has been considerably reduced.

East Orange, N. J. JOHN E. UNGER

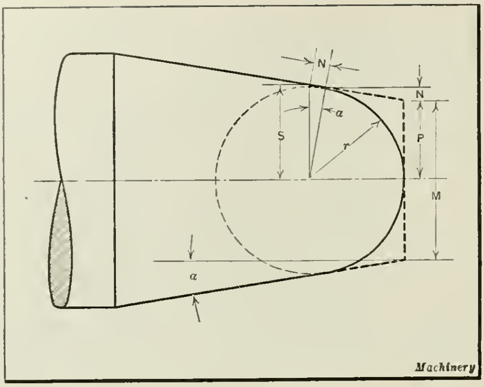


Diagram for finding Diameter at End of Tapered Rod

DETERMINING THE DIAMETER AT THE END OF A TAPERED ROD

When the tapered end of a rod has been machined to a semi-spherical form, as shown in the accompanying illustration, it is sometimes desirable to determine the original diameter M at the end of the rod. The following solution to this problem may be of interest to tool designers and toolmakers. Referring to the accompanying illustration, the known dimensions are:

a = angle of taper at end of rod; and

r = radius at rounded end.

With these values known, it is required to find M, or in other words, to find the original diameter at the end of the piece before forming. Now by trigonometry,

$$N = r \tan a \quad \text{and} \quad S = r \sec a$$

$$P = S - N$$

Substituting,

$$P = r \sec a - r \tan a = r (\sec a - \tan a)$$

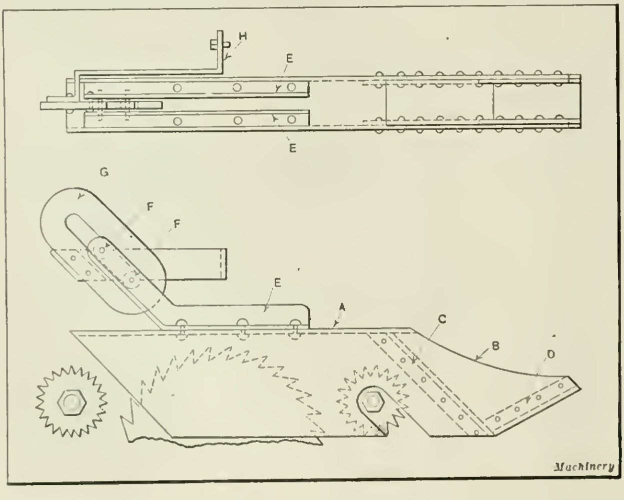
Then

$$M = 2P = 2r (\sec a - \tan a)$$

Flint, Mich. W. G. HOLMES

GUARD FOR CIRCULAR SAW

A guard for a power-fed circular saw that will cover both the saw and the feed-wheels properly is shown in the accompanying illustration. It consists of a hood or guard A and



Guard for Circular Saw

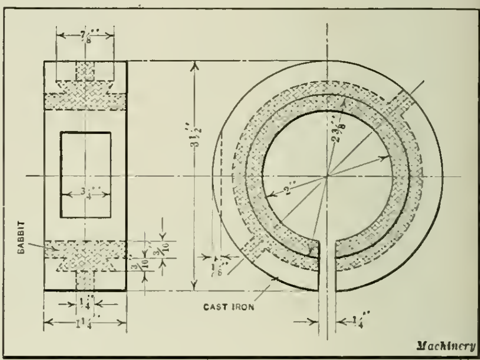
a nose-piece B, both of which are made of heavy sheet-iron stock. The two sides and the top are in one piece with the division plates C and D, which are riveted to the sides as shown.

The angle-irons E are equipped with anti-friction rollers F, which fit loosely in a slot in plate G. Plate G is fastened to the bar H, which, in turn, is bolted to the frame that carries the feed-rolls. As the slot in plate G is at an angle of 45 degrees with the top of the saw table, the guard will slide upward at this angle when a board is forced under the nose piece. When the guard is to be removed, it is only necessary to take out the two bolts which fasten bracket H to the feed-roll frame. This guard has proved very satisfactory, and in addition to protecting the operator from the saw, it prevents sawdust or small splinters from getting into his eyes.

Kenosha, Wis. M. E. DUGGAN

BUSHING FOR STEADYREST

The writer read with interest the description of a steadyrest bushing on page 566 of March MACHINERY. Another method of preventing the marring of ground or polished work and one which the writer believes would be more economical is to employ brass steadyrest jaws. In addition to



Babbitt-lined Bushing for Steadyrest

being less expensive, jaws of this type would give a wider range of adjustment.

A compression collar bushing for use in a steadyrest when it is required to support splined shafts or shafts having keyways is shown in the illustration. The particular bushing here illustrated is designed to support shafts approximately 2 inches in diameter, and is made from a piece of scrap cast iron lined with babbitt metal. The collar is dovetailed and drilled in such a manner as to retain the babbitt under the severe usage to which equipment of this nature is usually subjected. It will be noted by referring to the illustration that there is a flat on the top of the collar. This provision is made so that the top steadyrest jaw can be tightened on this flat spot, and thus prevent the bushing from turning in the steadyrest.

If the bore of the bushing is worn, the collar can be rebored to the next larger size, or if desired, the babbitt can be melted and the collar rebabbitted. A mandrel or bushing that will give the correct bore diameter is set on a cast-iron plate to form the mold used in rebabbitting the collar. Replacements of this kind have proved satisfactory and are inexpensive.

Cincinnati, Ohio FRANK C. LANG

Do's and Don'ts on the Care of Hobs

By HARRY E. HARRIS, President, Harris Engineering Co., Bridgeport, Conn.

HOBS are expensive tools when the initial cost alone is considered. They must be carefully designed with regard to what they are to produce, and must be accurately made by skilled mechanics with costly equipment. It is therefore impossible to produce a good hob without a considerable expenditure. In spite of this high initial cost, if properly used and cared for, hobs are, in point of quality and quantity of work produced, among the most economical tools used in the manufacture of gears and other parts that permit of hobbing. This economy is due to the fact that the hobbing operation is continuous, there being no necessity of interruption for table return or indexing. The purpose of this article is to give a number of points on the care and upkeep of hobs, so that their primary high-cost may be distributed over the maximum amount of work. The rules are simple and brief, and should be followed by those responsible in any way for hobs and hobbing operations.

Hobs should be checked for tooth clearance, as the clearance often varies on teeth of the same hob due to faults of the master forming cam on the machine in which the clearance is cut or to distortion in hardening. If the amount of clearance varies, the cutting edges will assume different heights from the center of the hob when the faces are uniformly ground in resharpening. This will cause some teeth to take heavier chips than others, resulting in marks on the work.

Rules Concerning New Hobs

First, care should be taken to make sure that only good hobs are purchased, because a good hob is the only one that it really pays to use. If a hob is inaccurate or partly distorted, expensive work on individual teeth, as for example grinding the faces different amounts or otherwise, will not make the hob good, and such practice, which is merely sending good money after bad, should be discontinued. Good hobs are readily obtainable, and there is no excuse for accepting and tinkering with defective hobs.

The following rules should be carefully followed by the user of hobs:

1. New hobs should be checked for concentricity while mounted on an arbor placed between centers.

2. The clamping faces should be checked for squareness; if these faces are not square with the hole, the hob will spring the arbor on which it is mounted when in the machine.

3. The hole should be round and to size; if it is otherwise, the hob will rotate eccentrically to some extent.

4. Hobs having the tooth form and clearance ground are preferable, even on rough work, because of the longer life of cutting edges. However, if ground hobs are not used, those that have not been smoothly formed or have been pitted or scaled in hardening should be rejected.

5. Each tooth should be tested on the face and heel for hardness by employing a file or some other recognized method, but the cutting edge or clearance should not be filed, because such practice may injure the hob.

6. The faces of the teeth should be inspected to see that they are ground smoothly and that the cutting edges are really sharp and have not merely been polished bright with an elastic wheel after hardening while holding the hob by hand. The least rounding of the cutting edges causes the hob to cut hard and tear, so that it will not stand up long.

7. Hobs should be rejected when the face of the teeth is at all convex or when this surface has a negative rake, that is, when the face is tipped back from a radial line extending to the center of the hob. In fact, preference should be given to hobs having the faces slightly concave.

8. For best cutting results as regards speed of production, life of cutting edges, and smoothness of work, hobs should be so designed that the teeth can be given a rake or hook; that is, they should have the face ground under-cut from the cutting edge at from 7 to 15 degrees relative to a radial line. Such hobs cut easier, faster, and smoother, and last longer than when each tooth face is radial.

9. The gashes or flutes should not be so narrow that an insufficient chip space between the heel of one tooth and the face of the succeeding tooth will permit the hob to become clogged up with chips. Such clogging with a narrow-fluted hob is one reason that many new hobs work poorly, as compared with old hobs, which, by repeated grindings, have had the flutes widened and thus have adequate room for lubricant and chips. Hobs with fewer and wider spaced teeth and fewer flutes give far better results than hobs with more teeth which are closely spaced.

10. Each tooth should be checked for depth, form, and width by the use of templets, or a bevel gage or protractor and a depth gage.

11. The hob lead should be checked; this may be done by mounting the hob between the centers of a lathe having a good lead-screw geared for the proper hob lead and then using an indicator carried on the toolpost.

12. It is important that the gashes or flutes be properly spaced, because a hob with inaccurately spaced flutes cannot be made to cut satisfactorily. There is no excuse for inaccurate indexing of a hob when it is being made, and so it may be assumed, in instances where the flute spacing is inaccurate, either that the operator of the machine on which the hob was produced made an error in his settings or else that the hob has been distorted in hardening.

13. Hobs should be checked for tooth clearance, as this often varies on teeth of the same hob due to faults of the master forming cam on the machine in which the clearance was cut or to distortion in hardening. If the amount of clearance varies, the cutting edges will assume different heights from the center of the hob when the faces are uniformly ground in resharpening. This will cause some teeth to take heavier chips than others, and the hob will be used up faster and will make marks on the work. A hob may be checked for tooth clearance by clamping an arbor in a V-block placed on a surface plate, mounting the hob on the arbor and then rotating the face of each tooth in succession against a horizontal spring stop. As each face is brought against the stop, the amount of clearance can be measured near the tooth heel by means of an indicator in a height gage, located at a fixed distance from the end of the stop.

Caring for Hobs in Use

Care should be taken to get as much work as possible from hobs. They should not be wasted by abuse or misuse; unnecessary shut-downs of machines while waiting for hobs to be resharpened should be eliminated, and resharpening should be accurately and expeditiously done. More time and money are lost daily from neglect of the foregoing points than is generally realized. If the following rules are observed in the use of hobs, these tools will last longer and there will be less non-productive time, higher production and lower upkeep cost.

14. A hob should never be put in a machine until it has been carefully inspected, as outlined in the preceding rules.

15. A hob should be examined each time it is used, to make sure that all cutting edges are sharp. One dull tooth is sufficient to cause hard cutting, a poor finish, and inaccurate results. Furthermore, as the dull tooth is invariably the highest one, it has the most work to do and speedily becomes excessively dull or "dubbed off," so that it may be necessary to grind the faces of all teeth 1/8 inch or more before they are satisfactory. As from 0.005 to 0.010 inch only, at the most, should be removed from the faces at a sharpening, this would result in a great loss of time and money.

16. When sharpening a hob, the grinding should never be forced. Light, quick cuts should be taken with a high-speed soft, coarse wheel. Many hobs are burnt on their cutting edges through using hard, slow running wheels or because the hob is crowded against the wheel in trying to grind it quickly. Not only may the same amount of stock be removed by light, quick cuts in the same time, but the effect of burning, even if the hob shows no discoloration, is a softening of the cutting edges, which causes them to dull rapidly and "dub off." Then at each successive grinding, a greater amount of tooth face must be ground off, and as the operator forces the grinding a little more each time, the hob is rapidly used up or cast aside as worthless.

17. Hobs should always be ground under flooded lubrication for the same reason that light, quick cuts should be taken with a soft wheel running at a high speed. The stream of lubricant should be directed at the grinding contact.

18. In sharpening a hob it is advisable to make sure that the grinding wheel will produce a smooth face. Rough scratchy grinding means fine saw-tooth cutting edges, which crumble and lose their keenness. If the proper facilities and the right wheel are not obtainable, apply an India oilstone by hand after the grinding operation, to produce fine sharp edges.

(Careful attention to Rules 16, 17 and 18 will effectively prevent burning and result in smooth surfaces and finer, keener, and more durable cutting edges.)

19. In sharpening hobs having radial faces, care should be taken to see that the teeth are not given a negative rake, as mentioned in Rule 7. In attempting to sharpen hob faces to radial lines, it is difficult to prevent this from happening, because if the cutting face of the wheel is set radial to the center of the hob, that part of the wheel grinding at the bottom of the teeth wears away much faster than the part grinding at the tops, because it has more metal to remove. The result will be a negative rake. To overcome this effect, the wheel should be set over so as to tend to under-cut or give a rake to the tooth faces. Then, after the hob is ground, the tooth faces will be approximately radial from top to bottom and slightly concave due to the wear of the wheel. The amount that the wheel should be set over varies, depending on the wheel, hob, and the amount to be ground from the latter, but the set-over may be readily determined from observation.

20. It has been proved beyond question that hobs should be under-cut, that is, that they should have the front face of the teeth slanting from top to bottom at least 8 degrees back from a radial line. The cutting angle on this style hob is generally stamped on one end of the tool, and care should be taken to maintain this angle. The cutting face of the wheel should be carefully set in resharpening, and the hob checked after such an operation. It is often possible to grind radial-tooth hobs so that the face will have a cutting angle of a few degrees. This will improve the cutting action of the hob without affecting the developed contour of the work or the depth of cut sufficiently to be objectionable.

21. It is poor practice to grind back and forth through a flute more than once at a time; the better method is to index to the next flute and grind back and forth through that flute and so on, all around the hob. The practice of grinding back and forth through a flute many times in succession is unsatisfactory, although often followed in grinding hobs with attachments or by makeshift methods. It should be avoided for the following reasons: First, because the teeth become so hot that they are burnt; second, the wheel wears and changes its shape, with the result that the cutting faces of the hob teeth are at different angles; and, finally, the spacing of the flutes becomes irregular.

22. A hob should be ground until all the teeth are sharp, because one dull tooth will cause trouble.

Do not grind back and forth through a flute more than once at a time, but rather index to the next flute and grind back and forth through that flute and so on, all around the hob. The practice of grinding back and forth through a flute many times in succession is unsatisfactory, although often followed in grinding hobs with attachments or by makeshift methods. The reason this practice should be avoided is that, first, the teeth become so hot that they are burnt; second, the wheel wears and changes its shape, with the result that the cutting faces of the teeth are at different angles; and, third, the spacing of the flutes is irregular.

23. A hob should not be allowed to remain in a machine after it becomes dull; it should be sharpened immediately. The unsatisfactory results obtained with a dull hob have previously been mentioned under Rule 15.

24. The hobbing machine should be kept running at the maximum feed and speed for the job.

25. The life of a hob must not be judged by the number of days it lasts in production, but by the number of parts or inches of metal that have been cut. Furthermore, the need for sharpening must not be judged by the number of hours run, but by the number of parts or inches of metal cut between grindings.

26. Hobs should be changed and sharpened frequently; thus less metal is required to be ground off each time. The production rate can then be materially increased by speeding up the machine. Sharp hobs will easily give double the production obtained with dull hobs.

27. The resharpening of hobs should be made easy. The reason that much work is spoiled by the use of dull hobs is that sharpening, especially of spiral-fluted hobs, is usually a difficult operation in a shop not properly equipped for this purpose. The result is that dull hobs accumulate and are often put away and used again without sharpening. Then, when a set-up is made at last to grind the dull hobs, the work is likely to be rushed through, wrong wheels, speeds and feeds being used and the hobs ground dry. Even with the most skilled grinding machine operator, results under such conditions will be poor. A machine for grinding hobs properly should always be ready to receive a job.

28. An individual record should be kept on a suitable card of the work produced by each hob. This will make it possible to compare hobs made from different brands of steel, subjected to different heat-treatments or purchased from different concerns. The results of ground hobs may also be compared with unground hobs.

29. Hobs should be kept oiled or greased when not in use, because a rusty cutting edge will not be sharp.

30. Hobs should not be stored loose on a shelf or in a box. Their edges are easily damaged in this way and they are likely to chip and nick one another in being shuffled about. Then, too, they may roll off a shelf and drop on a metal base or cement floor. A board provided with wooden pegs fitting the holes of the hobs is an excellent means of storing these tools. An individual peg board, having the name and number of the hob for which it is intended, is also satisfactory for storing hobs in a tool-room.

The British Metal-working Industries

From MACHINERY'S Special Correspondent

London, June 14

EXPERIENCE in all quarters of the engineering industry points definitely to the fact that trade is at last gathering momentum. Even the protracted labor dispute of the last two and a half months has not been sufficient to counteract the tendency toward general improvement.

The Machine Tool Trade

The machine tool trade is moving very slowly with the general trade improvement. There is a more decided tendency to buy, and the stocks of manufacturers are being slowly reduced. The machine tool trade has perhaps suffered more by the lock-out than the majority of trades, since the proportion of skilled workmen is very high in the general run of British machine tool shops.

Very little stability exists in prices of machine tools, and quotations from several firms for substantially the same machines frequently show a wide range of prices. Selling prices are controlled, not so much by the cost of production, as by the great necessity of turning money over and reducing stocks. The influence of the second-hand market continues to be felt, although the war surplus has been substantially reduced, and the machines have passed largely into the hands of the dealers instead of being put into production.

Overseas Trade in Machine Tools

Inquiry for machine tools from other countries is excellent and of a much better tone. The export and import returns for machine tools showed a small drop from the figures reached during the previous month. In tonnage, exports fell from 1447 to 1421 and in value from £184,776, to £171,612; import tonnage was reduced from 343 to 266, the value being £30,779 instead of £37,338. The value per ton of imports showed a tendency to rise after the fall over several months; the value per ton of exports continues the tendency to fall shown during the last twelve months. The imports and exports are now approximately equal in value —about £115 to £120 per ton.

Figures show that Germany is now the most important exporter into this country. During April Germany sent 141 tons of the 266 tons of machine tools imported; the amount was divided among all classes of machine tools, although drilling machines and lathes predominated. America sent 54 tons, principally grinding machines and special machines, but practically none of the classes in which Germany led. Against this, it must be realized that whereas America's contribution had a value of £12,000, Germany's much larger contribution had a value of only £8000. These figures are significant in view of the fact that Germany's contribution to the British market is now in process of growth.

New Machine Tools

A few new designs of machine tools have appeared during the last few weeks. These include radial drilling machines by Kitchen and Wade, of Halifax. A prominent feature of these machines is an auxiliary spindle for tapping purposes. The extra spindle runs at one-third the speed of the main drill spindle and can be arranged for driving right- or left-hand taps. The same firm has also introduced a line of girder type radial drilling machines.

An interesting pipe flange facing and turning machine has been developed by Haighs (Oldham) Ltd., Oldham. It is particularly suitable for machining simultaneously the three flanges of large pipe fittings such as tees, etc. Producer plant piping and many types of valves also can be conveniently faced on this machine. It is built on the lines of a lathe with heads at each end of the bed, while another bed carries a third head the spindle of which is driven in unison with the other two, and is arranged at right angles to the main bed. The work is held stationary during machining, and is gripped in two self-centering vises that can be moved to convenient positions along the bed.

The spindles carry faceplates on which are mounted facing and boring tools. The facing tools are carried on cross-slides on the faceplates and these enable facing cuts to be taken. The feed is automatic through a "picking gear" or "star wheel" operated at each revolution of the spindle. For turning the flange diameters or for boring, the heads are fed along the bed. The machine accommodates pipes up to 9 feet in length by 20 inches in diameter; one 10-inch and two 14-inch flanges can be faced and turned in two hours.

The Automobile Industry

Automobile manufacturers maintain their strong position. Demand has exceeded all expectations, and buyers are pressing for prompt delivery. There is a large accumulation of orders which though taken early in the season, are still waiting to be filled, and it is imperative that there should be no further hindrance to production.

Owing to high taxation and similar causes, particular attention has been paid to the development of automobiles which, while giving ample power for ordinary requirements, are rated sufficiently low to come within the scope of the lower grade of taxation. Cars that fulfill these requirements are about 10 horsepower, and besides being subject to a relatively low tax they can be obtained at a reasonable price and are economical to run.

So strongly is it felt that the light automobile is assured of an exceptionally bright future that, after carefully considering the question, several prominent firms have decided upon an increased output and are arranging to expand their plants accordingly. In one factory in the Coventry district, such extensions are already in progress, and when completed will provide for a threefold increase in the output.

Iron and Steel Trades and Material Prices

In the iron and steel trades there is a quiet but steady demand. Conditions in the home trade have not materially altered, and business has been held in check by the engineering dispute. However, although there is but little buying, consumers are keeping in touch with the market in anticipation of the demand arising as soon as the dispute is settled.

Foreign demands for British materials continue to increase, and for this reason steel makers are able to maintain their recent rate of output. India, Siam, South America, and South Africa are in the market for large quantities of railway equipment, and it is thought that a good share of these orders will come to this country, provided suitable credits can be arranged. The situation in the pig iron market is still encouraging, and buyers of both hematite and foundry irons may expect an advance in prices almost immediately. American buying of British iron has not developed to the extent that was anticipated, but the over-seas demand generally is good. Germany is still a prominent buyer and some sales in Czecho-Slovakia have recently been made.

Metal prices have shown little or no fluctuation during the last two months. Finished steel in the form of round bars remains at £9 15s to £10 10s per ton, while finished iron as crown bars sells at £11 to £12 10s per ton. Pig iron varies from £3 12s 6d to £4 10s, according to grade.

The Machine Tool Industry

THERE is steady improvement in the machine tool industry. New orders now average between 20 and 25 per cent of the peak business. Six firms out of seventy-seven state that their business is more than 50 per cent of peak business, which may well be considered normal or above normal. About thirty firms out of the seventy-seven are doing a business that may be considered from one-third to one-half normal or better. Stocks have been materially reduced within the last two months, and it is only in a few instances that machine tool manufacturers now say there is no improvement in their business. Practically all the shops that were shut down during the most severe period of the depression are now running to some extent, and some of the largest report sales averaging 50 per cent of what is considered normal. Such statements as, "we have had more business in the last six weeks than we had in the previous six months," or "we have had twice as much business since the first of January as we had during all last year" are not unusual.

On account of working off the stocks on hand, the shops as yet do not run in proportion to orders received, but the assembling departments of several plants are working to a satisfactory degree—some to capacity—using parts in stock. On account of the activity of the radio business, the demand for small automatic screw machines has been exceptionally brisk. All the smaller sizes of these machines that were in the hands of the used-machinery dealers, have been absorbed, and one of the well-known makers of small automatics quotes from six weeks' to three months' delivery. The demand for special machinery of certain types is also good, gear tooth grinding machines particularly being in demand, one shop operating over-time to meet this demand.

In the electrical welding machine field conditions are practically normal, the demand coming mainly from the automobile industry. Shops devoted to electric welding on a jobbing basis are also well occupied. The electrical repair and motor rebuilding business keeps the shops doing this work running at full capacity, and the electrical tool business averages about 50 per cent of normal.

Gradual Return to a Normal Business

The difficulty in making comparisons is that we have no "normal" standard with which to compare. One machine tool manufacturer, therefore, took an average of the output of his plant for the last ten years, and states that the present business is 84 per cent of that average, it being about 50 per cent of the maximum business that was done during the war years. It is of interest to note that this machine tool builder is not depending on the automobile industry for his business, but caters to the general machine-building field. Some of the well-known dealers in machine tools, having defined as normal business an average trade that will enable them to maintain their organization intact, pay overhead expenses, and realize a reasonable profit, state that business is now 50 per cent of such a normal.

In the Pittsburg district good business in second-hand machinery is reported as compared with last year; but one of the dealers states that "those who believe that the second-hand business was very brisk last year should be told that at that time most dealers in used machinery lost money." The second-hand machinery business appeared good simply because the business in new machines was small. The trade in both second-hand and new machines is now more active. In the used machinery field, large types are especially in demand, but the present owners want too high prices, sometimes as high as the present reduced prices on new tools.

Dealers who handle both new and second-hand machines in the Pittsburg district state that it is still much easier to sell second-hand machines than new machinery, because many firms that never bought used machines in the past are now forced to do so by financial considerations; but these shops will most likely buy only new machines as soon as they can afford to do so. In the Cleveland district this return to new machines seems to have already taken place, one dealer reporting that of his sales 85 per cent represents new machinery, and only 15 per cent used tools, his total sales being three times the sales for an equal period last year.

Small Tools and Accessories

The tap and die business averages from 25 to 40 per cent of capacity. Some manufacturers report the reamer business to be above the pre-war level. One firm states that the business in self-opening dies is about 40 per cent normal. The volume of business done in twist drills is quite large, several of the important manufacturers in this branch running their plants about 75 per cent normal, but prices of twist drills are very low.

The makers of special tools, jigs, and fixtures average about 50 per cent of a normal business, and a few of these shops are running full and even over-time. On the other hand, a great many of them have gone out of business, thereby increasing the opportunities for those that remain. It is well known that many makers of special tools started in the business during the war years, and with the return of peace conditions there could not possibly be enough business for all. Those who had the best organizations and were best qualified to meet the requirements have survived.

The vise business may be said to be practically normal. Two of the important vise manufacturers state that the volume is greater than the pre-war business. One of the large shops making vises is running practically to capacity, while others report business considerably improved, but not yet up to normal.

In the ball and roller bearing field the activity is 100 per cent; in fact, in some instances it is above 100 per cent, the overflow work being taken care of in outside shops. This activity is due mainly to the heavy demands of the automobile industry.

Forging and Foundry Business

The drop-forging shops are fully occupied, and those engaged in making automobile forgings have difficulty in meeting the demands. There is considerable demand for forgings for railroad cars, large orders for which have been placed by the roads during recent months. One of the forging shops, specializing in steam and gas engine forgings, operates at 75 per cent capacity, and one plant making general machine forgings, at from 40 to 50 per cent capacity. Prices for forgings, which were very low a year ago, have come up to a point where it is now possible to operate without a loss. The activity in the forging shops has placed a fair demand upon steam hammers, and one of the plants building this kind of machinery operates at two-thirds capacity. Business is at present fair in the forging machinery line, and one of the plants specializing in this line is putting on men, expecting a fair business in the fall, while another plant is running full time and full force in most of its departments.

The foundry business is much better, and prices of castings have increased to a level that is said to be satisfactory by the foundry operators. The die-casting business is operating at about 75 per cent capacity. The upward trend is distinct and definite.

NEW MACHINERY AND TOOLS

THE COMPLETE MONTHLY RECORD OF NEW AMERICAN METAL-WORKING MACHINERY

The New Tool descriptions in MACHINERY are restricted to the special field the journal covers—machine tools and accessories and other machine shop equipment. The editorial policy is to describe the machine or accessory so as to give the technical reader a definite idea of the design, construction, and function of the machine, of the mechanical principles involved, and of its application.

Heald Cylinder Grinding Machine

AMONG the important factors upon which successful automobile cylinder grinding depends are the smoothness of the table movements and the rate of table feed. To insure efficiency of table operation on the machine here illustrated, a hydraulic arrangement operated by oil is utilized to drive the main table. By means of this arrangent any table feed from zero to maximum is instantly obtainable, and reversing of the table may be effected at any desired point without shock or noise. This machine is a recent addition to the line of grinding equipment built by the Heald Machine Co., 16 New Bond St., Worcester, Mass., and is known as the No. 50. It is intended for both manufacturing and repair shops. The hydraulic arrangement incorporated in its design is also applied on an automatic piston-ring grinding machine built by this firm and described in February MACHINERY.

The main driving shaft is placed on the rear of the bed as shown in Fig. 2. It is mounted in ball bearings and is designed to be driven directly from a lineshaft at a constant speed, thus eliminating the necessity of a countershaft. The grinding head and the feeding arrangement for the eccentric are similar in design to those that have been used successfully by the builders of this machine for over seventeen years. For the benefit of those not familiar with the construction, it may be stated that the locating head is made up of two eccentrics, one within the other, which give the grinding spindle a sort of planetary adjustment for accurately feeding the wheel to the work. There are three speeds for the eccentric which are controlled by a convenient lever.

The grinding spindle is driven from the driving shaft through an idler which maintains a uniform belt tension. The spindle is hardened, ground, and runs in a taper bronze bearing at the wheel end and in a self-aligning ball bearing at the pulley end. It is equipped with interchangeable pulleys which provide different speeds for the grinding wheels, so that the operator can always obtain the correct speed for the work in hand, whether using large or small wheels. The depth of cut is obtained by a feeding mechanism on the right-hand end of the rotating head. This is operated either by means of a knob when a small adjustment is desired, or

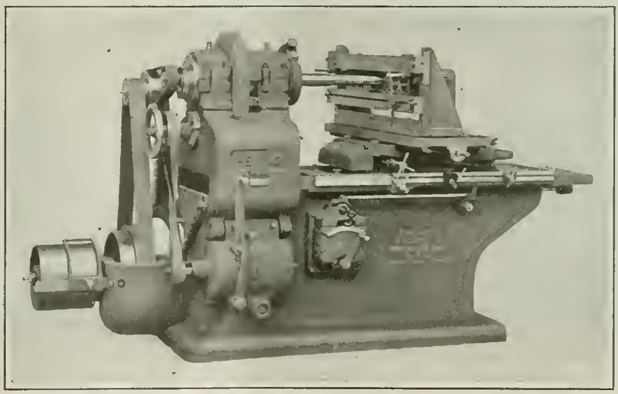


Fig. 1. Style No. 50 Cylinder Grinding Machine made by the Heald Machine Co.

through a small crank when large adjustments are to be made, as when changing the setting of the wheel to suit the grinding of different sizes of holes.

An 11–18-inch combination spindle for grinding holes 2⅜ inches in diameter and larger by 11 inches long and holes 3 inches in diameter and larger by 18 inches long, is regularly supplied, although the following sized spindles may also be furnished: 7½-inch, which grinds holes 1⅛ inches in diameter and larger by 7½ inches long; 10-inch, which grinds holes 2⅜ inches in diameter and larger by 10 inches long; 18-inch, which grinds holes 3 inches in diameter and larger by 18 inches long; 23-inch, which grinds holes 5 inches in diameter and larger by 23 inches long, and holes 3 inches in diameter by 16½ inches long; and special 15- and 18-inch spindles that are intended for use with large wheels.

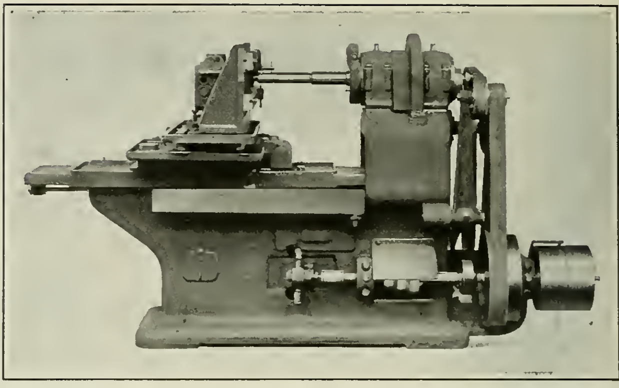


Fig. 2. Rear View of Cylinder Grinding Machine showing the Driving Arrangement

Main and Cross-slide Tables

The main table is heavy, wide, and of sufficient length to protect fully the ways on which it slides from grit or dirt. These ways are of dovetail form, and the table is gibbed to them. Oil-pockets and rolls provide adequate lubrication. The cross-slide table has an adjustment of 28 inches through a feed-screw equipped with a dial graduated to thousandths of an inch. Adjustable dogs are used to indicate long distances through which the table is moved, such as when traveling from hole to hole. Exact distances are obtained by means of the micrometer dial on the feed-screw; this can be set at zero for the first hole, and the position of the dial noted for the other holes.

A vertical adjustment of the cross-slide table up to 5/16 inch is obtainable through two inclined slides between the cross-slide table and the main table. This adjustment is made by turning a small pilot wheel connected through gears to a screw which causes the upper of the inclined slides to be moved on the lower inclined slide. In so doing the upper inclined slide causes the cross-slide table and work to be raised or lowered, depending upon the direction in which the pilot wheel is rotated.

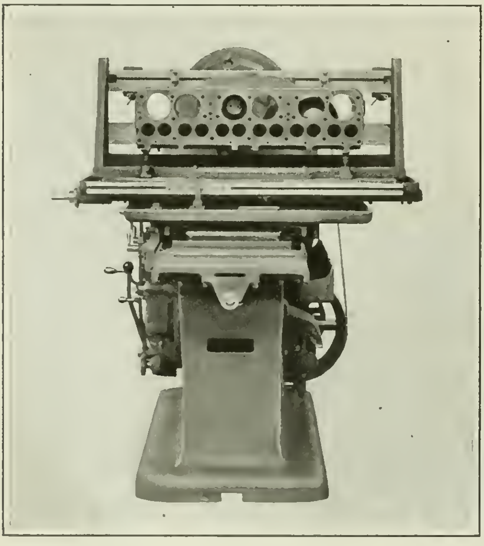


Fig. 3. End View of Heald Grinding Machine showing the Manner of setting up a Cylinder Block

As only a slight vertical adjustment is required to obtain the exact position or to take care of any vertical errors that may exist in the different bores of a cylinder casting, the 5/16-inch vertical movement of the cross-slide table is employed. To accommodate the handling of a large variety of work, a universal jig can be furnished, which locates the hole for the grinding center. When the work is of such a size that there is not a sufficient distance between the grinding center of the eccentric and the top of the cross-slide table, all slides and the cross-slide table can be removed so the operator can set up the work directly on the main table.

Universal Quick-locating Jig

A universal quick-locating jig having a capacity for all styles and sizes of cylinder blocks used with standard makes of automobiles may be furnished for the use of regrinding shops and manufacturers desiring such equipment. This jig is constructed of two bars bolted to the face of an angle casting. The bars can be so adjusted that the center of the holes to be ground will be at the correct height for the grinding wheel to enter the hole.

The standard grinding wheels for the regular 11–18-inch grinding spindle are 2¾ and 3½ inches in diameter. The speed of these grinding wheels is 4950 and 4500 surface feet per minute. A 5-horsepower motor having a speed of from 1000 to 1200 revolutions per minute is recommended for a motor-driven machine. The weight of this machine, when fully equipped with the universal jig, is about 5000 pounds.

ACKERMITE BEARING METAL

A bearing alloy consisting of copper and lead is being produced by the Ackermite Co. of America, 3643 Beaubien St., Detroit, Mich., by a patented process which is claimed to insure a uniform alloy that has no tendency toward segregation of its two components. The metal is cast solid or cored in bars 12 inches long and from ½ to 8 inches in outside diameter. These bars may be used in various ways for lining bearings; they may be remelted to allow the metal to be poured into the bearings, or they may be cut up and machined to form bearing bushings. Ackermite may be cut freely.

When used as a lining for bearings, Ackermite will wear away in time, but a shaft will not become scored while running in a bearing lined with this material. Under high temperatures resulting from lack of lubrication or especially severe service, small quantities of lead will be given off from the alloy. These particles of lead act as a lubricant which prevents bearing trouble. Ackermite may be used for lining any bearings in which babbitt is customarily employed. A somewhat similar alloy is produced by the same company for making steam-engine packing rings.

PAWLING & HARNISCHFEGER BORING, DRILLING, AND MILLING MACHINE

A high-precision horizontal boring, drilling, and milling machine which is equally adaptable to tool-room and manufacturing work has been recently developed by the Pawling & Harnischfeger Co., 3826 National Ave., Milwaukee, Wis. In a test, a surface 22 inches square is said to have been milled flat within 0.001 inch. This degree of accuracy is claimed to be possible because of the use of square-lock, narrow guides with taper gibs, and an unusually heavy construction of the spindle, saddle, and column, coupled with scraped sliding fits. All sliding members on the machine have a take-up for wear. Attention is called particularly to the centralized control, the automatic stops for the saddle and platen, and the interchangeable externally and internally driven faceplates.

From the close-up view, Fig. 2, it will be seen that all operating levers and handwheels are within easy reach of the operator and conveniently arranged for controlling the different operations. The starting, stopping, reversing and changing of feeds or speeds by hand or power are controlled by the operator without moving from his position. All levers are interlocking so that it is impossible to have two conflicting speeds or feeds in action at the same time.

The column is of heavy box construction, and grooved and tongued to the bed. The latter is also of box section and contains chutes for the quick removal of chips. The bed is cast in one piece with four walls under the column. The feeding, feed-distributing, and rapid-traverse mechanisms are contained in the bed. The platen contains T-slots and can be arranged for using cutting compound in connection with an operation. All bearings in the saddle are phospher-bronze bushed, and the main spindle sleeve bushing is also made from phospher-bronze and scraped to a light taper to furnish a means of readily taking up wear of the spindle driving sleeve. The guide on the column for the saddle is located at the front close to where the cutting pressure is applied. Adjustment for wear of the saddle is made by means of two steel tapered gibs. The saddle can be raised and lowered on the column either through a handwheel, power feed or quick traverse. A counterweight for balancing

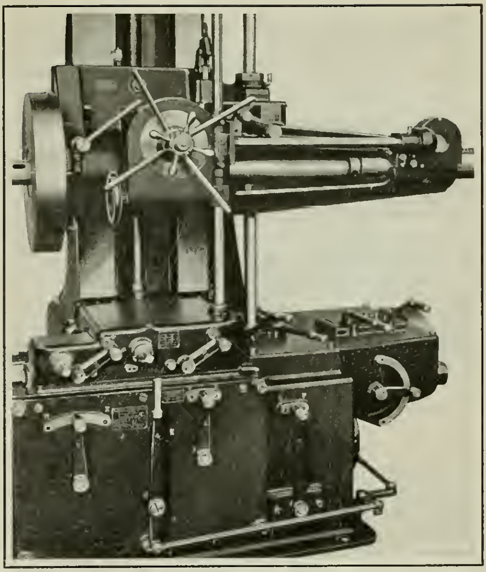


Fig. 2. Close-up View showing Centralized Control on the Pawling & Harnischfeger Boring, Drilling, and Milling Machine

the saddle members is located within the column. The spindle is a high-carbon hammered alloy steel forging, and it is ground to a sliding fit in its driving sleeve. Power for driving the spindle is applied at its front end, and power for feeding it is applied at the rear end through a rack and pinion. This construction permits the use of large bearings at the front and rear. The front end of the spindle is bored to a Morse taper and contains slots for driving milling cutters and boring-bars. The drive is delivered to the spindle either through a small faceplate by means of a wide-faced coarse-pitch gear or through a large faceplate by means of an internal gear. This large faceplate has tapped holes to provide for attaching milling cutters and facing heads. The spindle driving sleeve contains adjustable bronze taper shoes for taking up wear due to the spindle sliding in the sleeve.

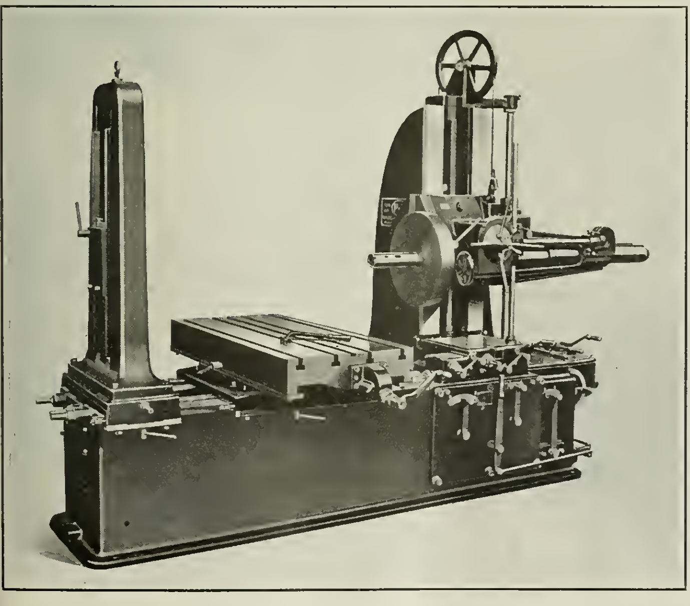


Fig. 1. No. 3T Horizontal Boring, Drilling, and Milling Machine brought out by the Pawling & Harnischfeger Co.

Sixteen speeds ranging from 14.5 to 225 revolutions per minute are obtainable with a pulley speed of 350 revolutions per minute, when the small faceplate is used. When the larger faceplate is used, the speeds obtainable with the same pulley speed, range from 8.7 to 136 revolutions per minute. Power is transmitted to the machine by a belt directly connected to a lineshaft. For a motor-driven machine a five-horsepower constant-speed motor running at a speed of from 1200 to 1400 R.P.M. is recommended.

The feeds obtainable are eight in number and range from 0.005 to 0.288 inch per revolution of the spindle for boring, and from 0.0084 to 0.44 inch per revolution of the spindle for milling, when using the small faceplate. When using the larger faceplate, feeds ranging from 0.0008 to 0.48 inch per revolution of the spindle for boring, and from 0.013 to 0.73 inch per revolution of the spindle for milling, are obtainable.

The boring-bar support can be removed from its base without disturbing any of its mechanism. Helical gearing is used between its screw and the saddle screw so as to have a minimum amount of backlash. A thread-chasing attachment can be furnished to cut threads from 2 to 16 per inch. Other attachments which may be supplied include a circular swiveling table 24 inches in diameter, graduated to minutes and having a hand or power feed; an auxiliary table 5 feet long by 5 inches wide for supporting long work; boring-bars of any diameter up to 3 inches; and a star-feed facing head for facing work up to 16 inches in diameter. The facing head can be clamped to the spindle or bolted to the faceplate. Some of the specifications of this machine are as follows: Travel of spindle, 23½ inches; maximum distance between faceplate and boring-bar support, 5 feet; maximum distance from top of platen to center of spindle, 28 inches; top surface of platen, 24 by 54 inches; cross-feed of platen with automatic trip, 36 inches; and weight, 11,300 pounds.

NEWTON CRANK PLANER

Locomotive cross-heads, shoes and wedges, die-blocks forming dies, and other parts which it is desirable to machine on a planer having a short stroke, are included in the class of work for which the heavy-duty crank shaper illustrated was designed. This machine has been brought out by the Newton Machine Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa. The rated capacity is for work 32 inches wide by 32 inches high, and the maximum stroke is 34 inches. The base is a one-piece box casting to which the uprights, which are also of box cross-section, are bolted and doweled. The driving motor is mounted on the left-hand side of the machine, as shown in Fig. 1.

Variations in table speed are obtained through a gear-box on the right-hand side of the machine, which may be seen in Fig. 2. By means of this gear-box, 6, 8¼, 12 1/3, 17½, 23 2/3, and 35½ strokes per minute are obtainable. The gears in this box are all of the sliding type, made from hardened steel, and are fully enclosed to run in oil. The main driving gear is of the helical type, has a face width of 4½ inches, and a diameter of 37 inches. It drives the rocker arm, and gives a relatively uniform speed to the table, although the speed is slightly lower at the beginning of a cut. The compactness of the drive will be apparent by reference to Fig. 2.

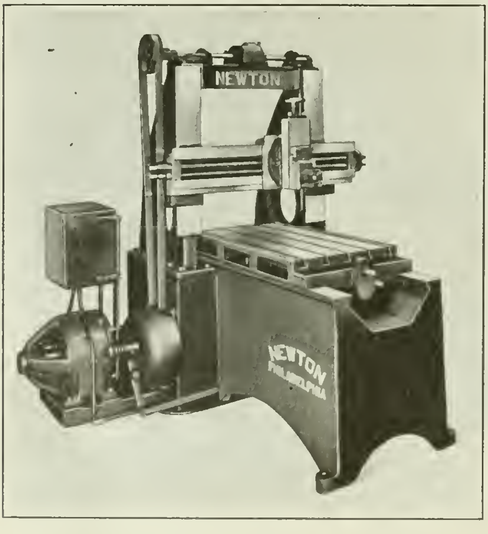


Fig. 1. Heavy-duty Crank Planer built by the Newton Machine Tool Works, Inc.

The table is of the double-plate construction, and has an adjustment of 20 inches, which can be made while the machine is in operation. After the table has been positioned, the driving element is solidly clamped by means of the square-end shaft at the front end of the table. The length of stroke is set from the operating side of the machine, an indicator showing the stroke for which the machine is arranged at any given time.

The table operation is controlled by means of a clutch and brake operated by a lever on the right-hand side of the machine (not shown in the illustration). Provision is made for locking this lever when it has been moved to the disengaged position to prevent it from re-engaging and possibly injuring the operator. The feeding mechanism is of the cycle type, being operated during the return stroke of the machine. Power is transmitted to the cross-rail through a rack and pinion to furnish the transverse, downward, and angular feeding movements. The cross-rail is raised and lowered by screws driven from the shaft extending along the top brace. In an operation, this machine has taken cuts ⅜ inch deep on steel forgings, with a feed of from 1/16 to ⅛ inch per stroke.

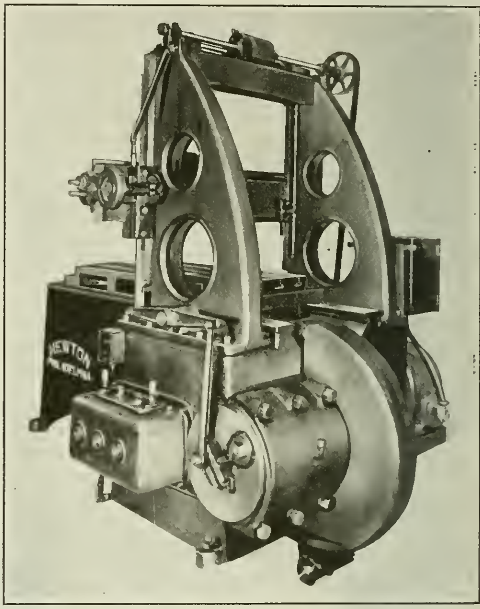
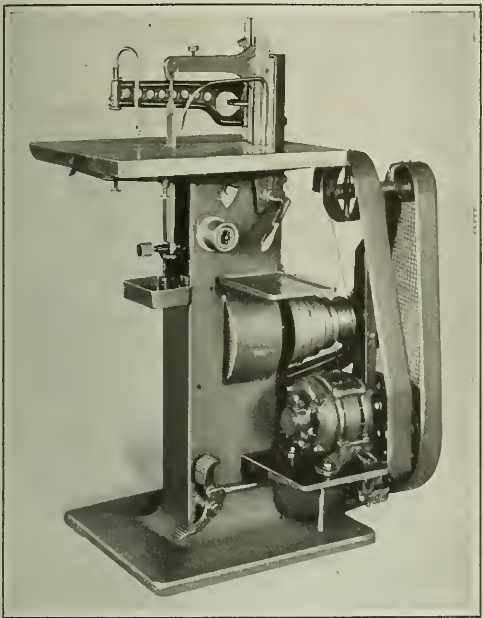


Fig. 2. View of Newton Crank Planer showing the Compact Design of the Units on the Operating Side

OLIVER HIGH-POWER FILING MACHINE

To permit the rapid filing of work up to 9 inches in height (although work up to 6 inches in height is recommended when the machine receives constant use), the Oliver Machinery Co., Grand Rapids, Mich., is building the filing machine here illustrated. This machine takes all sizes of standard or special files from a 3-inch long needle to a 14-inch bastard. The file is operated at four different speeds, ranging from 80 to 320 strokes per minute. The length of stroke is adjustable from ½ to 7 inches, the adjustment being effected by means of an eccentric inside the column, which is readily accessible. This eccentric is connected with the vertical slide mechanism by a telescopic connecting-rod, which permits the use of the different lengths of files. The four-step cone pulley used for driving the machine is directly connected to the eccentric shaft. All moving parts are balanced by a counterweight to insure smooth operation.

The working surface of the table measures 20 by 24 inches. The table tilts to provide for the filing of draft or clearance in parts. A clamping arm, which swings over the table and holds the work, is designed to so regulate the pressure on the work that it may be easily forced against the file. This clamping arm eliminates any danger of the work being forced upward with the file, and the possibility of injuring the fingers of the operator. The file is released 1/32 inch from the work on the up stroke by means of a patented arrangement in the head. This movement is produced by a cam on the inside of the cone pulley. It serves to lengthen the life of files and results in a uniform degree of clearance on dies and other particular work. A self-contained pump and diagonal grooves on the table carry filings from the point of contact of the files with the work.

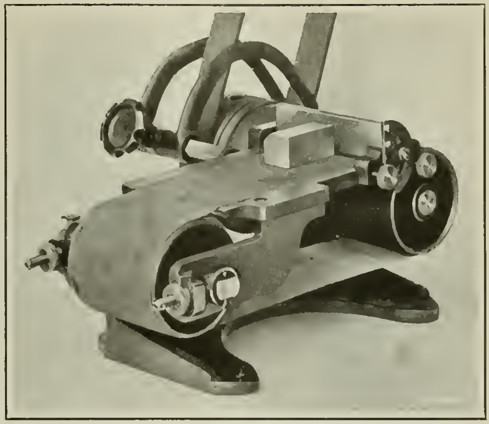


Filing Machine of a Recent Design placed on the Market by the Oliver Machinery Co.

The vertical slide has a cast-steel arm welded to its lower end on which provision is made for aligning both straight or taper files with the work. Extra attachments which may be furnished, include an overhead supporting arm for use in filing closed bottom dies or similar work, a lower supporting clamp for filing closed top dies or work of that kind, and a sawing attachment which consists of upper and lower arms for holding hacksaws. A ½-horsepower motor, operating at a speed of 1800 revolutions per minute, is mounted on the machine as shown. It is belted to a speed-reducing jack-shaft which has a yoke support that makes the machine a self-contained unit. The weight of this filing machine is about 700 pounds.

COATS ABRASIVE-BAND GRINDER

An abrasive-band grinder for straight-line finishing of all kinds of small metal parts, and for polishing fiber, vulcanized rubber, wood, and similar materials, is now being introduced to the trade by the Coats Machine Tool Co., Inc., 112 W. 40th St., New York City. Satisfactory results can be obtained in operating this grinder with unskilled help. A uniform band speed and a comparatively large grinding surface are two other advantages claimed. The work is applied to the band as the latter travels over the table. The tension on the band may be regulated to insure smooth operation, by adjusting the front band pulley, either forward or backward. This is done by turning two nuts. A graduated rest or back stop, which is detachable, may be adjusted 45 degrees either way to facilitate the grinding of angular surfaces.



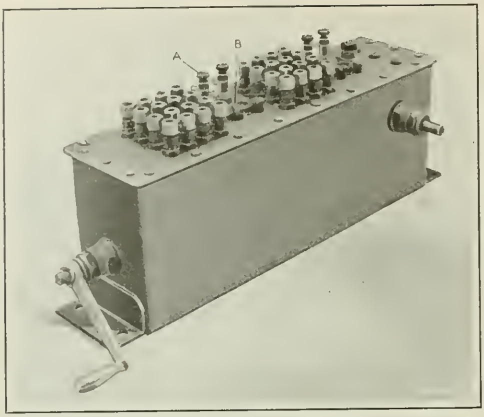
Abrasive-band Grinder recently placed on the Market by the Coats Machine Tool Co., Inc.

The loose pulley runs on a cast-iron sleeve extending from the body casting, instead of being mounted on the driving shaft, and so eliminates belt strain on the driving shaft when the machine is idle. All bearings are dustproof and are supplied with lubricators. The driving shaft runs in an oil-retaining bushing. Bands of various materials may be supplied for use on this grinder. The surface of the table measures 10 by 5½ inches, and the abrasive band is 4 inches wide by 36 inches long. The approximate weight of this grinder is 60 pounds.

MADISON-KIPP MACHINE TOOL LUBRICATOR

Adequate lubrication of the bearing surfaces on machine tools is usually a troublesome problem for designers, and so the automatic force-feed lubricator here illustrated will be of special interest to them, as well as to maintenance engineers. This lubricator is built in various styles by the Madison-Kipp Corporation, Madison, Wis., for application to practically every machine tool, from large complicated automatics to simple bench grinding machines. The device may be arranged to deliver lubricant to any number of bearing surfaces from four to one hundred without becoming bulky, the particular lubricator shown in the illustration being provided with thirty-two feeding outlets. These outlets are connected by means of tubes to the surfaces to be lubricated. The lubricator is built in a standard design, consisting of a reservoir and a cover to which are fastened pumping units for delivering lubricant to the sets of feeding outlets.

The lubricator operates on the Kipp valveless pumping principle, the main feature of which is a grooved plunger actuated by a double eccentric which causes a registration of inlet and outlet ports with the grooves of the plunger. For each stroke of the plunger, there is only one path through which oil may escape to one of the bearings fed by a pumping unit. Either four or eight outlets can be fed by each unit. The lubricator is driven by the machine it lubricates, and therefore starts and stops with it. It may be arranged with the driving shaft extending from one side of the reservoir, from one end, or from the top. The



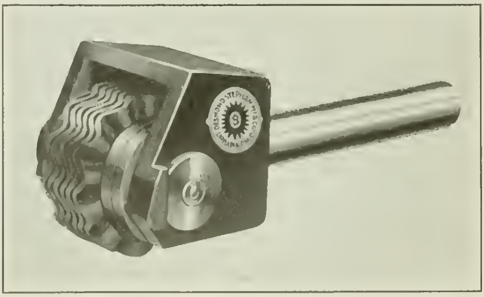
Lubricator for Machine Tools, which is manufactured by the Madison-Kipp Corporation

drive may be of a ratchet type requiring a reciprocating motion or through a pulley to which power may be transmitted from a shaft on the machine.

The amount of oil delivered to an outlet can be regulated from as little as one drop per eight revolutions of the pump driving shaft up to ten drops per eight revolutions of this shaft. This regulation is accomplished by means of a button *B* located on the cover for each set of four or eight outlets. The speed of the driving shaft may also be changed to obtain a further regulation of the amount of oil delivered. Means for observing the amount of oil being delivered by a pumping unit is provided by a test connector *A*. The reservoir is provided with an oil level indicator, filler cap, and strainer. The design of the lubricator is such that the reservoir can be made an integral part of a standard machine casting, and the cover supplied with the pumping mechanisms attached. The reservoir is sometimes built with two compartments to permit the use of two grades of oil. The crank on the lubricator furnishes a means of delivering oil when starting a machine after it has been idle for a long time.

DESMOND-STEPHAN GRINDING-WHEEL DRESSER

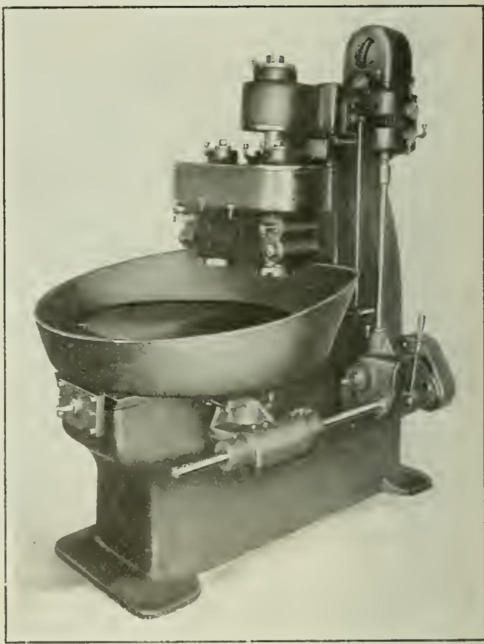
A grinding-wheel dresser in which tool-steel cutters are mounted on a bushing which revolves on a roller bearing and thus minimizes wear of the bearing surfaces, is a recent product of the Desmond-Stephan Mfg. Co., Urbana, Ohio. This dresser is designed for use either while mounted in a toolpost or on a magnetic chuck. When used with a magnetic chuck, the flat surface of the holder shown uppermost in the illustration rests on the chuck. The cutters are 2 3/4 inches in diameter, and are of a corrugated form. The rollers of the bearings on which the cutter bushing rotates revolve, in turn, on a 3/4-inch diameter pin. The bearings are dustproof, and have a simple means for oiling. It is said that in a fifteen hour test with one of these dressers, the bearings showed no indication of wear, although the cutters were reduced 3/16 inch in diameter.



Desmond-Stephan Roller-bearing Grinding-wheel Dresser

NEWTON CONTINUOUS MILLING MACHINE

Users of quantity production equipment will be interested in the new 30-inch continuous milling machine shown in the accompanying illustration. This machine has been added to the line of machine tools manufactured by the Newton Machine Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa. The machine is shown equipped for using cutting compound, but the large pan is omitted when handling iron castings. The table of the machine has two separate and distinct types of feed, the first of which is continuous and is used for straight continuous milling. The second feed is intermittently a feed and a rapid traverse and is intended for use with limited quantities of parts or when there is considerable space between the surfaces to be machined. The rapid traverse is 10 2/3 times the rate of feed. The feeds are variable through change-gears. The table has a solid top to which jigs may be bolted and doweled. There are two bearings, one of which is of an annular type. The table overhangs the saddle only 5/8 inch, so that there is no twisting or buckling. It is rotated by a fully enclosed helical gear running in oil. The pinion that drives the table and the helical gear is rotated through worm-gearing.



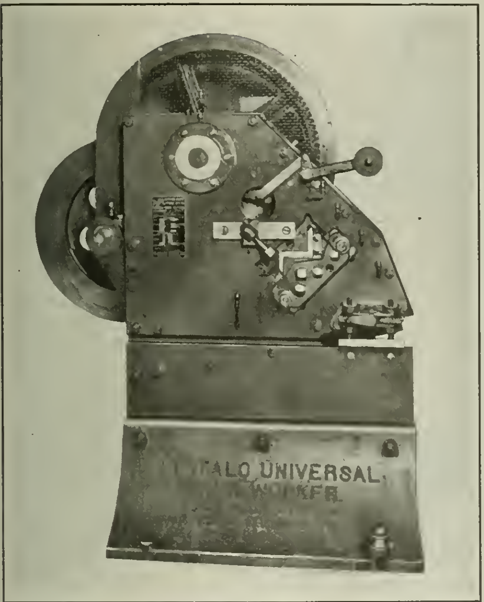
Thirty-inch Continuous Milling Machine brought out by the Newton Machine Tool Works, Inc.

A safety clutch prevents breakage of tools or machine members in the event of overloading or jamming the machine. The table saddle is adjustable on the base to permit the table to be positioned properly relative to the cutters. The two spindles have a No. 5 Morse taper hole face keyway and draw-in bolt. They are driven by hardened steel gears and supported between bearings fully enclosed and running in oil. The sleeve in which each spindle is contained has an individual end adjustment of 2 inches for setting cutters and may be clamped after such a setting has been made. The motor drives through change-gears, which provide a variation in spindle speeds.

Some of the principal dimensions of this machine are as follows: Distance from center of spindles to upright, 10 inches; distance between spindle centers, 13 inches; minimum and maximum height from top of table to lower end of spindle, 4 and 12 inches, respectively; diameter of table working surface, 30 inches; and maximum distance from center of spindle to center of table, 18 inches. The machine is driven by a 7½-horsepower motor running at 1200 R.P.M.

BUFFALO UNIVERSAL SLITTING SHEAR AND BAR CUTTER

A universal slitting shear and bar cutter, designed particularly for use in shops where punching equipment is not required, has just been placed on the market by the Buffalo Forge Co., 490 Broadway, Buffalo, N. Y. The shearing unit



New Universal Slitting Shear and Bar Cutter built by the Buffalo Forge Co.

is equipped with 10-inch knives which will cut plates ½ inch thick of any length or width, or 6- by ⅝-inch flat bars. These knives may be operated at thirty strokes per minute.

The bar-cutter unit is regularly supplied with 5-inch knives, which will cut 4- by 4- by ⅜-inch angle-iron square; 3- by 3- by ¼-inch angle-iron to a 45-degree miter, either right- or left-hand; 3- by 3- by ⅜-inch T-iron square; round bars up to 1⅝ inches in diameter, and square bars up to 1½ inches. When furnished with special knives, I-beams up to 5 inches, 9.76 pounds, and channel iron up to 5 inches, 9 pounds, may be cut, as well as other rolled sections having the same cross-sectional area. One set of blades suffices to shear both channel irons and I-beams of the same nominal size, but a different pair of knives is required for each size. This machine has an armor plate frame. About 3 horsepower is required to run this machine at full capacity. Its over-all length is 5 feet 4 inches; width, 2 feet 8 inches; height 6 feet 4 inches; and weight, 4500 pounds.

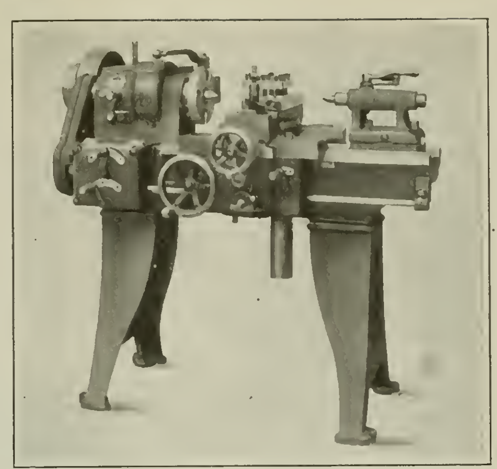


Fig. 1. Eleven-inch Rapid-production Lathe placed on the Market by the R. K. LeBlond Machine Tool Co.

LEBLOND HEAVY-DUTY RAPID-PRODUCTION LATHE

Heavier cuts, greater production, and quicker manipulation than are possible with ordinary lathes of the same size were the aims of the engineers of the R. K. LeBlond Machine Tool Co., Cincinnati, Ohio, in designing the 11-inch rapid-production lathe illustrated in Figs. 1 and 2. This machine is especially intended for small-diameter turning and facing jobs in automobile and other manufacturing plants. The headstock is of the selective speed type, and provides six speed changes through sliding gears driven from a constant-speed pulley. This pulley is driven by a multiple-disk automobile-type clutch which runs continuously in oil. The pulley revolves on a bushing, and thus relieves the driving shaft from belt pull. The six speed changes are secured through the operation of two levers.

All gears in the headstock are made of nickel steel, hardened, and have stub teeth which are rounded to facilitate their engagement. The sliding gears are mounted on short shafts having four keyways. The keys in the gears are broached from the solid. The headstock spindle runs in taper bronze bearings which are babbitt-lined and adjustable for wear, and is also provided with ball thrust

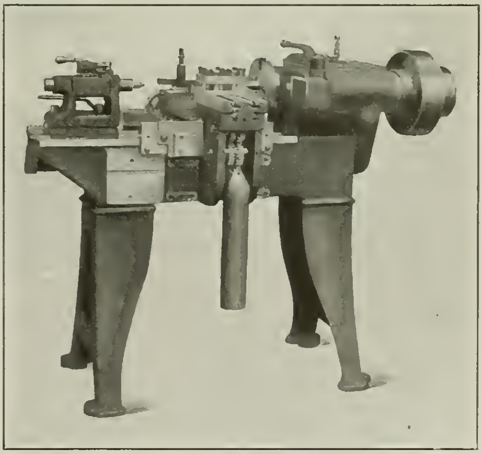


Fig. 2. Construction of Facing Attachment mounted on Rear of LeBlond Rapid-production Lathe

bearings. The spindle has a large hole extending through its entire length to permit the passing of work through it or the mounting of draw-in or expansion chucks, which may be operated either by hand or automatically. When the clutch is released from the driving pulley, a brake is automatically applied to the spindle.

The feeding mechanism is especially designed to meet the requirements of large-quantity plain turning and facing work. It consists essentially of a feed-box which provides nine feed changes for the carriage by the manipulation of two levers. The bottom lever compounds the range of feeds obtainable by means of the top lever, and this gives a quick change of feed without the necessity of gradually stepping the feed upward through a series of gear combinations until the desired feed is obtained. The feed is transmitted to the carriage by operating a lever on the apron which controls a positive clutch. The gears in the feed-box are driven directly from the spindle by means of sprockets. The sprocket chain is adjustable to vary its tension. The bearing surfaces of the carriage are scraped their entire length, and all bearings in the apron for gears and shafts are cast integral with the apron casting.

The tailstock is of an improved design, arranged to permit the quick removal and replacement of work with a single movement of the operating handle. The tailstock center may be brought into contact with the work at any desired pressure by means of a second lever, a further movement of which serves to lock the tailstock barrel rigidly and clamp the spindle. A facing attachment is furnished for work requiring facing or grooving; this attachment allows such operations to be accomplished at the same time as turning operations. The application of this facing attachment really converts the machine into a semi-automatic lathe for covering a range of smaller and lighter work than that for which the "multi-cut" lathes built by the same company are intended.

From Fig. 2 it will be seen that the facing attachment is mounted on a bracket bolted to a planed pad on the rear of the bed. The bracket is adjustable to any desired position along the bed. A roller on the attachment engages a simple cast-iron form plate bolted to and traversing with the carriage. This roller transmits the motion imparted to it by the form plate, through a rack and pinion to the facing slide, and thus feeds the latter toward the center of the lathe. The facing slide is dovetailed and gibbed to the attachment bracket. When the carriage is brought back along the bed toward its starting position, the facing attachment is also automatically returned by the counterweight. The form plate for controlling the movements of the facing attachment is readily interchangeable with one of greater or less taper to vary the movement of the slide.

Among the special equipment that may be supplied for this machine are included a draw-in attachment and collets, a turret toolpost for the carriage, an oil-pump, pan and piping, an automatic stop for the carriage, and multiple cross-stops. The principal specifications are as follows: Maximum diameter of work which can be turned, 13¾ inches; maximum length of work which can be handled, 18½ inches; range of spindle speeds, 50 to 250 revolutions per minute; range of carriage feeds, 0.008 to 0.092 inch per revolution of the spindle.

NUT CASTELLATING AND "HEXING" MACHINE

For castellating nuts and milling hexagonal ends of spark plugs, the semi-automatic machine illustrated has recently been designed by the Manufacturers' Consulting Engineers, McCarthy Bldg., Syracuse, N. Y. While the machine is primarily intended for the automobile trade, it is applicable to other operations similar to those mentioned. The machine is essentially a high-production tool. With each indexing movement of the work-holding turret, a nut, spark plug, or some other part is completed. The collets in the turret for holding the work are opened and closed automatically at the loading station, and so the only manual labor required is loading.

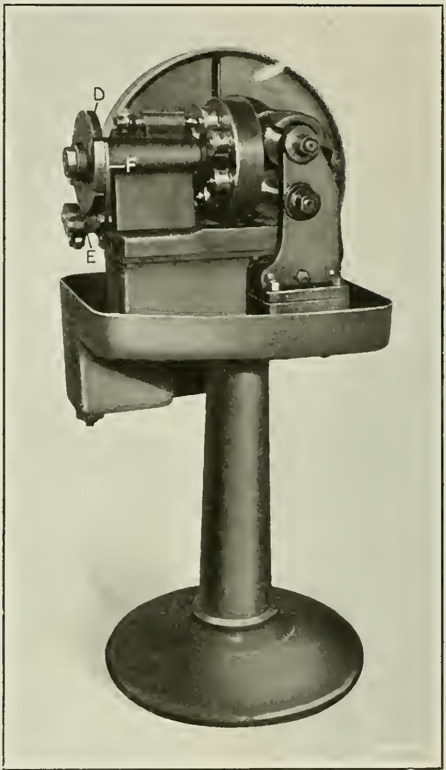


Fig. 1. Nut Castellating and "Hexing" Machine brought out by the Manufacturers' Consulting Engineers

The machine is driven through a large pulley which also serves as a flywheel. This pulley is equipped with a clutch that is operated by means of a convenient handle. From Fig. 1 it will be seen that the turret is mounted on a sliding head and has six work-holding stations. This head slides forward and backward to bring the work into and out of contact with cutters mounted on two arbors placed at right angles to the axis of the turret. The turret is indexed one position, or 60 degrees, prior to each forward movement of the head.

In Fig. 2 the two cutter-arbors *A* and *B* are provided with one and two cutters, respectively, for castellating nuts. Arbor *A* is driven directly from the main driving shaft and arbor *B* from this shaft through spur gearing. Shaft *C*, which is driven from the driving shaft through worm-gearing, extends through the machine to the indexing end. On this shaft are mounted an indexing cam and a special side cam. The front face of the side cam operates a mechanism for automatically chucking and releasing the work, and the other face imparts the feeding and returning movements to the turret head. An adjustable stop in the collets provides for placing the work properly to obtain the correct depth of cut.

In loading, the adjustable stop is pressed against an ejector that also serves as a stop, at which time the collet is automatically closed on the work. A pawl on the rear side of the index-plate *D*, Fig. 1, remains in engagement with one of the six notches in the index-plate, until the loading has been completed, when a pin on the indexing cam releases this pawl. A lobe on the cam then pivots lever

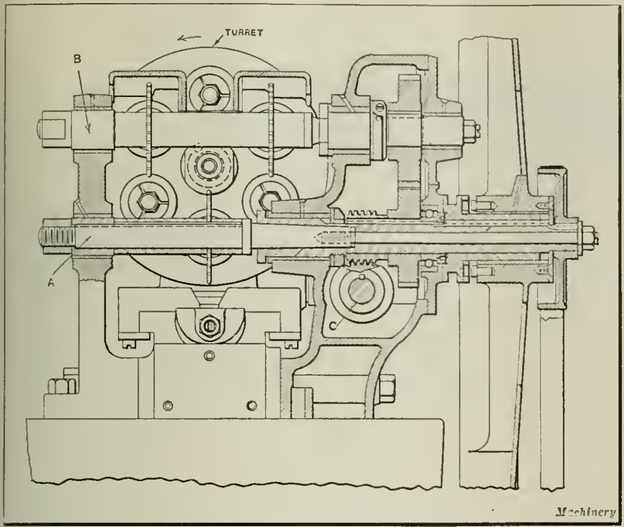


Fig. 2. Cross-section showing Method of driving the Cutter-arbors and the Camshaft

E, causing pawl *F* to engage one of six pins on the index-plate and revolve the turret through 60 degrees. As this movement is completed, the pawl at the rear again engages a notch in the index-plate and thus locks the turret.

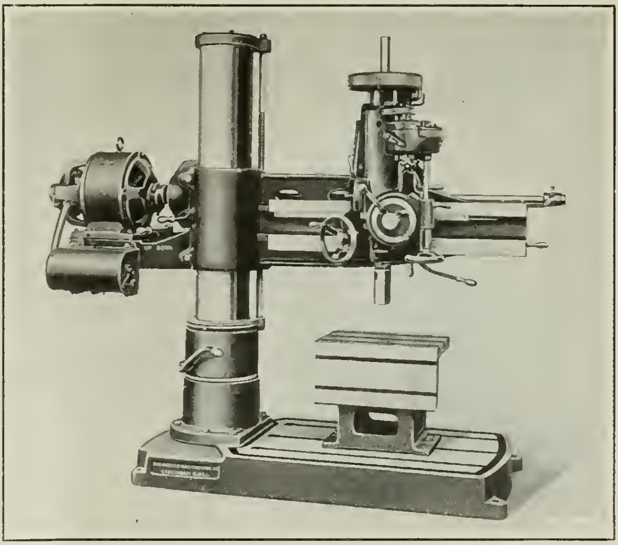
A cut is taken on three of the six pieces in the turret with each feeding movement of the turret head. Thus there is an idle station between each working station. The top one of these idle stations is used for loading. When a collet reaches the loading position, a plunger in the bearing on top of the turret head, advances into contact with the ejector, opening the collet, and at the same time allowing a spring to force the adjustable stop forward and remove the work. When this movement has ended and the operator has pushed the ejector back again in loading the collet, the plunger is withdrawn by a spring within its bearing, after which the collet is drawn in and the work chucked through the action of a series of coil springs contained in a housing on the rear of the turret.

Cutting compound is pumped to the inside of the turret spindle from a tank in the pan surrounding the machine. Passages lead from this spindle to the rear of the collets for the delivery of the compound to them. By this arrangement the compound washes out all dirt or chips, and keeps the collets clean at all times. No compound is forced to the collets when they are in either the loading or idle positions.

MORRIS RADIAL DRILLING MACHINE

In the radial drilling machine shown in the accompanying illustration, the driving motor is placed on the arm in back of the column. As a result of this design a power saving of from 20 to 25 per cent is claimed, and the number of machine parts is considerably reduced, with a consequent lessening of repairs. This machine has been recently added to the line of similar equipment built by the Morris Machine Tool Co., Cincinnati, Ohio. It is made in 4- and 4½-foot sizes. Another advantage of the design is that the motor serves to balance the arm and permits the arm to be raised and lowered on the column without straining the mechanism employed in accomplishing this. This mechanism is mounted as a unit on the back of the arm near the motor and is only in operation while the arm is being raised or lowered. The screw by means of which the up and down adjustment of the arm is obtained is always stationary.

The revolving unit of the machine is mounted on a ball thrust bearing of a capacity more than enough to carry the weight of the arm, head, motor and other details. A safety mechanism disengages the clutch which operates the arm raising and lowering mechanism when the arm reaches its extreme positions. The controller is mounted beneath the motor, within easy reach of the operator. The drill head has the same features as other radial drilling machines built by this concern, including a tapping attachment running in oil; back-gears and clutches made of nickel steel, and hardened; and helical spindle gears. All bearings are made of bronze and have an oil chamber to provide ample lubrication. The spindle speeds range from 26 to 450 revolutions per minute. A 3½-horsepower motor is required for driving the machine.

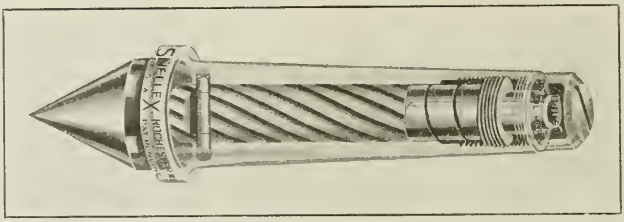


Radial Drilling Machine built by the Morris Machine Tool Co.

SNELLEX AUTOMATIC CENTERS

Difficulties met with in supporting work between the centers of lathes and grinding machines may be reduced by means of anti-friction and anti-expansion centers produced by the Snellex Mfg. Co., Rochester, N. Y. The anti-expansion center is here illustrated. It is intended for use on the headstock of a lathe to compensate for the pressure caused by the expansion of work during its machining thus eliminating the necessity of adjusting the position of the tailstock center during an operation. This center obviates the expansive force by withdrawing into its sleeve, this movement being limited by a stop-pin. An adjustable spring equalizes the cutting pressure. It is necessary to supply the center with oil only about once in six months.

The anti-friction center is intended for use on the tailstock to eliminate friction on the center and thus prevent burning of centers. It is similar in design to a center made by the same concern which was described in MACHINERY, for November, 1920, except that the balls of the race near the front are about three times larger in volume than on the original center, the size being increased to carry heavier loads. Also, the cone now has a push-fit assembly and is provided with a key instead of a lock washer. The adjusting nut is split so as to clamp itself tightly on the thread, and is made long enough to project from the sleeve for adjusting by means of a special wrench.


Anti-expansion Center placed on the Market by the Snellex Mfg. Co.

NEWTON RADIUS-LINK GRINDING MACHINE

Grinding the curved surfaces of reverse or radius links and blocks is one of the comparatively few precision operations performed in locomotive building and repair shops. To facilitate this work and to permit the grinding of other parts on which the surfaces to be ground have a radius of between 18 and 100 inches, the Newton Machine Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa., have developed the machine shown in the accompanying illustration. The reciprocation of the table is controlled automatically by dogs. This reciprocatory motion incorporates a period of dwell to permit the operation of the vertical wheel feed and the removal of pressure during the reversal of the table. The radius at which the table reciprocates is governed by the position of a pivot bearing, which may be positioned along the radius-bar by means of a rack and pinion. A scale indicates the radius for which the machine is set at any time. The radius-bar is a tube 4 inches in diameter. The slide on which the table is mounted is fitted at both ends with a cast-iron shield to protect the surface on which the table slides. The top surface of the table contains three machined T-slots.

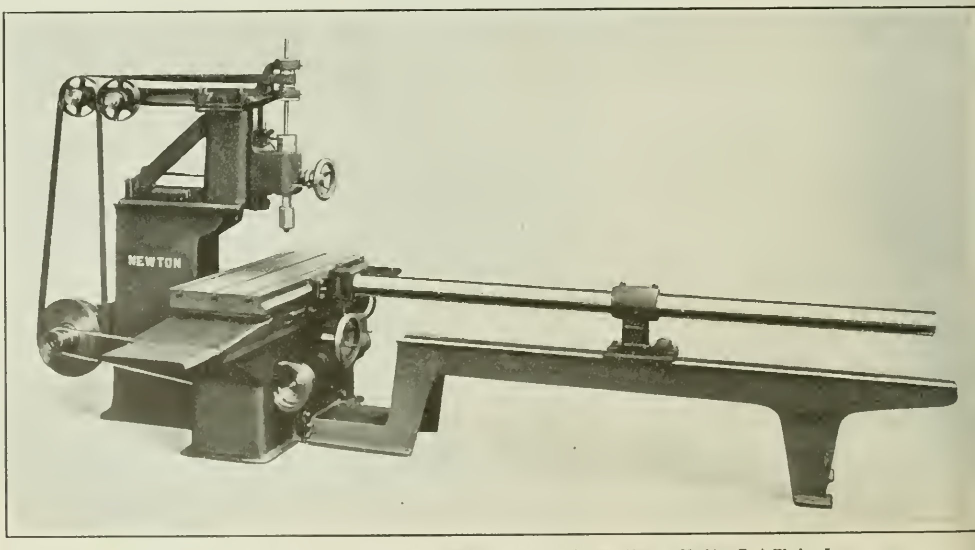
The spindle has a taper end and is provided with ball bearings. The driving pulley is carried on separate ball bearings so that there is no thrust other that that obtained by rotation. The spindle sleeve has a 3-inch adjustment in the slide. The slide is counterweighted and is adjusted by hand. It has an oscillating motion for wide-faced wheels and an intermittent feeding motion for narrow-faced wheels. This latter motion is reversible by means of a ratchet box. The spindle head is adjustable on the upright for regulating the depth of cut, and has a sufficient movement to permit the grinding of blocks as well as links.

A wheel-truing device is arranged in such a manner that the motion of the spindle slide is utilized for truing the wheel. The truing device can be readily swung out of position when not in use. The machine may be driven by a 5-horsepower motor or by a single-pulley drive.

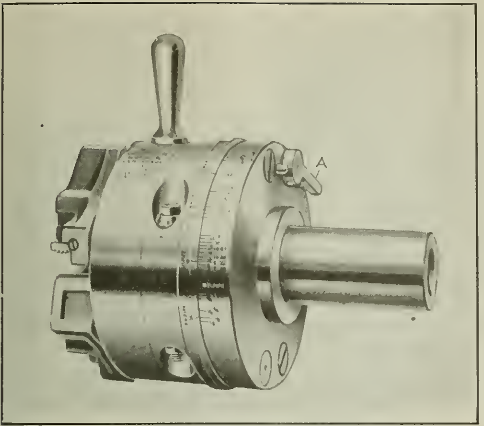
Some of the principal specifications of the machine are as follows: Spindle speed, 6000 revolutions per minute; minimum and maximum distance from center of spindle to column, 7 and 13 inches, respectively; vertical movement of spindle slide, 8⅝ inches; minimum and maximum height from spindle flange to table, 7 and 18⅝ inches, respectively; dimensions of table surface, 42 by 18 inches; minimum and maximum table stroke, 2 and 30 inches; and table speeds, 5 feet 3 inches, 7 feet 10 inches, and 10 feet 6 inches per minute.

LANDIS AUTOMATIC DIE-HEADS

An automatic screw-cutting die-head in which the chasers were supported on the face of the head was described in June, 1919, MACHINERY, at the time the tool was brought out by the Landis Machine Co., Inc., Waynesboro, Pa. This die-head was later withdrawn from the market, and after being redesigned, as shown in the accompanying illustration, it is again being introduced in five sizes, of which the 1¼-, 2- and 3-inch sizes are identical with the die-head illustrated. The ⅝- and ⅞-inch sizes are also automatic but are some-



Locomotive Reverse Link and Block Grinding Machine produced by the Newton Machine Tool Works, Inc.



Improved Automatic Die-head brought out by the Landis Machine Co.

what different, as will be mentioned later. This die-head is applicable to practically all makes of screw machines and turret lathes having a sufficient swing.

The original design was locked by the operating handle, which contained a latch having a tongue milled off center on the lower end. To adjust this head for taking either a roughing or a finishing cut, it was necessary to turn the latch to certain graduations. The new die-head is locked by engaging two hardened cylindrical pins in hardened bushings. Both roughing and finishing cuts can be taken with the three larger sizes of die-heads mentioned by moving the lock pin lever A, attached to one of the pins. The die-heads are opened automatically and closed by hand.

When cutting threads with one pass of the die-head, both lock-pins are engaged, but when cutting threads with two passes, both lock-pins are engaged for the first cut, and only that to which the lock-pin lever is attached, for the second cut. The lock-pins are machined eccentrically.

The die-head is adjustable to size by means of a screw which engages the body. The operating, adjusting, and closing rings remain in a fixed position when the head is closed, and thus, by rotating the head body within these rings, the die-head may be set to the diameters within its range. It is graduated for all sizes of right- and left-hand bolts and right-hand pipe, within its range. In setting the old-style head for left-hand threading, it was necessary to remove a screw that locked the latch pin and rotate the latter to a left-hand graduation, after which the screw was replaced and left-hand holders attached. To adjust the new die-head of the larger sizes for left-hand threading, the position of the lock-pin lever is simply reversed.

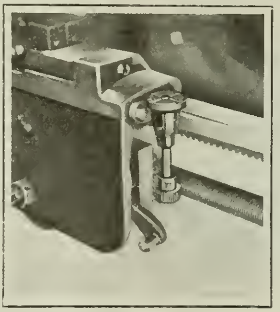
On the 5/8- and 7/8-inch die-heads the chaser and trunnions are integral. These die-heads are not provided with roughing and finishing attachments. The one set of chaser holders furnished is suitable for threading bolt and pipe within its range. Each chaser-holder and trunnion may be easily taken out of the die-head to substitute holders for special threads, by merely removing the shank and loosening one screw. The 5/8- and 7/8-inch sizes do not have the lock-pin lever. The chaser-holders and trunnions furnished with the 1 1/4, 2-, and 3-inch die-heads are separate. These sizes are regularly supplied with right-hand bolt chaser-holders for cutting U. S. standard threads but they may also be equipped for cutting S.A.E., vee, metric, Whitworth, and Briggs standard threads.

COLVEN THREAD-CHASING DIAL

Many modern lathes are equipped with a thread-chasing dial that facilitates the return of the carriage by hand to the starting point after each cut. For use on lathes not so equipped, James M. Colven, 20 Wolffe St., Yonkers, N. Y., is placing on the market the "E-Z" chasing dial illustrated. It consists essentially of a bracket attached by means of two machine screws to the rear end of the carriage on the front side. This bracket supports a vertical shaft, having a graduated dial at the upper end and a bronze worm-wheel at the lower end which meshes with the lead-screw. The worm-wheel is protected by a suitable cover. There are eight graduations on the dial, four of which are numbered and four unnumbered.

The number of teeth on the worm-wheel is a multiple of the number of threads per inch on the lead-screw, and the number of main divisions on the dial equals the number of teeth on the worm-wheel divided by the number of threads per inch on the lead-screw. Thus each main division, or the distance between two numbered or two unnumbered graduations, represents an inch of carriage travel. In re-engaging the carriage with the lead-screw, after having returned the carriage to the approximate starting point, it is only necessary to watch the dial and immediately close the apron half-nuts on the lead-screw as the proper graduation registers with a line scribed on the dial bracket.

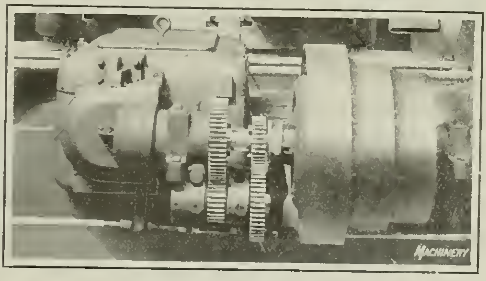
In cutting an even number of threads per inch, the nuts may be closed when any one of the dial graduations comes into alignment with the line on the bracket, but when cutting an odd number of threads per inch, only the numbered graduations are employed. In cutting 11 1/2 threads per inch, or a similar number, if the dial is set to Line 1 when beginning the first cut, the following cuts can be taken by closing the apron half-nuts when the dial is either at Line 1 or 3 until the thread is finished. The device is equally adaptable to right- and left-hand, external and internal threads. The cutting of threads close to a shoulder can be readily accomplished with this device, because the operator does not have to shift the driving belt each time the end of the thread is reached. On a lathe equipped with the dial, work may be removed for fitting into the part with which it is to be used and then easily replaced between the centers for taking additional cuts.



Thread-chasing Dial made by James M. Colven

CINCINNATI SLOW-SPEED DEVICE FOR BORING MILL

A slow-speed device has been designed by the Cincinnati Planer Co., Cincinnati, Ohio, for application to a 7-foot boring mill built by this company which was arranged for operation at a speed 30 per cent greater than standard. The machine was built for handling locomotive driving



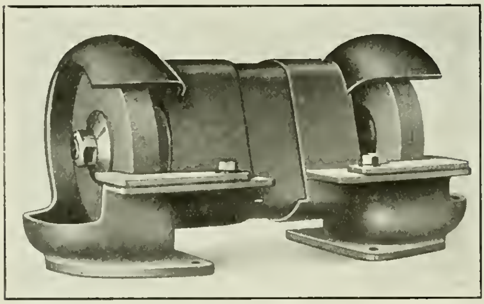
Slow-speed Device for Boring Mill which has been brought out by the Cincinnati Planer Co.

boxes and other brass parts. By means of the slow-speed device, the speed of this machine may be reduced to about 2/3 of a revolution per minute so as to also adapt the machine to the turning of tires. The accompanying illustration shows the gears of this device in mesh for driving the machine at the slow speed. The regular boring mill speeds are obtained through a direct drive when the small upper gear is slid to the left to bring its clutch teeth into mesh with those of the larger gear on the same shaft.

The friction clutch to the right of the gearing is the standard equipment for starting and stopping the boring mill. Ordinarily this clutch drives the machine through bevel gears without any of the spur gears shown. In this case the shaft is made short and the bevel gear hearing is merely used as a support. A cover which protects the gears carries a shifter for moving the sliding gear to and fro.

FORBES & MYERS TOOL GRINDER

In order to have the motor as large as possible without interfering with the grinding of long work and without destroying compactness of the design, Forbes & Myers, 178 Union St., Worcester, Mass., have provided a motor with windings only on the rear side, on the tool grinder illustrated. The motor is of the squirrel-cage induction type. As a result of this design the 6-inch wheels with which the grinder is equipped, project 1¼ inches beyond the front of the motor housing. Thus, three-quarters of the wheels may



Tool Grinder made by Forbes & Myers in Bench and Floor Types

be worn away before the periphery comes on a line with the housing. The design also permits the grinding of parts on both sides of the wheels.

The wheels that are regularly supplied are suitable for grinding tool steel; however, other grades may also be furnished. The spindle is ¾ inch in diameter at the wheels and revolves in Norma annular ball bearings which are fully enclosed. The wheel flanges are comparatively large in diameter and bear only at the outer edge. The tool rests are adjustable in two directions. The motor is of ½ horsepower, runs 3600 revolutions per minute and is fully enclosed. It can be furnished for operation on 2- or 3-phase, 60-cycle current of 110-, 220-, 440-, or 550-voltage. The bench model weighs 35 pounds, and the floor stand type, 140 pounds.

NORTON GRINDING MACHINES

Four grinding machines, one of the surface type and three of the cylindrical type, particularly adapted to the grinding of automobile parts, have been recently developed by the Norton Co., Worcester, Mass., and are presented in the accompanying illustrations. In Fig. 1, the surface grinding machine is illustrated. It is of the open-side design and has a table surface of 6 by 36 inches, on which work up to 8½ inches in width may be ground. The maximum distance from the table to the under side of the wheel is 10¼ inches.

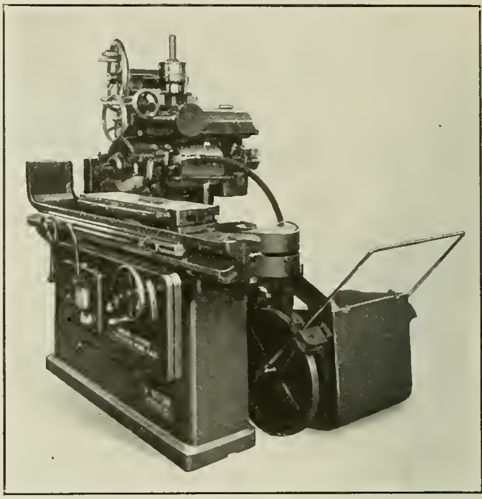
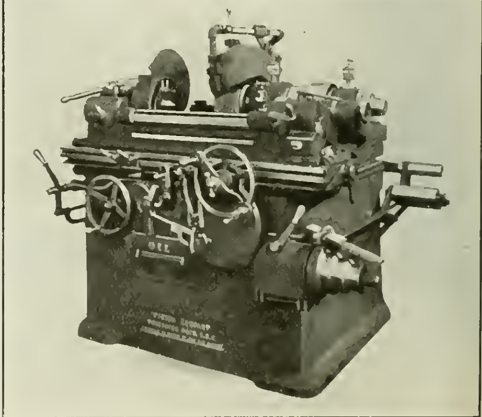


Fig. 1. Newly designed Surface Grinding Machine developed by the Norton Co.

spindle bearing construction having thumb-screw adjustments and flooded lubrication. It is said that the spindle requires no attention after the thumb-screws have been adjusted, provided the spindle is rotated at its normal speed. The machine has a rapid table traverse for enabling high rates of production to be obtained. A hand table traverse is automatically engaged when the power traverse is disengaged. A 15-horsepower motor mounted on the base drives the machine. The grinding lubricant is pumped from a portable tank which can be cleaned in a few minutes without requiring interruption of the machine operation.

Some of the principal specifications of the machine are as follows: Index feed for vertical slide, 0.00025 inch; speed of table, 80½ feet per minute; dimensions of grinding wheel, 10 by 3 inches; surface speed of wheel, about 3500 feet per minute; speed of wheel-spindle, about 1340 revolutions per minute; diameter of driving shaft and spindle pulleys, 14 inches; width of the motor driving belt, 5 inches; and weight of machine, approximately, 6500 pounds.

A 10- by 18-inch plain cylindrical grinding machine is shown in Fig. 2. This machine is similar to the regular Norton 10-inch cylindrical grinding machines except that the distance between the centers has been shortened to particularly adapt the machine to grinding automobile parts.



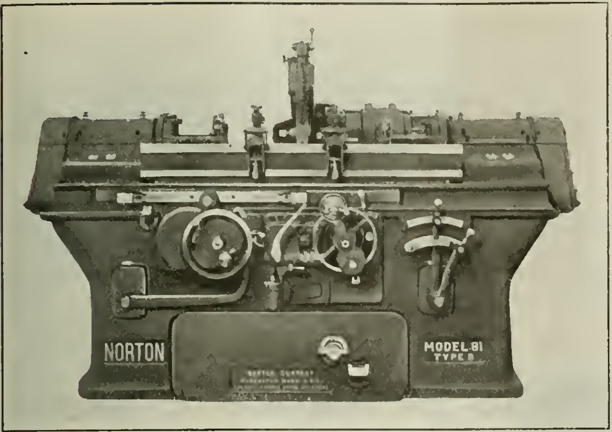


Fig. 3. Norton Model 81 Type B Crankpin Grinding Machine

The headstock, footstock, wheel-slide, and table- and wheel-feed mechanisms are the same as on the 10-inch machines.

A Model 81 Type B crankpin grinding machine is illustrated in Fig. 3. This machine has six work-speeds secured through heat-treated sliding gears which run in an oil bath. An automatic power in-feed, which is independent of the work-speed, provides a means of feeding the wheel to suit each individual crank being ground. The apron has a two-speed hand table traverse, the slower of which is used in truing. The faster speed is utilized for moving the table from one pin to another. A safety mechanism renders it impossible for the operator to injure the wheel or the work by feeding the wheel too suddenly when commencing to grind the pin. The wheel-spindle is of an improved type provided with flooded lubrication and a thumb-screw adjustment. This machine is built in four sizes weighing from about 11,400 to 11,600 pounds, this weight including the 25-horsepower motor by which each size is driven.

In Fig. 4 is illustrated a Norton 18- by 72-inch "Autopart" regrinding machine equipped with a power table traverse and arranged for a motor drive. This machine has been developed to meet the demands of regrinding shops in which there is not sufficient crankshaft work to keep busy the standard 18- by 55-inch "Autopart" regrinding machine that was described in MACHINERY for June, 1921. By adding the power table traverse, the machine is also suitable for ordinary cylindrical grinding operations. The dimensions of the wheel-slide, headstock, footstock, and other important members of this machine are the same as for these parts on the standard machine. The latter may also be equipped with a power table traverse and either a belt or motor drive.

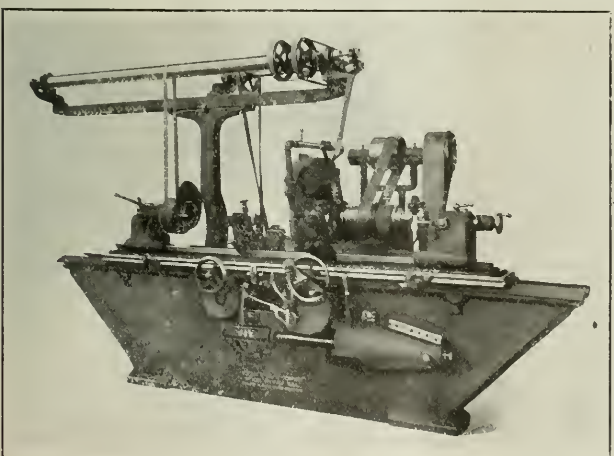
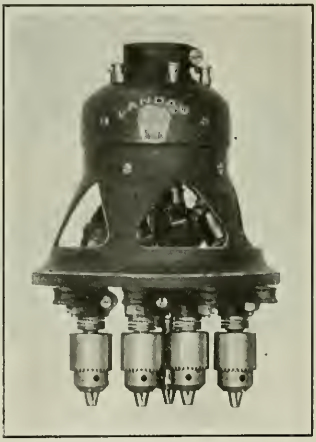


Fig. 4. "Autopart" Regrinding Machine with a Power Table Traverse

LANDAU DRILLING AND TAPPING MACHINE

A sensitive multiple-spindle drilling and tapping machine, equipped with a head having five spindles which may be instantly and individually adapted for drilling or tapping without adding or removing parts, is now being built by the Landau Machine & Drill Press Co., 45 W. 18th St., New York City. This machine, except for the head, is similar in design to a machine brought out by the same company several years ago. On the former machine the head had four spindles, and could be indexed for performing a series of operations on one hole, such as drilling, tapping, reaming and countersinking. The head on the new machine is of the design shown in the accompanying illustration. It has a capacity for drilling holes up to 1/4 inch in diameter and tapping holes up to No. 10–32.



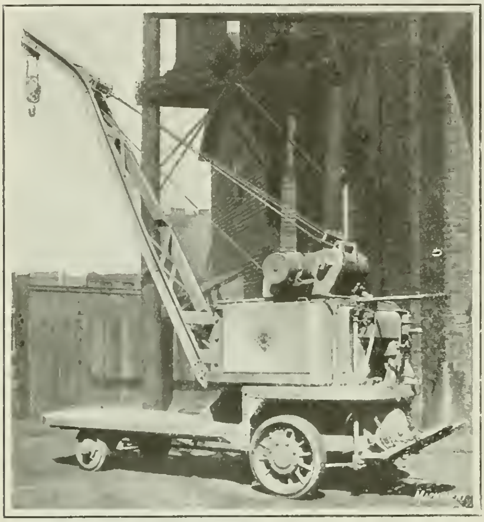
Landau Multiple-spindle Drilling and Tapping Head

The main spindle of the head is centrally located and mounted on ball bearings. The drilling and tapping spindles are adjustable relative to the center of the head by means of arms. In order to arrange a spindle for tapping when it has been employed for drilling, and vice versa, it is only necessary to loosen a set-screw. Any of the spindles can be used for tapping while the others are being used for drilling. When all the spindles are not required in an operation, those that are not to be used can be kept stationary by a simple adjustment. Each spindle may be adjusted vertically to suit short drills and taps. Upper and lower ball bearings reduce friction on the spindles. The head is fed through a rack and pinion.

Three spindle speeds of 500, 900, and 1800 revolutions per minute are obtainable by operating the belt shifter. The withdrawal speeds in tapping are 600, 1000, and 1800 R. P. M. Some of the specifications are as follows: Minimum and maximum spread of spindles, 7/8 and 4 1/2 inches, respectively; distance from center of spindle to column, 8 inches; travel of head, 3 1/2 inches; travel of table, 9 inches; weight of belt-driven machine, 300 pounds; and weight of motor-driven machine, 360 pounds.

ELWELL-PARKER CRANE TRUCK

The latest addition to the line of trucks built by the Elwell-Parker Electric Co., Cleveland, Ohio, is an electric truck having a revolving crane mounted as shown in the accompanying illustration. This equipment has a lifting capacity of 3000 pounds at a 6-foot radius and 1000 pounds at a 12-foot radius. It stacks 12 feet in height with the boom set for lifting 3000 pounds. The truck is of a heavy construction which provides sufficient stability when lifting, and absorbs the strains imposed. A single-motor double-drum hoisting unit handles a separate line to the boom and hook. The motor hoisting unit serves to counterbalance the boom and its load. The crane column is supported on a heavy pillar and revolves on ball and roller bearings. It may be swiveled through 180 degrees. The boom may be locked in any desired position and, when lowered, permits the truck to pass through a 6-foot doorway. A single battery furnishes power for the two motors of the truck. The controllers for these motors are in front of the operator. Such safety features as a crane trip switch, automatic control, worm-drive and pressure lubrication system, are incorporated in this truck.

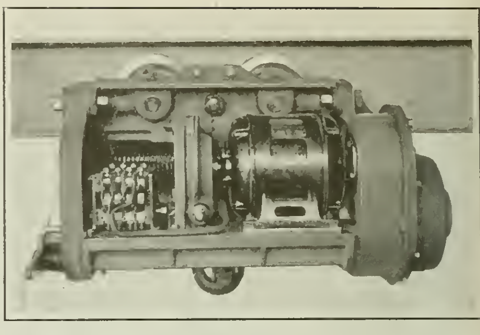


Industrial Crane Truck recently added to the Line of Equipment built by the Elwell-Parker Electric Co.

STANDARD "SHORT HEAD-ROOM" ELECTRIC HOIST

An important consideration in many hoist installations is the amount of head room required for the hoist. This factor was kept in mind by the Standard Electric Crane & Hoist Co., 1420 Chestnut St., Philadelphia, Pa. in bringing out a "Short Head-room" monorail electric hoist which is built in 1-, 2-, 3-, 4-, and 5-ton capacities. On the 3-ton size, for example, the head room is only 14 inches. In the accompanying illustration the hoist is shown with one cover removed in order to give an idea of the compact arrangement of the different units. The lifting hook is shown in its highest position.

All shafts are made of high-carbon steel, heat-treated and ground to size and have roller bearing races pressed on the ends. The bearings are of the Hyatt high-duty type. Spur gears made from forged steel are used for the drive, these gears being contained in the end housing. The pinions are made of high-carbon steel and heat-treated. The cable grooves of the hoisting drum are machine-turned and coil the rope in a single layer. The cable is connected to the exterior of the drum in a simple manner and can be easily replaced. The controller is built especially for hoisting service with all parts fireproof and completely protected from dust and moisture. The motor is of a standard make, fully enclosed and guaranteed against overheating during a half hour's continuous run. It is equipped with ball bearings.



"Short Head-room" Monorail Electric Hoist manufactured by the Standard Electric Crane & Hoist Co.

An automatic mechanical brake controls the lowering speed and another automatic brake applied on the pulley on the motor shaft and operated by a cam on the controller shaft, safely holds the load at any desired point. A device breaks the electric current and applies this holding brake when the load block reaches its upper limit of travel. Either a 2- or 4-part rope block is supplied. All gears operate in a bath of oil and automatically splash the main bearings. Bearings not oiled in this manner are lubricated by the Alemite system.

LANDAU PLAIN AND BACK-GEARED TAPPING CHUCKS

Three of a line of plain and back-geared tapping chucks recently placed on the market by the Landau Machine & Drill Press Co., 45 W. 18th St., New York City, are illustrated in Figs. 1 and 2. The back-geared chuck shown at the right in Fig. 1 is known as Model E. Its main spindle

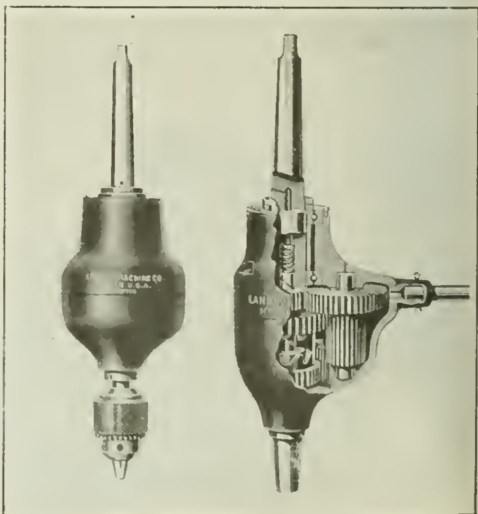


Fig. 1. Models B and E Tapping Chucks manufactured by the Landau Machine & Drill Press Co.

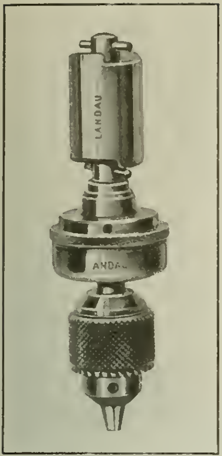


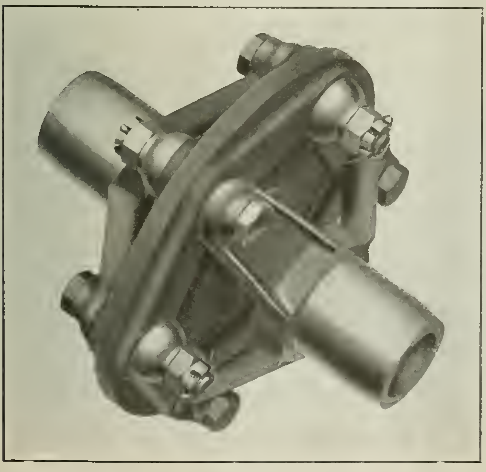
Fig. 2. Model G Tapping Chuck

revolves on ball bearings. In using this attachment, the tapping spindle remains stationary after the tap comes into contact with the work, until the teeth of the upper driving clutch are brought into mesh with a pin on the tapping spindle. The latter is then rotated in the proper direction for tapping the hole. When this operation has been completed and the machine spindle is raised for withdrawing the tap from the hole, the tapping spindle again remains stationary until the teeth of the lower clutch of the attachment are raised into engagement with the spindle driving pin. The tap is then revolved in the proper direction for withdrawing it from the work. The Model E chuck will tap holes up to 7/16 inch, and the Model F, which is similar in design, has a capacity for tapping holes from 3/8 to 1 1/8 inches in diameter. The Model B tapping chuck shown at the left in Fig. 1 has a capacity for taps up to a 1/4 inch.

In Fig. 2 is shown a Model G plain tapping chuck which is equipped with a friction device that slips and permits the tap to stop advancing whenever a hard spot is encountered in tapping, thus preventing breakage of the tap. As illustrated, this chuck is provided with a straight shank and a sleeve which adapts it to use on a turret lathe. It is also furnished with a taper shank for use on drilling machines and engine lathes.

CLIMAX CORD DISK COUPLING

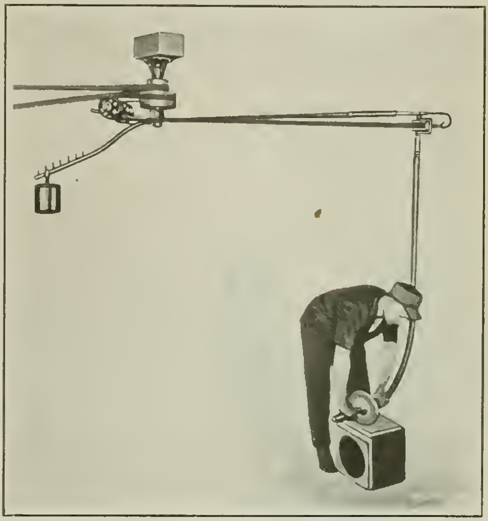
A flexible coupling intended both for use in the lineshaft installations of a shop or in the power transmitting shafts of machine tools, has been recently produced by the Climax Motor Devices Co., Chagrin Falls, Ohio. This coupling receives its flexibility from disks and cords wound in link form from bolt hole to bolt hole, thus forming a continuous reinforcing chain. Both disks and link cords are made from cotton duck. Semi-spherical projections at the bolt holes fit into the cup-shaped spider arms and cup washers. This


Cord Disk Coupling manufactured by the Climax Motor Devices Co.

arrangement prevents loosening of the bolts which hold the two sections of the coupling together. The flexibility compensates for all direct or angular misalignments of shafting and also absorbs shocks. This coupling is made in four sizes which have a disk diameter of 5 1/2, 6 1/2, 7 1/2, and 9 inches, respectively, and a capacity, at a speed of 100 revolutions per minute, of 1, 2, 4, and 6 horsepower, respectively.

STOW FLEXIBLE RADIAL GRINDER

A grinder intended for being driven directly from a lineshaft and having a flexible shaft at the end of an extension arm which may be swiveled to permit the use of the grinder on parts located on the floor around the equipment, is shown in the accompanying illustration. This grinder is made in five sizes by the Stow Mfg. Co., Inc., 443 State St., Binghamton, N. Y. The flexible shaft is counterbalanced by a

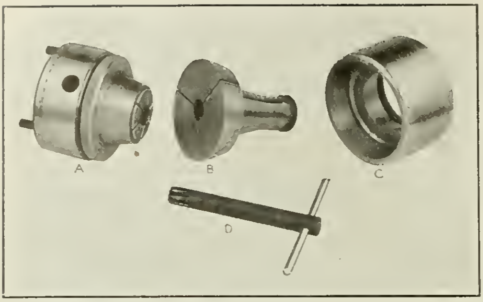

Flexible Radial Grinder made by the Stow Mfg. Co., Inc.

weight. The entire unit hangs from the ceiling, and may be driven by a motor instead of from a lineshaft as shown. In addition to being supplied for grinding operations, this equipment may be furnished with drill wire scratch brush attachments. It also serves as a convenient assembling tool when equipped with a screwdriving attachment.

HARTFORD COMBINATION COLLET AND STEP CHUCK

The different parts of a combination collet and step chuck manufactured by the Hartford Special Machinery Co., Hartford, Conn., for application to engine and turret lathes and screw, milling and grinding machines, etc., are presented in the accompanying illustration. At *A* the device is arranged as a collet chuck for attaching to an ordinary chuck faceplate. The collets are made to cover a range of work from 3/16 to 1 inch in diameter. In arranging the device as a step chuck, the knurled ring which is used to protect the thread is removed from the nose of the chuck and the collet withdrawn. The step member shown at *B* is then substituted for the collet and the closer member at *C* screwed on the threads from which the ring was removed.

The design of the collet is such that the gripping portion always seats on a straight line regardless of whether the diameter of the work varies as much as 1/32 inch from the nominal size of the collet hole. Several of the advantages

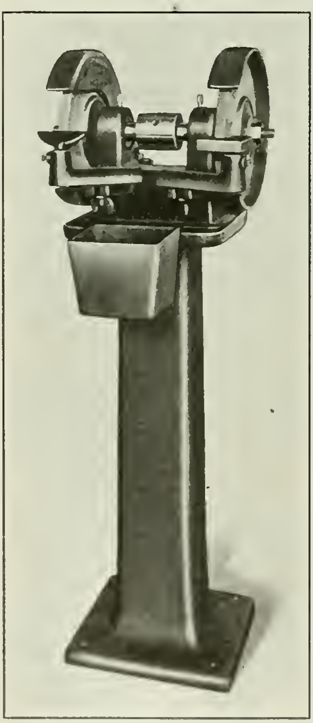


Parts of Combination Collet and Step Chuck made by the Hartford Special Machinery Co.

claimed for this chuck are that it is not necessary for the machine operator to leave his position at the front of the machine in order to tighten or loosen the chuck; a tight grip is readily obtained; and collets up to the full size of the hole through the spindle may be used.

FAFNIR BALL-BEARING TOOL GRINDER

In many machine shops the tool grinder is a source of annoyance to foremen, because those using it often neglect to stop it when they are through grinding. It was the aim of the Fafnir Bearing Co., New Britain, Conn., in developing the grinder here illustrated, to produce an equipment that could be run continuously by connecting to a lineshaft, without undue wear. The principal feature is the mounting of the grinding wheel spindle in ball bearings. The machine is driven through a pulley which is mounted on the wheel-spindle between the two ball bearings. The grinder may be supplied with a plate, instead of a pedestal for mounting on a bench, or with an offset bracket for bolting to a convenient post. It will be observed that the machine is equipped with a water pot, grinding-wheel guards, and adjustable tool-rests.

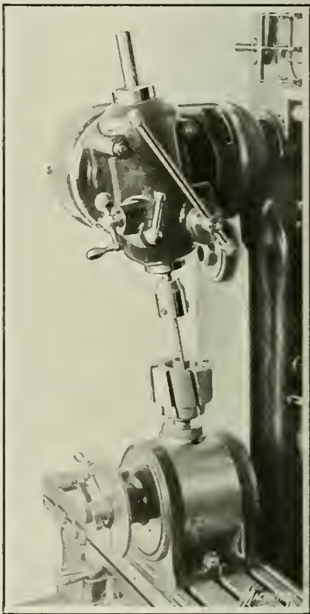


Tool Grinder built by the Fafnir Bearing Co.

ROCKFORD UNIVERSAL MILLING AND DRILLING ATTACHMENT

An attachment has recently been brought out by the Rockford Milling Machine Co., Rockford, Ill., for machines of its manufacture, which permits of milling angular surfaces or drilling holes at an angle. The illustration shows the attachment being used for reaming a taper hole in a cutter-head. The attachment is clamped to the face of the machine column, and driven by gears from the back of the main spindle through a driving sleeve substituted for the regular overhanging arm. The spindle of the attachment is driven from this sleeve through bevel gears. This driving arrangement leaves the main spindle of the machine free for use, and on many jobs it is possible to mill with a cutter in the main spindle at the same time that angular drilling or milling is being performed.

The attachment has two graduated bases located at right angles to each other, both of which can be swiveled through 360 degrees. This construction makes the spindle universal, as it can be set in any position. The spindle sleeve is graduated in inches and has an adjustment of 5 inches to increase the vertical range. Adjustments provide for compensating for wear of both upper and lower spindle sleeve bearings. The spindle is made of crucible steel, accurately ground, and runs in phospher-bronze bearings fitted with felt for retaining oil. The spindle end is bored to a No. 9 B & S taper.

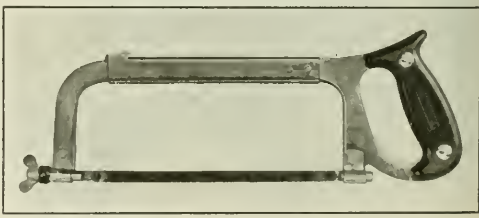


Rockford Universal Milling and Drilling Attachment

A rack and worm feed provides for boring to close limits. This feed is obtained by loosening a thumb-screw and moving the drill handle sleeve. It is in the ratio of 48 to 1, and thus permits a feed 1/48 that of the hand feed. The worm-feed handle is located at the front of the attachment within easy reach of the operator. Sixteen spindle speeds ranging from 21 to 414 revolutions per minute are obtainable and drills from 3/16 to 1¼ inches in diameter can be used. A drill chuck can be furnished.

STARRETT PISTOL GRIP HACKSAW FRAME

A number of interesting features are incorporated in the design of a new adjustable pistol-grip hacksaw frame lately brought out by the L. S. Starrett Co., Athol, Mass. On this frame a constant spring tension is maintained on the bolts



Pistol-grip Adjustable Hacksaw Frame manufactured by the L. S. Starrett Co.

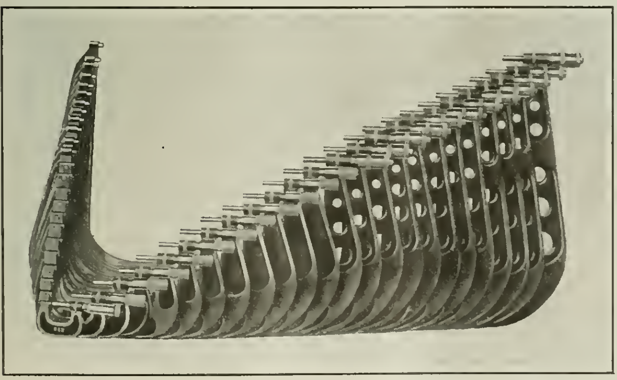
which hold the blade, and this in connection with a positive adjustment on the back which permits the use of blades from 8 to 12 inches in length, facilitates changing the blades. The pawl for adjusting to suit the length of blade is set into the frame as low as possible so as not to mar the appearance of the frame. The back is constructed of steel tubing, and all steel parts are nickel-plated. The blade may be set in any one of four positions by turning the wing-nut. It is not necessary to remove this nut entirely in order to position the blade as mentioned. The frame has a depth of 3⅜ inches from the cutting edge of the blade. The handle is made of hard rubber and checked to provide a good grip.

ATLAS "MIKRO-INDICATOR" CYLINDER AND PISTON GAGES

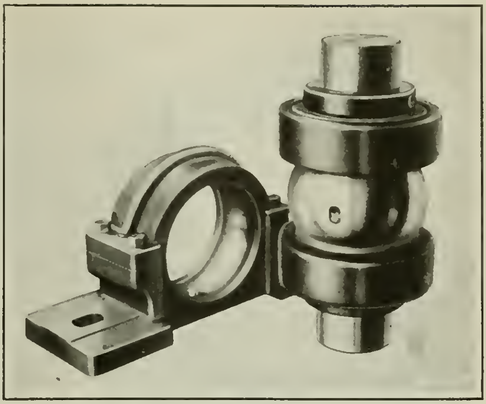
Two gages for detecting inaccuracies of automobile pistons and cylinders have been recently placed on the market by the George H. Wilkins Co., 180 N. Market St., Chicago, Ill. Both gages are equipped with an Atlas "Mikro-indicator." The cylinder gage consists of the indicator which has two contact points and a saddle having a stud upon which the indicator is supported. In testing the bore of a cylinder, the saddle is held firmly against the wall by means of a handle and is slid along the wall. Variations are shown in thousandths of an inch, and diameters from 2⅝ to 5 inches may be checked. This gage may also be used for testing turned work in a lathe, crankshaft bearings in a truing fixture, etc. The piston gage is of a bench type and is intended for rapidly checking the diameter of pistons, piston-rings, and other cylindrical parts having a diameter up to and including 6 inches. The gage has a scale for indicating the approximate diameter of the part, and the indicator shows the slight variations.

BROWN & SHARPE "REX" MICROMETERS

A new line of "Rex" micrometers made for both English and metric measure are now being announced by the Brown & Sharpe Mfg. Co., Providence, R. I. This line includes 24 sizes of micrometers for taking measurements up to 24 inches or 600 millimeters. The illustration shows the complete line in progression from the No. 59 micrometer which measures up to 1 inch, to the No. 88 micrometer which measures from 23 to 24 inches. These micrometers are regularly furnished with a ring for clamping the spindle and preserving its setting. Holes are provided in the frames of the larger sizes of micrometers to lighten them. The anvil, spindle, and other parts of this line are similar to the members furnished on the regular B & S micrometers. Means are provided to compensate for wear of measuring surfaces and the adjusting screw.



Line of Twenty-four "Rex" Micrometers made by the Brown & Sharpe Mfg. Co.



Double Ball-bearing Self-aligning Pillow-block made by the Fafnir Bearing Co.

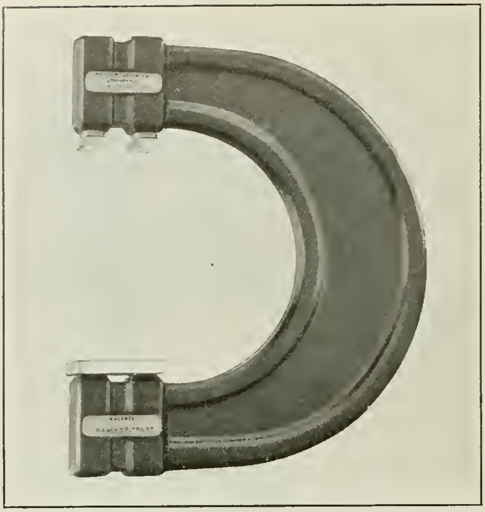
FAFNIR SELF-ALIGNING PILLOW-BLOCK

Both radial and end thrusts are taken by ball bearings in the double ball-bearing self-aligning pillow-block shown disassembled in the accompanying illustration. This pillow-block has been recently produced by the Fafnir Bearing Co., New Britain, Conn. It aligns itself to compensate for any discrepancies between the surface on which it rests and the position of the shaft that it supports. This self-alignment has no effect on the ball bearings, as they are installed in a box which aligns as a unit. Each unit has two Fafnir transmission ball bearings which have a radial ball contact and deep race grooves. The inner ring of the bearings is extra wide in order to give the bearing a firm seat on the shaft and to afford the shaft a greater support. The outer ring is mounted against a shoulder in the box. An end cap is held in place by a steel wire snapped into a groove machined in the housing. This cap contains a felt washer which prevents the escape of lubricant or the entrance of dirt.

The box is secured endwise on the shaft by collars clamped on the shaft by means of set-screws. These collars have lugs that mesh with corresponding slots cut in the wide inner rings of the ball bearings. Consequently the shaft, collars, and inner rings revolve together. The driving collars also transmit all end thrusts to the ball bearings. They abut against the inner rings, but do not come in contact with the housing or end caps. The installation of this pillow-block is an easy matter. The base can be bolted to the bed and the cap secured after the box and the shaft have been fitted in place. The shaft and box can also be removed without disturbing the base or the alignment. The shaft can be withdrawn by merely loosening the driving collars. The pillow-block may be adapted to special conditions by changing the spacing of bolt holes and the shaft center distance on the lower half of the unit.

MELDRUM-GABRIELSON ADJUSTABLE-LIMIT SNAP GAGE

A line of adjustable-limit snap gages manufactured by the Meldrum-Gabrielson Corporation, Syracuse, N. Y., was described in MACHINERY for October, 1921. Another gage now being manufactured by this concern is of the same general design but is provided with rectangular anvils which project beyond the frame a sufficient distance to permit of gaging close to shoulders. This gage is here illustrated. The position of the

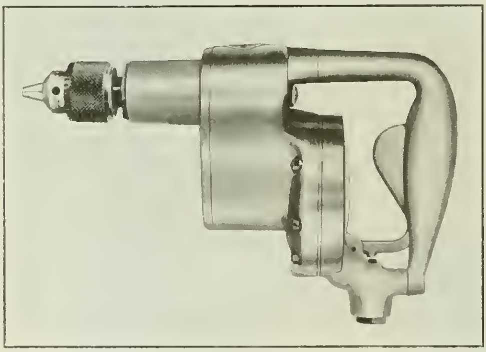


Latest Addition to Line of Adjustable-limit Snap Gages manufactured by the Meldrum-Gabrielson Corporation

two anvils at the top is adjustable, but the long anvil at the bottom has a fixed position. It is, however, possible to remove the lower anvil from the frame. The anvils project a full 1/32 inch beyond the frame.

TURBINE AIR DRILL

A portable No. 2-A "Tiny" air drill driven by a simple turbine weighing about ½ pound and having a capacity for driving ⅜-inch drills through steel and ½-inch drills through wood, has been added to the line of portable air-driven equipment manufactured by the Turbine Air Tool Co., 710 Huron Road, Cleveland, Ohio. The turbine consists of one solid piece and revolves on ball bearings. There is a clearance of 1/32 inch between the turbine and its housing. The features claimed for this drill include light weight, compactness, fewness of parts and wide range of speeds.



No. 2-A "Tiny" Air Drill manufactured by the Turbine Air Tool Co.

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NEW MACHINERY AND TOOLS NOTES

Electric Hoist: Joslyn Mfg. & Supply Co., 3700 S. Morgan St., Chicago, Ill. An electric hoist having a speed-reducing mechanism consisting of three internal ring-gears, three planetary pinions and a high-speed pinion mounted on the motor shaft. This gearing gives a speed reduction of from 100:1 to 350:1 between the driving pinion and the sheave which carries the load. The hoist may be supplied with either a rope or chain lift. With the chain lift, a hook can be used on either end of the chain.

Bench Metal Saw: Triangle Metal Products Corporation, Rochester, N. Y. A bench type saw designed for the rapid cutting of small or medium-sized cold-rolled steel, drill rod, etc. It is built in two sizes, the No. 1 being intended for work from ⅛ to ½ inch in diameter and the No. 2 for work from ½ to 1 inch in diameter. The saws are 1/32 inch thick, are hollow ground to give a clean cut and are interchangeable. The machine is driven by a ⅛ horsepower motor which receives the current from a lamp socket.

Melting Furnace: Johnson Gas Appliance Co., Cedar Rapids, Iowa. A medium-size gas furnace for melting soft metals which has a removable cast-iron pot that will hold 150 pounds of metal. Three patented atmospheric Bunsen burners develop any temperature up to 2250 degrees F. and are said to consume only about 40 cubic feet of gas per hour. Two burners are sufficient for keeping the metal in the molten state. These burners have shut-off valves and pilot lights. The furnace has a direct jet regulator having an orifice that can be instantly adjusted to any pressure or to suit the quality of the gas. It sends a jet of gas up the center of the mixing tube without the use of a forced air blast or blower.

Time-study Machine: H. H. Williams, 1613 Chestnut St., Philadelphia, Pa. A time-study machine in which a strip of paper is moved at a uniform rate of speed and a pen traces a line on the moving strip. This pen is moved back and forth across the paper when the operator presses two finger keys. One of these keys is pressed at the completion of each element of a cycle in an observation. Thus the pen moves by steps across the strip. At the end of the cycle the pen is returned to its starting position by pressing on the second key. The operator can keep his eyes constantly on the workman as it is not necessary to pay close attention to the machine. The length of time between each step of the pen can be determined by means of a scale.

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THE AUTOMOBILE INDUSTRY

According to a report of the Department of Commerce on industrial conditions, about 232,000 automobiles were built during the month of May in addition to 25,000 trucks. June is said to have been the largest producing month in the history of the automobile industry. Ford's June production schedule was 140,000, or a daily average of 5400 cars per working day; orders for June delivery were stated to total 195,000 cars, trucks, and tractors. The shops of the well-known automobiles were going at top speed during the month of June, and the same schedule will be continued at least until the middle of July. Equipment and parts manufacturers have a hard time keeping up with the demand. The tire industry which naturally follows the activity in the automobile industry is fully occupied, and machine shops devoted to the making of tire molds are running at 100 per cent capacity.

The manufacturers of alloy steels, the greater part of which product goes to automobile shops, are running their plants at capacity and one of the plants in this field is turning out 40 per cent greater tonnage than during the peak months in 1920. There is a growing scarcity of steel of all kinds, and deliveries are quoted far ahead. It is expected that there will be a slight reduction in automobile production in the fall, but the total production for the year is likely to be considerably greater than in 1921.

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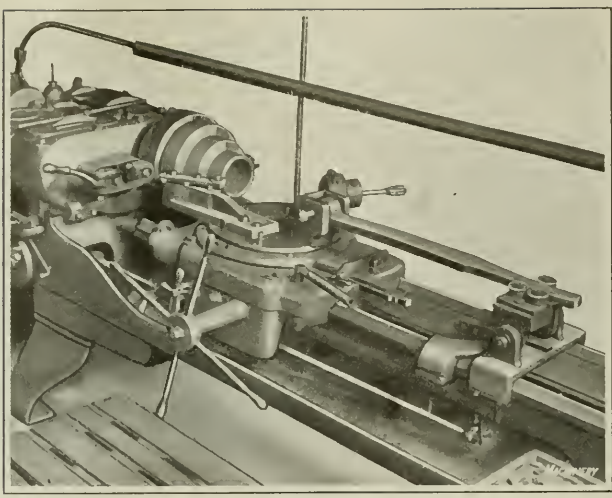
PULLEY-CROWNING ATTACHMENT

An attachment for crowning step pulleys on a Jones & Lamson flat turret lathe is used by the Valley City Machine Works, Grand Rapids, Mich., where this crowning attachment was developed. In using this device, the turret is released so that it is free to swing on its pivotal support. A bracket attached to the turret carries the cutting tools, there being one for each step on the pulley. A long bar is also attached to the turret, in line with the lathe spindle, the extended end of which has a cam surface that guides the tools in turning the crowns to the proper form. This forming bar can be tilted back by the withdrawal of two taper pins, leaving the turret clear. Inasmuch as three tools are attached to one bracket, there is, of course, a slight theoretical error in the form of the crowns, because the cam end of the bar can be correct for guiding only one crowning tool. However, the errors are insignificant, and do not affect the efficiency of the pulley.

The operation of the attachment is extremely simple. As the tools are fed across the work, in traversing the carriage longitudinally, the cam end of the bar is guided by three rollers between which it operates. This causes the turret to pivot and thus enables the tools to generate the desired crown on the pulley steps. The rollers are attached to a fixed bracket fastened to the ways of the lathe. The curvature of the cam surface is greater than that of the crown, the difference being proportionate to the radial lengths between the center of the turret and the cam-rolls, on the one hand, and the center of the turret and one tool on the other.



Turret Lathe with Cam-controlled Pulley-crowning Attachment

A device of the same general design as that illustrated is employed in this shop for taper-turning operations. The taper-turning attachment also has a cam-bar, the end of which is inclined to correspond with the taper desired on the work.

* * *

MEETING OF AUTOMOTIVE ENGINEERS

The society of Automotive Engineers held its summer convention at White Sulphur Springs, June 20 to 24. The entire first day was devoted to reports and discussion of the Standards Committee. During the following days special sessions were devoted to research, passenger cars, fuel and engines, aeronautics and motor buses. Mechanical problems were considered in papers by G. E. A. Hallett on "Methods of Developing Aircraft Engines"; by P. M. Held on "Overhead Camshaft Passenger Car Engines"; and by H. M. Crane on "A New System of Spring Suspension for Automotive Vehicles."

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MEETING OF AMERICAN RAILROAD ASSOCIATION

The annual meeting of the American Railroad Association was held in Atlantic City, June 14-21. The mechanical division held its sessions during the first three days of the meeting. Reports were presented by the various committees on the cost of labor and materials; arbitration; tank cars; loading rules; train lighting and equipment; car construction; couplers and draft gears; brake shoe and brake beam equipment; train brake and signal equipment; and car wheels. Saturday, June 17, was set apart for viewing the exhibits which were unusually complete this year. There were in all about 350 exhibitors, and about 100,000 square feet was devoted to exhibit space. Among the exhibitors there were over fifty in the machine tool, small tool, and shop equipment field. The committee in charge of exhibits was complimented upon the care that had been taken in having the exhibits ready at the beginning of the convention. The scope of the exhibits was doubtless the largest of any that has been held in connection with the Railway Association conventions. In addition to machine tools and shop equipment, practically all kinds of railway equipment were exhibited, from complete locomotives and cars to the small devices used in the construction of railway rolling stock. Every square foot of space in the machinery hall on the pier was used by manufacturers of machinery and tools, and the machine tool exhibit was without question the most complete that has ever been assembled for any exhibition of comparatively short duration. A great many of the machines shown were operated during the exhibit, and many of the machine tool builders showed a number of their new developments for the first time.

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AMERICAN MACHINE TOOLS AT BRUSSELS FAIR

An interesting exhibit at the Brussels Fair, consisting principally of American machine tools, is shown by the accompanying illustration. Henri Benedictus of Brussels was

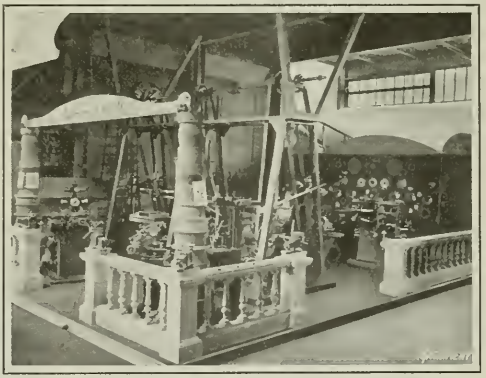

Exhibit of Henri Benedictus at Brussels Fair

the exhibitor, and the American machine tools included a Pratt & Whitney tool-room lathe and a vertical shaper; a LeBlond lathe and a milling machine; a Norton grinding machine; a Heald grinding machine; and a Stockbridge shaper. These machines were arranged for belt drive in order to provide actual demonstration. In addition, the exhibit included various forms of Norton grinding wheels, a variety of small tools from Pratt & Whitney, and files from Henry Disston & Sons, Inc.

CONSOLIDATED MACHINE TOOL CORPORATION OF AMERICA

The consolidation of five machine tool companies into a combination known as the Consolidated Machine Tool Corporation of America is announced. The new company is incorporated in Delaware, with a capitalization of $10,000,000 preferred stock, and 200,000 shares of common stock of no par value. The general offices of the company will be at 17 East 42nd St., New York City.

The merger includes the following well-known companies in the machine-tool building field: Newton Machine Tool Works, Inc., Philadelphia, Pa.; Hilles & Jones, Wilmington, Del.; Betts Machine Co., Rochester, N. Y.; Colburn Machine Tool Co., Cleveland, Ohio; and Modern Tool Co., Erie, Pa. Conferences to arrange for the consolidation have been in progress for about a year.

The officers of the new corporation have not yet been announced, but it is understood that W. H. Marshall is slated for chairman of the board of directors, and C. K. Lassiter for president. Mr. Marshall is a former president of the American Locomotive Works, and Mr. Lassiter was formerly vice-president of that company.

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PERSONALS

R. P. Volkmer, formerly purchasing agent for the Tate-Jones Co., of Pittsburg, Pa., industrial furnace engineers, is now connected with the Colonial Steel Co. of Pittsburg as Cleveland representative.

William J. Merten, metallurgical engineer of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., has been elected vice-chairman of the Pittsburg chapter of the American Society for Steel Treating.

Tobias Dantzig, formerly research engineer of S K F Industries, Inc., has opened an office at 1109 Canadian Pacific Bldg., New York City, to engage in scientific and technical consulting work. He will specialize in bearing problems and mathematical research of an engineering nature.

Ralph Templeton, for several years manager of the Whitman & Barnes Mfg. Co.'s New York office and store, assumed an important position in the company's executive offices in Akron, Ohio, on July 1. Mr. Templeton first entered the employ of the Whitman & Barnes organization in 1898, and has served it in various capacities continuously since that time. After demonstrating marked ability in the Akron office and as Detroit representative, he was appointed manager of the New York store in 1910.

John F. Schurch has been elected a vice-president of Manning, Maxwell & Moore, Inc., New York City, and has been placed in charge of western sales, with headquarters at the company's Chicago office, 27-29 N. Jefferson St. Mr. Schurch is a graduate of the University of Minnesota, and was connected for several years with the Minneapolis, St. Paul & Sault Sainte Marie Railroad. Later he became associated with the Railway Materials Co. of Chicago. In 1914 he was elected vice-president of the T. H. Symington Co., of New York.

Tillman D. Lynch, metallurgical engineer with the Westinghouse Electric & Mfg. Co., has been nominated for the presidency of the American Society for Steel Treating. Mr. Lynch is a graduate of the University of Virginia. He has been with the Westinghouse Electric & Mfg. Co. since 1899, holding various positions, among them inspector of materials, engineer of tests, section engineer in charge of manufaturing processes, and metallurgical engineer. He is the author of a number of technical papers read before various societies, and published in the technical press.

Harry M. Wey has been appointed manager of the Chicago district for the Pittsburg Testing Laboratory, with headquarters at 1560 Monadnock Block. Mr. Wey was previously connected with the Pennsylvania Railroad, holding the office of superintendent of motive power at Columbus, Ohio, and later was associated with the Illinois Central and the Atchison, Topeka & Santa Fe Railroads. From 1905 until 1909 he was in the mechanical department of the Pennsylvania Lines west of Pittsburg, after which he entered the sales department of the United States Metallic Packing Co.

J. J. Gibson, manager of the supply sales department of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., has been made assistant to the vice-president. In his new position Mr. Gibson will have general supervision over the activities of both the supply sales department and the recently established merchandising sales department. He has been associated with the company for over twenty years. From 1900 to 1905 he was connected with the Chicago office, after which he was sent to Philadelphia. He was appointed district manager of the Philadelphia district in 1906, and in 1914 was promoted to the managership of the supply department at East Pittsburg.

Samuel T. Freas, of Henry Disston & Sons, Inc., Philadelphia, Pa., has been awarded the Edward Longstreth medal by the Franklin Institute in recognition of his invention of the interlocking tooth metal-cutting saw. This medal is awarded by the Franklin Institute on recommendation of the Committee on the Sciences and the Arts for "inventions of high order, and for particularly meritorious improvements and developments in machines and mechanical processes." Mr. Freas has been asssociated with Henry Disston & Sons, Inc., for the last twenty-one years. The saw for which he was awarded the medal was designed and developed by him in the Disston factory, and is manufactured as a standard Disston product.

Frank W. Oliver has become connected with the sales organization of the Whitman & Barnes Mfg. Co., Akron, Ohio. Beginning July 10 he will become eastern sales manager of the company, with headquarters at the New York store, 64 Reade St. Mr. Oliver has been connected with the drill and reamer industries since 1899, when he became a salesman for one of the twist drill manufacturers, and for six years he covered the United States and Canada for this concern. In 1905 he became associated with another well-known company in the same field as representative in the Chicago territory. For fifteen years he remained with this corporation, being district manager in charge of western sales for six years.

Joseph F. Keller, vice-president of the Keller Mechanical Engraving Co., of Brooklyn, N. Y., has been awarded the Edward Longstreth Medal of Merit for Invention, in consideration of substantial improvements and inventions made by him in the art of mechanical die cutting, as represented in the Keller automatic die-cutting machine of the reproducing type. The citation accompanying the medal was in part as follows: "The Institute believes credit should be given to Mr. J. F. Keller for having met a recognized need for increasing die production and reproduction over that which was possible by the old hand method and skilled operators. His efforts have resulted in quicker and better production by less skillful operators and a reduction of the costs."

W. E. Whiting is now associated with the Greenfield Tap & Die Corporation, Greenfield, Mass., representing the machine tool division of the company. He will specialize on the "Hydroil" internal grinder of this company's manufacture, which has been recently placed on the market. His headquarters will be at 2990 Concord Ave., Detroit, Mich. Mr. Whiting has been connected with the grinding industry for fourteen years. From 1909 to 1916 he was with the Heald Machine Co. of Worcester, Mass., serving as apprentice, journeyman grinder, demonstrator, and finally as superintendent of the grinding department. In 1916 he went with the Norton Co., doing laboratory and demonstration work for a short time. For the last four years he has been handling sales for the grinding wheel division of the Norton Co. in Michigan, and is therefore well known in that territory.

William H. Eager, since 1918 first vice-president of the Whitman & Barnes Mfg. Co., Akron, Ohio, has been made president of that organization to succeed A. D. Armitage, who has resigned in order to give more of his time to his duties as vice-president and general manager of the J. H. Williams Co. Mr. Eager is a graduate of the Massachusetts Institute of Technology, and for the last sixteen years he has been with the Whitman & Barnes Mfg. Co. At first he was assistant superintendent of the Chicago factory, and later became works manager. In 1908 he was elected treasurer, and in 1909 he was transferred to Akron when the executive offices were removed to that city. In 1911 he was made sales manager, and was elected first vice-president in 1918. Mr. Armitage, whom he succeeds as president, will still remain a member of the Whitman & Barnes Mfg. Co.'s board of directors.

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OBITUARY

Benjamin Hill Bristol, for many years president of the Bristol Co., Waterbury, Conn., died at his home in Platts Mills, May 25. Mr. Bristol was badly injured when hit by a trolley car last July, and never fully recovered from his injuries. He was born in Naugatuck in 1837, and was in the employ of the Platts Mill Co. for forty years. In 1889 he assisted in organizing the Bristol Co., and was its president until a few years ago.

PROPOSED REDUCTION IN SECOND-CLASS POSTAGE RATES

A reduction in the second-class postage rates, which were originally imposed as war taxes but which have since been retained, is provided for in a bill which was introduced in the House of Representatives by Representative M. Clyde Kelly of Pennsylvania. This bill proposes to repeal the last two of the four increases in postal rates which have been made under the war revenue law of 1917. It is pointed out in a statement by Mr. Kelly that the publishers of periodicals are in need of this relief from discriminatory war taxation in order that they may be able to continue to serve the public effectively. The rates that would be established in accordance with Mr. Kelly's bill would still be 175 per cent higher than the pre-war rates; the present rates are 325 per cent higher than pre-war rates.

Educational periodicals, in particular, should not be taxed for revenue purposes, but should be expected merely to pay for the service rendered in carrying this class of mail matter. The fact that the higher rates are charged on the advertising pages does not lessen the injustice. Advertising is not merely merchandise, but information. Mechanical periodicals are information highways, just as essential to business prosperity as are regular highways and waterways. The advertisements in mechanical periodicals are the chronicles of every advance in industrial achievement, and without them the publication of the educational information in magazines would be impossible.

COMING EVENTS

August 28-September 2—Annual Safety Congress of the National Safety Council in Detroit, Mich. Secretary S. J. Williams, 168 N. Michigan Ave., Chicago, Ill.

September 11-16—Eighth national exposition of chemical industries in the Grand Central Palace, New York City. Managers, Charles F. Roth and Fred W. Payne, Grand Central Palace, 46th St. and Lexington Ave., New York City.

October 2-7—Annual convention and exposition of the American Society for Steel Treating in Detroit, Mich., General Motors Bldg. Secretary, W. H. Eisenman, 4600 Prospect Ave., Cleveland, Ohio.

December 7-13—National Exposition of Power and Mechanical Engineering at the Grand Central Palace, New York City. Charles F. Roth, manager, Grand Central Palace, 46th St. and Lexington Ave., New York.

NEW BOOKS AND PAMPHLETS

Thermal Stresses in Chilled Iron Car Wheels. By G. K. Burgess and R. W. Woodward. 34 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Technologic Paper No. 209 of the Bureau of Standards. Price, 5 cents.

Graphic Comparison of Screw-thread Pitches. Chart published by the Department of Commerce, Washington, D. C., as Miscellaneous Publication No. 49 of the Bureau of Standards.

The chart shows the number of threads per inch and pitch in millimeters for both inch and millimeter systems, and comprises a graphical determination of the relation between English and metric screw-thread pitches.

The A B C of Vacuum Tubes in Radio Reception. By E. H. Lewis. 132 pages, 5 by 7½ inches. Published by the Norman W. Henley Publishing Co., New York City. Price, $1.

This is an elementary book describing in simple language the theory and operation of the vacuum tube in a radio receiving circuit. It is written especially for beginners who know nothing about radio and very little about electricity, no previous technical knowledge being necessary to understand it. Starting with an explanation of elementary electrical terms and a list of symbols, the functioning of various vacuum tubes as detectors and amplifiers is explained step by step in a simple manner. The subject of speech distortion is discussed and its elimination explained. A section of questions and answers is included, which gives information for those who are contemplating the installation of receiving equipment or who are getting unsatisfactory results with their equipment.

Publicity Methods for Engineers. 207 pages, 5 by 7½ inches. Published by the American Association of Engineers, 63 E. Adams St., Chicago, Ill. Price, $1.50.

The purpose of this book is to make plain the principles of presenting to the public information about engineers, and to show how this is being accomplished. The book is based on the talks and discussions at the First National Engineering Conference on Public Information held by the American Association of Engineers in Chicago in 1921. It has been carefully edited to conserve the time of the reader and amended to form a working manual of modern public information methods used by associations, municipalities, public service corporations, and trade organizations in promoting favorable public opinion. The contents include five chapters covering the following subjects: Some Reasons for Publicity; the Right Conception of Publicity; Ways and Means that Bring Publicity; Getting News in the Newspapers, and the Publicity Man and what he Needs to Know.

The Gantt Chart. By Wallace Clark. 157 pages, 6 by 9 inches. Published by the Ronald Press Co., 20 Vesey St., New York City. Price 2.50.

In these times, when the problem of decreasing costs and increasing production is of vital importance to all executives and engineers responsible for production control, books dealing with different phases of scientific management are of particular interest. The book under review is a valuable addition to this class. It describes the principles and methods of construction of the Gantt management chart. The purpose of the chart is to enable work to be readily planned for a whole plant or an entire industry, so as to make the best use of available equipment and to get work done when it is wanted. The construction is such that information can be concentrated in a single sheet which would require a large number of sheets, if the usual type of curve sheets were used. The ways in which these charts have been applied are described, and all the types of charts thus far developed are explained. These include the machine record chart, the man record chart, the lay-out chart, the load chart, and the progress chart. The field of application of these carts is almost unlimited; besides their use in connection with manufacturing operations, they may also be used for office work, sales quotations, stores keeping, budgeting, and other activities.

Machine Shop Work. Pamphlet published by the Bureau of Education of the United States Department of the Interior, Washington, D. C. Sent free on application.

This little pamphlet contains an outline of a reading course on machine shop work, including electric and oxy-acetylene welding, prepared by the American Library Association for the Bureau of Education of the United States Department of the Interior. This pamphlet points out that mechanical drawing and mathematics are foundation studies for shop practice, and that the machinist who can read drawings, solve shop problems, and make calculations is making his services more valuable than the man who must always ask questions. The shop man should also know as thoroughly as possible, not only the operation of his own machine, but of other machines and tools used in the machine shop. It is not enough to learn by one's own experience, but one should also learn and profit by the experience of others. By studying books, it is possible to find short-cuts, avoid mistakes, and get a new understanding and a new interest in the daily task, all of which will ultimately lead to greater success. The reading course outlined contains twenty-four books, covering mechanical drawing, general shop practice, turning and boring, drilling, gear-cutting, milling, automatic screw machine work, planing and milling, die-making and die design, electric welding, and oxy-acetylene welding.

Principles of Bearings. By Louis Langhaar. 125 pages, 7 by 9 inches; 55 illustrations. Published by the Langhaar Ball Bearing Co., Aurora, Ind. Price, $2.

The purpose of this book is to present and clarify the basic principles of bearings. It resolves bearings into their elementary types, and then dissects these types, showing the few elementary principles which govern each. The five principal objects in the selection of a bearing, it is pointed out, are reliability, durability, accomplishment of a definite result, the carrying of a definite load at the lowest costs per year, per pound, or per mile—all things considered—and the attainment of the greatest carrying capacity with the least weight and bulk. The book first briefly considers plain bearings, and then gives more extended treatment to ball and roller bearings, the former being dealt with completely. In covering ball bearings, the author first deals with the evolution of ball bearings, and follows his treatment with special chapters on radial bearings, the strength of raceways, the assembling of radial bearings, thrust bearings, three- and four-point contact bearings, two-point angular contact bearings, adjustable bearings, and two-row ball bearings. Stribeck's formulas for load are dealt with, and the lubrication of ball bearings is thoroughly covered. Separate consideration is given to ball separators, material and workmanship, vibration and noise of bearings, the fitting of ball bearings on shafts and in housings, proper construction of raceways, and durability of bearings. It will be noted from this review of the contents that this book deals with all the varied problems that have been met with in ball bearing design since the early developments of the ball bearing industry. Those interested in ball bearings, as manufacturers, designers, or users will doubtless find much of interest in this book. It covers the subject both from a theoretical and a practical point of view. In referring to the fact that mathematics cannot be avoided in a proper mechanical analysis, the author states that he has made an effort to have the mathematics in this book simple and clear, bearing in mind one of the best definitions given for mathematics: "Mathematics is applied common sense."

NEW CATALOGUES AND CIRCULARS

Edison Lamp Works of General Electric Co., Harrison, N. J. Bulletin 102-A of the Lighting Data series, treating of the effect of color of walls and ceilings on resultant illumination.

Monitor Controller Co., Baltimore, Md. Circular illustrating the Monitor "Thermaload" starter, which is suitable for any size motor from the smallest up to 10 horsepower, 220 volts, two or three phase.

Paragon Machine Co., Rochester, N. Y. Circular describing Paragon blueprinting and print-drying machines. The construction of these machines is described in detail and the distinctive features are pointed out.

Watts Bros. Tool Works, Turtle Creek, Pa. Catalogue 5, illustrating and describing this company's line of square and hexagon hole drilling tools, and giving data on the saving in production costs of drilling these holes in steel, etc.

Barnhart Bros. & Spindler, Monroe and Throop Sts., Chicago, Ill. Circular descriptive of the characteristics, physical properties, and ingredients of "Tenso" die-castings. A large number of parts for which this alloy is suitable are shown.

American Spiral Pipe Works, Chicago, Ill. Circular illustrating the large variety of spiral pipe fittings produced by this concern. These fittings are furnished for all sizes of pipe from 3-inch light spiral pipe to 96-inch forge-welded pipe, 1½ inches thick.

Roeper Crane & Hoist Works, 1720 N. 10th St., Reading, Pa. Catalogue 52, containing descriptive material and tables of capacities, dimensions, and prices of Roeper I-beam trolleys, chain hoists, switches, and turntables for the overhead handling and conveying of materials.

Christiana Machine Co., Christiana, Pa. Catalogue 101, containing tabular matter covering the dimensions, horsepower transmitted, prices, etc., of the line of cast-iron spur gears, miter gears, bevel gears, spur mortise gears and pinions, worms and worm-gears, etc., made by this concern.

Thwing Instrument Co., 3339 Lexington Ave., Philadelphia, Pa. Bulletin 11, describing Thwing radiation pyrometers of the indexing and multiple-recording types, for measuring temperatures in heat-treating furnaces, coke ovens, etc., and for measuring local temperatures of dies in hardening furnaces.

Wagner Electric Mfg. Co., St. Louis, Mo., manufacturer of motors and other electric equipment, has issued a calendar for May 1922—May 1923, inclusive, designed to show three months at a glance. On each sheet is printed a brief statement of the characteristics and uses of Wagner "Pow-R-full" motors.

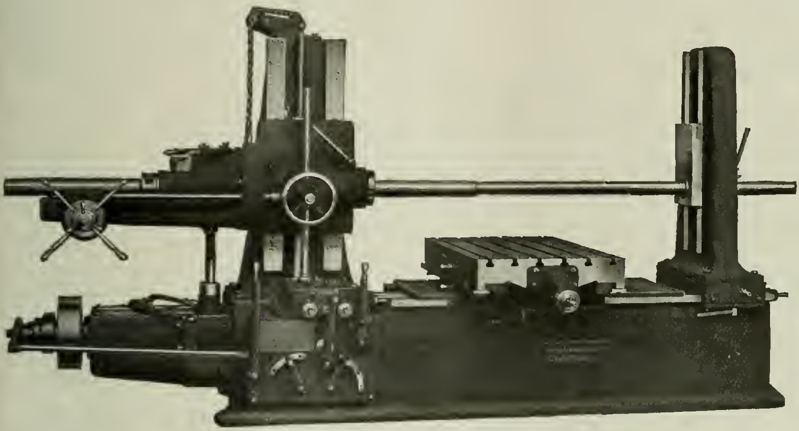
Condensite Co. of America, Bloomfield, N. J. Circular descriptive of the plastic molding of condensite, describing in detail how this material is molded, and the design of the molds used. The properties of condensite are explained at length. Circular containing a list of the products made by this company.

Hanson Tool & Die Co., Detroit, Mich. Catalogue containing illustrations and tables of dimensions and prices, covering the line of "West" tools made by this concern, which includes tool-

Distance lends enchantment to—lots of things but NOT to the

"PRECISION"

Boring, Drilling and MILLING MACHINE



The closer you get, and the more you know it, the better you like it; it has no tricks to plague you either before or after you get familiar with it, which does not take long, because

IT IS SIMPLE

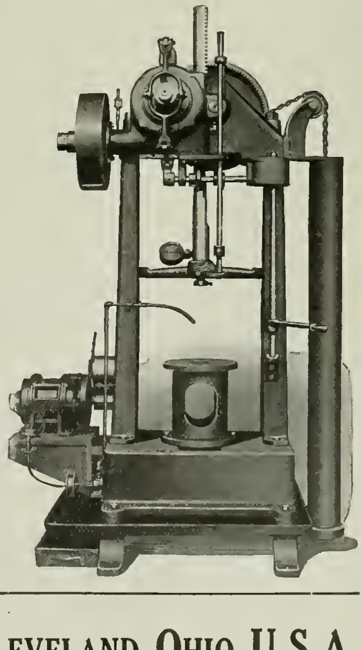
Almost like SLEIGHT OF HAND is the ease and quickness with which our new

Vertical Push-Broaching Machine

handles the broach.

"A SIMPLE TWIST OF THE WRIST" DOES THE TRICK

Less floor space—More production



LUCAS MACHINE TOOL CO. NOW AND ALWAYS OF **CLEVELAND, OHIO, U.S.A.**

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry. Societe Anoyme Belge, Alfred Herbert, Brussels. Aux Forges de Vulcain, Paris. Allied Machinery Company, Turin, Barcelona, Zurich. Benson Brothers, Sydney, Melbourne. V. Lowener, Copenhagen, Christiania, Stockholm. R. S. Stokvis & Zonen, Rotterdam. Andrews & George Company, Tokyo, Japan.

holders, connecting-rod tools, end-mills and keyway cutters, counterbores and countersinks, drills, face and side milling cutters, and reamers.

E. J. Codd Co., 700 S. Caroline St., Baltimore, Md. Circular descriptive of the Wiegand chain furnace screens for oven and furnace openings, which are designed in such a way as not to interfere with the free manipulation of the tools required to handle the charge and at the same time to keep the heat in and the cold air out.

Erie Foundry Co., Erie, Pa. Bulletin 90, containing descriptive material and illustrations of Erie sheet galvanizing equipment, squaring shears, and sheet levelers. The Erie sheet galvanizing machine is designed for galvanizing flat sheets of all standard sizes and gages, and it is arranged for either belt or motor drive.

Pannier Bros. Stamp Co., 207 Sandusky St., Pittsburg, Pa. Circular illustrating the line of marking equipment made by this concern for marking trademarks, company names, or other data, on sheets, plates, and structural material. These markers are made with interchangeable rubber dies which can be quickly attached and removed.

Cooper Hewitt Electric Co., 95 River St., Hoboken, N. J., is publishing a series of pamphlets known as "Industrial Lighting Briefs" which will appear from time to time and will deal with important phases of the subject of lighting. Those who are interested in industrial lighting will be placed on the mailing list to receive copies, upon application.

Roller-Smith Co., 233 Broadway, New York City. Bulletin 560, illustrating and describing Roller-Smith enclosed circuit breakers, Types E and P. Bulletin 820, descriptive of Roller-Smith PV ammeters and voltmeters and COD indicators for automotive vehicles, farm lighting plants, battery charging outfits, small panels, and similar applications.

Crescent Pump Co., 743 Beaubien St., Detroit, Mich. Description of Crescent vacuum tools, in which application is made of vacuum for chucking flat materials and for handling and lifting flat materials of all kinds, the principle of operation being similar to that of magnetic tools. The tools shown include vacuum chucks, bench blocks, hand lifters, suction cups, oldman, and rivet hold-on.

Niagara Machine & Tool Works, 637 Northland Ave., Buffalo, N. Y. Bulletin containing instructions for the proper care of squaring shear knives. It tells what tests should be applied to the shears, and describes methods of attaching the knives, adjustment, and regrinding of the knives. The bulletin is printed on a large sized sheet, which is intended to be tacked up near the shear.

Ajax Flexible Coupling Co., Westfield, N. Y. Leaflet descriptive of Ajax flexible shaft couplings, which are made in various sizes of bores and types of driving connections for all kinds of service. The construction of the coupling is illustrated by a line engraving, and a table is included giving the dimensions and prices of the different sizes of heavy- and light-duty couplings.

MacGovern & Co., Inc., 114 Liberty St., New York City. Catalogue 51, covering the line of power machinery and contractors' equipment handled by this company, which includes turbines, motors, gas engines and oil engines, generators, converters, air compressors, centrifugal pumps, boilers, condensers, cranes and derricks, etc. The equipment listed and classified in this catalogue is ready for immediate shipment.

Hisey-Wolf Machine Co., Cincinnati, Ohio. Leaflet 3020, descriptive of Hisey electric tools, including ball bearing portable grinders and buffers, ball bearing buffing lathes, heavy-duty portable drills and reamers, toolpost grinders with combination bearings, internal and external grinders, parallel or angle-plate grinders, ball bearing bench and floor grinding machines, bench drilling stand, universal motor drills, and heavy-duty ball bearing grinders.

C. F. Pease Co., 861 N. Franklin St., Chicago, Ill. Catalogue C-61, of American-made drawing instruments, completely illustrating and describing the line manufactured by the company in its Chicago factory. It is pointed out that the manufacture of American-made drawing instruments was developed in this country as a matter of necessity during the war, and that high-grade drawing instruments of American manufacture are now available.

Sabin Machine Co., Cleveland, Ohio. Catalogue A, describing the points of construction of Sabin "one-man" trucks, which are designed for handling open-top steel and wooden barrels or boxes used in foundries, machine shops, stamping works, forge shops, and many other industries. An extension foot-pedal is used on all the trucks except Type S, thus greatly increasing the leverage and eliminating the necessity of helpers for heavy loads. Specifications are given for the various models.

Newark Gear Cutting Machine Co., 69 Prospect St., Newark, N. J. Catalogue 4, descriptive of the Newark No. 2B spur and bevel gear cutting machine, which is designed for the all-around work of machine shops, as well as for manufacturing light and medium work, such as gears used in textile work, automotive work, and special machinery. Specifications are given for this machine, and its application for cutting quill gears, gang cutting, and a number of other jobs is illustrated. Tables of tooth parts are included.

W. S. Rockwell Co., 50 Church St., New York City. Bulletin 242, on heat-treatment furnaces, illustrating a variety of methods of applying the principles of proper heating and handling to different manufacturing requirements and shop conditions. The influence of the method of heating and handling on the quality and cost of heat-treated products is pointed out, and information is given on the factors that determine the selection of the proper method. A large number of installations of heat-treating furnaces of the stationary type are shown.

David Lupton's Sons Co., Allegheny Ave. and Tulip St., Philadelphia, Pa. General catalogue 11, containing 191 pages, 8½ by 11 inches, covering the line made by this company, which includes steel sash, casement and double hung windows, rolled steel skylights, roof trusses, corrugated wire glass shelving, bookstacks, and other steel factory equipment. The attempt has been made in preparing this catalogue to make it a comprehensive and up-to-date handbook on the best practices in the use of steel sash, regardless of the make, in all kinds of buildings.

O. S. Walker Co., Inc., Worcester, Mass. Circular W2, descriptive of Walker magnetic chucks of the rectangular, swiveling, and vertical face styles, all of which are of the single coil or single magnet type of construction. Complete descriptions of the different chucks are included, as well as halftone and diagrammatic illustrations which make the construction very clear. Tables of specifications giving the dimensions, size numbers, weights, and electric current used, are included. The use of the Walker improved demagnetizing switch, which is furnished with all these magnetic chucks, is also described.

Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. Circular 1579-B, treating of gears and pinions made of micarta, which is a non-metallic material that may be substituted for steel, cast iron, bronze, and other metals, when a silent drive is desired. The catalogue points out the distinctive features of micarta, and gives the physical and mechanical properties. It describes in detail the manufacture of the gears, including cutting the blanks, turning and drilling, and cutting the teeth. A number of illustrations are shown which give a fair idea of the standard construction that has been recommended and generally adopted for gear and pinion construction. Tables of horsepower ratings of micarta gears are included.

Cleveland Worm & Gear Co., Cleveland, Ohio. Bulletin 1, of Cleveland worm-gear drives, containing general information relating to Cleveland worm-gear reduction units, which are suitable for use in textile machinery, turbines, mining machinery, hoisting and conveying devices, automobiles, elevators, rolling mills, and other industrial drives. Lubrication bulletin for Cleveland worm-gear drives, giving instruction for installation, lubrication, and maintenance. Circular containing suggestions relating to the installation of Cleveland worm-drives. The information given makes it possible to obtain the most economical installation for the particular class of work to be done, the selection of a proper sized unit depending upon the load characteristics and motive power conditions. Circular entitled "The Banks are Demanding Economy," showing a blueprint that gives the horsepower and standard dimensions for Cleveland worm-drives for lineshafts.

TRADE NOTES

Wagner Electric Mfg. Co., St. Louis, Mo., has removed its Salt Lake City office to 313 Dooly Bldg.

Vandyck Churchill Co. has removed its office from the Singer Building to 52 Vesey St., New York City.

Buell, Scheib, Mueller, Inc., is a new concern of consulting and combustion engineers which is located at the Columbia Bank Bldg., Pittsburg, Pa. The company will specialize on fuel economy and conservation, and furnace design.

Perdieu Tool Mfg. Co., Milwaukee, Wis., has taken over the business and factory of the Meigs-Powell Co. and will continue the manufacture of calipers, dividers, and other machinists' tools. R. A. Perdieu is president and J. B. Matthews, secretary of the concern.

Diamant Tool & Mfg. Co., Inc., 95 Runyon St., Newark, N. J., has appointed the Cleveland Duplex Machinery Co., Inc., 1224 W. 6th St., Cleveland, Ohio, as exclusive representative for the sale of Diamant standard punch and die sets, in the territory covered by the northeastern section of Ohio.

Fred C. Dickow Machinery Co., for the last fifteen years dealer in new and used machinery and tools, and manufacturer of the Dickow 10-inch universal index-centers, has moved the main office and salesroom of the company from 3504 W. Lake St. to 2105 W. Lake St., Chicago, Ill. The new telephone number is West 1352 J.

American Stamping Co., 5400 Windsor Ave., N. E., Cleveland, Ohio, is a new concern which has been formed to specialize in all kinds of stampings. The general manager is F. W. Vilmar, and the president and works manager is W. E. Gemmill, both of whom were associated for many years with the Parish & Bingham Corporation of Cleveland.

V & O Press Co., Brooklyn, N. Y., has recently purchased additional machine shop equipment and is planning to erect an up-to-date factory on a 7½-acre tract of land which the company owns on Cooper Ave. and Long Island Railroad, Glendale. The present factory on Dry Harbor Road has become inadequate because of the increasing demand for V & O power presses and sheet metal working machinery.

United Alloy Steel Corporation, Canton, Ohio, announces the purchase of the plant of the Canton Sheet Steel Co., which was necessitated by the rapidly increasing volume of its business. The alloy plant has been running at capacity for some time, and as soon as possible the new division will be placed in full operation. The company's iron and steel products are marketed under the trade names of "Toncan" and "U-Loy."

I. B. Williams & Sons, Dover, N. H., manufacturers of leather belting, have announced the establishment of a new department of their business for the manufacture of mill strapping of all kinds. They have equipped the department with special machinery for the manufacture of every type of strapping or leather pieces of special shapes required by manufacturers in any line. T. L. Chapman will have charge of the new department.

Air Reduction Sales Co., 342 Madison Ave., New York City, at a recent meeting of the board of directors elected the following officers: First vice-president, A. R. Ludlow, formerly vice-president in charge of sales; vice-president and secretary, M. W. Randall, formerly secretary; vice-president and operating manager, Herman Van Fleet, formerly chief engineer; vice-president in charge of research and development, Dr. F. J. Metzger.

Cleveland Tractor Co., Cleveland, Ohio, manufacturer of the "Cletrac" tank-type tractor for farm and industrial uses, is to be reorganized as the Allyne-Zeder Motors Co., to manufacture and market a new six-cylinder automobile which is being designed by F. M. Zeder, formerly chief engineer of the Willys Corporation and the Studebaker Corporation. A new corporation subsidiary to the Allyne-Zeder Motors Co. will be organized under the name of the Cleveland Tractor Co., which will continue to market "Cletrac" tractors through the present distribution and dealers.

Kent-Owens Machine Co., Toledo, Ohio, has taken over the Diamond Alloy Tool Co., of St. Louis, Mo., and will in the future manufacture "Diamond Alloy," a cutting metal which is cast accurately to form in permanent molds, and is suitable for tool bits, milling cutters, cut-off blades, slitting saws, counterbores, keyway cutters, inserted blades for milling cutters, reamers, and boring tools. The metal has high wear-resisting qualities; it is tough and hard and yet not brittle. The sales of "Diamond Alloy" will be handled by P. H. Briggs, 1235 W. 9th St., Cleveland, Ohio.

Firth-Sterling Steel Co., McKeesport, Pa., has opened a branch office in Los Angeles, Cal., at 836 E. 3rd St., which will be under the charge of E. S. Jackman & Co. of Chicago, who look after all the business of this company west of Pittsburg. William E. Nelson who has been selling Firth-Sterling steels for twenty years, will have direct charge of the work. The Los Angeles office will carry in stock "Blue Chip" high-speed bits for tool-holders in all standard sizes and both square and beveled styles. Orders for tool and die steel in bars will be filled from the Chicago warehouse or from McKeesport as in the past.

Pittsburg Testing Laboratory has opened a sales office and complete inspection bureau at 1864 Railway Exchange Bldg., St. Louis, Mo. Colonel N. C. Hoyles will be district manager. Colonel Hoyles has been associated with the company for a number of years, having entered the service as inspector at the Birmingham office in 1908. In 1912 he was promoted to the position of manager in the Birmingham office, and in 1914 was transferred to the Vancouver office. At the outbreak of the war he entered the service of the Canadian Army but returned to the Pittsburg Testing Laboratory after the war was over, and has been assistant sales manager at New York and manager at Cincinnati.

Gardner Tap & Die Co., Cleveland, Ohio, has recently been incorporated for the purpose of taking over the business of the Gardner-Bryan Co. of Cleveland, manufacturer of taps, dies, and screw plates. F. W. Wood, president of the Wood & Spencer Co. and of the Cleveland Castings Pattern Co., is president of the new company; J. M. Gardner and R. H. Smart of the former Gardner-Bryan Co. are vice-president and sales manager, and treasurer, respectively, and D. G. Miller, secretary of the Wood & Spencer Co. and of the Cleveland Castings Pattern Co., is secretary. The board of directors comprises the officers mentioned and A. K. Spencer, vice-president of the Wood & Spencer Co. and the Cleveland Castings Pattern Co., F. H. Wood of Watertown, Mass., and F. E. Gardner of Beloit, Wis.

VOLUME 28 MACHINERY NUMBER 12

AUGUST, 1922

THE INDUSTRIAL PRESS, 140-148 LAFAYETTE ST., NEW YORK CITY

CONTENTS OF THIS NUMBER

CIRCULATION FOR JULY, 1922, 19,000 COPIES

Member Audit Bureau of Circulations

Published monthly. Yearly subscription in United States and territories, Philippines, Porto Rico, Canal Zone, Cuba, Mexico and Shanghai, $3; Canada, $4; foreign countries, $6; single copies 35 cents, postage extra. The receipt of a subscription is acknowledged by sending the current number. Checks and money orders should be made payable to THE INDUSTRIAL PRESS.

September MACHINERY will be of more than ordinary interest. It covers a wide range of unusual subjects—Diamond Tools, Rivet Spinning, Bending Large Pipe, Metal Polishing, Molding Radio Insulators, Grinding Small Tools, Wire Forming, Cutting Bevel Gears, etc.

 Entered as second-class mail matter, September, 1894, at the Post Office, in New York, N. Y., under the Act of March 3, 1879. Printed in U. S. A. It is understood that all contributed articles are submitted exclusively to MACHINERY; when accepted and published, payment is made at our regular space rates.

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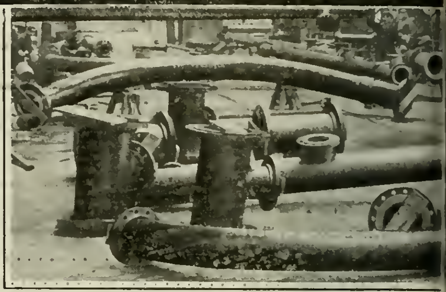
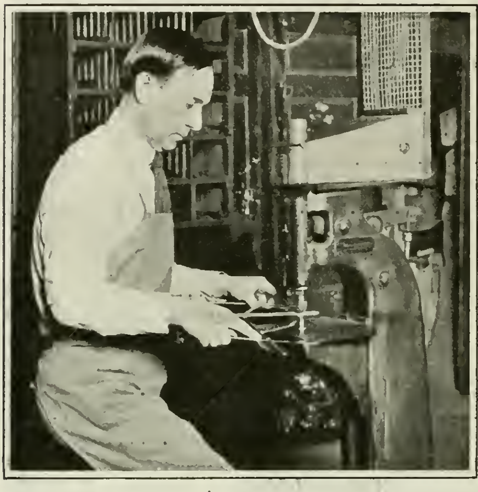
What September

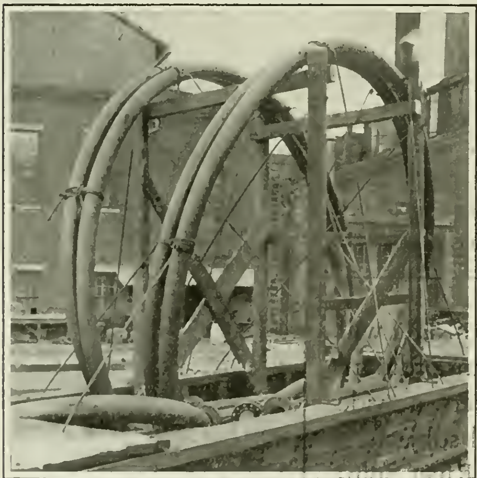




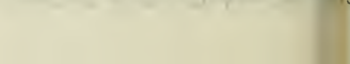
The September number of MACHINERY will be of more than ordinary interest because of the unusual subjects covered. The leading article "Bending Large Pipe" describes in detail the general practice for handling this work. Pipe up to 4 inches can be bent cold, by using machines designed for the purpose, but larger sizes must be heated. The heating process and the unusual methods employed to secure the desired shapes are extremely interesting and a great deal of skill is required to bend large pipe without flattening or buckling on the inside of the bend.

Another article—"Rivet Spinning"—deals with the use of rivet spinning machines for heading or "setting down" pins, studs and bushings as well as rivets.

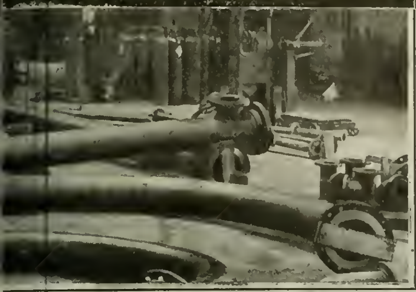
September also marks the beginning of a series on the "Principle of Metal Polishing"—covering the subject of polishing thoroughly and completely. One of the prominent manufacturers in the polishing line has written a great part of the matter and the articles will cover the general points concerning metal polishing, polishing

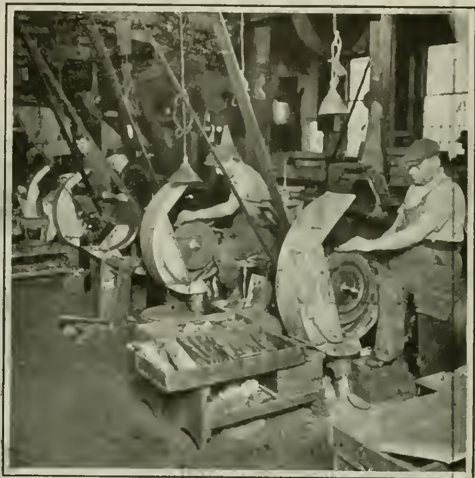


Latest Mechanical Developments



MACHINERY Offers



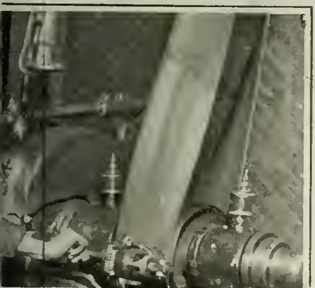


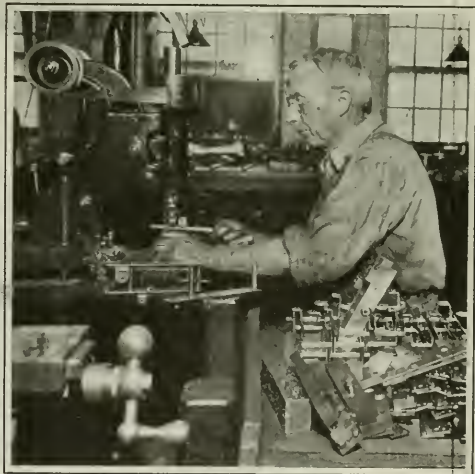
wheels and abrasives, polishing methods and equipment, the making of polishing wheels and special wheel shapes, together with a number of examples of polishing practice in different metal-working industries. Another instance where MACHINERY takes up a subject and deals with it completely in all its phases in a series of articles.

"Molding Radio Insulators" is another chapter in the series on making radio instruments, and includes a complete review of the dies and methods used in this work.

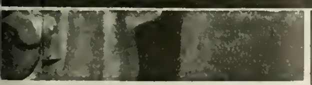
"Diamond Tools as Cost Reducers" indicates how diamonds may be used for cutting various materials, with special emphasis on the economies introduced by the application of diamonds as cutting tools.

"Grinding in the Small Tool Industry" continues the grinding series. The last installment of "Cutting Bevel Gears" and the second and last installment of "Wire Forming" appear in September, and the designer and draftsman will be especially interested in the article "Following up Alterations in Design."





Interesting—Educational—Timely



SPECIAL FEATURES

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Frame castings have the strongest section at the point of greatest stress.

The *rated* stroke and the *working* stroke are the same —the feed does not take up any part of rated stroke.

Feed screws are always in tension.

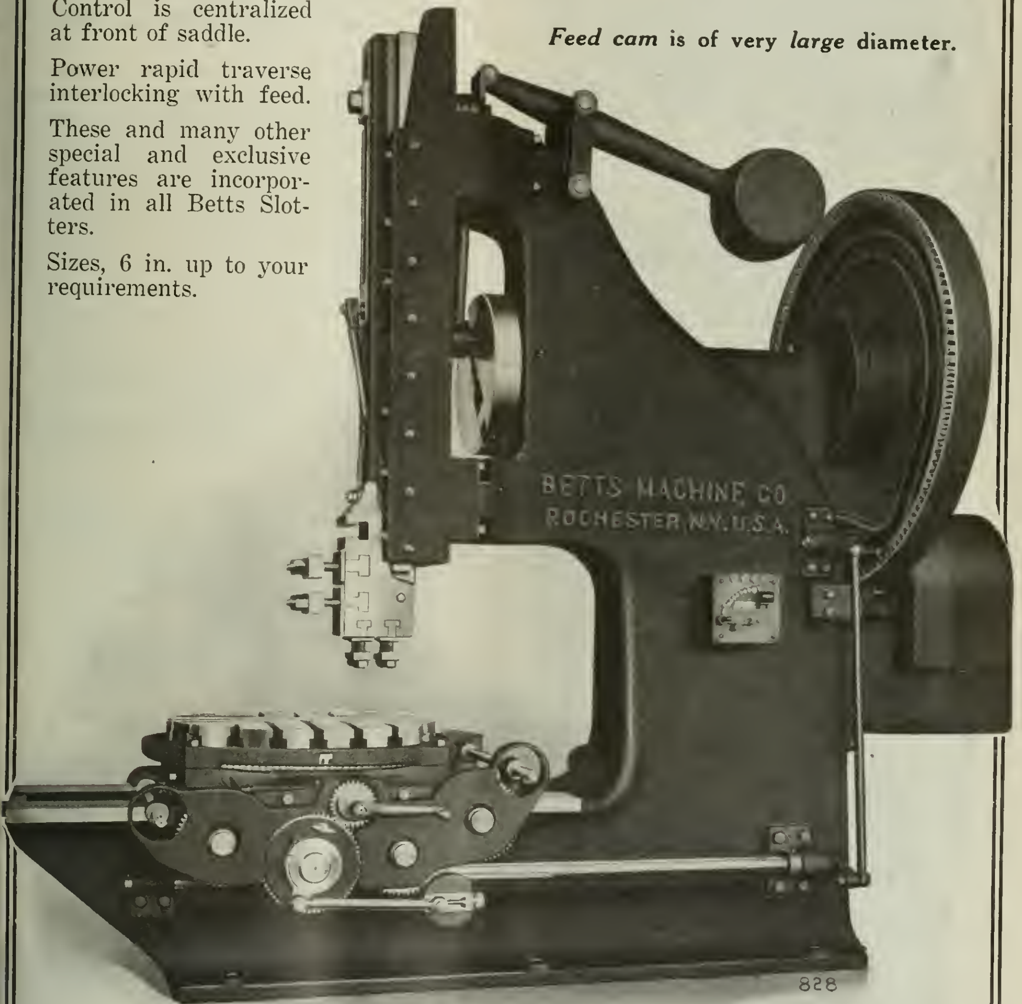
Control is centralized at front of saddle.

Power rapid traverse interlocking with feed.

These and many other special and exclusive features are incorporated in all Betts Slotters.

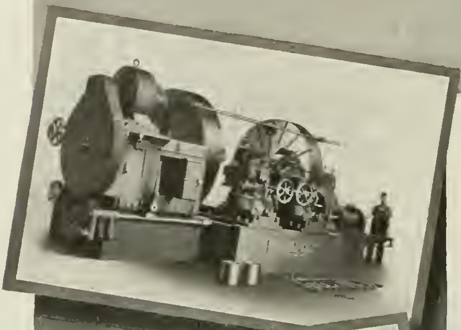
Sizes, 6 in. up to your requirements.

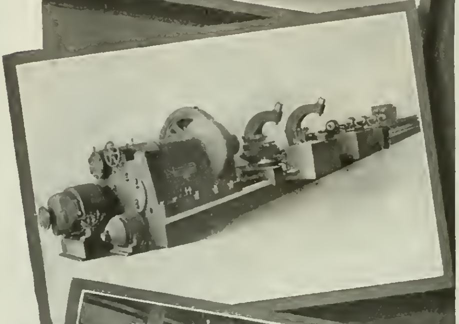
Feed cam **is of very** ***large*** **diameter.**

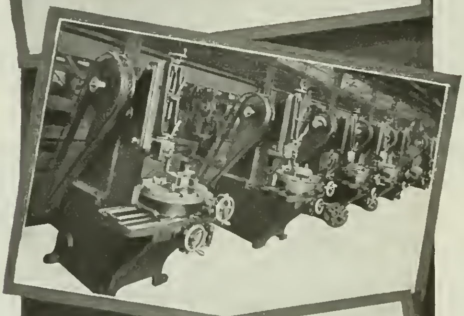


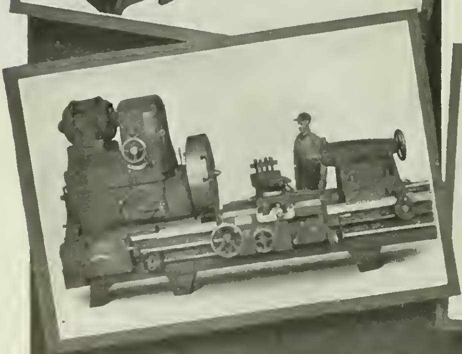
BETTS MACHINE CO., 400 Blossom Road, Rochester, N. Y.

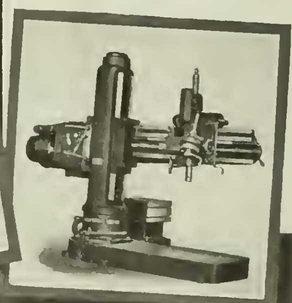
BETTS MACHINE TOOLS











Complete Machin

For General Manufacturin
Railway Shops, Shipyard

OUR eight factories, greatly enlarged and re-equipped within the past few years, are today manufacturing our extensive line of standard products to serve *all* your machine tool needs. We furnish *complete* machine tool and crane equipment for general machine shops, locomotive and car building shops, railroad repair shops, arsenals and shipyards. Our engineering departments have had wide experience in such installations and their services are at your disposal. We build

- Engine and Forge Lathes—7 in. to 170 in. swing.
- Gun Boring and Turning Lathes—for guns up to 20 in. calibre.
- Planers—from 30 in. to 20 ft. between housings.
- Boring and Turning Mills—30 in. to 45 ft. swing.
- Drilling Machines—all types and sizes.
- Slotters—6 in. to 92 in. stroke.
- Horizontal Boring, Drilling and Milling Machines—all types.
- Horizontal and Vertical Milling Machines—various types and sizes.
- Bending and Straightening Rolls.
- Punching and Shearing Machines.

Electric Traveling Cranes—2 to 250 ton capacity.

PRATT & WHITNEY
Precision Machine Tools

Engine Lathes	Die Sinkers
Automatic Lathes	Milling Machines
Turret Lathes	Thread Milling Machines
Vertical Shapers	Deep Hole Drilling Machines

WORKS:

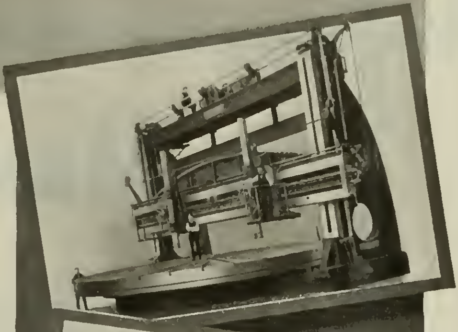
Niles Works—Hamilton, Ohio.
Bement Works—Philadelphia, Pa.
Pond Works—Plainfield, N. J.
Crane Works—Philadelphia, Pa.
Ridgway Works—Ridgway, Pa.
Bertram Works—Dundas, Canada.
Pratt & Whitney, Hartford, Conn.
Pratt & Whitney Co. of Canada—Dundas, Can.

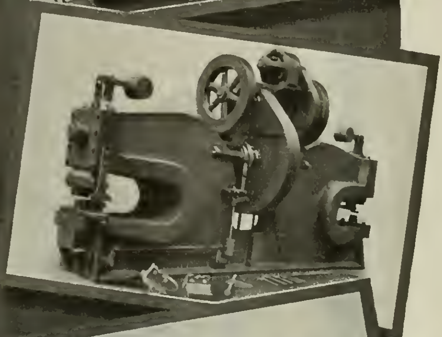
LON
25 Vi

NILES-BEMENT-

GENERAL OFFICES

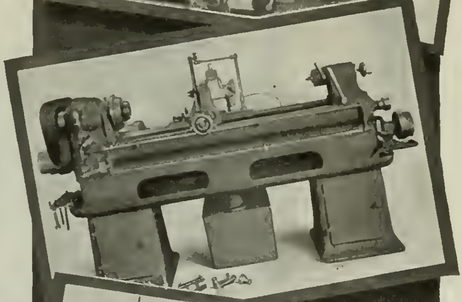
'ool Equipment
d Repair Plants,
avy Yards, Arsenals





FOR over forty years our object has been to build the highest grade products only. The success of our efforts is best proven by the extensive use of Niles-Bement-Pond and Pratt and Whitney equipment not only in the United States and Canada but in most European countries as well as in India, Japan, China, Australasia, South Africa, South America, Java, etc.

Driving Wheel Lathes—51 in. to 100 in. swing.
Car Wheel Lathes—Four types.
Axles Lathes—Four types.
Car Wheel Presses—For wheels up to 90 in.
Car Wheel Borers—Three types.
Tire and Wheel. Center Boring and Turning Mills.
Axle Centering and Cutting-off Machines.
Wheel Quartering Machines.
Traveling Head Shapers—Single and double.
Cylinder Boring Machines.



Steam Hammers—250 lbs. to 2500 lbs. falling weight.

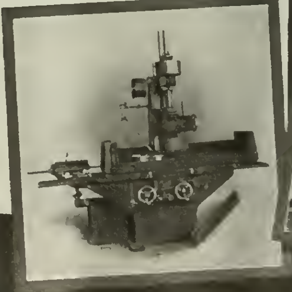
PRATT & WHITNEY
Small Tools and Gages

Taps	Milling Cutters
Dies	Punches
Reamers, etc.	Gages and Standards

OFFICES:

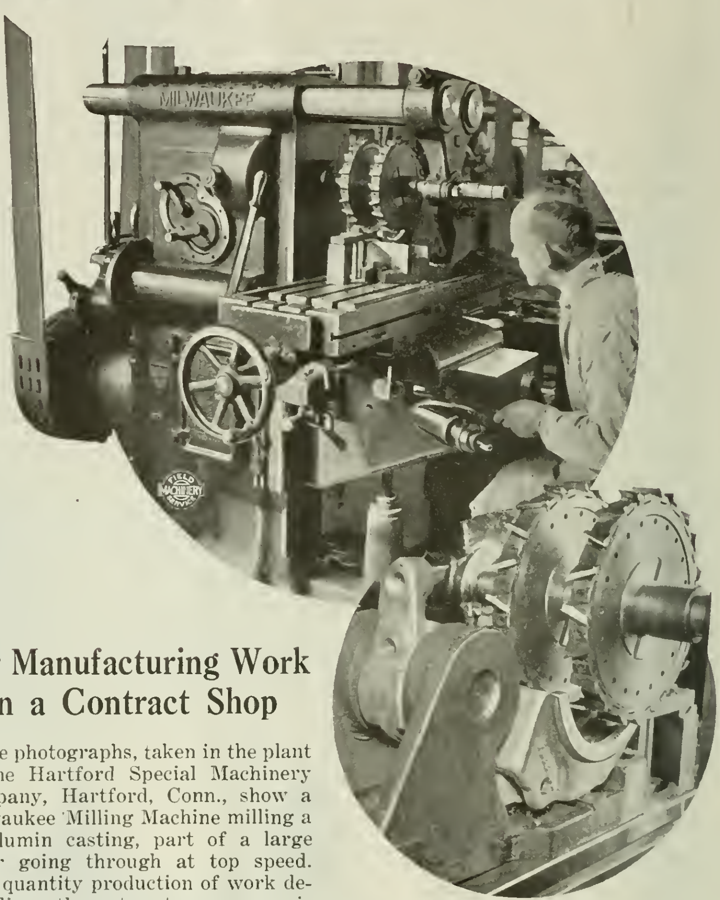
Philadelphia	Detroit
Chicago	Pittsburgh
Boston	St. Louis
Birmingham	St. Paul
Cincinnati	Los Angeles
Cleveland	San Francisco
Rochester	Denver

CE
. S.W.



POND COMPANY
111 BROADWAY, NEW YORK

MILWAUKEE MILLING MACHINES



For Manufacturing Work in a Contract Shop

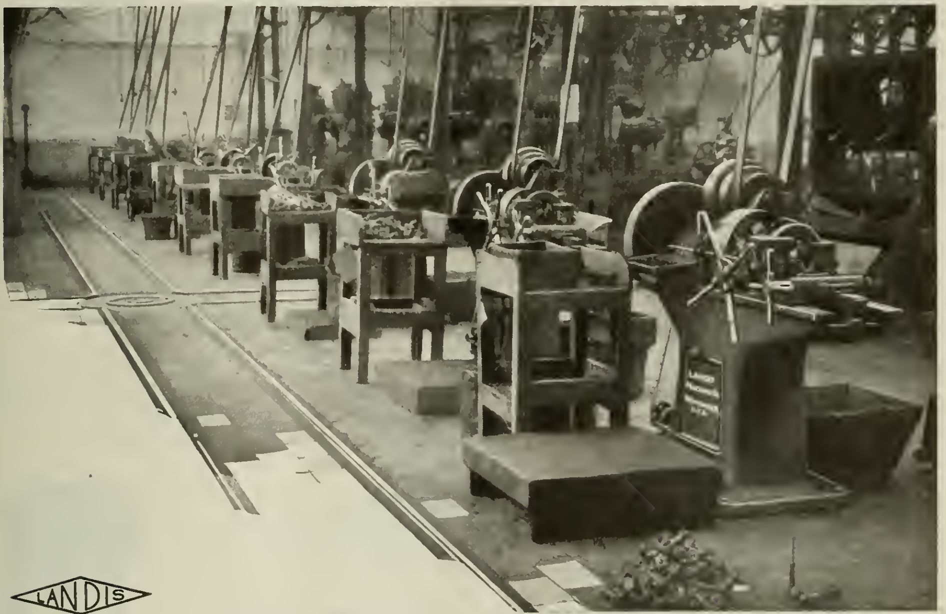
These photographs, taken in the plant of the Hartford Special Machinery Company, Hartford, Conn., show a Milwaukee Milling Machine milling a duralumin casting, part of a large order going through at top speed. This quantity production of work demanding the utmost accuracy is handled without difficulty; the range, accuracy and operating conveniences of Milwaukee Milling Machines make them particularly valuable equipment for manufacturing operations of this class.

There are nine Milwaukee Milling Machines here giving uniformly satisfactory service on all the varied milling operations that come up on contract work.

If your work includes milling—any kind—get the details of these machines.

KEARNEY & TRECKER
CORPORATION
MILWAUKEE, WIS., U.S.A.

CHICAGO OFFICE 631 WASHINGTON BLVD — CLEVELAND OFFICE 738 SUPERIOR AVE N W — NEW YORK OFFICE 50 CHURCH STREET



LANDIS

At the Louviere (Belgium) Bolt Co. Works—Ten Landis Single Head Threading Machines in this Row

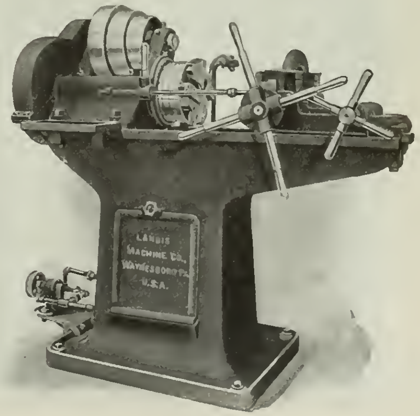
In addition to these ten 1½″ Landis Single Head Threading Machines the Louviere Bolt Company has two more machines of the same size and one 2″ Double Head machine, in another department. All of these machines are used for threading bolts; all are highly efficient and profitable; that they are entirely satisfactory to their owner is evident by the size of the installation.

If yours is a problem of cutting threads we'll be glad to put our engineering department at your command—no matter where you may be. Write us.

LANDIS MACHINE CO., Inc.
Waynesboro, Pa., U. S. A.

The Famous Landis Chaser

Landis Single Head Threading Machine



STEWART
Industrial Furnaces

The development of more than a quarter of a century of practical contact with every sort of industry. There's a Stewart Industrial Furnace for

- Annealing
- Billet Heating
- Brass Melting
- Carburizing
- Cyanide Hardening
- Drop Forging
- Galvanizing
- High Speed Steel Hardening
- Lead Hardening
- Oil Tempering
- Pre-Heating
- Rivet Heating
- Rod End Heating
- Soft Metal Melting
- Spring Hardening
- Tinning, Etc.

A very extensive line of standard sizes—the largest listed by any industrial furnace manufacturer. Also built in any special size to meet your requirements.

Exclusive United States Sales Agents for the Selas One Valve Control System

Chicago Flexible Shaft Company

1154 South Central Avenue, Chicago

350 Broadway, New York — 921 Granite Bldg., Rochester, N. Y. — 420 Wainwright Bldg., St. Louis — 608 Kerr Bldg., Detroit

Stewart Double Deck Hardening Furnace

Lower chamber for high heats necessary for high speed steel hardening—fitted with carbofrax hearth and supports. Also used for carbon steel hardening.

Upper chamber for preheating—heated by waste gases from lower chamber.

Five standard sizes.

Stewart No. 3 Forge

Dandy shop accessory for small blacksmithing and tool dressing.

Opening, 3¼" x 8"; depth 10"

Floor space, 24" x 24"

Operates on gas only.

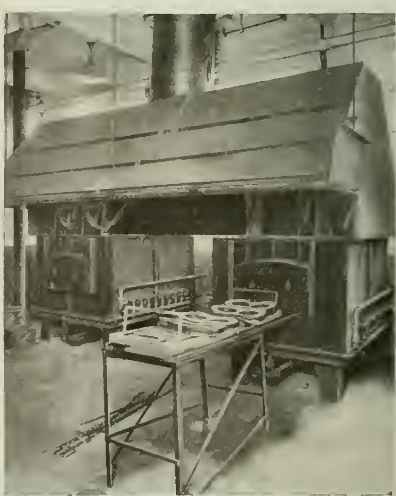
Shipping weight, 490 lbs.

Stewart Accuracy Makes It Ideal Equipment for the Technical School

Stewart Triple Purpose Furnace installation in Pratt Institute, Brooklyn, N. Y.

Stewart Oven Furnaces

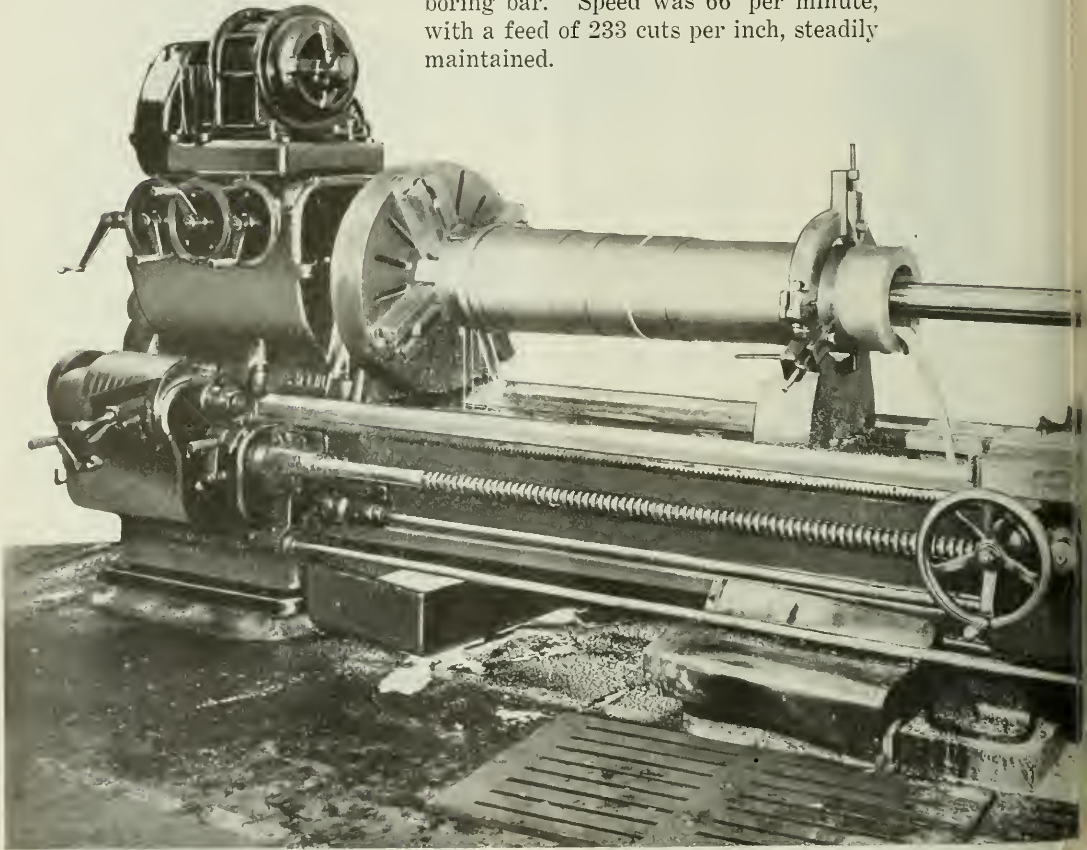
Used for Annealing by the Victor Mfg. & Gasket Company, Chicago, makers of copper-asbestos gaskets for automobiles, marine and stationary engines, etc.



LATHES **AMERICAN** PLANERS

Boring an 8" Hole Through Solid Steel on a 30" "American" Lathe—

An operation well calculated to test the power and workmanship of any machine. The piece is a forged bar of .40 carbon 3½% nickel steel, 60½" long; and no pilot hole was drilled before entering the boring bar. Speed was 66' per minute, with a feed of 233 cuts per inch, steadily maintained.



THE AMERICAN TOOL WORKS

Thread Comparator

the Accuracy of their Product

The thread to be visually gaged is placed here. Its enlarged shadow on the screen can be unerringly checked at the rate of approximately 500 screws per hour.

Explanation of Chart. The diagram on the chart (the dotted section) marks the limit of tolerance. The shaded portion is the thread enlarged.

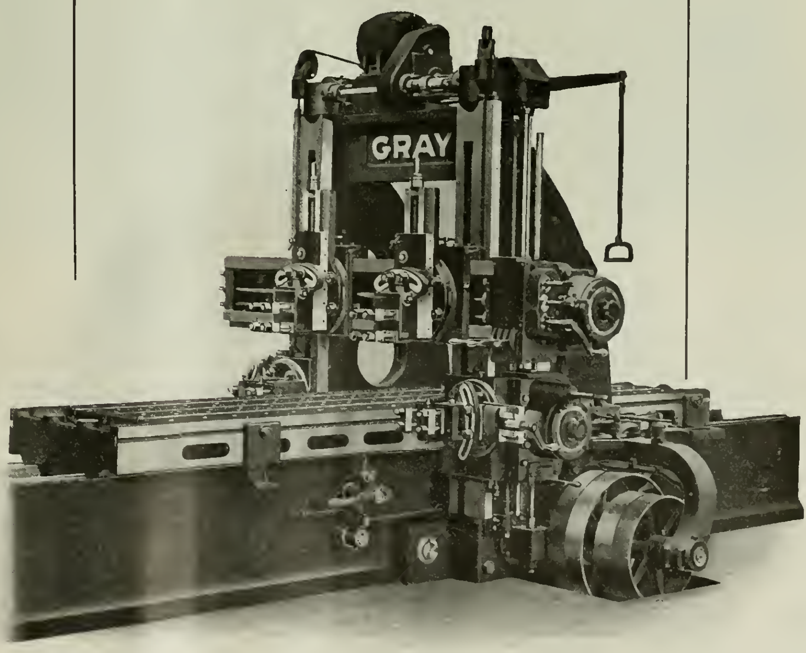
Machine Company

-10 Water Lane, Queen Victoria St., London, E.C., Eng.

503 Market Street, San Francisco, California

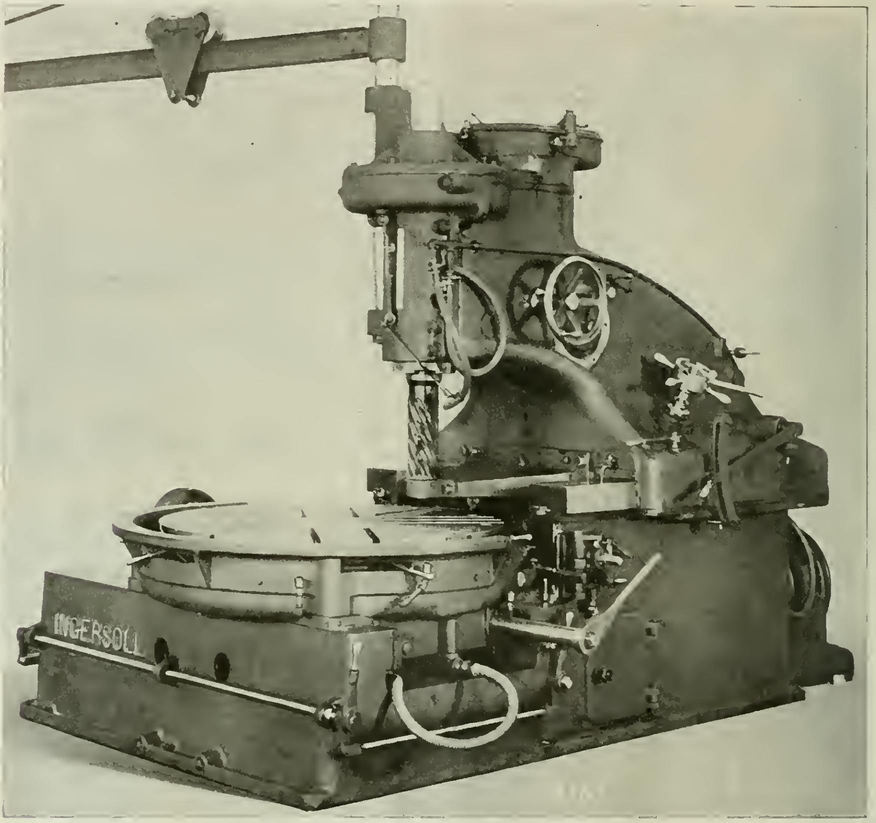
AGENTS

Japan, Korea, etc., Mitsui & Co., Ltd., Tokio. Australasia—McPherson's Pty., Ltd., 554 Collins St., Melbourne. Sweden—A. Boll. Oscar Lindbom, Stockholm—Post Box 420.


GRAY

INGERSOLL

Adjustable Rotary Milling Machine for Profile Milling, Face Milling and Die Sinking



The Ingersoll Adjustable Rotary Milling Machine is a tool developed for shops having a wide range of work. It can be used to advantage for profile milling, die sinking or face milling. It is invaluable in railroad shops for profiling locomotive rods and straps, milling out piston and strap ends of main rods and milling slots from the solid, etc. An exceptionally large combination of movements can be obtained from the head, housing, table and saddle of this machine.

The table rotates by hand or power on a saddle which in turn is mounted on wide ways of the bed and can be fed in either direction. The table and saddle can be locked together so that they form virtually a single casting.

The spindle is mounted in a housing which can be fed toward or away from the line of the table travel. The spindle has a vertical adjustment of 21 inches and is fitted with boring and drilling feed.

The control levers are all located so that the operator can reach them while watching his work. The jib crane on the machine is standard equipment and is of great value in setting heavy castings or forgings.

The Ingersoll Milling Machine Co.

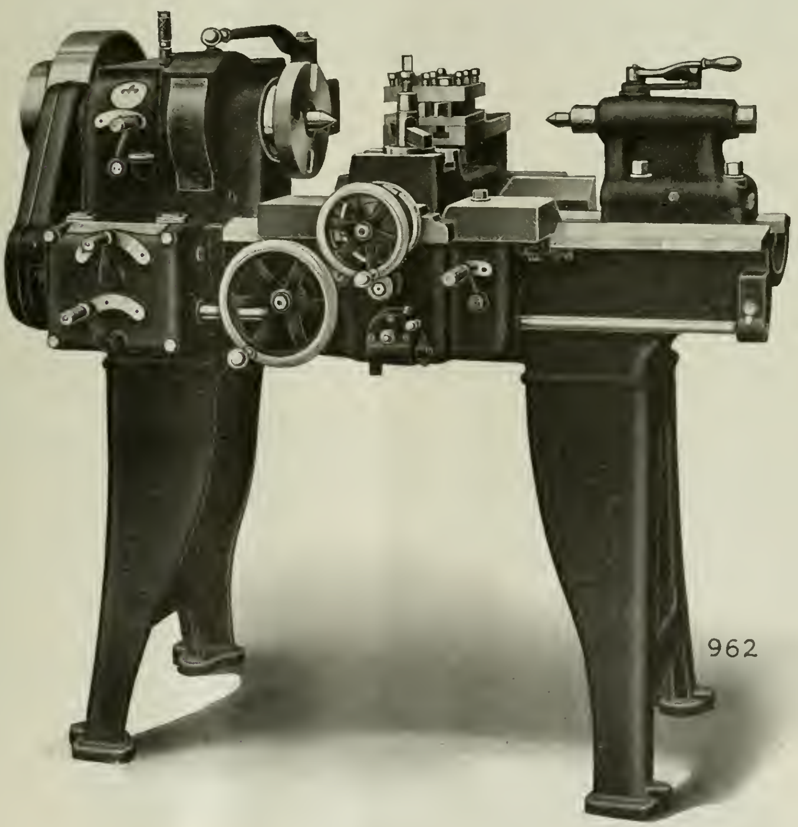
Milling Machines and Their Equipment

Detroit: David Whitney Bldg. ROCKFORD, ILL. 50 Church Street, New York

Introducing

The 11-Inch Heavy Duty Rapid Production Lathe

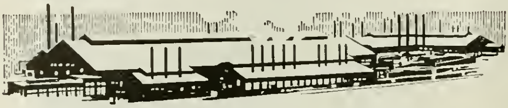
A new LeBlond Heavy Duty Lathe of small swing and high production capacity for the manufacture of small parts in quantity —retaining all regular LeBlond Heavy Duty features making for increased production per *unit of labor.* Can be supplied as a plain turning lathe or with automatic back facing attachment for combining turning and facing cuts. We will gladly submit production estimates.



The R.K. Le Blond Machine Tool Co.

Cincinnati. Ohio.

COLONIAL TOOL STEELS



The Colonial Mill at Monaca, Pa.

Jobs that are done well with *Colonial*

An interesting example:—for cutting tempered steel blades "Colonial No. 7 stands the job best."

THE BENEDICT MFG. CO.

EAST SYRACUSE, N. Y., U. S. A.

Colonial Steel Co.,
177 Hudson St.,
New York City.

Gentlemen:—

We are sending you today steel blades, and also two handles, which we are cutting up here with your Colonial No. 7 Cut Die Steel.

Mr. Peck says he has tried every kind of steel for these two jobs and finds that the Colonial No. 7 is the only Die which will stand to cut the standard hardened blade from a coil 7/8″ wide.

We cut 140 gross of blades and then grind the dies and repeat the operation. The dies are made in four separate pieces, to allow for the grooves which come on the cutting edge. These can be ground out by flexible shaft grinding, and the center recess shortened up. This makes the blades always the same length. The two outside pieces are Colonial No. 7, and the center pieces are machinery steel.

The handles are cut with the same kind of made up dies. The hot rolled scale on the handles is of course very hard on the dies.

No. 7 stands the job the best of any steel on the market anywhere near the price.

Yours very truly,

BENEDICT MFG. CO.

LIST OF TOOLS
and Grades of Colonial Steel
adapted for their use

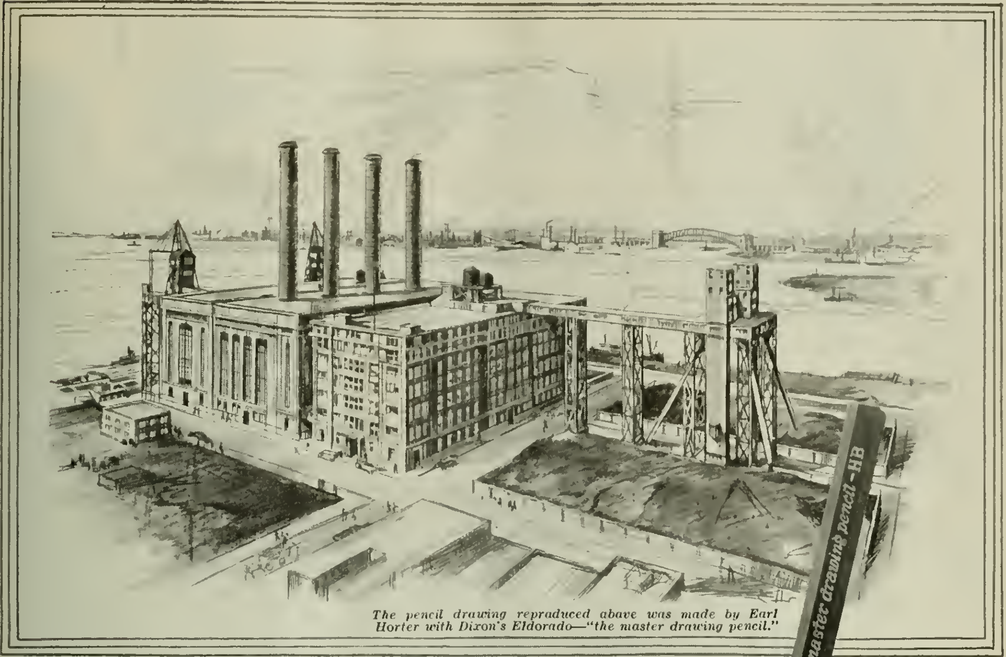
Name of Tool	Grades of Steel
Arbors	Red Star
Augers, Wood & Bits	Red Star
Axe	Red Star
Ball Bearings	Superior
Bits, Channeling Machine	Red Star
Bits, Coal Mining	Anchor
Bits, Tong	Red Star
Bits, Well Stone Drilling	Standard Well Bit
Bush Hammer, Stone Tools	Red Star Sheets
Bunter, Heading	Red Star
Broaches, Machine	No. 7, High Speed
Bushings	Red Star
Center Punches	Red Star
Center, Lathe (see L)	Red Star
Chasers, Threading	H. S., No. 7, No. 14
Chain, Pipe, Links	Vanadium, Type A
Chisels, Pneumatic	No. 7
Chisels, Hand	Red Star
Chisels, Stone Cutters	Red Star
Chisels, Wood Working	Red Star
Cupping Tools	Red Star
Caulking Tools	Red Star
Claw Bars	Red Star
Creasers, Hot	H. S., No. 7 E
Counterbores	H. S., No. 14
Counterbores, Solid, Interchangeable	H. S., No. 7, No. 14
Collets, Bit Brace	Red Star
Collets, Spring	Red Star
Cutters, Fine Finishing	No. 5
Cutter, Pipe	H. S., No. 14
Cutters, Flue	No. 7, High Speed
Cutters, Flue Hole	No. 7
Cutters, Nail	High Speed
Cutters, Corn Stalk	Alto Sheets
Cutters, File	High Speed
Cutters, Milling, Plain	High Speed
Cutters, Form	High Speed
Cutters, Inserted Blade	High Speed
Cutters, Profile	High Speed
Cutters, Metal Slitting	High Speed
Cutters, Screw Slotting	No. 5
Cutters, Wood Forming	High Speed, No. 5
Cutting off Tools	High Speed
Dies, Bolt Threading	H. S., No. 7, No. 14
Dies, Blanking	H. S., No. 7, No. 14
Dies, Forming & Bending	No. 7, No. 14
Dies, Sub-Press	No. 7, No. 14
Dies, Drawing	H. S., No. 7, No. 14
Dies, Cartridge Shell	High Speed, No. 7
Dies, Hammer Dies, Power	Red Star
Flat Jack Jewelers' Dies	High Speed No. 7
Dies, Drop Forging	Red Star, Alto
Dies, Nail	High Speed
Dies, for Paper	H. S., No. 14
Dies, Pipe Threading	H. S., No. 7, No. 14
Dies, Solid & Adjustable Threading	H. S., No. 7, No. 14
Dies, Glove	No. 7, No. 14
Dies, Rivet	No. 7, Red Star
Dies, Shoe Knife	Red Star
Dies, Spring Screw, Threading	H. S., No. 7, No. 14
Dies, Solid Bolt	No. 7, No. 14
Dies, Adjustable, Round	
Dies, Split Threading	H. S., No. 7, No. 14
Dies, Spoon, Silver	No. 14
Dies, Silversmith	No. 7
Dies, Domino Screw Cold Heading	No. 7, Red Star
Dies, Cold Heading	No. 7, Red Star
Dies, Hot Heading	H. S. or No. 35
Dies, Wire Drawing	No. 14
Dies, Plates	No. 7, No. 14
Digging Bars	Red Star
Drills for Boring	Red Star
Drills, Tool Steel	H. S., Superior
Drills for Stone	Red Star
Drills, Twist	High Speed
Drills, Flat	High Speed
Engraver Tools	No. 14
Furnace Bars	Anchor
Flatters, Blacksmiths	Red Star
Fullers, Blacksmiths	Red Star
Forming Tools for Metals	H. S., No. 5, No. 14
Flange Tire Forming Tools	High Speed
Gear Cutters	High Speed
Gauges	Oil Hardening No. 6
Grip Dies for Rivets, Hot	No. 35
Hatchets	Red Star
Hammers, Blacksmiths	Red Star
Hammers for Crushing Machines	Red Star
Hammers, Pneumatic	No. 7
Hammers, Nail Machines	No. 7
Hammers, Riveting Pneumatic	No. 7
Hobs, Gear	H. S., No. 7, No. 14
Header Dies, Cold	No. 7, Red Star
Header Dies, Hot	No. 36

Name of Tool	Grades of Steel
Jaw Chuck	Anchor
Jaw Vise	Anchor
Keys for Drop Hammers	Red Star
Knives, Pocket	Red Star Sheets
Knives, Carver	Red Star Sheets
Knives, Butcher	Red Star Sheets
Knives, Cleavers	Red Star Sheets
Knives, Back Spring	Alto Sheets
Knives, Heel Forming Shoe	No. 14
Knives, Shoe Makers	Red Star Sheets
Knives, Shoe Sole	Red Star
Knives, Surgical	No. 14
Knives, Table	Alto Sheets
Knives, Potato	Alto Sheets
Knives, Corn Knife	Alto Sheets
Knives, Drawing	No. 14, Red Star
Knives, Hog	No. 14
Knives, Machine	H. S., Red Star
Knives, Paper	H. S., or No. 14
Knives, Shear	No. 7, Red Star
Knives, Wood Working	H. S., Red Star
Knurling Tools	No. 7, No. 14
Lathe Centers, Dead	Red Star
Lathe Center, Live	Red Star
Lathe Tools for Metal Turning	High Speed
Lathe Tools for Woodworking	High Speed
Liners for Brick Dies	Imperial
Letter Stamps, Hand	No. 7, No. 14
Letter Stamps, Roll	No. 7, No. 14
Mandrels	Red Star
Mills, End	High Speed
Mills, Hollow	High Speed
Mills, Shell End	High Speed
Piercers, Hot	High Speed
Pick Steel	Alto
Pinion Bars	Red Star
Pins, Drift	Red Star
Pinch Bars	Red Star
Planer for Metal Tools	High Speed
Planer for Stone	High Speed
Planer for Wood	Red Star
Point Steel for Stone Cutters	Red Star
Punches, Cartridge Shell	No. 7
Punches, Hand—Hot or Cold Work	H. S., or No. 7
Punches, Drawing	No. 7, No. 14
Plug Gauges	No. 6, Oil Hard'ng
Pneumatic Tools	No. 7E or F
Reins, Tong	Red Star
Rods, Piston	Red Star
Reamers, Hand, Solid	H. S., or No. 5
Reamers, Shell	High Speed
Reamers, Taper	High Speed
Reamers, Rose, Chucking	High Speed
Reamers, Locomotive, Taper	No. 14, H. S.
Reamers, Bridge	High Speed
Reamers, Expansion, Hand	High Speed
Reamers, Drill & Center	No. 5
Rolls, Flue Expanding	No. 7
Ring Gauges	No. 6, Oil Hard'ng
Rivet Sets	No. 7, Red Star
Shear Blades—Hot Work	H. S., No. 7
Shear Blades—Cold Work	No. 7, Red Star
Saws, Circular Metal	H. S., Nikro
Saws, Circular Wood	Nikro
Scrapers for Scraping Machine Parts	No. 5
Scrapers, Tube	Red Star
Screw Drivers	Red Star
Set—Rivet	No. 7, Red Star
Sets—Button	No. 7, Red Star
Sets—Nail	Red Star
Spinning Tool	High Speed
Shaper Tool	High Speed
Stamping Tools	No. 7, No. 14
Sledges, Blacksmith & Stone	Red Star
Snaps, Rivet	No. 7, Red Star
Springs	Red Star
Swages, Blacksmith	Red Star
Swaging Metal	No. 7
Taps, Tapper	No. 14, Red Star
Taps, Hand	Red Star Tap, Extra No. 14
Taps, Machine	H. S., Red Star
Taps, Automatic Machine Screw	High Speed, No. 7
Taps, Staybolt	No. 14
Taps, Pipe Taps	Red Star
Taps, Pipe Tap Chasers	High Speed, No. 7
Tire Turning	High Speed
Tool Holder Bits	High Speed
Wedge, Stone	Red Star
Wedges	Red Star
Wrenches, Track	Red Star

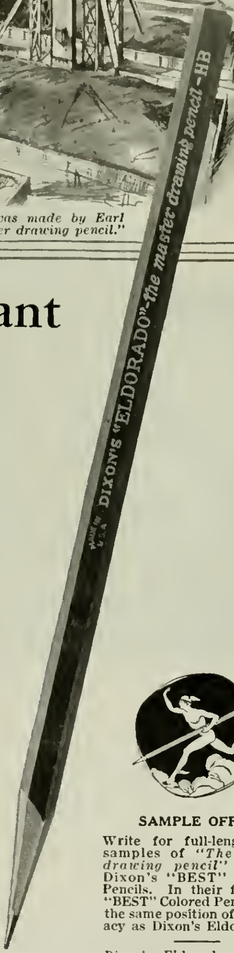
Full instructions for hardening and tempering all Colonial Tool Steels will be found in the *Colonial Heat Treating Book.*
MAILED FREE.

Colonial Steel Company

PITTSBURGH BOSTON NEW HAVEN NEW YORK CLEVELAND
DETROIT CHICAGO ST. LOUIS



The pencil drawing reproduced above was made by Earl Horter with Dixon's Eldorado—"the master drawing pencil."



The Largest Steam Power Plant in the United States

The new Hell Gate Power Station of the United Electric Light and Power Company (shown above) was designed by Thomas E. Murray, Inc., of New York City.

When completed, it will be the largest steam power plant in the United States with an ultimate capacity of 300,000 K. W.

The plans for this plant, as for so many others of conspicuous size and importance, were prepared with Eldorado pencils.

DIXON'S ELDORADO

"the master drawing pencil"

JOSEPH DIXON CRUCIBLE COMPANY
Pencil Dept. 74-J Jersey City, New Jersey
Canadian Distributors: A. R. MacDougall & Co., Ltd., Toronto

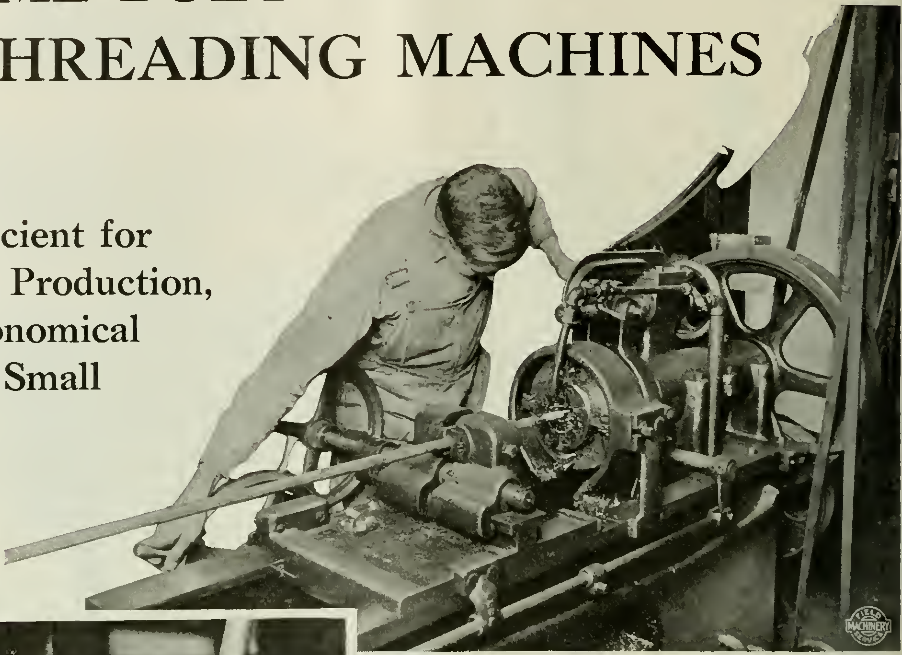
SAMPLE OFFER

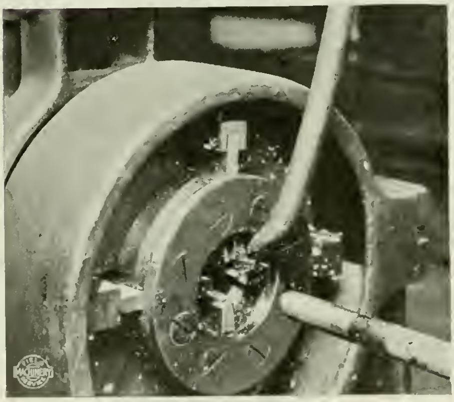
Write for full-length free samples of *"The master drawing pencil"* and of Dixon's "BEST" Colored Pencils. In their field, the "BEST" Colored Pencils hold the same position of supremacy as Dixon's Eldorado.

Dixon's Eldorado is made in 17 leads—for all pencil work.

ACME BOLT CUTTING AND THREADING MACHINES

Efficient for Big Production, Economical for Small





Photographs shown through courtesy of Herman Behr & Company, Brooklyn, N. Y. A 2″ Single Head Acme Bolt Cutter installed four years ago, cutting thread on end of a 3/4″ steel rod. By changing dies this Acme is used for bolt and pipe threading, accommodating any work up to 2″ diameter.

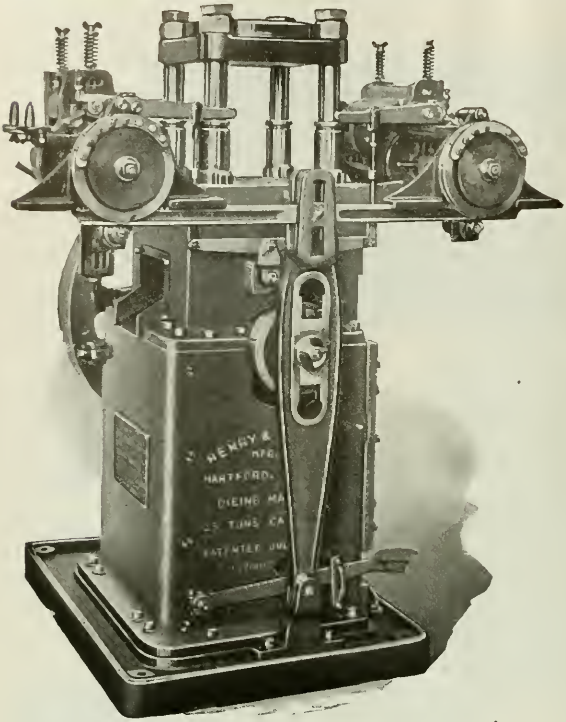
Acme Bolt Cutters and Threaders are designed for strength, durability and ease of operation. They are efficient for large production and economical for small—two characteristics which have won many orders for this equipment.

Another Acme feature is the lubricating method, insuring a generous stream of coolant to the dies at all spindle speeds. The Acme Die Head is simple, lasting and cheap to maintain. All wearing parts are of hardened tool steel ground to size.

We've printed a copy of our new catalog for you.

THE ACME MACHINERY COMPANY, Cleveland, Ohio

Foreign Agents: Burton, Griffiths & Co., Ltd., London; Glaenzer & Perreaud, Paris, France



In 25 and 50 Ton Capacities

Wright Dieing Machines

Patented July 2nd, 1918.
Other Patents Pending.

The Wright Dieing Machine has pulled punch press work out of its rut and put it on a genuine manufacturing basis. The Wright is daily slashing costs, tripling output, revolutionizing manufacturing procedure and giving an entirely new meaning to production efficiency.

Punch presses have been in common use since the time the artisan first employed sheet metal as a basis of manufacture. For the past hundred years there had been but little change in the type or construction of presses for the use of blanking, forming, drawing, embossing, etc., of sheet metal until the Wright Dieing Machine appeared. The Wright has helped every user to turn over a new leaf—to increase production from 20 to 50 per cent.

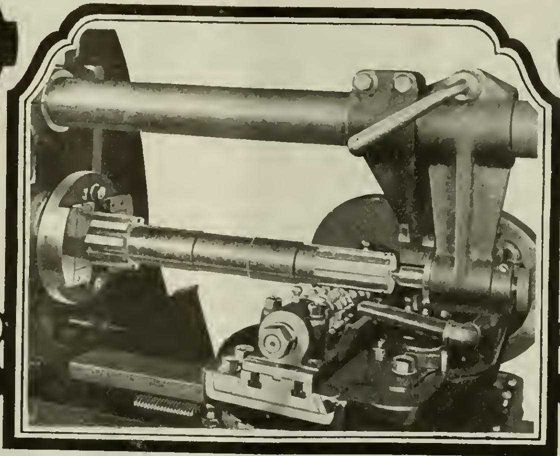
The Wright's center of gravity is low. The flywheel and crankshaft being located beneath the dies. Power is transmitted to a lower gate or crosshead, guided on long ways taking both lateral and vertical thrusts. Four bronze bushed chrome nickel steel rods connect the lower gate with the punch carrying crosshead. This precludes torsional strains on upper crosshead, assures direct vertical pull at corners and the perfect alignment of punch and die otherwise only achieved with a sub-press.

Send for Descriptive Circulars.

The Henry & Wright Manufacturing Company

Builders of Dieing and Drilling Machines

760 Windsor Street Hartford, Conn., U. S. A.



Spline Shafts

The Spline Shaft has come into general use by reason of its wide adoption in automobile construction, where it has proven its practicability.

This adoption of the Spline Shaft has received further impetus by the development of two modern processes that have made it a practical manufacturing proposition—the pull broaching process and the hobbing process.

Hobbing Spline Shafts is the same in principle as hobbing gears—the work and hob both rotating, the cutting is continuous until the cut is finished. This eliminates the possibility of inaccuracy by distortion from localized heating in cutting and insures accurately indexed keys.

It should be as evident as it is actual, that no other process can equal the Hobbing Process in producing accurate Spline Shafts.

Submit your spline shaft problems to our engineers for solution. Our experience and research are at your service.

BARBER-COLMAN SPLINE SHAFT HOB

BARBER-COLMAN NO. 12 HOBBING MACHINE

BARBER-COLMAN COMPANY

BRANCH OFFICES
BOSTON, MASS. CHICAGO, ILL.
CLEVELAND, O. DAYTON, OHIO.
DETROIT, MICH. MILWAUKEE, WIS.
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MAIN OFFICE & PLANT
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GUNTHER-PLANT CO. MINNEAPOLIS, MINN.
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EUROPEAN REPRESENTATIVES
BARBER & COLMAN, LTD.
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Uniform
Quality and
Perfect
Accuracy
Tell the Story
of the Success of
"MORSE"
Twist Drills
MORSE
Twist Drill & Mach Co.,
New Bedford Mass., U.S.A.


NICHOLSON U.S.A.
Even a few years ago the idea of measuring and weighing the planets would have caused comment. Aided by the invention of new and powerful instruments astronomers are constantly adding to our knowledge of the solar system.
THE NICHOLSON FILE CO.
is adding to the file knowledge of the world. For Nicholson files are absolutely uniform, are durable and cut sharply from the first stroke. The Nicholson trade mark goes only on the tang of a perfect file.
NICHOLSON U.S.A.
NICHOLSON FILE CO.
PROVIDENCE, R.I., U.S.A.

CAPACITY

THERE can be no doubt about the capacity of a Whitman & Barnes drill or reamer.

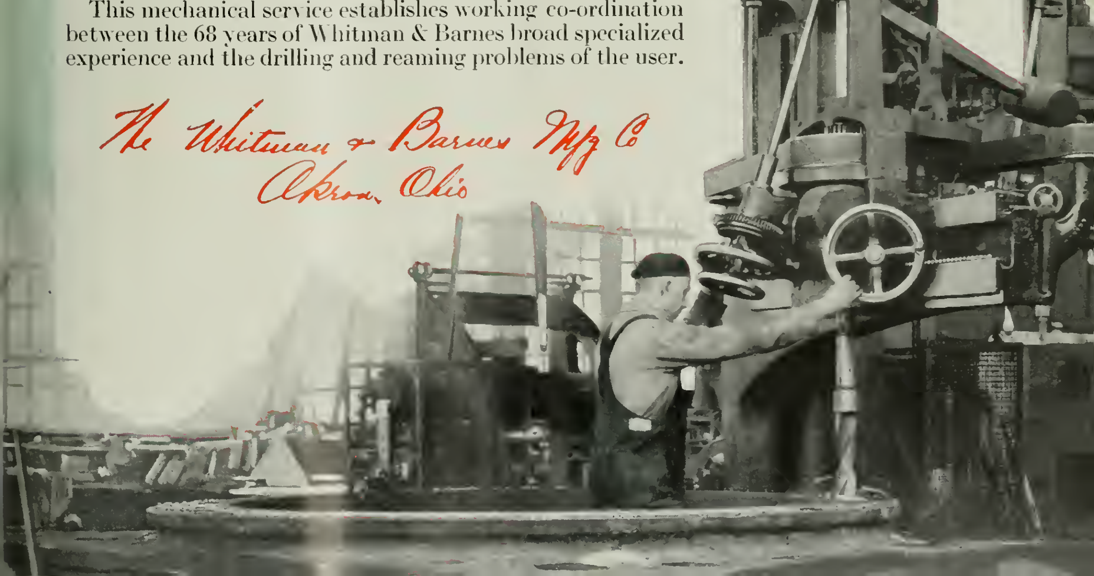
The makers of these tools know the technical history of American industry, as well as the needs and general requirements of modern manufacturing.

The inherent qualities in a "W & B" drill or reamer are so far in advance of these requirements that it is a question, largely, of selecting the proper "W & B" drill or reamer for the work to be done.

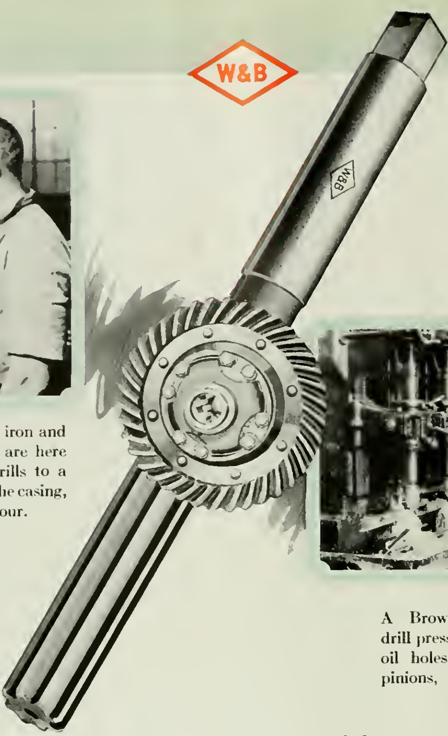
That is a partial explanation for the remarkable success of "W & B" mechanical service to the user.

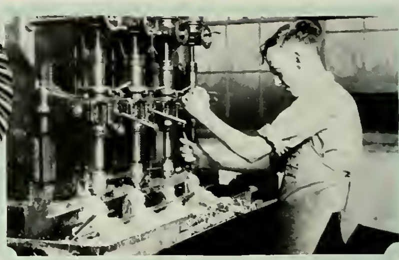
This mechanical service establishes working co-ordination between the 68 years of Whitman & Barnes broad specialized experience and the drilling and reaming problems of the user.

The Whitman & Barnes Mfg Co
Akron, Ohio

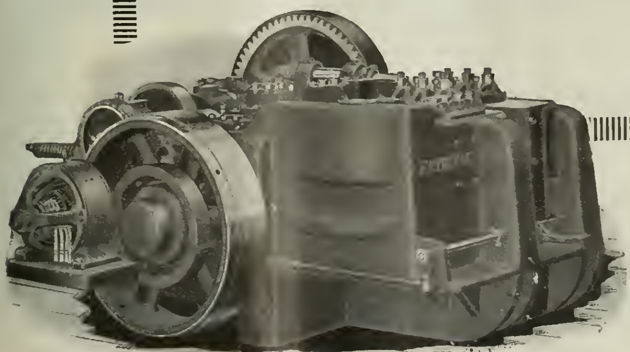


Brown-Lipe-Chapin malleable iron and steel forged differential cases are here being drilled with ¾-inch drills to a depth of ¾ inches, 4 holes to the casing, at a rate of 60 cases per hour.

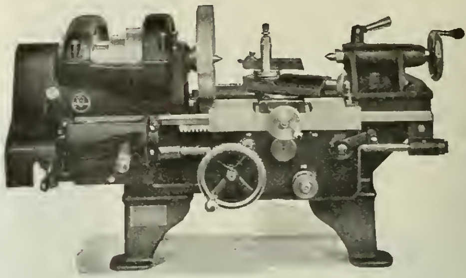




A Brown-Lipe-Chapin four spindle drill press with "W & B" drills, drilling oil holes in 3½% nickel steel side pinions, at a continuous rate of 350 pieces per hour.



Monarch Lathes Lead

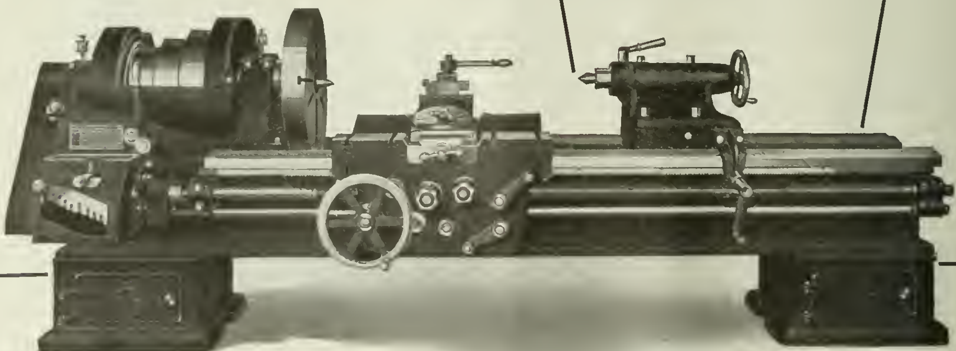


All sizes and styles. Special equipment is furnished on all Monarch Lathes from 9-inch to 30-inch swing.

They are always manufactured in such large quantities that the production cost is kept to the minimum and the buyer saves in first cost.

The first cost isn't the only saving the buyer makes. *Repeat orders* from MONARCH USERS testify to the accuracy and lasting qualities of Monarch Lathes. The MONARCH factory is busy. MONARCH Lathes are selling. Investigate Monarch before buying any lathe from 9 inches to 30 inches in size.

From the little Monarch Junior 9-inch lathe weighing 500 pounds, to the massive 30-inch Monarch weighing 8500 pounds, there will be found a lathe meeting your requirements. And at a price you will consider very reasonable.

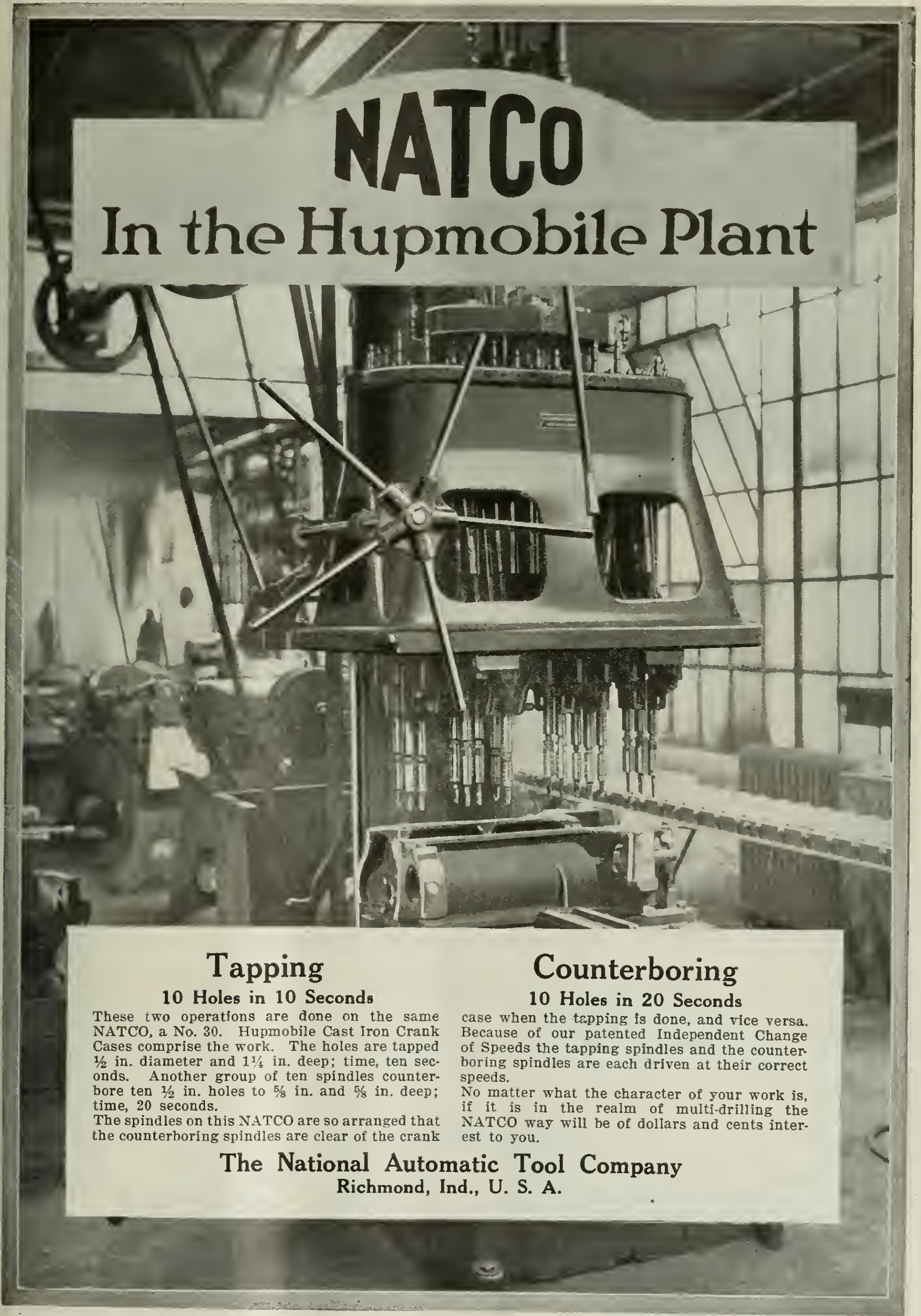


THE MONARCH MACHINE TOOL CO.

209 Oak Street, Sidney, Ohio, U. S. A.

AGENTS:

Lynd-Farquhar Co., Boston, Mass., Brownell Machinery Co., Providence, R. I., Purinton & Smith, Hartford, Conn.; Vandyck Churchill Co., New York, N. Y.; Syracuse Supply Co., Syracuse, N. Y.; Syracuse Supply Co., Buffalo, N. Y.; Syracuse Supply Co., Rochester, N. Y.; Simmons Machine Co., Albany, N. Y.; Morris Machinery Co., Newark, N. J.; Monarch Machinery Co., Philadelphia, Pa.; J. S Miller Mchy. Co., Pittsburgh, Pa.; Banks Supply Co., Huntington, W Va.; Greensboro Supply Co., Greensboro, N. C.; John P. Dale Machinery Co., Nashville, Tenn., Oliver H. Van Horn Co., Inc., New Orleans, La.; Cameron & Barkley Co., Jacksonville, Fla., and Charleston, S. C.; Walraven Co., Atlanta, Ga., Hartfelder-Garbutt Co., Savannah, Ga.; Strong, Carlisle & Hammond Co., Cleveland, O.; The National Supply Co., Toledo, O.; Hallidie Machinery Co., Seattle, Wash.; Herberts Machinery & Supply Co., Los Angeles, Calif.; Herberts Machinery & Supply Co., San Francisco, Calif.; Reed & Duecker, Memphis, Tenn.; Peden Iron & Steel Co., Houston, Texas; Osborne & Sexton Machinery Co., Columbus, Ohio; Vonnegut Machinery Co., Indianapolis, Ind.; Charles A. Strelinger Co., Detroit, Mich.; McMullen Machinery Co., Grand Rapids, Mich.; Northern Mchy. Co., Minneapolis, Minn.; Nelson Mchy. Exchange, Green Bay, Wis.; English Tool & Supply Co., Kansas City, Mo.; Sunderland Machinery & Supply Co., Omaha, Nebr.; Hendrie & Bolthoff Mfg. & Supply Co., Denver, Colo.; Salt Lake Hardware Co., Salt Lake City, Utah; General Machinery Co., Spokane, Wash.; Zimmerman-Wells-Brown Co., Portland, Ore.; Stockdell Meyers Hardware Co., Petersburg, Va.; E. L. Essley Machinery Co., Chicago, Ill.; The Murray Co., Dallas, Texas; Charles A. Strelinger Co., Windsor, Ont., Canada; Yamatake & Co., 7-C Marunouchi, Tokyo, Japan.


NATCO
In the Hupmobile Plant
Tapping
10 Holes in 10 Seconds
Counterboring
10 Holes in 20 Seconds
These two operations are done on the same NATCO, a No. 30. Hupmobile Cast Iron Crank Cases comprise the work. The holes are tapped ½ in. diameter and 1¼ in. deep; time, ten seconds. Another group of ten spindles counterbore ten ½ in. holes to ⅝ in. and ⅝ in. deep; time, 20 seconds.
The spindles on this NATCO are so arranged that the counterboring spindles are clear of the crank case when the tapping is done, and vice versa. Because of our patented Independent Change of Speeds the tapping spindles and the counterboring spindles are each driven at their correct speeds.
No matter what the character of your work is, if it is in the realm of multi-drilling the NATCO way will be of dollars and cents interest to you.
The National Automatic Tool Company
Richmond, Ind., U. S. A.

Battery Installation of New High-speed Gear Shapers. One 6-H.P. Motor furnishes Ample Power for Ten Machines.

Power Used to Overcome Friction is Wasted

It does not produce anything but heat, which in a production machine is wasted energy.

The new High-speed Gear Shaper is full ball bearing equipped, automatically lubricated, and with all reciprocating members light weight; therefore, the power consumed is unusually low.

A one H.P. motor furnishes more than ample power to operate a single machine at full capacity, whereas a six H.P. motor will easily fulfill the power requirements of ten machines.

Floor space required is one-third less than any other gear cutting machine having the same capacity.

The installation of a new High-speed Gear Shaper will undoubtedly reduce your overhead and production costs.

Give us an opportunity to prove it.

The Fellows Gear Shaper Company

SPRINGFIELD, VERMONT, U. S. A.

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry, England; Societe Anonyme Alfred Herbert, Paris, France; Societa Anonima Italiana Alfred Herbert, Milan, Italy; Alfred Herbert, Ltd., Yokohama, Japan; Societe Anonyme Belge Alfred Herbert, Brussels, Belgium; Alfred Herbert (India) Ltd., Head Office, Calcutta, India. PACIFIC COAST REPRESENTATIVES: Eccles & Smith Company, Portland, Oregon; Seattle, Washington; San Francisco and Los Angeles, Calif.

Former Price, $85.00
Now $50.00

SERVICE

ECONOMY

AIRCO-DAVIS-BOURNONVILLE CUTTING TORCH

A strong, dependable, oxyacetylene torch—the embodiment of years of experiment and test. Widely sold, and quality proved under all conditions of service. A style for every class of work.

Write for Airco booklet:
"Anything and Everything for Oxyacetylene Welding and Cutting."

AIR REDUCTION SALES COMPANY

Manufacturer of Airco Oxygen — Airco Acetylene — Airco-Davis-Bournonville Welding and Cutting Apparatus and Supplies, Acetylene Generators, and Specially Designed Machines for Automatic Welding and Cutting — Nitrogen, Argon and other Airco Atmospheric Gas Products.

Controls the manufacture and sale of National Carbide

Home Office: 342 Madison Avenue, New York, N. Y.

Airco District Offices, Plants and Distributing Stations conveniently located throughout the Country.

"Airco Oxygen and Acetylene Service is Good Service"

—ACTUAL SIZE—

"HANSON" H PROCESS

PATENTS PENDING

Standard Hand Taps of all sizes.

Finished after hardening.

ACCURATE DIAMETER

ACCURATE LEAD

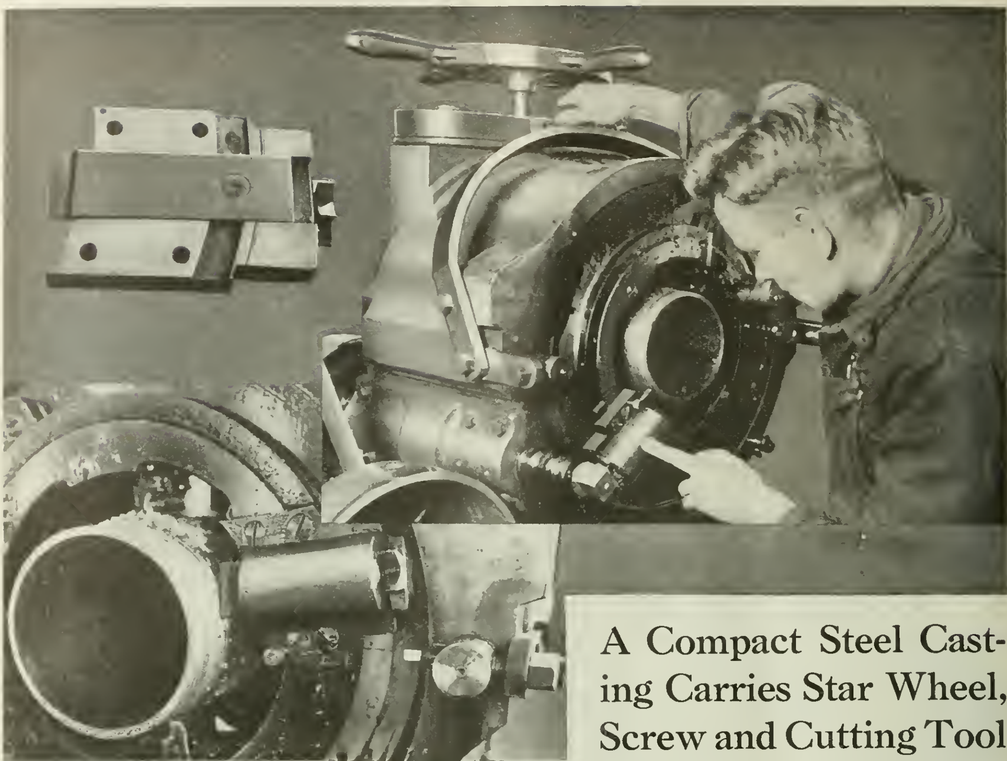
THE HARTFORD TAP & GAUGE COMPANY
HARTFORD, CONN.

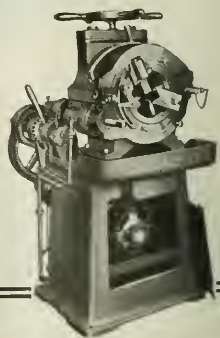
We know that you will be interested in "Facts" and "Just Facts" in this booklet.

They tell coldly the story of the Royersford Sells Commercial Roller Bearings for ***your judgment***.

ROYERS

COMMERCIAL





For Profitable Die Work

"Consider the Brass"

IN THE LABORATORY

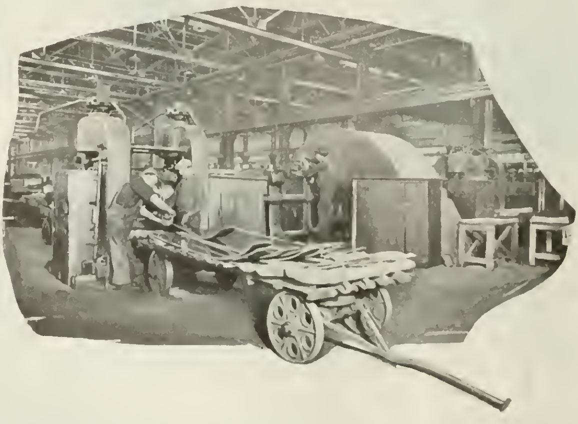
The microscopic examination of a sample of brass makes it possible to see the inner structure of the metal at any desired magnification.

Durability, elasticity and *uniformity* are the factors that insure profitable production on this work.

The big punch presses operate with clock-like precision, but if the brass is not uniform, cracks, strains and other imperfections mar the work. Experience has taught us to produce good brass—Science enables us to make it uniform. That's why we consider our laboratory as important as any other part of the work. Only by the scientifically accurate tests made by experts working with highly sensitive apparatus can we tell why the brass we specify for a particular job will give the desired results; can we guarantee that the quality of future lots for the same purpose will *not vary*—though years separate the orders.

For uniform results in the matter of production and work—in other words, uniform profits—make sure of your material. Specify Chase Brass.

CHASE METAL WORKS
Division of Chase Companies Inc
WATERBURY CONNECTICUT
PLANTS
CHASE METAL WORKS — Trade CHASE Mark — CHASE ROLLING MILLS



IN THE SHOP

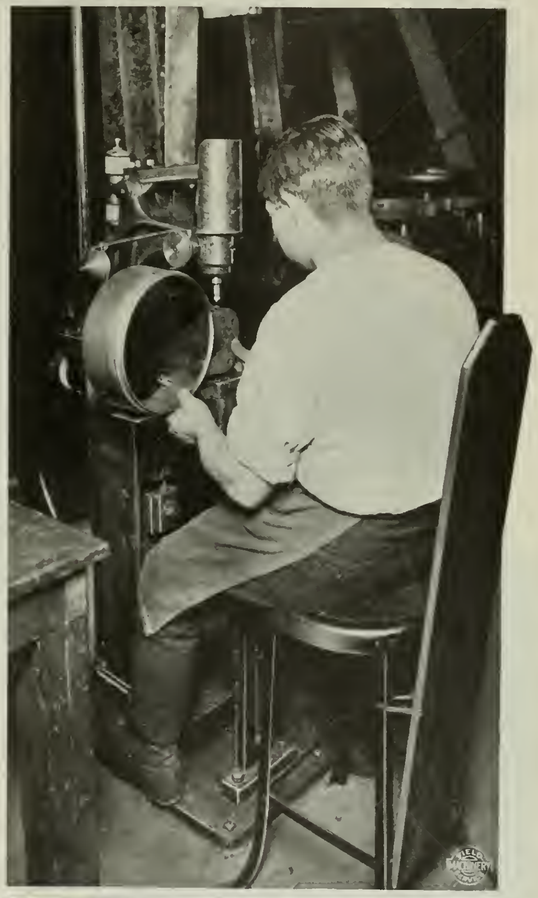
Rolling sheet metal—a job for an expert. The most efficiently designed rolling mills cannot reduce the need for **EXPERIENCE** on the part of the man who holds this job.

Trade
CHASE
Mark

HIGH SPEED HAMMERS

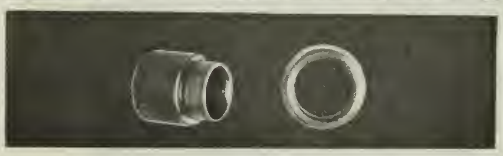
(PATENTED)

In the Famous "*Tycos*" Plant



In the world-famous "*Tycos*" factory one High Speed Riveting Hammer performs 300 riveting operations per hour. For ten years the machine in the picture has been at work in the Rochester, N. Y., plant of the Taylor Instrument Company—and it is still doing full duty.

The work shown is the case and partial assembly of a "*Tycos*" heat recording instrument familiar to all manufacturers engaged in the heat treatment of metals. The case is a brass stamping .064″ thick. In the small end of it, two brass shells with turned shoulders are inserted in holes, washers slipped over the protruding ends which are in turn riveted, fastening the tubes securely to the recorder case. Production is 150 cases per hour, which means assembling the shells and washers into position from 300 rivetings on the High Speed Hammer.



You will find it profitable to thoroughly investigate the efficient High Speed Hammer. It will serve you as well as it does "Tycos." Write us.

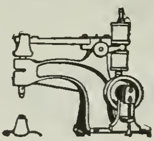
THE PRINCIPLE IS RIGHT

THE HIGH SPEED HAMMER COMPANY, Inc.

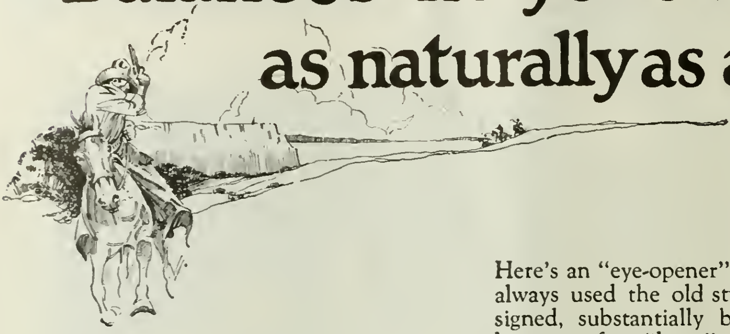
Rochester New York

CHICAGO BRANCH: C. W. Schuchardt, Mgr., 568 W. Washington Blvd. AGENCIES: F. O. Stallman Supply Co., 167-173 First St., San Francisco. Agents for Pacific Coast: Burton, Griffiths & Co., Ltd., London, E. C., for the British Isles. Aktiebolaget Rylander & Asplund, Stockholm, Sweden, for Sweden and Finland. China, Japan and South American Trading Company, Ltd., Yokohama, Kobe and Osaka, Japan, for Japan and Dependencies.

THE HAMMER WITH THE HUMAN STROKE



Balances in your hand as naturally as a Colt 45



Here's an "eye-opener" for the man who has always used the old style frame. A well designed, substantially built hack saw frame has a perfect "hang"—takes any length of blade from 8 to 12 inches and can be set to cut in four directions without removing the wing nut. A constant tension on the bolts holding the blade and a positive adjustment on the tubular back saves cuss words and much valuable time when changing blades. Hard rubber checked handle and stream line design. A Hack Saw Frame you will always swear *by*—never *at*.

Ask for *Starrett Pistol Grip Adjustable Hack Saw Frame No. 169.* You can get it at almost any hardware store.

Write for Catalog No. 22 D and the Supplement describing the new Starrett Tools.

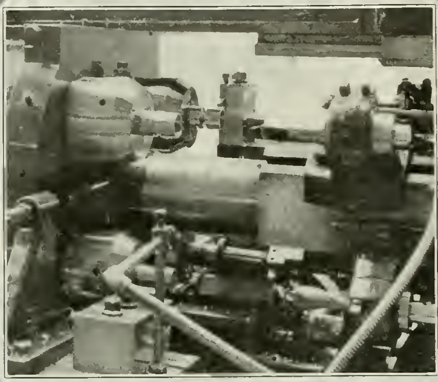
THE L. S. STARRETT CO.
The World's Greatest Toolmakers
Manufacturers of Hacksaws Unexcelled
ATHOL, MASS.

The Starrett Hack Saw Chart and "Hack Sawa and Their Use" (a standard reference book on the subject) will be sent free on request

42-391

STARRETT TOOLS
STARRETT HACK SAWS

Starrett Hack Saws



Prejudice *vs.* Profit

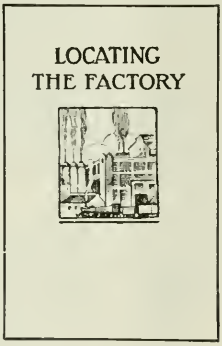
MANUFACTURING plants are very often located in the immediate vicinity of the moving spirits of the organization, without any regard to the advisability of the district being the best for obtaining raw materials, transportation, labor, power, etc., or of it being in the center of the greatest market in which the plant will distribute its product.

It is a well-known fact that large corporations thoroughly investigate every possible location before deciding where a new plant will be built. Their foresight has always resulted in a marked advantage over competitors and decided increases in *profits*.

Many organizations, believing that they have neither the time nor the money to spend on an extended investigation, fail to consider the advantages that can be secured by obtaining the data and statistics that the railroads have to offer on any section that they may be considering.

The railroads believe that their success depends upon the prosperity of the industries along their lines. They are therefore earnestly endeavoring to co-operate with the manufacturers in collecting all available data pertaining to different sites in order to assist the manufacturer in scientifically selecting the section of the country that would be *best* in which to locate any particular industry.

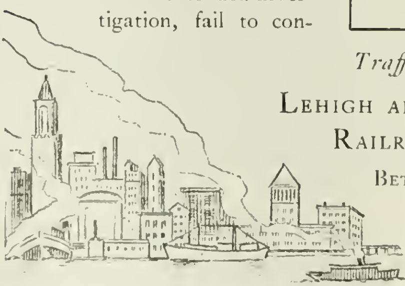
Some of the most pertinent data compiled by the Lehigh and New England Railroad Company on this subject, has been assembled in book form under the title, "Locating the Factory." A request on your business letterhead will bring you a copy without cost or obligation.

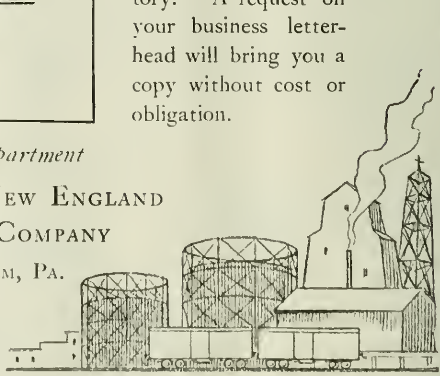


Traffic Department

LEHIGH AND NEW ENGLAND
RAILROAD COMPANY

BETHLEHEM, PA.





NEWTON

(REGISTERED TRADE MARK)

CRANK PLANING MACHINE

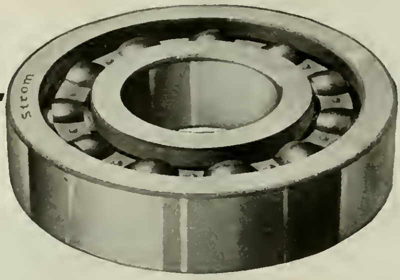
Stroke 34 in. Max.

Positive stroke, quick return, proper speeds, 10 H. P. drive makes this the best tool for production on short single piece jobs.

Slotting Machines — Milling Machines — Cold Metal Sawing Machines

NEWTON MACHINE TOOL WORKS, Inc.

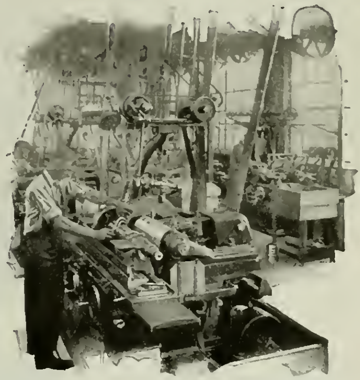
Twenty-third and Vine Streets — Philadelphia, U.S.A.



Grinding Accuracy in the Manufacture of STROM BEARINGS

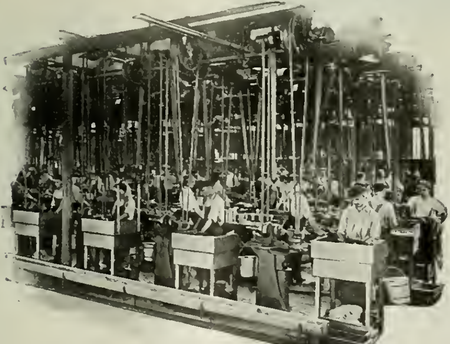
Bores, outside diameters, and widths are ground on precision grinders to limits measured within the ten thousandth of an inch, thereby insuring a uniformity of dimensions which enables the user to install Strom Bearings without further inspection or selection for his requirements.

Races are ground to true circumference and accurate contour. They have that smooth surface which is so essential to the reduction of friction.



Accurate Machine Tools and skillful workmanship are requisites in the manufacture of Strom Bearings

The Grinding Department is equipped for quantity production



These refinements are characteristics of the complete line of Strom radial, thrust and angular contact bearings.

Strom engineers are especially trained to solve bearing problems. They will be glad to work with you in determining the type and size of bearing that will give you the best results.

U. S. BALL BEARING MFG. CO., 4563 Palmer St., Chicago, Ill.

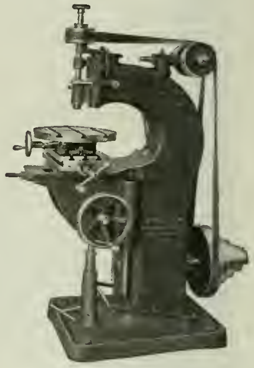
(Conrad Patent Licensee) (204)

Strom BEARINGS

Becker Vertical Milling Machines

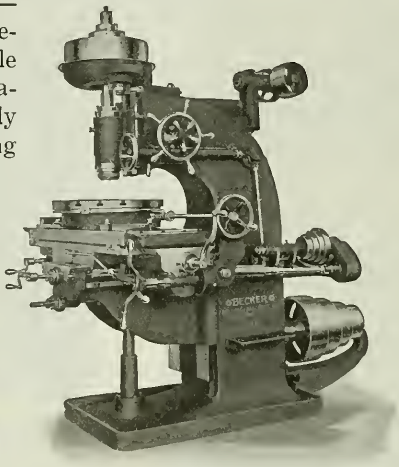
Operating Efficiency—Production Economy

Three models from our large line of standard type vertical milling machines—"The Machines That *Give the Smooth Finish.*" The Becker Standard Vertical Miller No. 2—our smallest machine—is a particular favorite with engravers and makers of small dies.

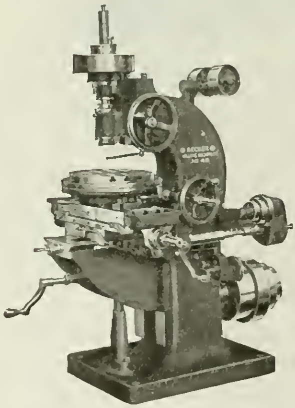


Becker Standard Vertical Milling Machine No. 2.

No. 4B has longitudinal feed of 28″, cross feed 14″ and vertical feed of knee 19″—maximum distance between spindle and table 19¼″. A wide range machine that is especially useful in manufacturing and repair shops.



Becker Improved Standard Vertical Milling Machine No. 6.



Becker Standard Vertical Milling Machine No. 4B.

The Becker Improved Standard Vertical Milling Machine is an extremely powerful machine with unusual range. Longitudinal power feed 62″, power cross feed 20″, vertical power feed to table 22″; maximum distance between spindle and table 30″. A popular machine for automobile and die work.

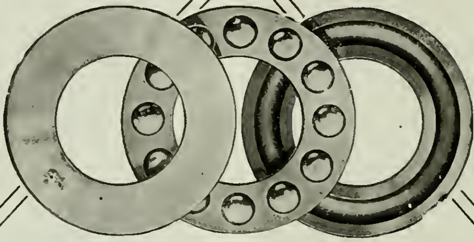
Send for the details of the entire line; efficient machines in popular sizes.

BECKER-MILLING MACHINE COMPANY | **REED-PRENTICE CO.** | **WHITCOMB-BLAISDELL MACHINE TOOL CO.**

677 CAMBRIDGE STREET, WORCESTER, MASS.

SALES OFFICES: Indianapolis, Detroit, New York

PLUG THE LEAKS!



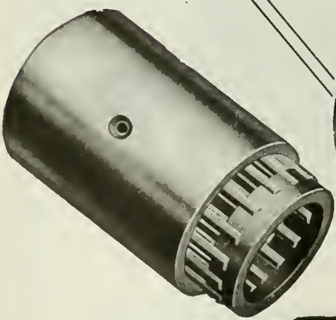
Plug that power leak, stop that profit leak, prevent future leaks. Use *Ball and Roller Bearings*—they are the efficient leak plugs. They cut power costs and stop its waste. They fight friction continuously.

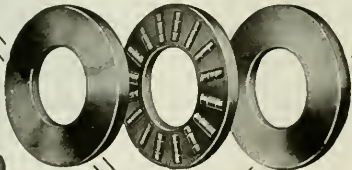
When carefully selected for the purpose, and installed properly in so far as working conditions are considered, *Ball and Roller Bearings* will meet every requirement—this we guarantee. Misjudgment of the need, the when and the where are alone responsible for insufficient service, irrespective of the make of bearing. Know the bearing and you know the service. Let us assist you with your bearing problems—we can save you money. Write us about it.

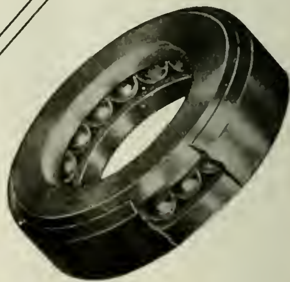
The Ball and Roller Bearing Company

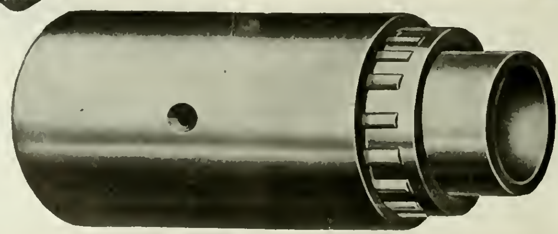
Danbury, Conn., U. S. A.

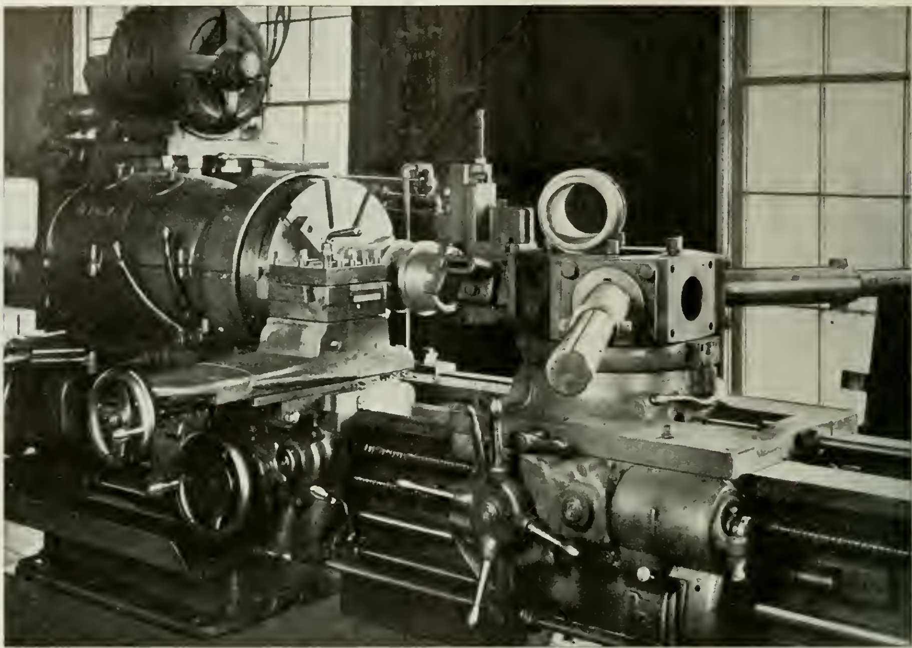
Makers of Radial Roller Bearings, Journal Roller Bearings, Roller Thrust Bearings and Ball End Thrust Bearings (in bath inch and millimeter sizes). Unusual Facilities for making Cylindrical Rollers.

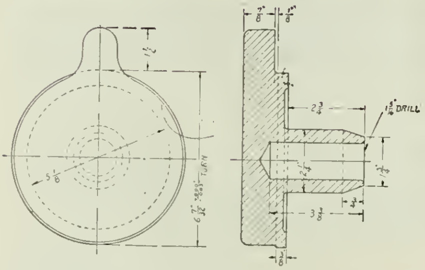












WATER BOX VALVE CAP

LIBBY LATHES

Saving Over $13.00 Per Hour

Here are facts and figures to show how this Libby Lathe saved $121.80 per day —more than $13.00 an hour for 9 hours. Look at the accompanying sketch. On each water box valve cap the Lucey Manufacturing Corporation, Houston, Texas, saved through this Libby installation 17½c. on labor. In labor plus overhead it saved 43½c. Production is 280 valve caps per day which puts the total saving per lathe at $121.80 or better than $13.00 an hour.

Suppose you could save this sum on your work! Do you know what you do save? Do you save *anything?* Tell us what you make; send blueprints; then, we'll write you. Libby Lathes are built for production and profit—your profit. Write us today.

Leave it to Libby.

INTERNATIONAL MACHINE TOOL CO.

Indianapolis **Indiana, U. S. A.**

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No. 4 taper hole in spindle
Weight 3,300 lbs.
Table 24" x 65"

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Dimensions No. 3 Horizontal Drill:

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Center of bearing to maximum height of spindle, 38¼ inches.

Bearing, 9 by 12 inches long.

Spindle arm moves through circle of 180 degrees.

Face of arm, 8 x 9 inches.

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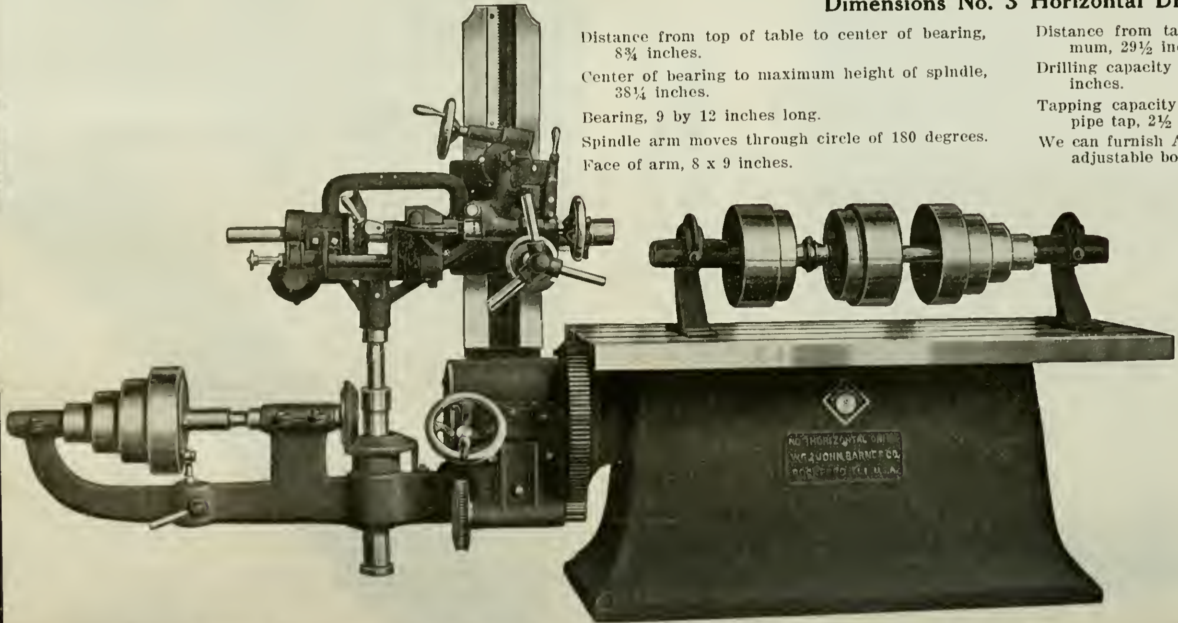

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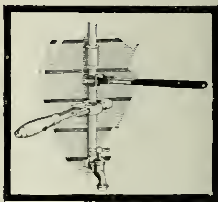

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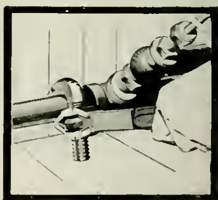

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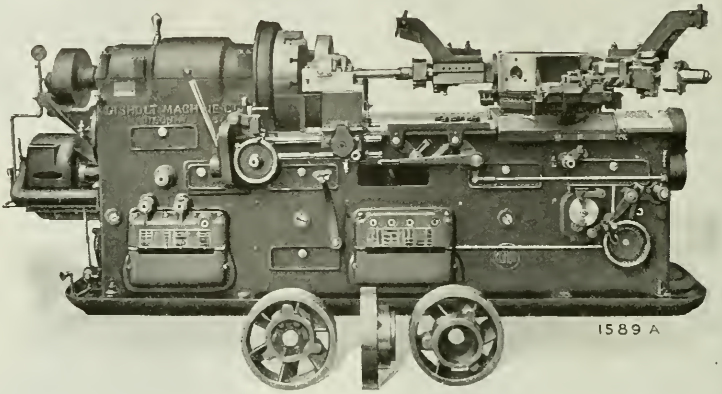

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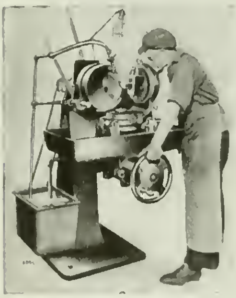

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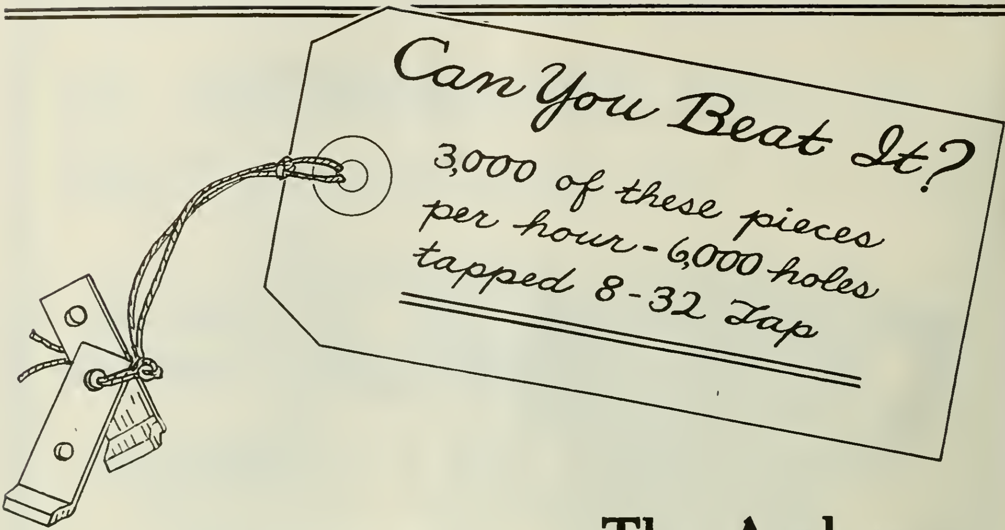

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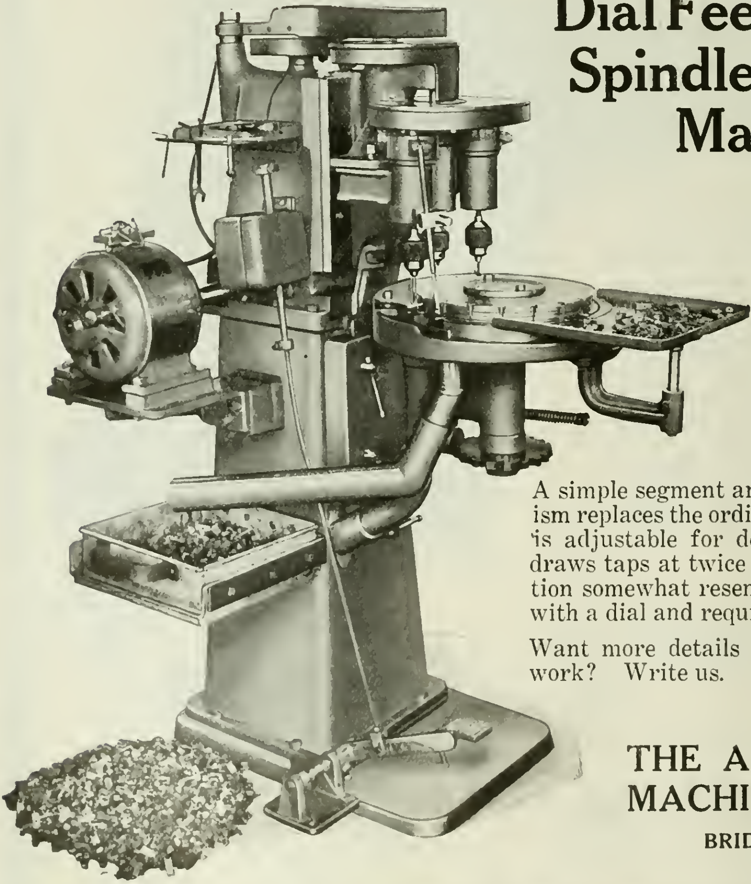

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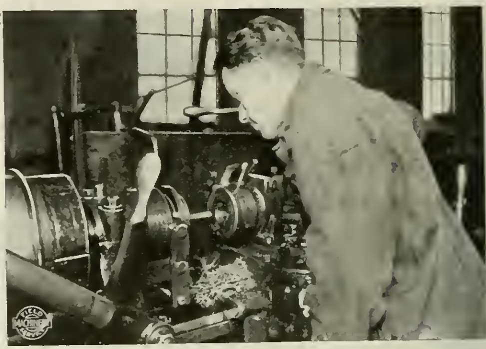


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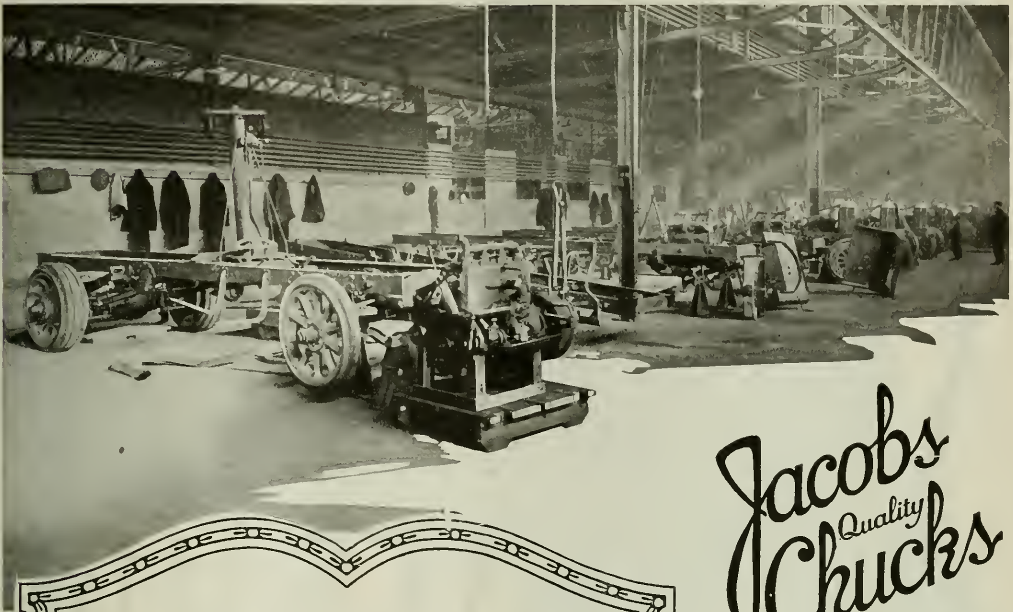

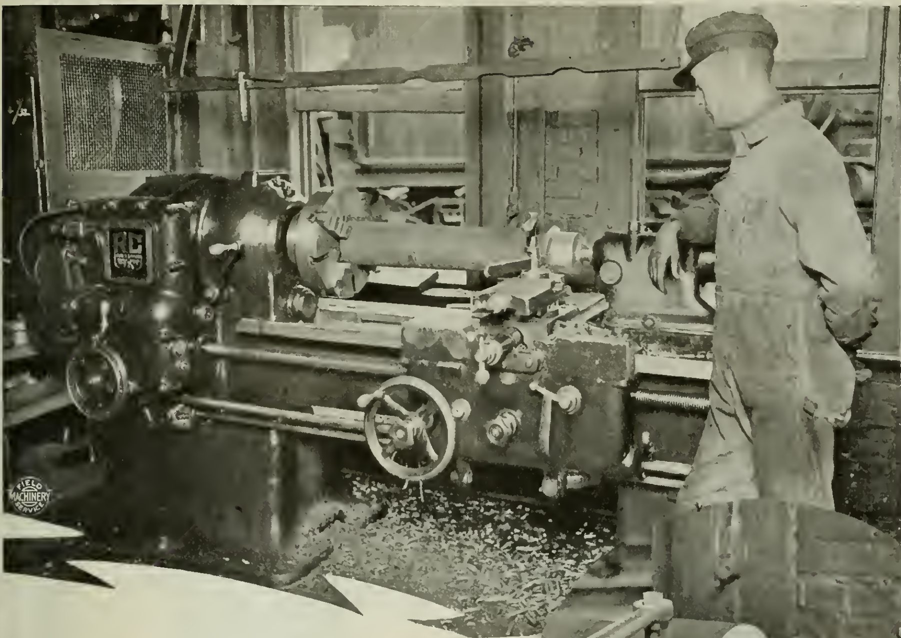

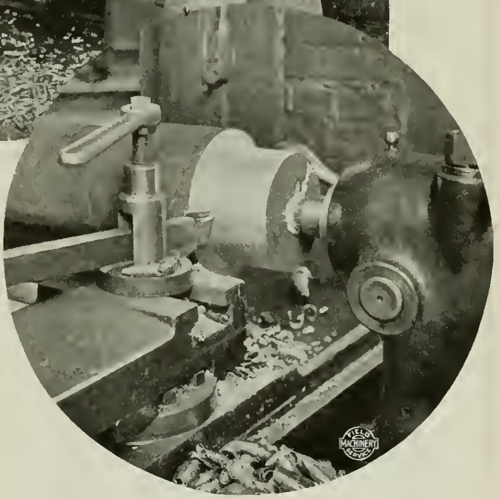

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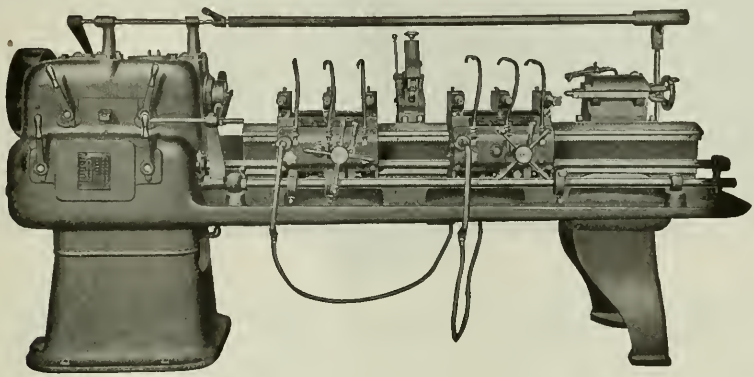
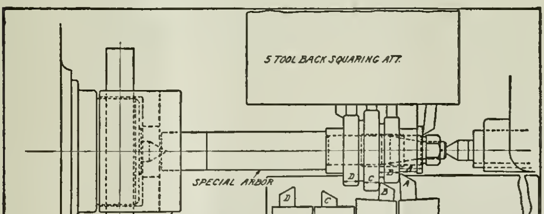


This is the 4″ Lo-swing Lathe. The drawing shows how one machinery manufacturer profitably uses its production possibilities in the manufacture of cluster gears. They are finished from the rough stock in one setting by tools working simultaneously from the back and front of the machine.



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Wire Forming

Section of a Wire-forming Shop

First of Two Articles Describing the Methods Used in the Manufacture of Wire Goods and the General Principles Applied in the Design of Typical Wire-forming Machines

WIRE can be bent, twisted, curled, upset, or otherwise formed into innumerable shapes. Greater liberties may be taken in the manufacture of wire goods than in making articles from metal in any other form. The possibilities are not limited by any special sectional shape of wire, by any particular material, or by any physical condition of the wire except extreme hardness. Iron and steel wire of various degrees of hardness are commonly used, as well as copper, brass, bronze, and precious metals.

The mechanical means for forming the wire are essentially the same for all materials, but the peculiarities of shape make it necessary to employ some interesting methods in performing the work, and some extremely ingenious tooling for the machines is used. Nearly every conceivable shape can be produced in wire by the use of the familiar type of wire-forming machine, supplemented in some instances, particularly where ribbon stock is to be formed, by the power press.

The various machines in common use are designed to operate substantially in the same manner. They consist fundamentally of four cam-operated slides arranged 90 degrees apart; these advance to a common center at which point a vertical member, called the "king-post," is located. The king-post is the member around which the wire is shaped by the dies or forming members that are carried in the slides. Obviously, the range of service of the machine depends upon the ingenuity employed in laying out suitable cams and in setting up the job. Considerable variation from the four-slide arrangement is practicable, because it is possible to mount auxiliary cams on each camshaft for operating levers and additional slides, so that pieces requiring more than four bending operations can be produced by thus increasing the scope of the machine.

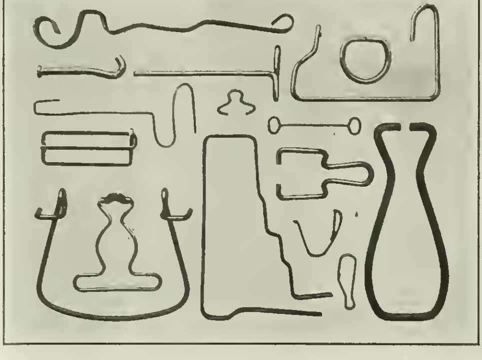


Fig. 1. Wire-formed Parts, showing Variety of Work

The forming dies themselves are simple in construction, and consist of finger members attached to the slides, usually provided with a groove at the end to receive and guide the wire as it is bent. Auxiliary levers are frequently interposed between the slides when extra bending members are required, and these are essentially of the same design as the dies except that they usually move independently of the slides. The grooves in the bending members are sometimes machined with wide mouths, so that the sagging wire may be brought against the angular surface and raised to the proper level, or the end of the wire may be brought to any desired plane to prevent interference with other parts of the wire, preparatory to the next operation.

The Eastern Tool & Mfg. Co., Bloomfield, N. J., whose practice is described in this article, has found it necessary to carry a great many different kinds of die steel on hand, in order to meet the requirements for manufacturing wire goods of varying material and design. Experience has shown that the design, as well as the kind of wire, affects the suitability of a steel for any particular die service. For a piece of work made from soft steel wire, having an average number of not too complicated bends, it is the usual practice to use 0.90 per cent carbon steel. Other steels commonly used for small spring wire work, which is particularly severe on the dies, and for forming hard wire and certain more difficult shapes, are chrome-vanadium and chrome-nickel steels. Widely varying compositions of each of these steels are regularly used, and they are, of course, carefully hardened and tempered, according to the specifications of the steel manufacturer.

The movements necessary to form a piece of wire into a more or less complicated shape may be varied in their sequence. The first consideration when a part is to be manufactured is the proper starting place in relation to subsequent operations. It has been found, even after large quantities of pieces have been manufactured commercially by one method, that greater production can be obtained by making certain simple changes which affect the entire cycle of the movements and completely revise the manufacturing procedure.

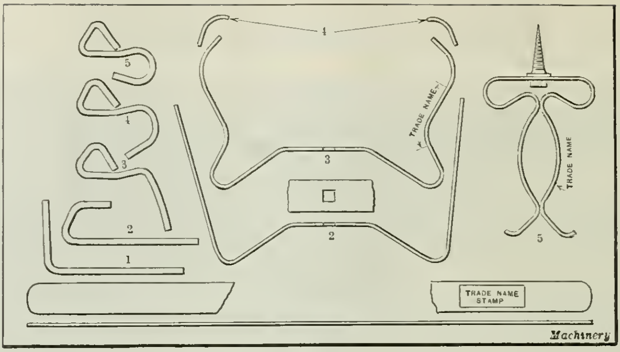


Fig. 2. Successive Shapes in the Manufacture of an S-hook and of a Holder made from Ribbon Stock

Order of Operations and Design of Tools

After the design of the piece has been studied and the number of operations required to produce it has been determined, it is necessary to arrange the order of operations and design the tools for each. If a complicated piece is to be made the use of auxiliary tools actuated by one of the regular slide movements should be considered. For example, it is common practice to use bellcrank levers as auxiliary forming members, and it should be the aim to operate these in the simplest manner possible. Although this may be done by the use of an extra cam, it can often be more simply accomplished by designing one end of the lever with a cam surface and the adjacent die with a suitable cam rise.

Again, if a curling or heading operation is to be performed, care should be taken to provide a temporary support for the comparatively slender wire. This may be advantageously accomplished by designing the cams so that the side tools will advance against the wire and remain there while the curling or upsetting die is in operation, thus holding the wire rigidly and preventing it from buckling under the end thrust. This is one method that has been successfully used, but the most available facility should, of course, always be utilized. It might even be desirable to design the curling or upsetting die with an extending member that will bear against the side of the wire and in this way steady the stock, but such a practice depends on the space available for auxiliary members.

The slides are regularly referred to as front and back slides and side slides. Most wire articles would naturally be produced by first operating the front die, although the peculiarities of design may be such as to make it advantageous to reverse the order and actuate the front die last, as is sometimes necessary in the manufacture of links and specially shaped hooks. In making wire goods from certain kinds of wire, such as spring wire, for example, allowances must be made for an over-travel of the stroke of the slide, which will take care of the natural spring in the wire, so that when it becomes set it will have the proper shape. The design of the work will suggest methods of forming it, and it will not be found difficult to arrange the tools so that they can work in different planes, if necessary.

Production may be facilitated by the ingenious design of the king-post. If a piece like a clasp is to be made, it is frequently possible to produce tension where the ends meet, by designing the king-post so as to make a bulge in the work, which may afterward be automatically straightened as the work is stripped from the king-post, and thus bring the two ends together in tension. Extensive application is made in wire bending of this principle of obtaining spring tension. In designing the king-post, it is well to consider what surfaces may be subjected to excessive wear, and to construct the king-post in sections that may be replaced.

Provision for Elevating the King-post

The king-post is usually assembled rigidly in the machine, but certain designs of wire goods make it desirable to provide for raising the king-post, as the final operations cannot be performed if the king-post remains within the formed work. A case of this kind is where flat stock is to be folded into a T-shaped paper fastener and it is necessary to elevate the king-post in order to permit closing the stock.

The grooves in the ends of the dies may be staggered or offset; by arranging these grooves properly in the various dies of a job, slight bends may be made, without regard to the direction of the sharper bends formed as a result of the slide movements. In forming an article that lies in one plane, it will commonly be found that the opposite ends of the wire will interfere, and some method must be used to displace one end temporarily while the other end is being bent over or under, as the case may be. This is sometimes done by attaching to the side of a die a separate piece which has an angular end so that the wire may ride up its inclined surface;

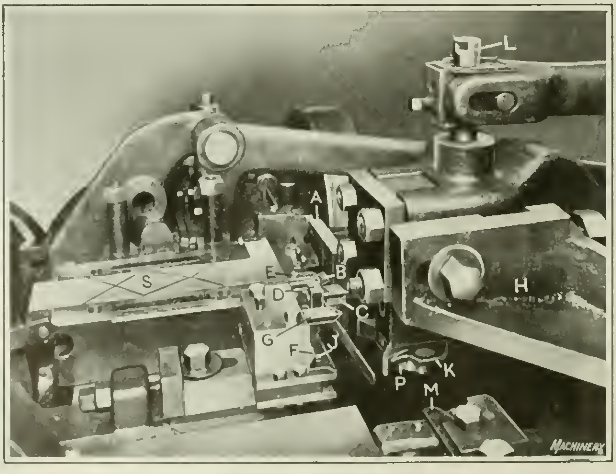


Fig. 3. Right-hand Side of a Wire-forming Machine equipped with a Punch Press Attachment and Dies for forming Ribbon Stock

or the interference may be avoided by using a sliding member to operate in the stationary king-post and bear downward against the wire.

It is often advisable to utilize the cut-off for a double purpose. The cut-off tool can be designed so that with one movement of the cut-off mechanism the stock will be severed and the end bent at the extreme downward travel of the tool. Sometimes this bend can be taken care of by attaching a separate piece to the side of the cut-off, especially if the bend to be produced is a considerable distance from the severed end of the stock.

It will be seen from the few phases of wire forming mentioned that the possibilities of varying the tooling arrangement to meet special conditions are numerous—so numerous, in fact, that it is impracticable to attempt to include all operating conditions here. Some of the points mentioned will now be brought out in describing the manufacture of a few articles of familiar design. The methods described have been selected with a view to presenting a rather diversified line of wire goods manufacture.

Forming an S-Hook

The S-hook shown in the upper left-hand corner of Fig. 2 is a simple example of wire forming without the use of auxiliary slides or special mechanical movements. As will be seen by the numerals, this hook is completed in five bending operations. The hook is made from No. 14 W & M gage (0.080 inch diameter) soft steel wire, tinned. The work is performed in a Nilson No. 0 four-slide wire-forming machine, in which it is first cut off and bent as shown, by a cut-off tool made in two parts; one part severs the stock and the other forms the right-angle bend. This is a case where the front die does not come into action first, and the reason for this will be readily understood by an inspection of the shape of the work and by following the description of the operations required to complete it.

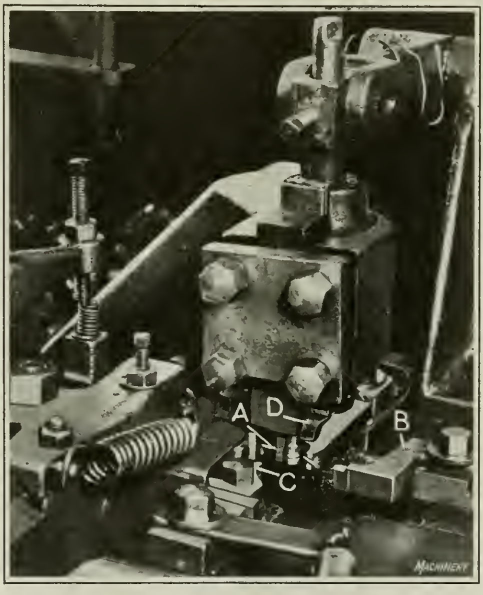


Fig. 4. Top of Wire-forming Machine showing Arrangement of Die-slides for making a Hook

The king-post has two separate members at its lower end, shaped to correspond to the loops in the hook, and the wire passes between these two members. The die on the left side of the machine then advances, bends the left end in the second operation, as shown, and recedes. The back die closes the triangular loop, and at the same time starts the bend for the hook end, but it cannot bend the hook end further than shown, on account of its position relative to the king-post. The right-hand die is next operated to produce the fourth shape shown in the diagram. This is the operation illustrated in Fig. 4. Here the position of the wire as it passes between the two members of the king-post may be seen at *A*, as well as the goose-neck shape of the side die *B* used to make the bend in the hook, which is offset relative to the loop in the opposite end.

Finally, the front die *C* advances and closes the hook end around the post, which completes the forming of the S-hook. The downward stroke of stripper *D*, which surrounds the king-post, then removes the work. Special designs of strippers may be employed to aid in forming the wire, as well as in removing it from the king-post, which will be referred to later. These S-hooks are produced at the rate of 7500 per hour, which is considered a very satisfactory production.

Flat Wire Forming

The manufacture of wire goods from ribbon stock may be properly classified as wire forming, but this work must often be supplemented by the use of a power press. Ribbon stock is handled in cam-operated slide machines of the same general type as those used for wire of other sectional shapes, and the tooling is not very different except where affected by the special design of the work. It is quite common, when ribbon stock is being worked, to employ a punch press attachment on the wire-forming machine, besides the regular slides. This makes it possible to perform many operations that would otherwise require a separate machine.

The piece shown at the right, Fig. 2, is a "three in one" holder suitable for suspending mop sticks and similar household articles. It is made from ½- by 0.041-inch extra-hard cold-rolled ribbon stock, and is stamped with the trademark, punched with a square hole and formed into the fourth shape shown in a Nilson No. 4 wire-forming machine equipped with a punch press attachment. This machine and set-up used for this operation are illustrated in Fig. 3. The slide *S* of the attachment (which has been exposed to view by the removal of the cover) is essentially the same in design as the slide of a power press. It is operated by a cam on the camshaft at the front of the machine.

The stock is fed in to a stop, and held in the correct relation to the dies by guides on the back-plate *A*. The back-plate corresponds to the bolster-plate on a power press. At one stroke of the punch-press slide the stock is cut off with rounded ends and stamped. The stamping die *B* and the cut-off punch *C* are located on the back-plate and are stationary. The cut-off die *D*, which produces the rounded ends on the stock, is attached to the slide member, and a piece of flat stock *E* is fastened directly above the die, extending forward and hooking down over it so that when the slide is advanced sufficiently the stock will pass between this piece and the face of the die. The purpose of this is to carry the end of the incoming stock backward after the blank has been cut off, and prevent its rounded end from catching in the curved surface of the punch.

The front bending die *F*, which is located in a slide at the right of the punch press attachment, then immediately comes into operation, bending the work against the plate *P* at the lower end of the king-post, to produce the second shape shown in Fig. 2, and at the same time punching the square hole. This hole must be located centrally in the stock. As wear is bound to occur in the slide, in order to locate the work accurately relative to the punch an auxiliary guide is employed in the form of a locating post *G*, shaped similar to a lathe center, which enters a bushed hole in the king-post. Wherever a king-post is used as a die-holder, as it is in this case, it is advisable to provide an additional bracket on the machine to support the king-post under the thrust of the punching operation. Such a bracket is shown at *H*. The end of the punch can just be seen at *J*. The die for this punch is a separate steel block having a suitable bushing carried in the king-post.

The steel plate *P* is designed on the sides as required to produce the third shape, and the two side dies (one of which is shown at *M*) advance together to form the wire to this shape. It will be noticed, from Fig. 2, that a separate operation is required to turn in the ends of the stock. This is necessary because, in order to produce a permanent set in these ends, the bending pressure must be applied at right angles to the direction of movement of the side slides. The back die which is used for this operation is a plain rectangular-shaped member which contacts only at the ends of the stock. The formed wire is then removed from the forming plate by a stripper *K* of special shape, which, like most of the stripping mechanisms used on this kind of machines, is actuated by a cam that moves the post *L* by a cam-lever.

Power Press Bending Fixture for Ribbon Stock

As has previously been mentioned, the forming of flat stock often requires the supplementary use of a power press. Although the punch-press attachment for a wire bending machine can be made to perform all ordinary punch press operations, where a bend is to be made in comparatively long pieces of formed stock requiring considerable space for the sweeping ends it is usually advantageous to perform the work on a separate press.

A case in point is the final bending of these holders, and the equipment used on the power press for this operation is illustrated in Fig. 5. Here it will be seen that the ram of the Sidney press used carries two vertical posts in which rack teeth are cut to revolve two pinions in the base of the fixture and turn the bending cams *A* which are attached to the same shafts that carry the pinions. These cams are in the form of collars with projecting lugs *B* which bear against the work at the beginning of the operation in the manner indicated in the illustration. Previous to this final bending a square-shank wood-screw is assembled into the square hole punched in the work and headed over; use is made of this screw to locate the work symmetrically when bending. The screw is straddled by a slotted post *C* in the fixture, and two pins *D* extends from the base so that, when properly located, enough tension will be produced in the work to hold it rather tightly.

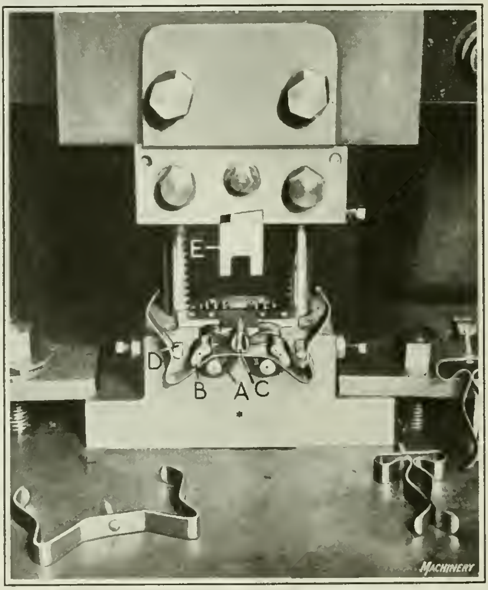


Fig. 5. Bending Fixture used on a Power Press

The bending operation itself is simple, and is of interest only in showing the transformation in shape which it is possible to realize by ingenious designs of bending fixtures. The downward stroke of the press ram results in lugs *B* bending the stock downward around the center posts, and sweeping the ends of the work around until the final shape is obtained. At this point the lugs, of course, are close together and shape the stock so that it touches directly below the head of the wood-screw. There is a tendency for the upper straight part of the stock to bulge outward due to this bending movement, so that an auxiliary die member *E* comes in contact with this part of the stock at the completion of the bend, and removes any bulge that may have been formed. An hourly output of 700 holders is attainable with this fixture.

The application of other principles of wire forming will be described in the second installment of this article, which will be published in September MACHINERY. Work of a more complicated nature will be described and illustrated, and views of the machines used and tooling lay-outs will be shown.

* * *

ACCURATE DESCRIPTIONS OF EXPORT SHIPMENTS

The Bureau of Foreign and Domestic Commerce of the Department of Commerce states that many glaring errors have been discovered in the statistics of exports for the first months of 1922, compiled under the new export classification which shows quantities in addition to values for every class. The records for previous years probably contained similar errors covered up in classes showing values only; for example, one lathe chuck at $3800 is mentioned; grinding and sharpening machines at $5 each, etc.

Investigation of the errors has disclosed that the majority are due to inaccurate description in the export declarations presented by the shipper or his agent at the custom house for clearance. Frequently inquiries have to be made at a great loss of time through collectors at distant ports in order to reach the original shipper and obtain accurate information for correction of the original reports.

One cause of inaccuracies is the practice of exporters to leave the preparation of the export declaration to forwarders or brokers at the port of exportation. The declaration should be prepared at the original point of shipment by a person having personal knowledge of the shipment. Preparation of export declarations should not be left to inexperienced clerks, who may not have a proper conception of its importance and regard it as a mere formality necessary to obtain customs clearance.

Exporters are urged to insert in the column headed "Class No. of Schedule B" on the declaration the number of the "Statistical Export Classification of 1922" under which they think the goods should be classified. This classification may be obtained upon application to the Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C. Treasury Decision 38410, containing regulations regarding filing of export declarations will also be furnished upon request. Compliance with these suggestions will eliminate the principal source of errors, facilitate compiling, and increase the value of the statistics to exporters.

* * *

The American Engineering Standards Committee has decided to undertake the development of a safety code for conveyors and conveying machinery. The National Bureau of Casualty and Surety Underwriters and the American Society of Mechanical Engineers have been appointed joint sponsors for this code.

CAVITY DRILLING TOOL FOR ENGINE CYLINDERS

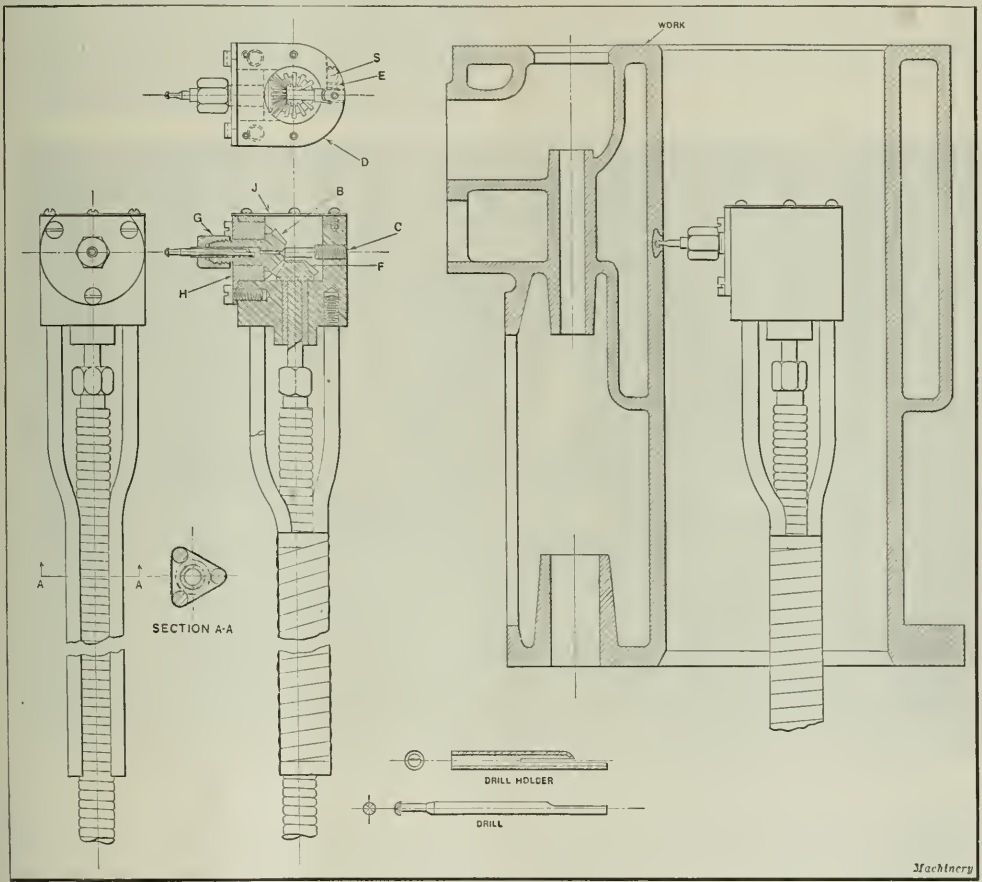
By CLARENCE M. SCHLEH

In the production of automobile engine cylinders it is customary to perform some of the machining operations before the final boring or grinding of the cylinder bore takes place. After the bore has been finished, the inspection department often finds little sand-holes or defects in the walls of the cylinder which could not be detected in the rough casting. In such cases the time spent on the former operations is entirely lost if no effective means of overcoming the defects are employed. Cylinders with defects of this kind, however, can be saved with little expenditure by cleaning out the cavities and then filling and closing them in by welding. The special drilling tool here illustrated has proved to be satisfactory for cleaning or drilling out the cavities preparatory to closing them in by welding. The cavity drilling machine is simple in construction and arrangement. It is equipped with miter gears which drive the drill, the gears, in turn, being driven by attaching the stem of one gear to the flexible shaft of a portable electric drill.

The drill itself is of a special design, of the type employed by dentists, as is shown in the small detailed view at the bottom of the illustration. This drill is slipped into the drill-holder, which is merely a small steel tube, the inside diameter of which fits the drill body. The holder is slotted at the rear end, and the upper portion is bent over and acts as a driver on the flattened end of the drill shank. The slot in the drill-holder gives it the spring tension required to hold the drill in place. A small chuck for holding the drill is provided by cutting a thread and turning a taper on the small end of gear *B*. Three slots spaced 120 degrees apart are cut in the end of the shank of gear *B*. When the hexagon nut *G* is drawn up tight, the tapered seat at the end of the threaded portion causes the slotted end of gear *B* to grip the drill-holder. Gear *B* has a flanged bronze bearing *H* which is held in place by three fillister-head screws.

At the large end of this gear is a center hole which fits the tapered end of the thrust screw *C*. This screw is inserted in a threaded hole in the gear-box *D*, being located directly opposite, and in line with, the gear center. The thrust screw is screwed in until the proper adjustment is obtained. It is then locked in place by the brass plug *E* which is pressed against it by tightening the headless setscrew *S* placed at right angles to the thrust screw. The driving gear *F* has a long shank, the diameter of which is turned to fit the chuck on the end of the flexible shaft of a portable electric drill. This gear is also provided with a brass bushing which is pressed in to the bottom of gear-box *D*.

The gear-box is made of a piece of cold-rolled steel stock, and is counterbored at the top to receive the driving gear *F*. A hole is also bored at right angles to that provided for the driving gear to receive the driven gear bushing *H*. The back of the gear-box is rounded, as shown in the plan view, to



Tool for drilling out Sand-holes or Other Cavities in Automobile Engine Cylinders permit a greater working space. The size of the gear-box is limited by the diameter of the cylinder, and must be made small enough to permit proper manipulation of the tool. An oil-tight gasket is placed under the flange of bushing *H*. After the gears are put in place and screw *C* properly adjusted, the gear-box is packed with grease. The cover *J*, is then screwed down on an oil-tight gasket.

Three threaded cold-rolled steel rods are screwed into tapped holes in the bottom of the gear-box. These rods are made so they will extend beyond the casting far enough to form a handle. These rods are bent inward and placed against the outside covering of the flexible shaft of the electrical drill. The three rods and the flexible shaft covering are wrapped together with tape as shown at *A–A*. It is necessary to make the handle longer when the tool is to be used for cylinders not of the detachable-head type, as the drilling tool in such cases can be entered at only one end.

The view at the right-hand side of the illustration shows the manner in which the tool is employed to clean out a cavity in a cylinder. When the defect in the cylinder is located, the drill is placed in the cavity and after being properly entered is shifted or manipulated in such a manner as to form a pocket beneath the surface, which is larger than the opening of the cavity. This is accomplished by means of the specially designed drill point. When the pocket has been cleaned out sufficiently, it is welded shut, being completely filled in with metal. As the maximum thickness of the cylinder wall is about 1/4 inch, care must be taken not to drill too deep. This may be easily avoided by securing the drill in its holder in such a position that only the allowable working depth protrudes. The end of the holder will then suffice as a stop for the drill. The enlarged pocket beneath the surface of the cylinder prevents the metal from working out should it by any chance become loosened. By this means the danger of doing severe damage to both the cylinder and the piston, is eliminated. The surface of the cylinder wall where the cavity is closed in is carefully smoothed off and the cylinder given a final boring or grinding operation. Thus the time, labor, and cost of the preliminary machining operations are not a total loss.

TOOLING FOR PITCHER PUMP CYLINDERS

Some very interesting special machine equipment and tooling for finishing the interior of pitcher pump cylinder castings is employed by the Goulds Mfg. Co., Seneca Falls, N. Y. Fig. 1 shows a battery of Prentice drilling machines tooled for boring, reaming and facing the small end of these castings. Instead of using the regular drilling machine table, the vertical ways of the drilling machines are equipped with a special clamping and supporting device, which is operated by handwheels at the sides. The castings are inverted and located on a seat *A*, which is clamped in the lower jaws by means of the handwheel at the left. This handwheel operates an opposite-hand screw so that both jaws are moved simultaneously.

The jaws are provided with outboard supports in the form of posts, and after this cast-iron seat has been set up for a particular size of pump casting it is not changed. The small end of the casting is clamped by a pair of jaws at the top that are operated similarly to the lower jaws, this arrangement assuring a true vertical position for the work. The seat is so located in the lower jaws that the work is properly aligned with the combination boring-bar. The upper clamping mediums are also provided with posts to support them.

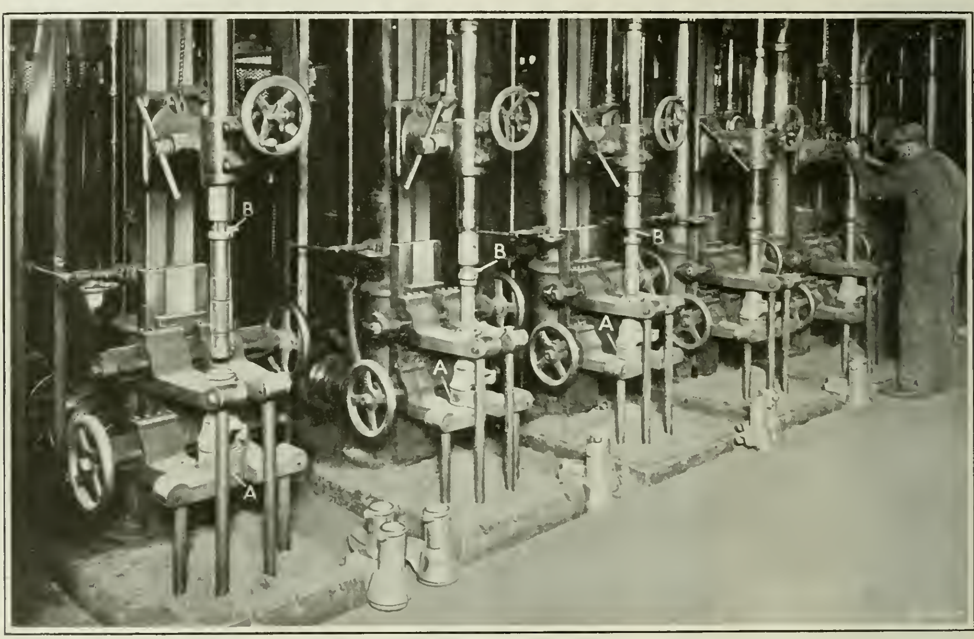


Fig. 1. Battery of Drilling Machines with Special Equipment for boring and facing Pitcher Pump Cylinders

A special extension boring-bar is used which has at the end five steel bits for stocking out the rough castings. After these have fed into the bore a few inches, three blades just above the stocking cutters finish-ream the holes. These two sets of cutters feed down through the casting until a fly-cutter *B* near the shank of the tool faces off the end of the casting. Directly under this cutter there is a floating collar which fits the finish-reamed hole preparatory to facing so that the end will be finished square with the cylinder bore. There are eight machines in this battery equipped as described, and they are all operated by one man who, by arranging the feed of successive spindles properly, may go from one to the other loading and unloading without loss of time. By this means a production of from 700 to 850 castings is attained in a nine-hour day.

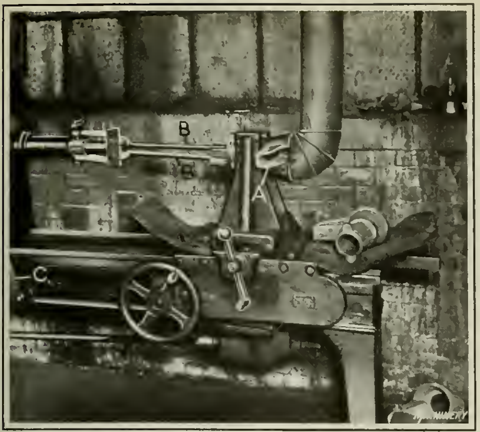


Fig. 2. Lathe equipped for grinding the Bores of Pitcher Pump Cylinders

The pitcher pump cylinder castings are ground on the bore with the lathe tooling shown in Fig. 2. Here it will be seen that the pump casting *A* is clamped in position, and aligned with the spindles of the machine by two special high cast-iron jaws. These jaws are operated by an opposite-hand thread cross-feed screw actuated by the handle shown at the front of the lathe. This entire unit—jaws, cross-slide, and apron—is special equipment applied to this lathe bed. The polishing tool consists of two pivoted arms *B*, on the end of each of which there is attached an emery pad. The arms are loosely held in a suitable holder in the machine spindle, and the pads on the extreme end may be spread to suit the diameter of the work being ground, by a screw adjustment at the opposite end of the arms. In grinding the work, the operator first closes the ends of the arms so that the pads will enter the hole in the casting and then advances the special carriage that carries the work, by means of lever *C*. The carriage movement is actuated by a rack and pinion.

The centrifugal force produced by the revolving spindle causes the arms carrying the emery pads to spread radially outward, so that as the carriage is fed toward the machine spindle the hole is ground. An exhaust pipe fits into the top of the cylinder castings to carry away the cast-iron dust produced in this operation.

* * *

THE WORLD'S MACHINERY TRADE

The present position of Germany as a competitor in the world's machinery markets has been considerably over-rated, according to William Althoff, assistant chief of the Industrial Machinery Division of the Department of Commerce. Mr. Althoff has compiled a review of the world's machinery trade in which he shows that while Germany held the first place in machinery exports from 1910 to 1913 inclusive, the United Kingdom following second and the United States third, in 1920 the United States ranked first, the United Kingdom second, and Germany third; and in 1921 the United States and the United Kingdom were practically on par, with Germany third.

The United Kingdom alone of the four leading machine exporters—the United States, the United Kingdom France, and Germany—shows an increase in its exports in 1921, due mostly to large shipments of textile machinery. Although the machinery exports from the United States fell off considerably during 1921, in value they exceeded the exports in 1918, and were more than twice as great as the exports in 1913. The value of machinery shipped from Germany in 1921 was only two-thirds the value of the machinery exported in 1913.

Fundamental conditions at present existing in Germany are such as seriously to impair its position as a competitor in the world's machinery markets. To a large extent present low costs have been the result of direct and indirect government subsidies which the German Government must necessarily abandon. Government control as applied to grain prices has already been abolished, bringing about a general movement for higher wages. Freight rates and raw material prices are rising rapidly, and labor difficulties are becoming increasingly numerous; and there is a shortage of both coal and coke. These and other factors make it practically impossible to quote firm prices for long-term commitments. The tendency now is to quote prices subject to increases to cover any enhanced production costs that may occur before the goods are delivered.

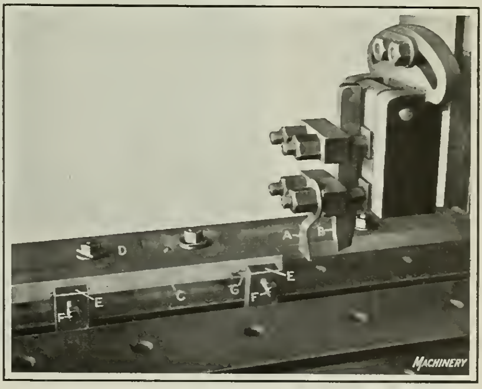
The complete review together with tables showing the exports from the four leading countries mentioned may be obtained upon application to the Industrial Machinery Division, Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C.

* * *

PLANING MEASURING MACHINE BARS

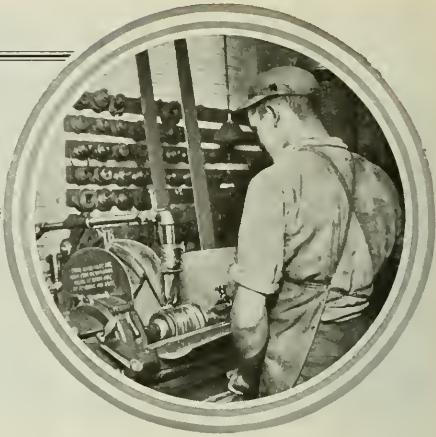
On the Woodward & Powell planer, which is shown in the accompanying illustration, engaged in machining bars for Pratt & Whitney measuring machines, the chief point of interest is the application of a sheet-metal brush *A* which runs over the work ahead of the cutting tool to remove chips from the surface, so that there is no tendency for the tool to ride up over the chips and cause them to roll and damage the surface of the work. The illustration does not show clearly the form of the cutting tool *B* used on this job. The impression might be gathered that this tool cuts with its narrow end surface, but as a matter of fact the cutting edge extends along the broad surface at the rear of the tool, as it is shown in the illustration, and this edge is inclined at an acute angle to the direction of the table travel in order that it may have an efficient shearing action and produce a smooth finished surface on the work.

A string of castings *C* is clamped against a parallel bar *D* that runs down the center of the table, the same arrangement of stops *E*, clamping bolts *F* and "butters" *G* being employed as in the case of the slide gibs. Only one cutting tool is employed, but two rows of measuring bars are set up on the planer table, as experience has shown that time can be saved by setting up a large number of pieces of work, so that while they are being machined the operator can attend to one of the other planers in the department. On this job the depth of cut is 0.006 inch, as it is desired to obtain a very fine finish. The feed is 1/8 inch per table stroke, and the cutting speed 25 feet per minute.



Finish-planing Operation on Pratt & Whitney Measuring Machine Bars

Grinding in the Automotive Industry



Methods of Grinding Steel Balls and Ball Bearing Races—Grinding Roller Bearing Cups, Cones and Rollers—Second Article of a Series

By The Engineering and Educational Departments
of the Norton Co., Worcester, Mass.

IMPORTANT grinding operations, such as are commonly encountered by manufacturers in the automotive field, were dealt with in the preceding installment of this article in July MACHINERY. Many of the parts used in the automotive industry, such as ball and roller bearings, springs, wheel rims, etc., are purchased by automobile manufacturers ready for assembling. Grinding as applied to the manufacture of these parts constitutes as important a series of operations as those in the automotive manufacturing plants, and grinding processes are employed for the same general reasons. In the case of such parts as ball and roller bearings, all of the finishing operations after hardening are done by grinding, because this is the only economical method of obtaining the required finish and accuracy. In the manufacture of such parts as leaf springs and wheel rims, however, grinding is employed because of the ease of application of the work to the grinding wheel and the resulting rapid removal of stock.

Instead of attempting to describe the grinding of a large variety of miscellaneous parts, a few of the more important operations will be dealt with. One or two of the standard makes of the various parts will be selected as typical, and the grinding operations used in their manufacture will be described. Where this description includes the make of grinding machine employed, it should be understood that other makes of machines of the same general type and capable of adaptation to the work could be used.

There are many types of ball bearings, but the interesting grinding operations are similar regardless of the type. In this article the grinding involved in the manufacture of the annular or radial type of bearing will be referred to specifically. The manufacture of steel balls for bearings is an art in itself. The mechanical equipment and problems are different from those in most manufacturing plants. On this account steel balls are frequently the only product manufactured by a concern. Typical grinding operations necessary in the manufacture of steel balls are described as follows:

Dry Grinding Operations on Steel Balls

The ball blanks, which are cold-headed for small sizes and hot-forged for large sizes, are subjected to a rough-grinding operation before they are heat-treated. This rough-grinding, which is done dry, removes a considerable part of the surplus metal, for the headed balls have a ring or fin around them left by the heading machine. As a result of this operation, each ball is brought to a much closer approximation of a truly spherical form than it is possible to obtain in the blank form made by either the cold-heading or hot-forging processes. Rough grinding also removes the decarbonized steel from the surfaces of the hot-forged blanks.

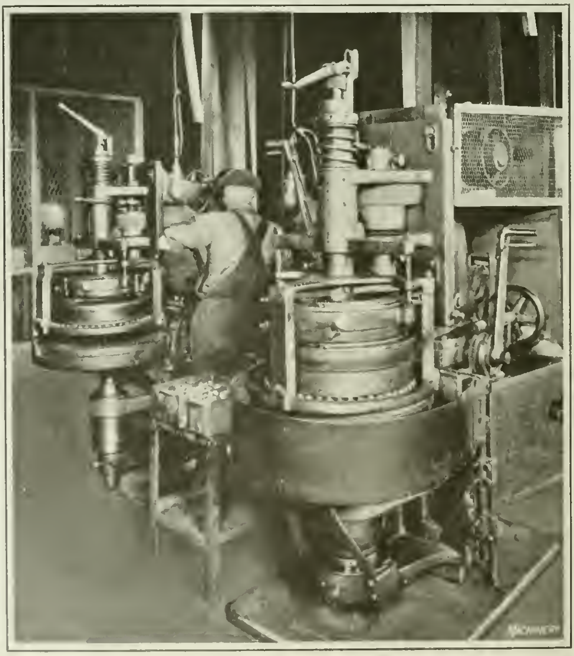


Fig. 1. Vertical Type of Machine used for rough-grinding Steel Balls for Bearings

The machines used for rough dry grinding are of the Grant type. A grinding wheel of the cylinder or ring type is mounted on a flat plate which is shown in the illustration Fig. 2. This plate, in turn, is mounted on the top of a vertical spindle, and rotates in the opposite direction to that of the driving or chaser ring *A* which presses down on the balls and keeps them in contact with the wheel. The inner and outer containing rings *B* and *C* are two concentric rings of different diameters, and are supported above the grinding wheel by springs. They are so beveled that the balls are held in a way that allows them to project slightly through the space between the beveled edges, and thus to be brought in contact with the grinding wheel.

The grinding wheel has a surface speed of about 5000 feet per minute, while the driving ring revolves in the opposite direction at about 60 revolutions per minute. The containing rings and grinding wheel are set eccentric to each other so that the balls, as they are rolled around the containing rings by the driving ring, travel across the top of the grinding wheel face. The side pull of the wheel on the ball constantly changes the axis upon which the ball rolls, and a new surface is constantly being presented to the grinding wheel. The result of the grinding is to produce a surface which is a close approximation to spherical form.

The grinding operation is not wholly automatic. The amount of pressure between the balls and wheel is controlled by a hand screw which raises the wheel-spindle. Only one ring of balls is ground at a time. The containing rings are filled with balls which are put in so that they touch each other, and while one charge of balls is being ground a second is being made ready. A gage indicates when the balls are ground to size.

After being rough-ground, the balls are heat-treated and hardened, then returned to the dry grinding department for the finish dry grinding operation. This operation is performed in the same manner and on the same type of machine as that employed in rough grinding, only a finer wheel is used, which removes the scale and brings the diameter a little closer to the desired finished size.

For rough dry grinding No. 40 grain wheels are used, while No. 60 grain wheels are used for finish dry grinding the large balls, and Nos. 90 or 100 grain wheels for grinding the small balls. The grade of wheel required is usually the hardest that it is possible to produce by the vitrified process. The point contact which exists between the wheel and the work results in a very high unit pressure, and this causes a severe dressing action, which softer wheels cannot withstand. Aluminous abrasive wheels are employed and they are operated at surface speeds ranging from 4500 to 5000 feet per minute.

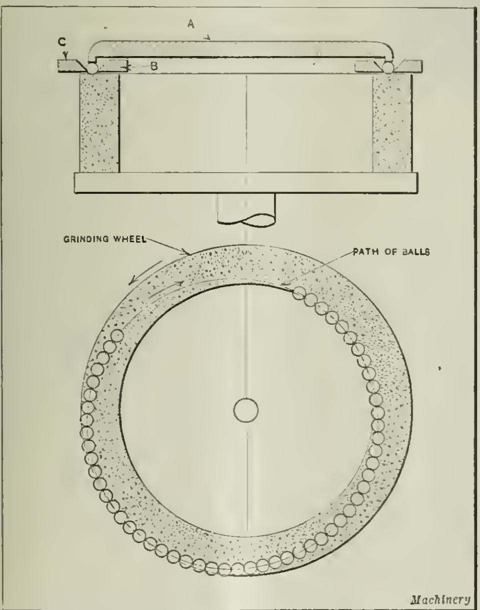


Fig. 2. Diagram showing Principle of Rough-grinding Operation

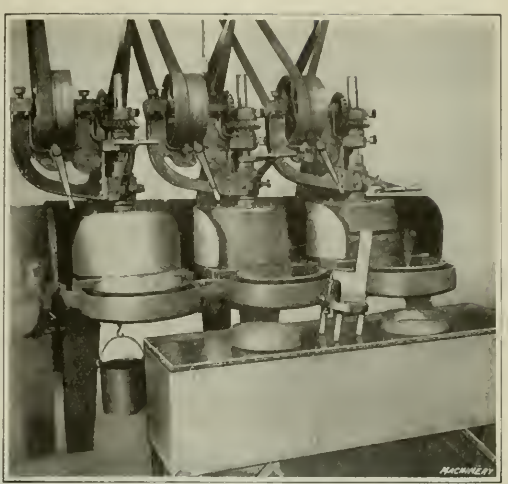


Fig. 3. Oil-grinding Machines, which are one Type used for finishing Steel Balls

The finish dry grinding leaves the balls in approximately spherical form, but with surfaces covered with small flat spots and scratches caused by the grinding wheel. There is still a considerable amount of excess metal on the balls, as they are about 0.010 inch over the finished size. The process of "oil-rolling" is for the purpose of removing the flat spots and scratches and bringing the balls down to nearly the proper size. The balls are tumbled in an iron barrel containing oil and No. 36 silicon carbide abrasive grain for from twenty to thirty hours, according to the amount of stock to be removed. The result of this operation is the production of practically perfect spheres, which are about 0.004 inch larger than the required finished dimension. This size is determined by selecting balls at random and measuring them with micrometer gages, the oil-rolling process being continued until they are 0.004 inch over the finished size.

Oil-grinding Steel Balls

The balls are reduced to the final size in oil-grinding machines (Fig. 3). The grinding part of these machines consists essentially of two iron rings, each of which contains an annular groove of such a size as to admit the balls. The balls roll in the groove of the lower of the two rings, which also contains oil and abrasive of the same kind as that used in the oil-rolling process, and are held by the upper ring. The upper ring is attached to a spindle and revolves the balls around in the groove containing the oil and abrasive. The grinding machines are provided with clock dials which, when the machines are started, are set to the approximate time when the grinding operation will be completed. Just previous to this time, balls are selected at random and measured for size. The time of grinding is usually from twenty to forty-five minutes, and the machine requires but little attention, except possibly to add more of the silicon carbide abrasive to the mixture.

Following the oil-grinding the balls are tumbled with hard wood sawdust, then with oil and Vienna lime, cleaned by being tumbled with hard wood sawdust again, and then tumbled with strips of kid leather, which completes the process.

Hoffman Process of Grinding Steel Balls

The final grinding operation on balls produced by the Atlas Ball Co. is performed on a Hoffman machine rather than on an oil-grinding or lapping machine, as it is claimed that more accurate results can be secured through this method. The oil-lapping machines are employed only on balls over ½ inch in diameter to remove some of the stock left for finish-grinding, these machines performing this operation more economically than has been possible on Hoffman machines because of the high grinding wheel cost with the latter. However, the difference in cost is not great, and, consequently, oil-lapping is omitted on balls less than ½ inch in diameter, and sometimes on the larger sizes.

The balls are produced from bar stock either by cold-heading, hot-forging, or hot-pressing, the process depending upon their size. Balls over ½ inch in diameter are next annealed, rough-ground, hardened and tempered, rough-ground once more, oil-ground or lapped, finish-ground, and polished. Balls less than ½ inch in diameter are ground before hardening on Hoffman machines after the first rough-grinding operation, then heat-treated and finish-ground on Hoffman machines.

Rough-grinding Operations Preceding Finishing Process on Hoffman Machine

The first and second rough-grinding operations are performed dry on vertical machines such as illustrated in Fig. 1, or horizontal machines of the type illustrated in Fig. 4. On the vertical machines the grinding wheel is located beneath the balls and is dropped to permit their removal at the completion of an operation. On the machine at the left, the grinding wheel is shown in the dropped position. These machines operate on the same principle as the Grant type of machines, the general arrangement illustrated in Fig. 2 being employed.

After a load of balls has been ground, the vertical lever at the rear of the machine on the right side is used to lower the grinding wheel. A tray attached to the left side of the machine is then swung into position above the grinding wheel. The lever at the top of the machine is next operated to lower the inner of the two rings forming the groove in which the balls rotate, and thus permit the balls to fall upon the tray. After the latter has been removed and the inner ring raised, both the outer and inner rings are dropped together a sufficient amount to permit unground balls to be poured between the driving and groove rings. When the machine has been loaded, the groove rings are raised to bring the balls in contact with the driving ring, after which the machine is ready for raising the grinding wheel into contact with the balls.

Grinding wheels of from 40 to 60 grain, according to the size of the balls, are employed for the first rough-grinding operation which lasts about eight minutes. In the second rough-grinding operation wheels of 60 to 90 grain are employed. An operation on ½-inch balls in which 0.005 inch of stock is removed, averages six minutes.

The horizontal machine illustrated in Fig. 4 is used for grinding balls from ½ to 2½ inches in diameter. It is supplied with a hopper when balls from ½ to 1 inch are being ground, but larger balls are fed by hand. The design of this machine is based upon the same principle as the vertical machines illustrated in Fig. 1. It consists essentially of a bed, a duplex wheel-head and two sliding work-heads. The wheel-head consists of a motor having a long armature shaft, both ends of which are provided with flanges for attaching ring grinding wheels. The wheel-head is stationary on the bed, the work-heads being adjusted to bring the balls into contact with the wheels by means of a large handwheel at each end of the bed. In this illustration the balls of one head can be seen projecting through the groove formed by the two stationary plates.

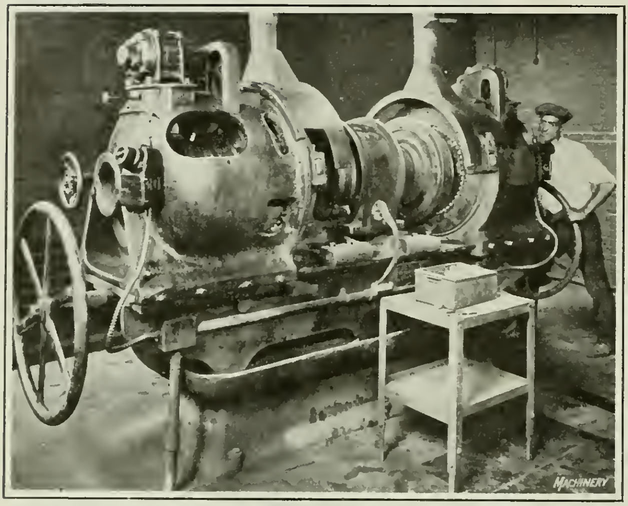


Fig. 4. Horizontal Type of Machine used for rough-grinding Balls varying from ½ to 2½ Inches in Diameter

Final Operation on the Hoffman Machine

The first Hoffman machine was designed to use abrasive grain for grinding. The balls were rotated between two grooved metal plates, together with a mixture of abrasive grain and oil covering the balls. Soft spots in the plates caused them to wear unevenly, making it necessary to repair or replace them frequently. The present Hoffman machine consists of a grinding wheel mounted on a horizontal spindle (Fig. 5). Opposite the grinding wheel is a stationary "rill plate," on the inner face of which (toward the grinding wheel) are a series of concentric annular grooves. The number and size of these grooves depend upon the size of the balls to be ground. In general the grooves are of such a depth as to admit one-third of the surface of the balls being ground.

The balls are fed into a runway which connects with the grooves in the plate, and under the action of the grinding wheel they rotate and roll around in the grooves until they have nearly completed one revolution, when they are thrown out into a trough and brought back into the runway to again pass through the grooves. The function of the trough is to mix the balls so that they will not be ground wholly in one groove, but each one will pass through all of the grooves, and in this way a more truly spherical ball will be produced. After the grinding wheel has been used for a time, grooves are worn in it corresponding to those in the metal plate. These grooves are allowed to become of practically the same depth as those in the metal plate, and are then maintained at this depth by dressing the surface of the wheel occasionally.

The grinding wheel is located close to the rill plate and revolves at slow speeds of from 30 to 60 revolutions per minute. At a certain point slots are cut through the rill plate through which fingers project to remove the balls from the grooves as the balls reach the fingers. When the balls leave the rill plate they are carried by gravity to a large magazine at the opposite end of the machine. A conveyor in this magazine carries the balls to a higher level from which they are once more returned by gravity through slots in the rill plate beneath the removing fingers and back into the grooves of this plate.

As a charge of balls is left for hours in one of these machines, each ball is carried many times through the different grooves of the rill plate. The illustration shows the balls in the trough which conveys them back into these grooves. Toward the end of an operation, balls from the charge are compared on a minimeter every ten minutes to ascertain whether they have reached the required diameter. A pressure of about 7000 pounds is maintained on the balls during the operation. This pressure is secured by means of a screw extending through the center of the wheel-spindle and the magazine to the right end of the machine where a handwheel is located for tightening or loosening the screw against a heavy spring. By locating the screw as mentioned, a uniform pressure is placed on all balls in contact with the wheel. There is no slipping or twisting of the balls because of this pressure.

The grinding wheel has an outside diameter of 24 inches, a hole 12 inches in diameter, and is 4 inches thick. As many grooves are cut in a rill plate as can be spaced across the ring wheel between its hole and periphery. The number of grooves ranges from two to twenty-eight, according to the size of the balls for which the plate is intended. The magazine permits the machine to be loaded with charges of balls averaging 240 pounds. With a charge of ½-inch balls, approximately 1½ hours are required to remove 0.001 inch of stock. Kerosene is used as a coolant, because it has been found that with this oil all sliminess on the balls is eliminated and that the abrasive particles loosen completely from the balls and are carried away by the kerosene. The abrasive particles also settle readily to the bottom of the filtration tanks.

The finished product of the Hoffman machine is of much better quality than can be produced by finish-grinding on other types of machines. The production is, however, much lower; furthermore, it is impossible to grind in this machine the rough ball blanks as they come from the forging or heading machine. Very fine, hard wheels are used on the Hoffman machine, the grain size being generally XF and the grade as hard as it is possible to make by the vitrified process.

Grinding Outer Rings of Ball Bearings

The outer soft steel rings of ball bearings are turned products, usually made on screw machines. The groove is roughed out and the ring is then ready for its first grinding operation. This consists in surfacing the sides of the ring on a surface grinding machine of the vertical-spindle type, such as the Blanchard, shown in Fig. 6, or Pratt & Whitney, or by the use of special machines which have been designed by manufacturers of bearings for this particular class of work. These special machines are similar to the Gardner or to the Besly double-head machine. The bearing is held in a special fixture and rough-ground to the proper thickness by the use of two wheels, one grinding on each side.

After being surface ground, the rings are hardened and finish surface ground on the same type of machine as that used in the first grinding operation, but with different grinding wheels. The rings are then mounted in gangs on arbors and ground cylindrically on ordinary plain cylindrical grinding machines (Fig. 7). In some cases, the rings are roughed on one machine and finished on another, but in other plants the operations are combined. The ordinary wheels used for cylindrically grinding hardened steel are generally used for this work, although the finish required may be better than the ordinary commercial finish. The requirements as to finish may make it necessary to use a No. 60 grain wheel in place of the more common No. 46 and 24 combination wheels. No. 36 combination grain wheels are also employed.

Grinding Grooves in Outer Rings

The grooves in outer ball-bearing rings are next rough-ground on special machines of the oscillating work-head type. The Van Norman automatic radial raceway grinding machine is shown in Fig. 8 grinding a large outer ring. After this machine has been set up and the work placed in the work-holder, the wheel is brought in contact with the raceway, after which the groove-grinding operation is entirely automatic. It is possible for one man to operate several of these machines.

For the groove grinding of outer rings, two wheels should be used—one for roughing and another for finishing. Vitrified wheels made up of grain No. 46 or 60 should be used for roughing, while for finishing, elastic wheels of about grain No. 80 give the best results. Elastic wheels are almost always used for finishing, but they are too expensive compared with vitrified wheels to be used for the removal of the large amount of stock necessary in the roughing operation. An excellent finish is produced by the elastic wheel when only a few thousandths of an inch of stock is removed. Groove-grinding should be done wet and the wheels trued and dressed with a diamond.

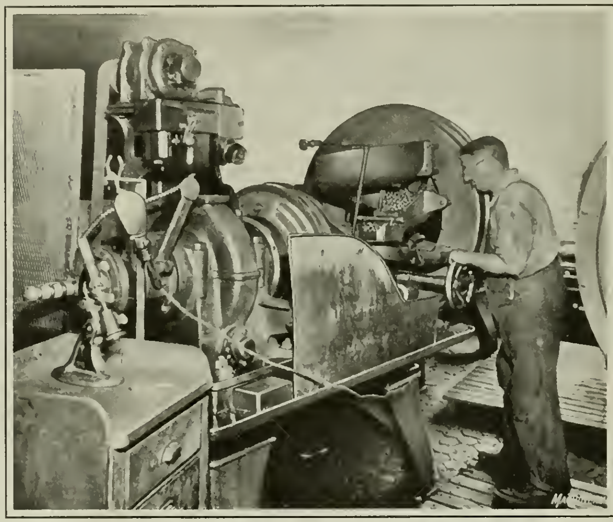


Fig. 5. Hoffman Machine which is used for finish-grinding Balls after the Roughing Operation

Grinding Inner Rings of Ball Bearings

Rough and finish surface grinding is done in exactly the same way as the corresponding operations on the outer rings, and the same types of machines are used.

The next operation on inner rings of ball bearings is that of bore grinding, which is an ordinary internal grinding operation, and may be performed on any standard internal grinding machine. A good finish is required, and this is secured by using wheels of No. 46, 50, or 60 grain.

The groove grinding can be done on the oscillating-head machine or on a small cylindrical grinding machine. The wheel face is formed with a diamond, and when a plain cylindrical machine is used the wheel is fed straight into the groove in the ring. With this type of machine, wheels of No. 46 grain are used for roughing and No. 80 or 100 grain for finishing. Generally both the roughing and finishing wheels are made by the vitrified process, although elastic wheels are sometimes used.

Great care must be exercised in grinding ball race grooves. Not only must the grooves be very accurately sized, but the

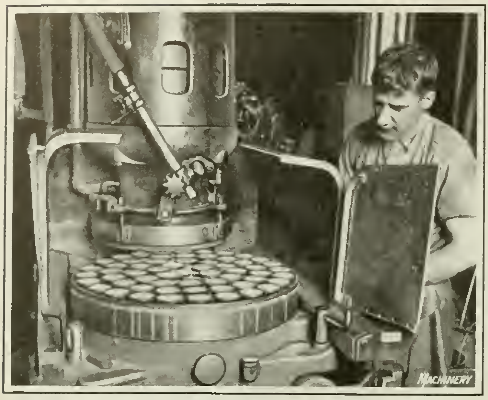


Fig. 6. Vertical-spindle Grinding Machine surface-grinding the Sides of Ball-bearing Rings

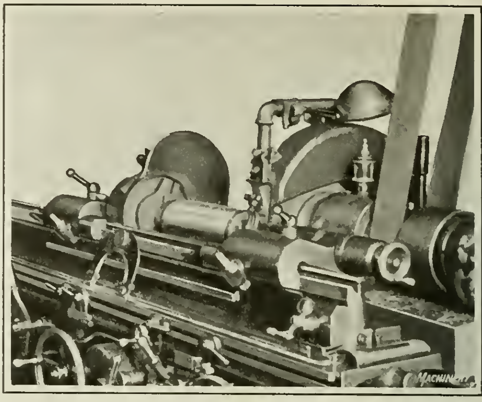


Fig. 7. Cylindrical Grinding Operation on the Outside of a Gang of Ball-bearing Rings

finish must be the best it is possible to obtain on a commercial basis. The life of a ball bearing depends as much on the character of the raceway as on the balls. The grinding must not overheat the surface of the raceway, on account of the resulting tendency to "skin soften" or produce minute cracks and checks in the surface, which would cause the bearing to fail after short service.

A Van Norman machine is shown in Fig. 9 grinding a double-row end-thrust ball-bearing plate. This plate is 14½ inches in diameter, and each groove is intended for balls two inches in diameter. The radial type of machine can also be applied to certain other classes of work in the automotive field. Two examples are shown in Figs. 10 and 11. The operation illustrated in Fig. 10 is that of grinding the outer radius on an automobile universal joint cover, and Fig. 11 shows a machine grinding the ball end of a steering knuckle.

Grinding Roller Bearing Cups

Grinding operations are employed in the making of three important parts of one type of roller bearing, namely, the cup, the cone and the rollers (Fig. 12). The cups, after being hardened and inspected, come to the first grinding operation about 0.008 inch over size. Approximately this amount of stock is left on all surfaces which are ground. The edge of the cup on the side having the opening of smaller diameter is first surface ground. This may be done on a machine of the universal type. The headstock is set at 90 degrees, and the piece is held on a magnetic chuck (the face of which is in a vertical plane) and the edge is ground on the face of a straight wheel, the operation being similar to surface grinding on a rotary surface grinding machine. This ground surface is then used as a reference surface during the next grinding operation. A Norton multi-purpose machine could be employed for this operation. A machine. such as the Heald automatic piston-ring grinder is also adapted for grinding the side or edges of bearing races, especially when the grinding is done on a large scale.

The next operation consists of grinding the taper bore, which constitutes the outer raceway of the bearing. A universal grinding machine is used, the work-head being swiveled to give the proper taper and a magnetic chuck for holding the work. A ring of non-magnetic material on the chuck is used to center the work. The taper bore is ground dry, this being the only dry grinding operation on the cup, and this ground surface is used as the reference surface for the grinding of the outside diameter.

The outer surfaces of roller bearing cups are finished by grinding on any plain cylindrical machine like the Norton type. A number of the cups are mounted on a special mandrel equipped with double tapered collars, each collar carrying two of the cups that are to be ground. The cups are placed on the mandrel with the tapers extending in opposite directions, and are held securely by being clamped between

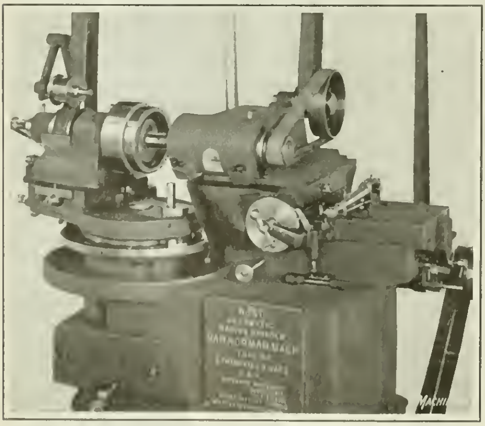


Fig. 8. Grinding the Raceway in an Outer Ring using an Automatic Radius Grinder

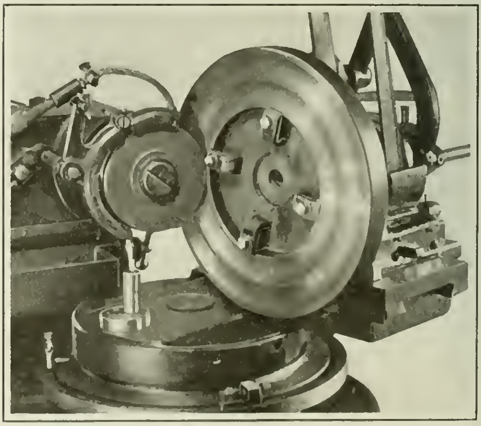


Fig. 9. Grinding a Double-row End-thrust Ball-bearing Plate on a Radius Grinder

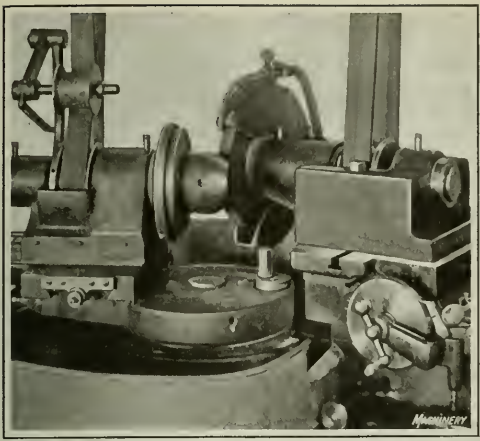


Fig. 10. Grinding the Outer Radius on a Universal Joint Cover

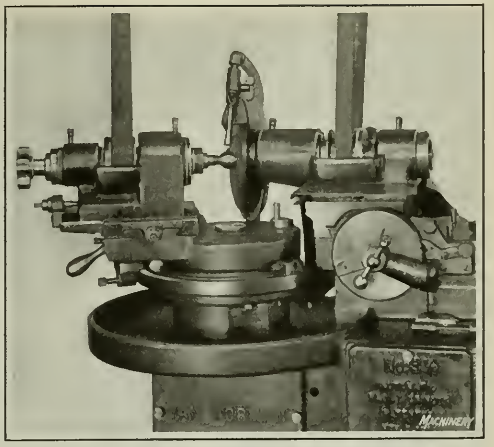


Fig. 11. Grinding the Ball End of a Steering Knuckle

a flange at one end and a ring at the other. While one "gang" of cups is being ground, another mandrel is being loaded.

Grinding Cone or Inner Raceway

The edge at the large end of the taper on the cone is ground first and used as a locating surface. The grinding is done wet on the same type of machine that is used for the first grinding operation on the cup.

Grinding the bore of the cone is a simple internal grinding operation performed on any well-constructed internal grinding machine. The bore is then used for locating the work on a mandrel while the tapered raceway is being ground. This is ground on a universal machine using an expanding mandrel to carry the cone. The work-head of the grinding machine is set at the desired angle and the grinding is done on the face of a straight wheel.

The last grinding operation on the cone is very important. The two shoulders *A* and *B* in Fig. 12 must be ground exactly parallel with each other and at the proper angle with the bearing surface, in order that the bearing may sustain a thrust load satisfactorily. The method by which this grinding operation is accomplished is to equip a universal grinding machine with two wheels of different diameters, and have the work-spindle of the machine set at an angle so that the two wheels may come in contact with the work simultaneously and grind the two shoulders. To facilitate the truing of the wheel, two diamonds are mounted in a holder secured to the work-spindle housing.

Grinding the Rollers

The only grinding operation on the rollers is that of grinding the bearing surface. This may be done on a Brown & Sharpe grinding machine equipped with a special magazine feed mechanism. The rollers are put in a feed chute, which brings them to a position to the right and in front of the grinding wheel face. A push-rod pushes an individual roller between two spring fingers, which then carry it forward to a position between the machine centers where it is automatically gripped and held in the proper position for grinding.

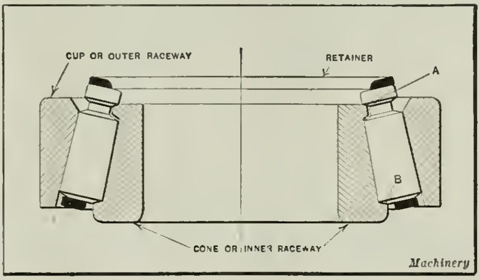


Fig. 12. One Type of Roller Bearing

After the roller is ground on the face of a straight wheel the tail center is withdrawn and the roller drops into a receiver. The tail center is then allowed to spring back into place, and as it does, it comes in contact with a new roller held in place by the spring fingers. This operation is entirely automatic except that it is necessary to feed the wheel in at intervals to compensate for wheel wear.

Another type of roller bearing contains only straight cylindrical parts. The grinding operations, although an important part of the manufacture, do not involve special features, as they are simply straight cylindrical and internal grinding processes performed in the same manner and with the same machines as work of a similar nature. Accuracy of grinding is essential.

* * *

THE SCARCITY OF PLATINUM

Platinum is used to a considerable extent in the industries, but the great advance in the price of this metal during recent year has had a retarding influence upon its industrial applications. The advance in price was due primarily to the use of platinum in the manufacture of war materials and to the scarcity of the metal, most of which in former years had come from Russia. As soon as the price increased, due to its scarcity, the metal was immediately diverted to a use for which it is really not adapted, namely, jewelry. There is no reason to doubt that the practice of setting precious stones in platinum has been adopted because of the high cost of the material. In 1920, 57 per cent of the platinum consumption of the United States was used in the jewelry trades, 19 per cent by the electrical industries, and 10 per cent by chemical works, while the remainder was distributed between dental uses and minor industries. While substitutes for many of the uses of platinum in the electrical industry have been found, it still plays an important part in this field. If through increased supply the price of platinum should again fall below that of gold, it is likely that it would cease to be used for jewelry, in which case the supply for industrial purposes would be all the greater.

Methods Employed in Making Radio Head-phones at the Plant of the Newark Engineering & Tool Co., Newark, N. J.

THE purpose of head telephone receivers is to change the varying direct-current impulses of the receiving circuit to sound waves, and the principles of construction are the same as in ordinary telephone receivers. More care is required, however, in building a radio receiver than for the ordinary telephone.

The construction of the head-phone receiver will be understood by reference to Fig. 1. The parts are assembled into an aluminum case, and are covered by the diaphragm which is enclosed by a hard rubber cap. The most vital unit is the magnetic coil, of which there are two in each instrument. These coils are wound on insulated iron cores, such as shown at *A*. After winding, the coils have the appearance shown at *B*, the lower one of which is insulated, while the upper is not. The two coils are connected; the ends of the wires are attached to two brass screws located in a fiber terminal piece *C*. The arrangement is shown in the view of the assembled instrument.

The terminal piece is fastened into the case and contains two radial holes for plugging in the connection to the radio receiving apparatus. An electromagnetic force is set up whenever a coil of wire is wound around a soft iron core, so that in a receiver coil any variation in strength of the electrical impulses correspondingly affects the movement of the diaphragm. Consequently, louder or fainter tones are received according to the excitation in the magnetic coils. In addition to the magnetic force induced by the winding of the coils there are two permanent magnets *D* fastened into the case which cause an additional bellows movement of the diaphragm and serve to balance its action. The instruments are hung in a yoke *E* so that they are free to swivel and adjust themselves to the head. The end of the yoke stem has a suitable connection to the head band, the parts of this connection being shown at each side of the yoke.

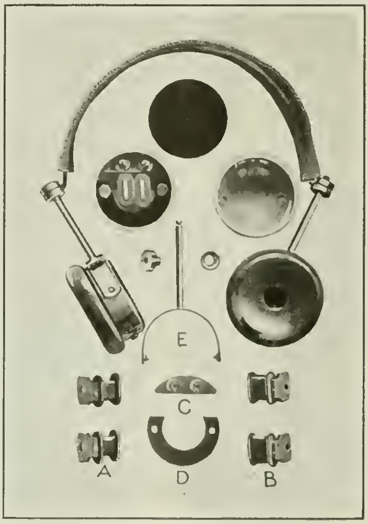


Fig. 1. Head-phones and Parts

Drawing and Threading the Case

In dealing with the manufacture of this instrument, as carried on by the Newark Engineering & Tool Co., Newark, N. J., only certain operations will be referred to. Attention will be focussed mainly on the making of the coils and the magnets. The aluminum cup which forms the case is made of sheet alumium, 0.080 inch thick, and is drawn in two operations, the second of which is performed with the set-up illustrated in Fig. 2. The machine used is a double-action back-geared Bliss press, and the dies are of the push-through type. A shell produced in the first operation is shown in the die; it is held in place by the punch-holder while the punch passes through it and completes the shell.

After the holes have been punched in the cases, they are ready to be threaded for the hard rubber cap. The thread is produced by rolling, as illustrated in Fig. 3. Here a Rockford tool-room lathe is shown equipped with a thread-rolling tool and a chuck having two pins that engage the punched holes in the cases to drive them. The cases are supported at the end during the threading operation by a fiber collar which has a female center to receive the regular lathe center. There are twenty threads per inch rolled on the case, and the tools are kept clean by the frequent application of kerosene. The open ends of the cases are next shaved to length; this is also done on a Rockford lathe. The parts are finally polished, properly stamped, and delivered to the assembling department where they are assembled and packed for shipment.

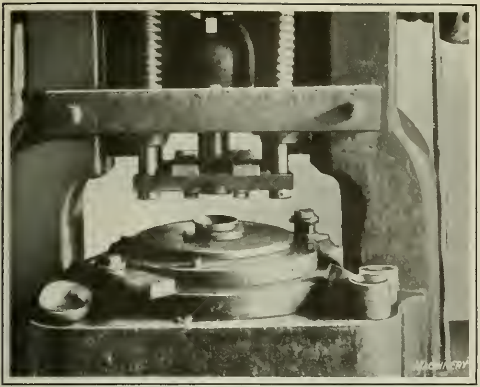


Fig. 2. Second Drawing Operation on the Aluminum Cases

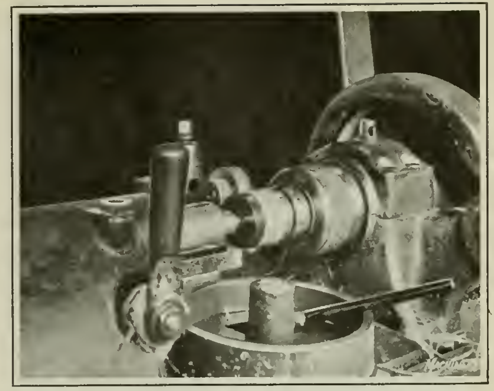


Fig. 3. Rolling the Threads on the Cases

Making the Magnetic Coils

The coils are the most important part of the telephone receiver, and careful workmanship is necessary in every phase of their manufacture. The cores are made from Norwegian iron, and are punched out and bent to a right angle, as shown at *A*, Fig. 1, on a power press. They are then fitted with fiber flanges, which are pressed on by means of a foot-press, the punch of which is slotted to pass over the end of the core. The operation of assembling the lower flange is illustrated in Fig. 5, which also shows a number of the fiber flanges and a box of iron cores to which the flanges are to be assembled. This operation is very simple, and is identical to that of assembling the upper flange. The section between the flanges is protected by insulating paper manufactured by the Irvington Varnish & Insulator Co., which is stuck on with shellac. After the coil has been wound it is also protected by insulating cloth, brushed with shellac.

Fig. 4 is a view showing one section of the winding department of the Newark Engineering & Tool Co. in which a number of special winding machines are employed to wind the coils. These machines were especially designed and constructed by George J. Zisch, president and general manager of this company, who is responsible for the designing and the manufacturing methods used in manufacturing the head-set.

The winding machines are driven by 1/50-horsepower induction motors which have proved the most efficient installation. The spindle which carries the core also drives a speedometer so that the exact number of turns may be obtained. No. 40 gage enameled magnetic wire is used, each core or spool containing approximately 4000 turns or about one-quarter mile of wire. It will be noted that these coils are placed in boxes on the bench. They are reconnected in pairs by a slightly coarser wire which furnishes the leads to the terminal connections of the instrument. Insulating the coils after winding completes their manufacture, and they are then sent to the assembling room.

Fig. 4. Section of the Coil Winding Department

Other Operations of Importance

The permanent magnets used in this telephone receiver are made of tungsten electric magnet steel, which is a very tough material; consequently, it has been found advantageous to punch out each magnet individually. The practice in this shop is first to cut out slabbed blanks from strip stock, 3/32 inch thick and 1½ inches wide, and next punch the two holes by means of which the magnets are fastened into the case. The final power press operation is punching out the center. The press work is performed on Zeh & Hahnemann single-action presses, the set-up for the final operation being shown in Fig. 6. The film of oil on the work makes it necessary to use a thin-edged pinch-bar to remove the work from the face of the die, but the dies themselves are of simple construction and need no special description. A quantity of finished magnet stampings is shown on the bolster plate of the press.

The hardening of the magnets preparatory to magnetizing is a very delicate operation, and great care must be taken not to apply too much heat; otherwise the steel cannot be properly magnetized. In magnetizing, which is the final operation, the magnetic plates are charged with a direct current of 110 volts, 12 amperes. The fiber terminal piece *C*, illustrated in Fig. 1, is punched from sheet stock, drilled and tapped for brass inserts which are pressed in place to accommodate the terminal screws for the magnetic coils.

Needless to say, all parts used in the construction of an

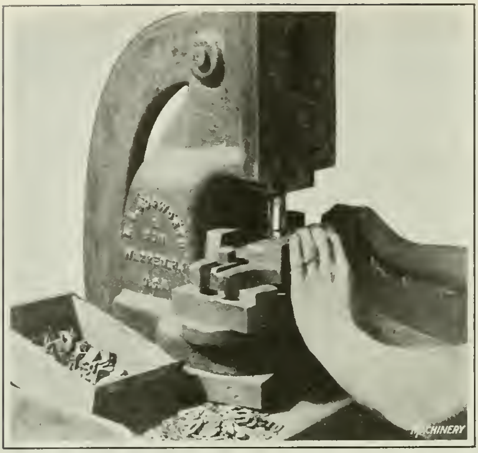


Fig. 5. Assembling the Fiber Flanges, using a Foot Press

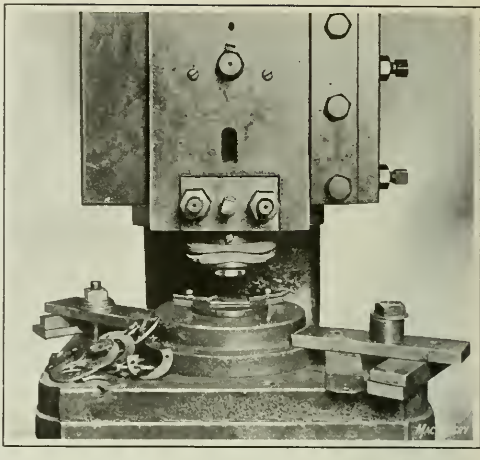


Fig 6. Press for punching out Centers of Permanent Magnets

instrnment of this kind are carefully inspected before assembling, and the assembled product is given a final and searching inspection. Coil terminals are brazed to the terminal screws and the lead wires from the coils are insulated with tubing. The permanent magnets are fastened into the bottom of the case and care is exercised to prevent them from touching the magnetic coils. The assembled instruments are then tested for sound, each head-phone being connected to a tuning coil so that both phones of a set will be closely paired for sound.

* * *

WINDING SMALL HELICAL SPRINGS

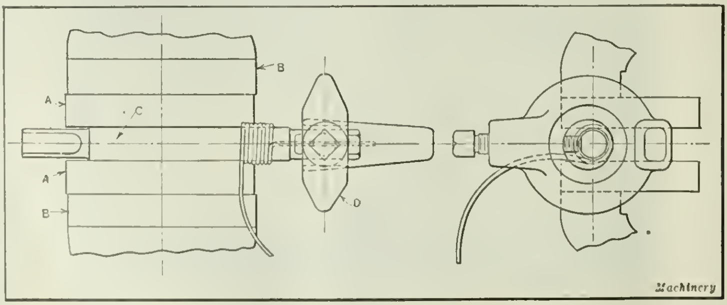
By A. A. FORSTER

The accompanying illustration shows a method of winding small helical springs which requires no equipment other than an ordinary bench vise, a suitable mandrel, a lathe dog, and two pieces of hard wood. The writer has found this method practical for making compression, tension, or twist helical springs from piano wire as large as No. 30 gage. In proceeding to wind a spring, the two hard wood blocks *A* are placed between vise jaws *B* as shown. The width of blocks *A* should be such that they will rest on the vise slide and come flush with the top of the jaws.

The bar or mandrel *C* must be selected to suit the size of spring required. A lathe dog *D* or a clamp is used to hold the spring wire to the end of the mandrel. To start winding after the wire has been clamped to the mandrel, first bend the wire so that it will be at an angle of 90 degrees with the mandrel at a point about ¾ inch from the lathe dog. With the spring wire held in the left hand in a vertical position and the lathe dog or clamp held so that the bend just made rests in a horizontal plane, the vise is closed so that the wire is forced into the wood.

The winding is now accomplished by turning the clamp or lathe dog, allowing the wire to follow the original indentation made in the wood. In winding tension and twist springs, the mandrel should be held nearly horizontal or parallel with the tops of the wood blocks, but to wind a compression spring the bar or mandrel should be held at an angle as determined by the pitch of the spring required.

The approximate diameter of a mandrel required to give a certain diameter spring, using a wire of known gage, can be determined by referring to MACHINERY'S HANDBOOK, page 443. If tables are not available some idea of the size of mandrel required may be gained from the fact that in winding a spring from No. 36 gage wire it was found necessary to use a steel bar or mandrel about ½ inch smaller in diameter to obtain a spring having an outside diameter of ¾ inch. For smaller springs the mandrel must be proportionately smaller to obtain the required outside diameter.



Method of winding Small Helical Springs in a Vise

* * *

GLASS-TOPPED DRAWING TABLE

By FRANK H. JONES

A handy table to have in any drafting-room can easily be made from an old, worn-out drawing-board placed on horses and covered all over with white paper. Around the two sides and back of the table thus covered, build up an enclosure by placing pieces of 2- by 4-inch planed stock, the 4-inch side upright, along the edges. Over the top place a piece of heavy glass which will cover the entire surface of the built-up area. This gives a plane glass surface covering a well four inches deep which is open on the front side.

A portable electric light cord with a hand lamp completes the outfit. The lamp cord should be long enough to allow the lamp to be moved anywhere under the glass. Such a table, once constructed, will be found indispensable in checking drawings and tracings. The part of the glass not in use should be kept covered with heavy paper or some dark material.

STANDARDIZATION OF TOLERANCES

While tolerances and allowances for machine parts must be related to the function of each part, it is of course practicable to standardize such data in so far as it applies to certain general classes of machine fits. This fact was emphasized in an editorial published in July, 1919, MACHINERY, page 1033, in which a reasonable degree of standardization for tolerances and allowances was advocated, the plan being to base the standards upon data which experience had proved to be satisfactory for different general classes of service.

Important work in connection with standardizing tolerances and allowances for machine fits is now being done by a sectional committee of the American Society of Mechanical Engineers. This "Committee on Plain Limit Gages for General Engineering Work" has as its chairman, Col. E. C. Peck, general superintendent of the Cleveland Twist Drill Co. At a meeting held July 17, the work previously done was discussed by the committee and certain changes suggested, the aim being to finally recommend standards for adoption by the society which will be based upon approved practice and which will be of considerable value to the machine-building industry in general.

These standards include eight classes of machine fits designated as: (1) loose fits; (2) free fits; (3) medium fits; (4) snug fits; (5) wringing fits; (6) tight fits; (7) medium force fits; (8) heavy force or shrink fits.

The loose fits allow considerable freedom and are intended for agricultural and mining machinery, controlling apparatus for marine works, textile, rubber, candy and bread machinery and general machinery of a similar grade, as well as some ordnance material.

The free fits provide for a liberal allowance and are for running fits with speeds of 600 revolutions per minute or over, and journal pressures of 600 pounds per square inch or over. Examples under this classification include certain parts of generators and engines, many machine tool parts and some automotive parts.

The medium fits are based upon a medium allowance and are for running fits under 600 revolutions per minute and with less than 600 pounds per square inch journal pressure. This class also includes sliding fits and the more accurate machine tool and automotive parts.

The snug fits have a small allowance and represent the closest fit which can be assembled by hand, requiring work of considerable precision. This class is used where no perceptible shake is permissible and where moving parts are not intended to move freely under load.

The wringing fits represent practically metal-to-metal contact, and the assembling is usually selective and not interchangeable.

The tight fits have a slight negative allowance and are more or less permanently set, light pressure being required to assemble. Examples include fixed ends of studs for gears, pulleys, rocker arms, etc., driving fits in thin sections or extremely long fits in other sections. This class is applied in automotive and ordnance work as well as in general machine manufacture. It may be used for shrinkage fits when the sections are very light.

The medium force fits require considerable pressure and are for permanent assembling. Applications include locomotive wheels, car wheels, armatures and the assembling of crank disks on their axles or shafts. This class also applies to shrinkage fits for medium sections or long fits.

The heavy force and shrinkage fits have considerable negative allowance and are applied where the metal will withstand considerable stress and where a heavy force fit is impracticable. Examples include locomotive tires and heavy crank disks of large engines.

THE BELGIAN MACHINE TOOL MARKET

Industrial conditions in Belgium are improved. There is no longer an immediate threat of German competition. Notwithstanding these favorable aspects, the Belgian market for American machine tools is not promising, because there is considerable American machinery in stock, probably aggregating 15,000,000 francs in value. It will no doubt require another year for the sale of these machines, even at the sacrifice prices at which they are being offered. Acting Commercial Attache S. H. Cross, of Brussels, states that American-made machine tools stand high in favor even at the prevailing higher prices. At the recent Commercial Fair this fact was shown to be true—one of the best known Belgian manufacturers is said to have sold no lathes whatever, while there were several purchases of American machine tools. Some universal milling machines as well as broaching and balancing machines were ordered from American manufacturers, which is an indication that the American prices are not prohibitive. The Belgian machine dealers, however, after having suffered considerable losses, cannot be expected to stock machinery again for some time to come.

German Competition in the Belgian Market

In view of constantly-increasing labor costs in Germany, the German manufacturer cannot produce a machine tool to order and deliver it in Belgium at a price much below the quotations of American machine tool builders. On the other hand, German machinery dealers who accumulated considerable machinery stocks before production costs in Germany had risen greatly, can still undersell American tools as long as such accumulated stocks hold out. A case of this kind is noted in which a well-known American radial drilling machine is quoted in Belgium at 13,500 francs, while a German machine, apparently a reproduction of the American tool, could be purchased in Germany a few months ago for 4000 francs. It is probable that at present this German machine at the factory would cost double this amount.

The position of the German manufacturer is exemplified by another instance: An American representative quoted a Belgian prospect 82,000 francs for a well-known make of American motor-driven lathe, with motor. The representative was told by this prospective customer that he could practically duplicate the machine for 40,000 francs by buying a German machine. The customer delayed placing the order in Germany; when he finally did so he was informed that the price had been advanced to 80,000 francs, without motor.

Future Outlook Encouraging

The outlook for American machine tool sales in Belgium appears, on the whole, to be more hopeful than it has been recently. Better results can probably be obtained in this market by supporting local representatives to the extent of supplying moderate stocks on consignment. The recent losses of the average Belgian firm have been too great to permit any purchases for stock. Orders for machinery for restoration purposes naturally have been concluded; however, some shop construction is reported in the vicinity of Brussels, and a certain amount of buying for replacement and development is being done. It is quite likely that moderate price reductions would somewhat increase the sale of American shop equipment in Belgium.

Efforts have been made recently to place agencies for small American electrically-driven woodworking machinery in Belgium. In view of the low wage rate of hand-labor and the small size and limited means of most Belgian woodworking shops, it is believed that the market for this equipment is very limited and would hardly compensate the cost of advertising necessary to place these products before the prospective customer.

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THE TREND OF MACHINE TOOL PRICES

During the last eighteen months machine tool prices have tended steadily downward, but there are signs which indicate that the low level has been reached and that from now on the trend will be upward. A few machine tool builders have already increased their prices in view of the conditions in the material and labor markets, and others are contemplating a readjustment in prices within a few months.

When prices were reduced to the present level, materials had come down to a point from which they have since considerably risen; also there was a general belief that wages would come down to a much lower level than they have, and on the strength of this, manufacturers reduced their prices below replacement costs. Now, with an increasing demand, it becomes necessary to replenish the stocks at costs higher than were anticipated. Pig iron, castings, and steel are higher than at the beginning of the year. The hourly rates for labor have not been materially reduced, and with the scarcity of skilled mechanics in the machine-tool building field, there is no reason to expect lower labor costs.

Doubtless the expectation of increased machine tool prices is the reason why many large corporations have placed substantial orders during the past two months. They realize that the present is the best time to buy not only because prices are at their lowest but because deliveries are prompt. Unmistakable indications of rising prices usually result in a rush of orders which in turn slows down deliveries.

* * *

TRADE ASSOCIATION ACTIVITIES

The activities of a number of associations, most of them in the building trades, formed for the purpose of maintaining prices of material and labor at fictitious levels, have created in the minds of many people the erroneous belief that trade associations as such are harmful to the public welfare. Secretary Hoover has stated, and investigations have shown, that not one-tenth of the many hundreds of manufacturers associations in the United States have engaged in any activities that could be construed as an infringement of the law. Trade associations may and should engage in many activities that are of benefit to the public interest as well as to their own members; because by decreasing the costs and hazards of conducting business, prices usually are reduced. Many such associations are actually working toward a reduction of prices to the public. Secretary Hoover is particularly emphatic in his statements that trade associations as a whole are useful, and that violations of the law by a few associations does not condemn the lawful and useful activities of the others.

Among the many useful activities in which trade associations may and should engage, are the adoption of standard forms of contracts; collection of credit information; standardization of machinery and processes; adoption of uniform trade practices and methods; promotion of the education of apprentices; employes' welfare work; cooperation to oppose unfair legislation; promotion of closer relations with the Department of Commerce; collection of statistics of production, costs, consumption, and distribution; and the publication of such statistics for the benefit of their members and the public.

Some of the activities in which trade associations may not engage are agreements to increase or maintain prices, and to curtail production or suppress competition. Neither may they adopt any marks or labels which would tend to result in the same price being charged for articles made by different manufacturers bearing identical labels. The collection of credit information is permissible; provided it is not for the purpose of establishing black-lists.

As practically every manufacturer, in whatever line engaged, is now a member of one or more trade associations, manufacturers generally are interested in knowing what trade association activities are legal and are encouraged by the Government, and what are not permitted.

* * *

UTILIZE YOUR SPARE TIME NOW

While manufacturers are taking advantage of the industrial depression to improve their plants, working men should prepare for increased activity. Many thousands of workers have more spare time than they know what to do with, and those who give thought to their future will devote this time to practical study of the work they wish to engage in so that when the door of opportunity opens they will be ready and qualified to enter. It is not necessary to attend school to accomplish this. There is an abundance of literature available on all phases of shop practice, and each man can be his own instructor.

Now is the time for every working man to take stock of his knowledge and to see what lack may bar his future progress. He should ask himself, "Do I know all there is to know about my job?" "Do I know what feeds and speeds should be used on different classes of work?" "Do I know what lubricants to use for different materials?" "Do I know what factors govern production and whether this design of die or jig is the most efficient for this particular work?" The answers to all these questions and many others are available in the technical literature of today and men can obtain the books needed with little expenditure. Even if that is not feasible for a man out of employment, he can always resort to the public library. The important objective is to form the habit of reading and studying, now that there is time.

* * *

BALL BEARINGS FOR TEXTILE MACHINERY

There are many opportunities for the economical use of ball bearings in textile machinery, and in several textile mills they have been provided to replace the plain bearings furnished by the builders of the machinery. In one instance several hundred ball bearings were so installed by one of the leading textile manufacturers.

The users of textile machinery would be better served if these bearings were made part of the original equipment by the manufacturer. Ball bearings are of as great value in textile machinery as in any other line of industrial equipment which requires bearings, and their use would often avert bearing trouble while effecting a considerable saving in power.

Textile machinery has been developed to a high state of efficiency by following the somewhat conservative principles of old-time mechanics; but some of the modern developments in machine construction could now be applied advantageously.

Cutting Prices Below Cost

By A. W. HENN, President, National Acme Co., Cleveland, Ohio

IN a period of depression such as we have just passed through and out of which we are now emerging, reductions in prices are naturally the order of the day, partly because labor and material costs in such times are generally reduced to a considerable extent, and partly because the law of supply and demand forces prices down. At first there is an attempt to keep prices at a level where a fair profit may still be realized, but after a while competition generally forces them down to a level where there are not only no profits but where goods are actually sold below cost.

At first sight it may seem uneconomical and unwise to sell the products of industry below cost at any time but there are reasons why it may be advisable to do so under certain circumstances; and there is generally a period during every depression when the need for selling below cost arises. The demand may be so small and competition so keen that if one or more manufacturers in a given field refused to accept conditions as they are, they would get scarcely any share whatever of the small business that is to be had. This, in turn, would make it necessary for them either to close their factories entirely and permit their organizations to go to pieces, or to carry a certain part of the plants along working on stock; this is not only expensive for the time being but sometimes may be followed by losses as great as would be the selling of the product immediately at a price lower than its actual cost.

During the present depression many manufacturers have concluded that it would be better for them to maintain their organizations as nearly intact as possible, even though this could be done only by selling at a loss. This has also made it impossible to hire more men, at least on a part-time basis, and to prevent too serious effects from unemployment.

Need for Selling below Cost is now Past

That period of the depression when it was necessary to accept practically whatever price the market would bring has now passed, and it is time to stop the practice of selling without regard to production costs. The demand in almost every line of metal products is now sufficient to warrant increases in prices to a level commensurate with costs, and manufacturers in general ought to recognize this fact. A prolonged period of selling below cost after the most acute stage of the depression has passed is injurious not only to the individual manufacturer but to the industry as a whole, because it deters the return to normal economic and industrial conditions. The shop or industry that continues to sell below cost naturally forces its competitors to follow a somewhat similar procedure, and as long as any industry disposes of its products thus, its economic condition is such that it cannot itself be in the market for the products of other industries, except to the extent of the bare materials that are used in production. On the other hand, as prices return to normal, and fair returns are realized on capital investment, the manufacturers themselves come into the market for new and improved equipment, thus aiding the early revival of industrial conditions in the entire field.

The demand at the present time for practically all of the products of the metal-working industries is brisk enough so that prices must rise. In some industries this increase in prices has already taken place, while in other branches it has yet to come; but in every case it is safe to say that the low level either has been reached and passed, or it has been reached and will soon be passed. Business is coming back much faster than one might have expected a few months ago, and unless some deterring influences are again brought into action—like nation-wide strikes that affect the supply of raw materials or transportation—there is every reason to believe that steady improvement is ahead, and that the return to normal conditions is assured. In some branches of the industry it may take somewhat longer to come back to normal than it will in others. The automobile industry may be said to have returned to a normal state already, and so have the industries depending upon it, such as the alloy-steel and the parts manufacturing lines.

Future Prices must be Higher than the Pre-war Level

Prices in finding a level which will cover costs and leave a satisfactory return on capital investment, must today unquestionably be a certain percentage higher than pre-war prices in every line of manufactured goods, because wages are definitely on a higher plane; and there is no reason to expect that wages will soon return to the pre-war level. Broadly considered, there is no reason why business should not be as stable and normal with a higher wage level and correspondingly higher prices as it was previous to the war. The only thing that is required is such an *equalization of wages* that labor in different industrial activities and in various trades will receive approximately the same compensation for similar work.

Equalization of Wages Necessary

It is impossible to continue to pay some trades wages that are two or three time as high as the wages in other trades. It is true that in those trades where steady employment throughout every day in the year is impossible, hourly wages should be correspondingly higher than in those where permanent employment is reasonably assured; but the adjustment should be equitable and proportionate to the reasonable period of employment. The workers in the transportation field particularly, who are assured of a permanency of employment equalled in few other occupations, are receiving proportionately higher wages than the employes in practically any other enterprise. Nevertheless, these men are more actively resisting a readjustment of their wage scales than the members of any other craft or trade; but an equalization of wages will nevertheless become necessary even if industry must pay the price of cessation of activity and unemployment due to strikes and labor troubles.

There is one thing that the labor unions must learn sooner or later—and the sooner they learn it the better it will be for their own well being and prosperity—and that is that you cannot get any more out of an industry than you put into it. If you put into an industry short working hours and inefficiency due to unreasonable rules and regulations, that industry in the long run will suffer and the fund out of which the workers must be compensated will be that much less. If we were all working at all times at the top speed that the piece workers did in the munitions factories during the war, the production that could be shared by all would be that much greater and the possibility for greater returns for labor would increase. It is when the cost of production begins to exceed the price at which the goods can be sold that the wheels of industry stop; if the cost of production could be continuously held below the price that the consuming public is willing and able to pay, the wheels of industry would continue to turn without interruption.

Diamond Alloy—A New Cutting Metal

DIAMOND alloy is a non-ferrous alloy composed mainly of chromium, molybdenum, and tungsten combined in proportions and by processes that result in a metal so hard that cutting tools made from it possess an unusual resistance against wear. Another favorable property is that tools made from the alloy may be used under conditions of feed and speed that raise the temperature almost to the fusion point without there being any tendency of the cutting edge to soften. The metal is non-magnetic, a property that is desirable under certain conditions.

The alloy cannot be forged, but milling cutters, slitting saws, reamers and other tools of this general character are cast in permanent molds, the process assuring a uniform composition of the metal and freedom from blow-holes and other defects sometimes found in cast metals. Some tools are cast on a steel core or center, or on a shank, while others are made entirely from the alloy. The possibility of casting on steel is especially important with such tools as keyway milling cutters where it is desirable to have the cutter at the end of a shank. In such cases the shank is made of chrome-vanadium steel which possesses ample strength to withstand severe service conditions. A flange on the end of the shank has a groove machined around its periphery, and when the alloy is cast on this flange, the groove serves to positively lock the metal against sidewise movement. The same general form of construction is employed in making other milling cutters, slitting saws, chucking reamers, etc., advantage being taken in every case of using a lower priced material of ample strength for the shank.

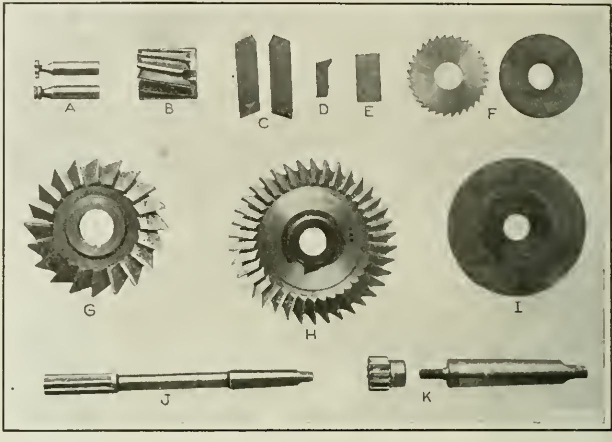


Fig. 1. Typical Examples of Tool Bits and Cutting Tools made from Diamond Alloy

A group of tools made from the alloy is shown in Fig. 1. A keyway milling cutter and shank of the design mentioned in the foregoing are illustrated at *A*, and a shell end-mill at *B*. The blades presented at *C* are for an inserted-tooth milling cutter, and that at *D*, for an inserted-tooth circular saw. A blade blank is shown at *E*. At *F* are illustrated a slitting saw and a solid Diamond alloy blank from which this tool is made. The milling cutters at *G* and *H* are machined from blank *I* on which the alloy is cast on a steel center. The chucking reamer at *J* has the alloy cast on a shank, and spot-facer *K* consists of a Diamond alloy cutter and a separate steel shank on which the cutter is screwed.

Advantage is also taken of the possibility of welding Diamond alloy to steel by making "laminated" tool bits which consist of a strip of the alloy welded to a strip of chrome-vanadium steel. Such a combination provides a tool having both the cutting properties of Diamond alloy and the strength possessed by the steel backing. Laminated tool bits are shown in Fig. 2 at *P*, and tool bits made entirely from the alloy, at *Q*.

The following examples of results obtained with tools made with Diamond alloy will be of interest: In milling cast iron the cutter was run at a speed of 370 feet per minute with a feed of 15 inches per minute and a 1/8-inch depth of cut. In turning machine steel having a carbon content of from 0.35 to 0.40 per cent, the tool was operated at a cutting speed of 125 feet per minute with a feed of 5/16 inch per revolution of the work and a 1/8-inch depth of cut. In turning a chrome-nickel steel shaft, the cutting speed was 125 feet per minute with a feed of 1/32 inch per revolution of the work, and a 7/32-inch depth of cut.

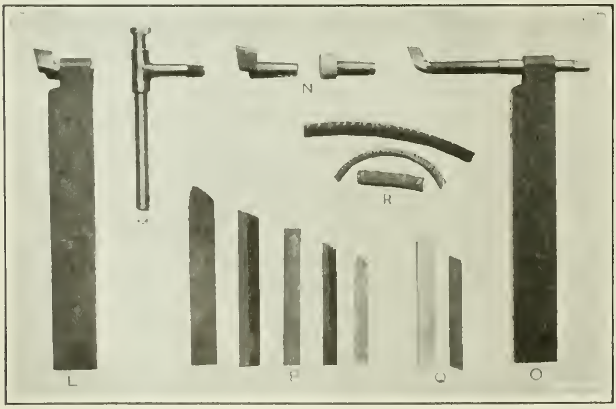


Fig. 2. "Super" Tool-holder and Tool Bits and Diamond Laminated and Solid Tool Bits

Referring to Fig. 2 there will be seen at each end of the illustration a tool-holder known by the makers as the "Super." This tool-holder is intended for use with different styles of cutter bits made from the alloy. It is made in nine sizes with shanks ranging in cross-section from 3/4 by 3/4 inch up to 1 1/4 by 2 1/2 inches. The boring tool *M* and the single-point and round-nose cutter bits *N* have a taper shank which fits into a corresponding socket in the tool-holder. In the case of a single-point bit the same bit and holder can be adapted for service where either a right-hand, straight, or left-hand tool is required, by changing the position of the bit in the holder.

The taper of the shank on the tool bits is very gradual, and as a result the pressure of the cut forces the shank securely into the holder and assures permanence of the bit position without the use of set-screws or other clamping means. This tool-holder can also be furnished for drills, boring tools, etc. Diamond alloy and the "Super" tool-holder are manufactured by the Kent-Owens Machine Co., Toledo, Ohio, and the exclusive selling agent for these products is P. H. Biggs, 1235 W. 9th St., Cleveland, Ohio. The alloy was formerly made by the Diamond Alloy Tool Co., St. Louis, Mo.; it was developed by Walter Brown, who is now manager of the Diamond Alloy Division of the Kent-Owens Machine Co.

* * *

STOP FOR AN AUTOMATIC MACHINE

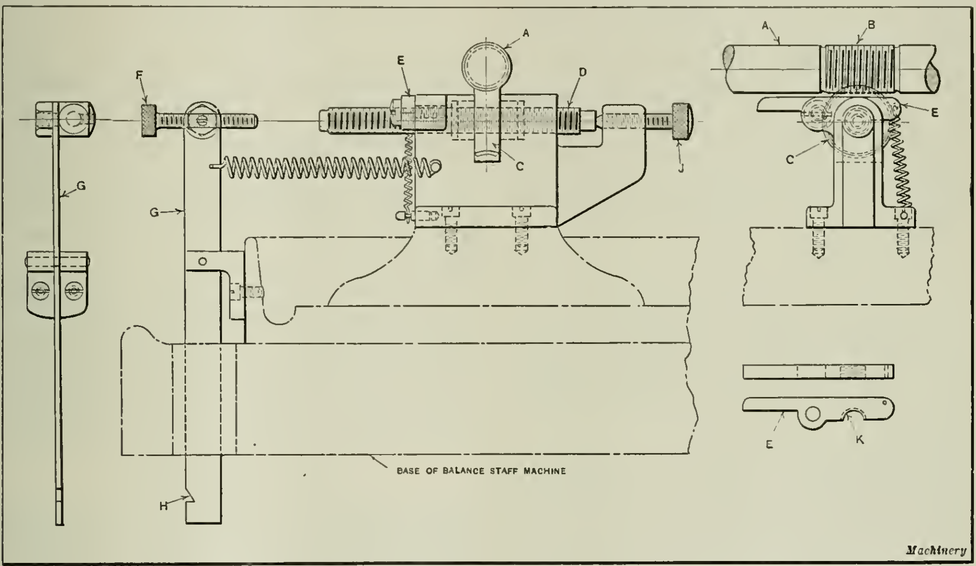
By I. BERNARD BLACK

An automatic stop designed to prevent the jamming of stock in the feeding chuck of a balance-staff machine when the end of the stock has been reached is shown in the accompanying illustration. Several automatic stops were tried out on these machines without success previous to the development of the stop shown. This stop is a modification of the type used on bench screw machines. Before proceeding with the description of the stop it may be well to mention that a balance-staff machine is used for turning the balance staffs for watches. The balance staff is the shaft on which the balance wheel of a watch is secured. At each end of this shaft is a fine pivot. When assembled in the watch these pivots are supported by jewel bearings.

The balance-staff machine is similar in design to a small bench screw machine. It consists of a spindle containing a chuck and a mechanism for feeding the stock forward, a camshaft with a set of cams for operating the chucking mechanism, for reversing and controlling the feed, and for operating the front and rear cross-slides. The front cross-slide carries the cutting-off milling cutter, and the rear cross-slide the milling cutters that form the pivots. It might be added that the balance staff is only rough-milled in this machine; it is afterward put into a pivot-turning machine and the pivots turned down to the required diameter and then polished. During the milling of the pivots and the cutting-off operation, the work is firmly held in a support. The spindle camshaft and the cutters in the cross-slides are all driven separately from the main driving shaft.

In attaching the stop it was necessary to alter the regular camshaft *A* somewhat. A left-hand quadruple-thread worm having five threads per inch with a lead of 0.20 inch and a pitch of 0.050 inch was cut on the shaft at *B*. This worm is employed to drive the worm-gear *C*. When the machine is in operation the camshaft turns the worm-gear *C* which, in turn, revolves shaft *D*. A keyway is cut the entire length of the threaded part of shaft *D*. A key held in worm-gear *C* is made a sliding fit in this keyway. Now as shaft *D* has a left-hand thread which fits the threaded part *K* of piece *E* (see view in lower right-hand corner), shaft *D* will move toward the set-screw *F* when the machine is in operation. When lever *G* is pushed back by the end of shaft *D* coming in contact with screw *F*, the stopping device of the machine, which is controlled by a latch held in V-slot *H*, is released and the machine stopped.

The stock used in the manufacture of the balance staffs comes in three-foot lengths, and the stopping device is set to stop the machine automatically when about 2 inches of stock is left in the feeding chuck. This prevents the jamming of the stock between the cutters and enables the operator to easily take out the piece left in the chuck and to feed in a new piece of stock by lifting part *E* sufficiently to disengage the thread of shaft *D*. The latter member may be pushed back into contact with the stop-screw *J*, when lever *G* will spring back to its former position as shown in the illustration. The machine is then started by lifting up the starting latch so that it will be engaged by the V-slot *H*.



Device for automatically stopping the Operation of a Balance-staff Machine when the End of the Stock is reached

* * *

The Bureau of Fire Underwriters has estimated that the destruction of property by fire in the United States during the five-year period ended with 1920 was $1,672,722,697. Carelessness in the use of matches is said to be the cause of property loss valued at $90,000 000. Spontaneous combustion, lightning, heating systems, sparks on roofs, and defective chimneys are other causes of fire loss named by the bureau. It is safe to say that the fire loss would have been greatly reduced had every property owner given the various causes named above due consideration and taken steps to remove all unnecessary hazards.

Advancement in the Machine Industries

By LUTHER D. BURLINGAME, Industrial Superintendent, Brown & Sharpe Mfg. Co., Providence, R. I.

THE worthwhile opportunities in the machine tool industry which should stimulate young men of ability to train in this field for their life work, have been well pointed out by Fred A. Geier and J. B. Doan in July MACHINERY. It is the purpose of this article to indicate some of the qualifications necessary to take advantage of these opportunities, and the preparatory steps required to make such a career successful.

When the writer entered the machine tool industry nearly forty years ago, he heard many expressions of discouragement from those already engaged in it—expressions to the effect that the "good old days" had gone, that there was no opportunity for men to advance, that there was nothing left for them but drudgery, and that they would advise their sons to go into other lines of work. Notwithstanding these pessimists (whom by the way we still have with us), there has been more progress during these forty years, and wider opportunities have opened up than in all the centuries before; and there is no reason to believe that the next forty years will not show equal and even greater opportunities, and opportunities along more specialized lines, so that each branch of training and of ability can have full scope. Those who are willing to train themselves now, will reap a rich harvest in the future.

Character

No matter what branch of the work is undertaken, there are certain qualifications essential to real success. The first of these is character. Many years ago the late Frederick W. Taylor said in speaking of the qualifications necessary to attain success in life: "Without the slightest question, character comes first, good sense second, and intellectual training third."

The training required to develop character and good sense is more difficult to define in a specific way than that of intellectual training. The former includes the cultivation of a spirit of loyalty, both to superiors and to the business with which one is connected; honesty in its broader sense, which might include faithfulness, promptness, thoroughness, etc.; and energy to prosecute the work in hand. It develops such qualities as are summed up in Hubbard's immortal "A Message to Garcia."

Character is not formed by studying rules in books, but is gradually developed by holding to a high standard through the many temptations in life, emulating the example of great men among contemporaries and acquaintances as well as characters in history and fiction. A man is fortunate indeed who through birth and home training starts his life work with a well-grounded character.

Good Sense

Under good sense might be placed the cultivation of judgment, which in turn can be acquired by learning from the mistakes of others, as well as one's own; by storing up a fund of information with which to measure new conditions as they arise; and by never depending on opinions without checking them up with facts. Intellectual training, through continued and extensive study, can be made an important adjunct to good sense because it gives, in addition to a broad knowledge, the ability to secure desired information quickly even though not carried in the mind. A trained mind that has learned to memorize, to analyze, and to coordinate knowledge, is a tool capable of being used in any emergency or for solving unexpected problems.

Speed and Accuracy

Every employer appreciates speed and accuracy in work, speed being a quality which counts directly in determining the value of designers, engineers, and executives, but which without accuracy may have its advantages entirely offset. Waste from inaccuracy is forcibly pointed out in a little booklet by Jerry McQuade, in which he cleverly shows how what seemed like a small error took the time of thirty-seven men, three women, two boys, and eight horses to correct.

Speaking and Writing

An important stepping-stone toward success lies in cultivating the power to speak and write convincingly. Whether speaking in public or in private, the ability to present forcibly before one or more hearers the reasons for pursuing a certain policy, or for accepting a proposed design, may mean success or failure. The faculty of stating clearly and briefly in a written report what it is desired to impress on others may lead to the acceptance of a plan or the adoption of a policy which, with poor presentation, would not be favorably considered even though good in itself.

The development of this ability can be helped by taking part in the activities of engineering societies, or such other societies as most directly deal with the particular phase of industry for which one is studying. This also can lead to a wide acquaintance, both personal and by correspondence, which is one of the best assets to insure future advancement. Many a young engineer has started on the road toward a wider field of activity by writing for the technical press, and by studying technical books and journals.

The Good Job is the Hard Job

The young man who is looking for an easy job is not likely to be the one who will excel later. It has been well said that "the good job is the hard job." Dr. Taylor, already quoted, says that in examining the careers of those men who have become successful: "It has been found that they are men of singleness and earnestness of purpose; men who have acquired by long training those habits both mental and physical which make them masters over themselves together with a firm determination to pay the price for success in hard work and self-denial."

The ability to serve well is the first qualification for success in directing others. One of the important lessons to learn is that of working with all kinds of people, both as superiors, as shopmates, and as subordinates. The cultivation of such traits as will make a man universally liked and respected by those about him, will prove a valuable possession in the successful handling of men.

Specialized Training

When the specific question is asked: "What shall I study to secure advancement in the machine tool industry?" it at once raises the question as to the definite line for which one is training. In addition to the general qualifications already discussed, the development of which should help in any branch of the work, there are many opportunities to specialize in training. For instance, there is the case of a boy brought up on a farm, with meager education, who when he became an apprentice in a machine shop, spent his evenings studying algebra and geometry. He afterward became eminent as an authority on gearing. Then there is another case of a young man who spent his spare time outside the machine shop studying French and German. He afterward represented his employers at a great exposition abroad and later became sales manager for a company having extensive foreign connections.

Many young men of an inventive turn of mind received much stimulus a generation ago from a series of articles on the Cultivation of the Inventive Faculty, giving problems in mechanisms to be worked out by the reader. One, when asked what studies he expected to pursue during the summer, said that he felt that he would gain the most by studying human nature.

These illustrations show the wide scope of training which may fit one for advancement. Such training might be classified under the heading of the Five M's: Men, Methods, Material, Machinery, and Money, which, generally speaking, constitute the factors in industry.

Men—Learning to deal with the human element, with equal emphasis on the need of learning how to work with the boss and with the workman. This may also include all branches of industrial service work, such as safety, medical supervision, industrial schools, recreation, and Americanization. The ability to meet and deal with men is an important, if not the most important, element of salesmanship.

Methods—The study of shop organization, with its many branches, such as efficiency, routing, etc. Also economical methods of production and elimination of waste.

Material—Raw material; stock to be carried; its cost; its quality, including questions of hardening, heat-treatment, etc., the utilization of scrap; all are subjects worthy of serious study.

Machinery—Cultivating ingenuity and invention; learning simplicity and adaptability of design; tool and jig work, etc.; acquiring a knowledge of the history of mechanical development, including the matter of patents; and competitors' products.

Money—Acquiring proficiency in timekeeping, cost accounting, auditing, credit rating, and general office and business administration.

The Value of Having a Hobby

Besides the study given to the particular line chosen, every man should have a hobby, something that will take his mind entirely off his work. It is not always advisable to devote every minute of one's spare time to studies, even though good in themselves. Some time should be given to activities which tend to widen the circle of vision outside of the professional field. Having a hobby has directly to do with health, because any interest enjoyed as an avocation is conducive to good health. It goes without saying that without a healthy body and a clear mind one is working under a great handicap, which limits success in any line of endeavor.

Any of the various branches of mechanical industry here discussed, successfully mastered, can be made an effective tool for advancement to a position of trust and profit. While study and preparation should not stop with school but be made a part of lifetime activities, it must not be forgotten that the main purpose in life is not to absorb knowledge but to give it out. Success is not attained until a point is reached where instead of assimilating, knowledge is distributed for the benefit and advancement of industry, and the good of the community.

The lines of study here mentioned are merely illustrative. Other lines will be suggested by simply having the requirements stated; and it must be understood that broad and extended experience, in addition to knowledge acquired by study, is the sure foundation on which success in the machine tool industry can be built.

LEARNING VERSUS STUDYING

By A. W. FORBES, Forbes & Myers, Worcester, Mass.

On page 870 of the July MACHINERY is found the statement: "There is much less inclination to devote spare time to study than in the years preceding the war, and the tendency to avoid serious effort is marked." This statement is made about the "younger generation" which probably means those under, say, twenty-five years of age.

It may look that way to manufacturers who are trying to get their younger employes to study for advancement in their work, but a glance at the schools for people of working age gives an entirely different impression. At least in Worcester, school attendance has increased in an astonishing manner, both day and evening. New public and private schools are continually being opened, and the old ones are overcrowded. Does this show a disinclination to study? It would be hard to convince the unprejudiced observer that it does, and yet there is something in the statement quoted. This enthusiasm for schools is rather a desire to be taught than a desire to study. There certainly has been a change in the general attitude, but this change has been more a loss of self-control than a loss of ambition. The modern youth is ready to rely on others to make him into somebody rather than to direct his own course. It must be remembered also that the schools are continually diverting an increasing number of boys from the factories, and that those so diverted are often the ones most inclined to study.

Educators feel that this change is a great improvement. They point with pride to the growing number seeking school education, and are doing all they can to promote the good work. The author is inclined to take the opposite view. The electrical shop of Forbes & Myers, Worcester, Mass., employs a number of boys. Practically all these boys have spent a considerable portion of their spare time in some form of school study, academic, trade, or technical; day, night, or correspondence. While some of this study is doubtless valuable for general culture, particularly the academic, it seems to have no practical value for making progress in the shop.

The kind of study that the boys in the shop are urged to do is the kind that it is most difficult to get them to do; namely, to take up a problem which occurs in connection with the work, and to study it thoroughly, both in books and periodicals, or any other place where they can find information. It was probably this lack of personal effort on the part of the younger generation in the matter of study that was felt by the author of the statement quoted in the first paragraph of this article. Only by such study, however, can the shop employe advance beyond the knowledge that any of the standard courses can give him.

The cause of the changed attitude toward study can most likely be found in the schools. It is not a change that occurred during the war, although the war may have accelerated it. It has been going on for many years. From the kindergarten up the boys must fit into the school routine. At the same time they are being impressed with the value of the school. After a certain amount of study the mind naturally becomes tired, at least to the extent of not looking for problems to solve. With the propoganda urging them toward school study, the boys devote to it practically all the time that they are willing to give to acquiring any kind of knowledge; after that they cannot be expected to start right in again studying their work.

There seems to be actual conflict between the schools and real study that leads to advancement, but this point is not often recognized. A boy whose mind has been thoroughly trained to receive information in the way it is presented in school, is not so well prepared to study by himself as he would be if he had never been to school. Instead of blaming the boy, it might be more just to blame the institution that has failed to teach him the most profitable form of study.

The British Metal-working Industries

From MACHINERY'S Special Correspondent

London, July 14

THE interruptions of the last three months have naturally deranged all branches of engineering industry and some time must elapse before production programs can be straightened out. There has, however, been a grain of comfort in the fact that, serious as the stoppage has been, it might have been disastrous had it not occurred during a period of very limited buying.

In the machine tool trade makers are finding that current demand is confined largely to special machines. Inquiries for standard machines continue and it is generally expected that export trade will be the first to recover. In the ordinary lines of machine tools, both manufacturers and dealers are still overstocked and there is doubt if more than a small percentage of the machine tools sold from Government stock have gone into service. Buyers of machine tools realize that machine tool builders can deliver stock machines to meet any emergency; hence they hesitate to purchase with a view to having equipment on hand for future production.

Machine Tool Prices

Although most machine tool makers are no doubt open to offers for their products, there is no tendency toward a general slump in prices. A substantial decline in machine tool exports or a large influx of foreign tools might have a serious effect on prices, but neither of these conditions is likely to arise. America has a good stock of machine tools in the country but there are no signs of selling at low prices. The downward movement of prices in general is rapidly slowing up, for the simple reason that it is impossible to produce new supplies at a lower cost.

During 1919, when prices had reached a zenith, machine tools averaged two and one-half times the 1914 values; they have now fallen to about twice these values. As general prices appear to be finding a level at about one and three-quarters to twice the pre-war levels, it will be seen that machine tool prices are in keeping with other products. In the machine tool industry several of the costs, such as fuel, railway rates, packing and many general supplies, have risen above the average increase for other commodities. Machine tool makers cannot be held responsible for this.

General Engineering

Motor car manufacturers continue to be in a strong position; demand is unabated and in the trade there is no accumulation of stocks. The disturbance of production systems owing to recent trouble has seriously upset delivery dates and in several sections of the industry multiple shifts are being worked in an endeavor to hasten the lagging production that is holding up delivery of complete cars.

There is a renewal of activity in railway car and locomotive shops, and substantial orders have been or are about to be placed. Among these may be mentioned materials to the value of £60,000,000 to be used in a big scheme of Indian railway reconstruction that has been postponed since 1914. The contracts will take ten years to complete. The Caledonian Railway Co. has ordered twenty new locomotives from the North British Locomotive Co., Glasgow, and the same railway company has placed orders for five hundred cars from Hurst, Nelson & Co., Motherwell.

An improved demand is urgently needed in the marine engineering and shipbuilding industry. British yards, however, are competing with more success for repair work that has been going to the Continental yards. The future is uncertain, and may remain so until the important questions of oil supply and control are satisfactorily settled. Upon this hinges, to a large extent, the type of prime mover which will be installed in the future, and the internal arrangement of the ships themselves.

An order has been placed by the United Fruit Co. of Boston with Cammell Laird & Co., Ltd., for three 4000-ton insulated motor ships. These will be driven by electric motors, with Camellaird-Fullager Diesel engines as prime movers.

The textile machinery trade is active, the demand being well sustained; moreover there are many orders that await completion. Wireless broadcasting is likely to develop very rapidly and the manufacture of the apparatus used in connection therewith will be largely a new industry. In the iron and steel trades, the position shows little change compared with a month ago.

The Foundry Trades Exhibition

The International Foundry Trades Exhibition was held at Bingley Hall, Birmingham, during the latter part of June. Out of a total of 178 malleable iron foundries in this country, 134 are in the Birmingham area; most of the nonferrous foundries and nearly 1000 out of 2800 gray iron foundries are in the same area, indicating the great importance of Birmingham to the foundry trade. The exhibition served to show that there are now quite a number of British firms producing molding machines of all types and sizes. There is also evidence that foundries in this country have developed their technical resources considerably and have at the same time been wide awake to any improvement introduced on the Continent or in America.

Overseas Trade in Machine Tools and New Equipment

During May the exports of machine tools reached a value of only £114,372 as compared with the April return of £171,612. The value per ton rose from £121 to £139. Imports fell during May from 266 to 250 tons for the month, the value per ton falling from £116 to £97. The latter is a lower figure than has been registered for a very long period. How much of these reductions in trade are definately due to the lock-out and its concomitant troubles, it is not easy to say, but last month's returns show a decided falling away from the promise of the previous few months.

Prominent among new machine tools is an 8½-inch lathe by Dean, Smith & Grace (1908), Ltd., Keighley. Since being first placed on the market some eighteen months ago, several new and interesting features have been added. One of them is an arrangement of supports for long lead-screws. At each side of the saddle the lead-screw is supported by jacks that are automatically moved into and out of position by the movement of the saddle as it is traversed. The result is an adequate support and a prevention of any undue sagging, while at the same time there is no obstacle left in the path of the saddle.

The Cambridge & Paul Instrument Co., Ltd., London, have introduced a furnace temperature controller that can be easily applied to any type of furnace fitted with an indicating pyrometer. The controller is suitable for the lowest temperature recorded by resistance thermometers up to the highest temperatures indicated by Fery instruments.

MAKING OVER-SIZE PISTON-RINGS

The manufacture of piston-rings involves skilled workmanship and careful inspection methods to insure the necessary degree of accuracy. The Houpert Machine Co. of Long Island City, N. Y., manufactures over-size piston-rings for its own use in refitting reground cylinders. The manufacturing methods employed by this company in making rings are here briefly reviewed.

Milling the Lap Joint in the Rings

The piston-rings are made from individual castings and are finished all over. They are concentric in form, and are sometimes provided with a lap joint and sometimes with an angular joint. Before cutting the joints, the castings are ground on the sides on a Heald rotary surface grinding machine, and rough-ground on the outside diameter on a cylindrical grinding machine. The method of milling the lap joint is illustrated in Fig. 1. This work is done on a duplex type of hand milling machine, the heads of which are provided with suitable adjustment so that the end-mills may be offset as required to produce the joints.

The rings are abutted against two pins and are located against the scraped surface of the heavy cast-iron angle-plate *A*. A parallel clamp *B* is secured against the opposite side of the ring, and operated by a capstan wheel at the front of the machine. The capstan wheel is fastened to an operating screw, one end of which tapers and extends into a corresponding hole in the clamping member *C*. This member is simply a short shaft, set at an angle in bracket *D*, and provided with an adjusting nut *E* so that various widths of piston-rings can be accommodated. When the operating screw is advanced by the capstan wheel, its tapered end moves member *C* forward, and forces the clamp *B* against the ring. Two coil springs attached to the clamp, one above and one below, free the work when the clamp is released.

This device is attached to the table of the milling machine, and the ring is fed by hand against the end-mills, thus producing the lap joint. When the two cuts that produce the joint have been completed, and the milling machine table has receded, the capstan wheel is turned, releasing the clamp and permitting the ring to drop into a receptacle beneath.

Finish-grinding and Boring

The next machining operation consists of finish-grinding the outside diameters. The rings are taken to a bench, where the grinding arbors are loaded with rings, but before loading on the arbors, the lap joint is faced off slightly at the ends, on the side of a disk grinding wheel. In loading the arbors, the rings are compressed between four high jaws, arranged radially 90 degrees apart on a faceplate, which are adjustable for different diameters of rings. While the rings are thus compressed, the arbor is run through them and they are clamped from the ends. The jaws are then removed and the arbors placed between centers in the grinding machine. The last machining operation required to finish the rings all over is boring. A quantity of rings are arranged in a suitable chuck and a boring-bar fed through them.

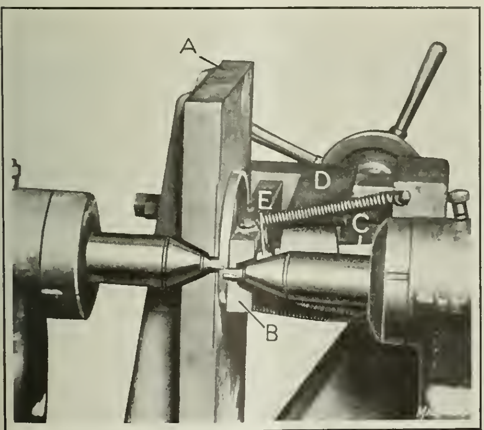


Fig. 1. Duplex Hand Milling Machine with Piston-ring Clamping Device

Fig. 2. Grinding Ends of Lap Joint before gaging for Expansion

Fitting the Rings to the Cylinder Bore

Finally, the rings are fitted to the cylinder bore. Although this is apparently a simple operation, it is of great importance, and the work must be carefully done. An allowance must be made for exactly the right amount of expansion; if the rings fit too tight, the cylinder bore will become excessively worn after being in use only a short time; and if the rings are too loose, the result will be poor compression and a consequent loss of power. The fitting operation consists simply of grinding the ends of the joints to allow the proper amount of clearance after the rings have been compressed in the bore. The operation is illustrated in Fig. 2, which shows a disk grinder and the Norton elastic wheel used. The wheel is 8 inches in diameter by 1/8 inch thick. It is made of No. 46 grain abrasive and is No. 4 grade. A cast-iron gage in the form of a cylinder is used, into which the rings are compressed, the joint being exposed through a slot in the side of the cylinder. Long experience enables the operator to determine with little experimenting the amount of metal that must be removed from each end of the joint in order to furnish the proper clearance.

From time to time a thickness gage is used between the joint, this gage being of proper thickness to agree with predetermined allowances for expansion. These allowances vary, of course, with the sizes of the rings. For example, for a 4 7/8-inch ring, such as here shown, a flat gage 0.010 inch thick is used, although the allowances may range from 0.006 to 0.012 inch. After the operator has ground three or four rings and compressed them into the gage, he removes them and uses the last one to locate the next three or four, usually gaging this locating ring only. Both ends of the lap joint are ground, an equal amount of metal being removed from each.

Effect of Design on Drilling Machine Efficiency

By F. E. JOHNSON

IT is often the case that a machine is lacking in certain essential points of design, with the result that the tools employed are subjected to various kinds of strains, stresses, or shock. Vibration, friction, and deflection of machine members are factors that must be overcome in producing different classes of machine tools. It is proposed to discuss in this article certain important factors in the design and operation of drilling machines, and to advance suggestions for improving the operative conditions commonly found in machines of this type.

The advent of high-speed steel made it compulsory for machine tool builders to make radical changes in the design of their machines in order to meet the new requirements. Many of the earlier types of machines, which were originally designed to employ carbon steel tools, have not been able to resist the strain set up when it was attempted to drive high-speed tools at their maximum capacity. The weaknesses developed also reacted on the tools with a destructive effect. Consequently, the quality of the work was not of the best, production was insufficient, and the expense for machine repairs was high. Vibration in an efficient quantity-production machine must be overcome as far as possible, and in order to do this and prevent the tools from chattering, it has been found necessary to employ mass design wherever practicable. The machine designer, in creating a new product, is almost wholly dependent upon his general knowledge of the successful adaptation of well-known elements of machine construction. The development of a new machine is also contingent upon certain other factors, such as knowledge of minute mechanical details and how they may be best incorporated in the design.

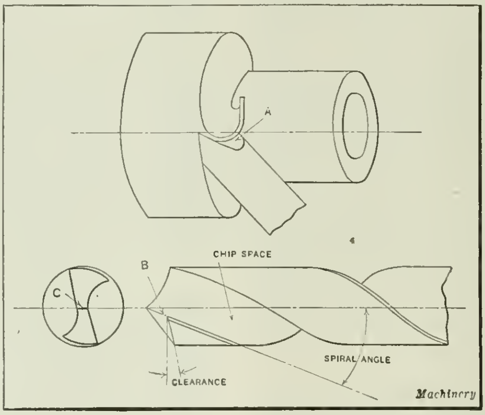


Fig. 1. Diagram used in analyzing the Cutting Action of Twist Drills

Diminishing the Amount of Sliding Friction in Machine Parts

Friction between parts of a machine consumes excessive power for operating. It also produces heat and wear of the parts. The effect of friction is greatest in heavily loaded machine parts which are slow-moving. This includes common slides and sliding shafts. The wear caused by friction decreases as the velocity of the parts increases; for high pressures, the friction is very great at low velocities. If bearing surfaces are flooded with oil, the friction is almost independent of the materials from which the parts are made, because it is the film of oil between the parts, rather than the parts themselves, with which the bearing surfaces come in contact. Theoretically, well lubricated contact surfaces do not bear against each other at all. The matter of sufficient lubrication for machine tools is therefore an important factor in their design.

The frictional losses in a drilling machine represent a large percentage of the power delivered, it being estimated that there is seldom more than one-fifth of this power which is actually transmitted to the point of the drill. This is apparently due to the nature of the cut which the drill takes, which is radically different from the cuts taken by most other cutting tools. By the use of ball and roller bearings, rolling friction is substituted for sliding friction, which results in reduced costs and power for driving the machine. In former times when the common plain type of machine bearing was used, it was impossible to obtain or maintain the velocities necessary in many modern machine tools. At the present time drilling machines, which are fully equipped with ball bearings, are available for operation at speeds ranging from 3000 to 10,000 revolutions per minute.

Direct Application of Motive Power

A point of importance in machine design is to apply power in as direct a manner as practicable. The interposition of a considerable number of shafts or other machine parts between the point of power application and the point of useful application, where power is applied to driving the tools, results in an increase in the total power requirements to operate the machine. The general arrangement of the machine parts in the assembly of a machine, as well as the number of parts which must be used and kept in motion, should always be carefully considered in machine design if most satisfactory results are to be obtained.

Drills and their Cutting Action

There are several rules that influence a machine operator in selecting speeds and feeds which he may safely follow on a particular piece of work with the available equipment. These rules are: (1) If the tool chips out at the cutting edge, the feed is too great or the drill has been ground with an excessive lip clearance; (2) a drill split along the web *C* (see Fig. 1), is evidence of too heavy a feed or of being ground with insufficient lip clearance at the center of the drill; and (3) when the extreme outer corners of the cutting edges wear away it is proof that the speed is too high.

Drills vary in hardness as much as other hardened tools, but the chipping out of steel at the cutting edges under a heavy power feed is more pronounced in drills than in other tools. This fact is due largely to the peculiar and severe duty that a drill performs. The action more nearly resembles tearing the metal than shearing or cutting it. The action of the point of the drill is one of crushing the metal, and this must be done first by the web before the cutting action can be performed by the lips. The drill point itself must be forced into the work and the metal crushed ahead of it before the lips can start to cut. A large drill requires great pressure behind it to bring about this crushing of the metal; for this reason when drilling large holes in tough materials, it is often advisable to start them by first drilling through with a drill of smaller diameter.

The action of the lips of the drill (not the drill as a whole) in removing the metal, is very similar to that of a turning tool, as shown at *A*, Fig. 1. By comparing the general formation of the lip of the drill at *B*, including the lip clearances, the great similarity that exists between the drill at this point and the cutting tool may be noted. By allowing sufficient top rake, the efficiency of the tool shown in the upper part of this illustration could be such that very little power would be consumed in feeding it laterally, as in a turning operation. Excessive top rake, however, gives the tool a tendency to pull itself into the cut, because the force required to curl the chip reacts on the tool. For the same reason, excessive lip rake will make it more difficult for the lips of a drill to curl the chip than to penetrate the work. The spiral angle or rake of a twist drill is, then, an important factor when considering the cutting action of a drill.

Factors Affecting Drilling Machine Efficiency

The speeds and feeds with which a drill may be operated depend largely upon its design and the material from which it is made, as well as upon the nature of the material to be worked. High-speed steel drills may generally be operated at double the speeds permissible in operating carbon steel drills. The length of time during which it is possible to operate a drill continuously under heavy feed, provided it has all the essential requirements of design and durability, depends upon the smoothness and efficiency with which the machine is capable of driving the drill. Weight, stiffness, and rigidity are necessary to counteract and absorb the vibration that is transmitted to the drill point. Rigidity is also required to prevent serious deflection of the machine frame and work-table—deflection caused by heavy feed pressures.

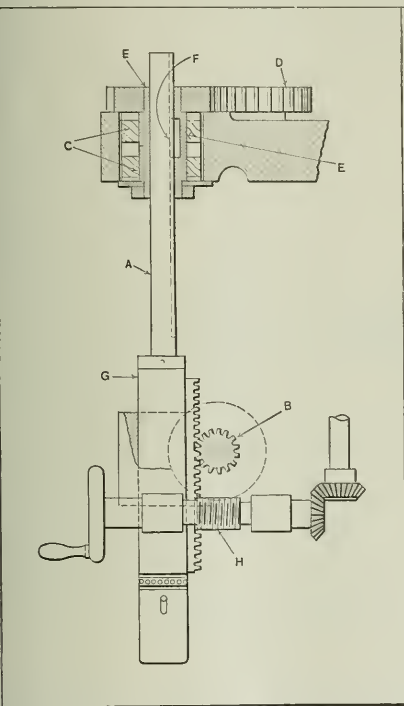


Fig. 2. Drill Feed and Spindle Drive Mechanism of Common Construction

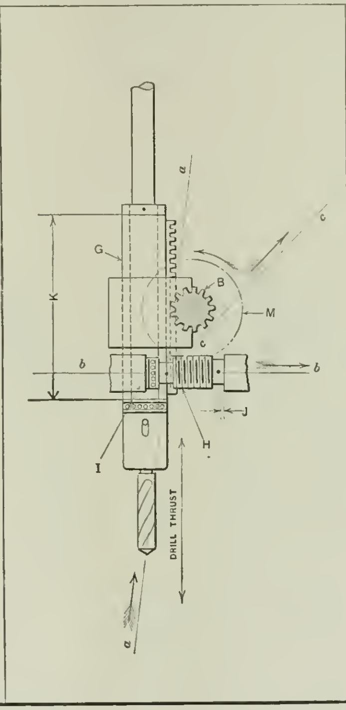


Fig. 3. Diagram indicating Thrusts set up in drilling

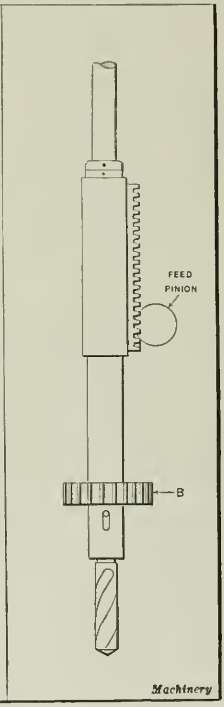


Fig. 4. Drill Spindle with Drive Gear near Nose

The web *C* is not in itself capable of any real cutting action. As previously stated, the duty that a drill must perform is more severe than is imposed on most other classes of cutting tools. The web of a drill must be comparatively thin in order to reduce end thrusts, and also to provide sufficient chip space. A small section is also necessary in order that the drill may cut properly. Because of the resistance which the machining of such metals as steel, wrought iron, and bronze offers, it is sometimes the practice to relieve the bluntness of the drill at the point by hand-grinding.

It has been determined that the feed pressure is greatest where the drill enters the work. At that stage where the lips begin cutting, the feed pressure is reduced somewhat. This is due to the fact that the top face or rake *B* of the drill lips, which is formed by the spiral angle of the drill, is sufficient in certain cases to assist in pulling the drill into the work.

Efficiency of power transmission to the drill point is important in obtaining smoothness of drill feed motion and drill spindle rotation. If the feed motion is irregular or jerky, due to friction, vibration, or backlash of machine parts, the drill point will suffer from continual shocks. It is probable, however, that there are no drilling machines that are not subject to some vibration in a greater or lesser degree, due either to the moving members of the machine or to disturbances caused by floor vibration. In drilling machines on which a heavy power feed is employed, the rate of feed in breaking through a hole is often accelerated over the normal feed, because of the reaction of different machine members which are under strain up to the time that the thrust exerted by the drill is relieved, and because of backlash that exists between the different machine parts. The material being drilled will vary, in many instances, in resisting properties, so that a varying deflection and strain in the operative machine parts is set up, together with a corresponding reaction when the strain is relieved.

Analysis of the Spindle Drive and Feed Mechanisms

The principle of a drill-spindle feed and drive arrangement such as is found in most classes of medium size and heavy-duty single-spindle drilling machines is illustrated in Fig. 2. The drill spindle is indicated at *A*, and the combined pinion and shaft which transmits the feed motion to the drill through a rack, at *B*. All the shafts which are interposed between the main driving pulley or motor and the mechanism indicated in the illustration may be mounted on ball or roller bearings to avoid frictional losses in the driving power. The friction caused by driving the drill spindle is generally relieved by placing ball or roller bearings at *C* to relieve the side thrust exerted by gear *D* upon the spindle drive gear. This driving gear is made fast to sleeve *E*, or the sleeve may be an integral part of the gear. The sleeve drives the drill spindle by means of the gear and a key *F*. It is customary to place a ball bearing at the lower end of the spindle sleeve *G* to receive the thrusts due to the feed. This ball bearing should be provided with a dust-proof cover to protect it from grit and flying particles which would cause injury or excessive wear. Before the use of a ball bearing at this point in the construction of a drilling machine became common, it was the custom to use steel and fiber washers in order to reduce heating and friction.

Heavy-duty drilling machines must be constructed with a very rigid frame. A serious deflection of the frame of a drilling machine due to heavy feed pressures results in a drill binding in the sides of the hole. Great pressure is brought to bear upon one side of the key *F* due to the resistance offered to the rotating action of the drill by the work. The resistance of the work sets up torsional strains in the drill spindle and drill, which is similar in effect to the results produced by the torsional strains in a shaft. Drills are most often broken, or shank ends twisted off, because of excessive strains of this kind. Breakage generally occurs when the drilling of a hole has been nearly completed, and where the drill point is about to break through.

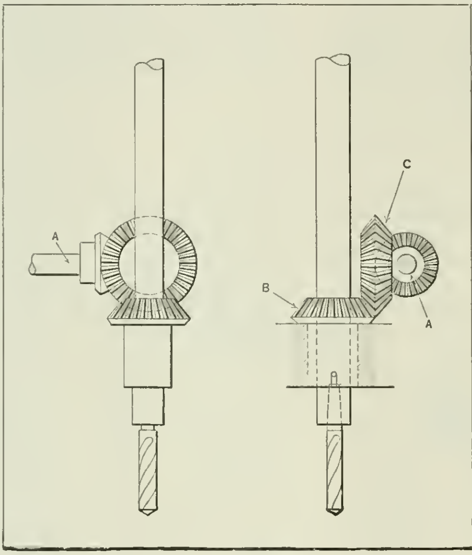


Fig. 5. Radial Drilling Machine Spindle with Drive Gear brought Close to Spindle

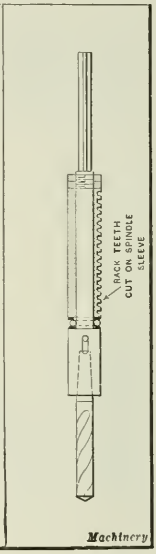


Fig. 6. Spindle with Rack cut in Sleeve

The side strain on key *F* is sufficient in heavy-duty work to prevent a smooth sliding action of the machine spindle. When the feed is engaged, the key slides in a long keyway in the spindle, and when the key is subjected to considerable side strain, this results in a binding effect on the spindle. The action of a drill spindle when great strain is imposed upon the key is particularly noticeable in tapping holes of large diameter, because the spindle must be forced forward or the threads will be stripped. Special tapping chucks containing ball-bearing keys are now being manufactured, by the use of which rolling friction is substituted for the sliding friction produced in the keyway of an ordinary drilling machine spindle.

A large amount of the thrust of a drill is taken by the slow-moving pinion-shaft *B*. The friction at this point is very great under heavy drill pressures, necessitating extra power to operate the machine. It is the practice to mount this shaft in plain bearings, since it is not a rotating shaft in the same sense as are other shafts contained in the machine. On most jobs this shaft is not required to make even one complete revolution during the entire feeding movement. If it were practicable to use ball or roller bearings to support the shaft at this point, the amount of power consumed in operating the machine, when engaged in heavy-duty work, would be greatly reduced. In addition, the increased smoothness of drill feed motion transmitted to the drill by thus eliminating much of the friction at this point, would result in more efficient operation of the machine. Reduced abrasion of worm *H* and the worm-wheel with which it engages would lessen the possibility of backlash between these two members. There is also a certain amount of friction developed between the spindle sleeve *G* and its bearing on the machine frame, due to the side thrust exerted by pinion *B*.

Fig. 3 illustrates certain other points in drilling machine construction which directly affect the efficiency of a drill. The pinion-shaft *B* which is keyed to the worm-wheel *M*, transmits the feed motion to the drill spindle rack through the rotation of worm-wheel *M* by worm *H*. The thrust produced by feeding the drill into a piece of work is indirectly transmitted to the face of the worm-shaft bearing *I*. The worm, in feeding the worm-wheel *M* in the direction indicated by the arrow, meets with resistance to motion which has the result of forcing it back against this bearing. This results in great friction being produced at this point.

Line *a-a* represents the force which is set up by the drill feed pressure, and *b-b* the resistant force produced as explained in the foregoing. The line *c-c* is the resultant of the two forces which act upon the pinion-shaft *B*, the direction of the different forces being indicated by arrows. Efficient drilling machines equipped with a drill feeding mechanism of the type described should have a ball thrust bearing between the end face of the worm and the end face of bearing *I*, as shown in the illustration, in order to reduce the friction generated at this point.

Action of Drill-feed Mechanism under Heavy Duty

In following out and studying the action which takes place in the drill-feed mechanism under heavy duty, and its effect on the drill, it may be assumed that the material to be drilled is machine steel and that the pressure exerted by the pinion-shaft *B* is 200 pounds. When the drill has nearly passed through the work, the strain upon the drill spindle driving key *F*, Fig. 2, is relieved, because the resistance to driving the drill spindle offered by the work is reduced. The power necessary to force the point of the drill into the work is not a factor at this stage of the drilling operation. The result is that the grip of the key on the spline in the drill spindle is partly released. Simultaneously the energy stored in the drill spindle causes it to be thrust forward an amount depending partly upon the backlash in the different machine members, as emphasized in discussing factors bearing on operative efficiency. The cutting lips of the drill (not the point) are not capable of offering great resistance to the accelerated feed movement thus brought about. If the rake on the lips is excessive, there is an increased tendency for the drill to pull itself through the hole which is nearly completed. The weight of the spindle and sleeve will assist in causing an accelerated feed movement if the spindle sleeve moves freely in its bearings and if backlash exists between the spindle rack and the feed pinion.

If, in the drilling process, the machine frame is sprung upward and the work-table downward, the reaction of these members, when the strain upon them is released, combines with the other factors mentioned, to impose a severe torsional strain upon the drill. The general effect of these conditions upon the drill, together with the excessive torsional strain imposed upon it, results in breakage of the drill. The chipping of drill lips when a heavy rate of feed is used is undoubtedly due, to a great extent, to the reasons mentioned. If the material being machined is comparatively soft, such as brass, for example, the tendency to increase the feed movement in the drill at the point where it breaks through the work is naturally greater. The turning of brass requires a cutting tool with negative top rake in order to prevent it from hogging into the work, and for the same reason it is necessary when machining brass with a twist drill to grind the lips by hand so that they have no top rake at the cutting edges.

Backlash between the different machine parts, due to wear or to improper fitting, may prove to be highly detrimental to the operation of the machine under certain conditions. In such cases a positive motion in its true sense does not result from the combination of so-called positive machine members which are involved.

Play and lost motion in the drill feed mechanism illustrated in Fig. 3 may result from wear or improper fitting at *J* and between the teeth of worm *H* and worm-wheel *M*. A worn condition of the spindle rack and the pinion *B* also results in developing backlash at this point. If the adjustment at *K* where the drill spindle is contained in sleeve *G*, is not properly made, the play at this point may be serious when there is a tendency for the drill to pull itself ahead as it breaks through. Play between the spindle and the sleeve would partially offset the advantages resulting from having all other operating conditions satisfactory.

Examples of Drilling Machine Spindle Drive Construction

Fig. 4 shows a drill spindle which has the drive gear *B* applied at a point close to the nose of the spindle. This construction is used in a certain make of radial drilling machines. The objective aimed at in this design is the elimination of torsional strains developed in the spindle when engaged in heavy-duty drilling. A portion of another radial drilling machine spindle drive is shown in Fig. 5. Here the spindle driving gear *B* is also brought close to the drill. Another feature of design is the elimination of as many intermediate driving shafts as possible between the motor and the drill spindle, in order to reduce friction. In attempting to eliminate torsional strains, the main drive shaft *A* has been brought close to the drill spindle by interposing a double-faced bevel gear *C* between the driving shaft bevel pinion and the spindle driving gear.

In order to reduce side thrust and to apply power more effectively, it is desirable to have the drill feed pressure applied as close to the axis of the drill spindle as possible. This is effected in certain makes of machines by cutting the rack teeth directly in the sleeve, as shown in Fig. 6, instead of employing a separate rack, as in the most common construction.

SCARCITY OF LABOR AND INCREASED DEMAND FOR MACHINERY

By ERNEST F. DuBRUL
General Manager, National Machine Tool Builders' Association

It is well to consider the present situation of the labor market. In many quarters there is even now some scarcity of labor, particularly skilled labor. The restriction of immigration certainly makes for a scarcity of common labor that will become evident as the building program progresses. It is said in the Pittsburg and Chicago districts that it would be impossible for the steel works to operate at more than about 70 per cent of their capacity, because of the scarcity of common labor.

The machine tool builder during the war did not train any all-around skilled labor. His orders came in such quantities that he was able to train and use more specialists, and as a matter of necessity he did not find time, even if he had the disposition, to train a more general class of workmen. Now that his orders are likely to be for smaller quantities, he is going to need more all-around men. Even most of the specialists that he trained and laid off after the boom have drifted into other industries. When the demand for machine tools becomes great enough to absorb all the stocks that are now on hand, the machine tool builder is likely to find himself in a bad labor market, with his costs considerably higher than he may now anticipate. It would not then be surprising to find labor costs as high as they were, and perhaps even higher, because of the smaller quantities to be produced with a very great shortage of good mechanics to produce them. It would appear that a machine tool plant that would accumulate a reasonable amount of stock now, would be doing the wise thing.

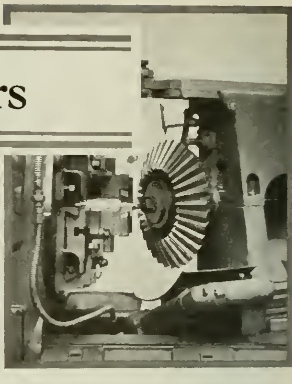
Scarcity of labor will naturally have another influence on the demand for machine tools by making it necessary for the world to use more machinery of all sorts than heretofore to supply its wants. Of course, a great deal can be done to use present machinery and equipment with more efficiency. "The Report on Industrial Waste" shows a great field for this, and scientific management and industrial engineering can develop methods for producing more with the same amount of equipment. But most managers are not able to apply scientific management very freely, and as the growing scarcity of labor becomes more apparent, there will be a natural increase in demand for industrial equipment of all kinds. Machine tools form about 25 per cent of the demand for all sorts of industrial machinery, according to the United States Census of Manufacturers. The man who is in need of equipment of any kind would do well to anticipate his requirements. It will not take much activity to create a demand in excess of the supply in a restricted labor market.

* * *

SAVINGS BY MODERN EQUIPMENT

The machine tools for which there is the greatest demand are those which can be shown to definitely reduce production costs. One manufacturer mentions how, by installing an automatic milling machine, he is able to produce forty parts of a certain product a day as compared with fourteen parts previous to the installation of this machine. In another case, a builder of railroad cars by installing a better drilling equipment than that formerly used, is now drilling seven hundred holes in an eight-hour day, using one operator. In the past, eight operators were required to drill that number of holes in one day. Improved facilities are the order of the day, and savings are made not only in the greater efficiency of machines, but also in the handling of the work. The installation of a certain type of hoist in an automobile plant may be mentioned as an example of the savings that can be made in the proper handling of work. This hoist saved its cost in two weeks.

Cutting Bevel Gears



Principal Adjustments Required in Setting up Gleason Bevel Gear Generators and Time Required for Cutting Gears of Different Sizes and Pitches—Second Installment

By FRANKLIN D. JONES

THE types of Gleason bevel gear generators to be considered first are used for cutting "straight-tooth" bevel gearing. The term "straight tooth" is used to distinguish between the ordinary bevel gears and so-called "spiral bevel" gears. These generators are so designed that the generating motion is applied to both the gear and the planing tools, as shown by the diagram Fig. 2, of the previous installment; that is, the machine operates on the principle of a gear and crown gear rolling together. In fact, segments of these gears are actually used to obtain the required generating or rolling motion between the gear blank and the cutting tools. These machines are used almost exclusively for finishing the teeth of gears that have been roughed out on machines especially adapted for this purpose. Special roughing machines will be considered in an article to be published later.

The bevel gear planer shown in Fig. 1 is an 18-inch size. A rear view of a similar machine set up for planing a gear of larger size is shown in Fig. 2. An important feature of the Gleason generator is that it has two tools for planing opposite sides of a tooth. One tool is cutting on the forward stroke while the other tool is returning, and each tooth is finished before the gear is indexed to present the next one to the cutting tools. The use of two tools increases production, and by operating the tools in opposite directions, vibrations are minimized.

The crown gear segment *A* (shown in Fig. 2) is attached to the outer end of the frame carrying the tool-slides. The master gear segment *B* is bolted to a large yoke or "generating arm" *C*, which is pivoted at one end and is connected to the work-spindle sleeve at the other end. This is a splined connection, so that the spindle sleeve oscillates with the arm, but may be adjusted longitudinally for setting the gear to be cut, so that the apex of the pitch cone coincides with the "center of the machine."

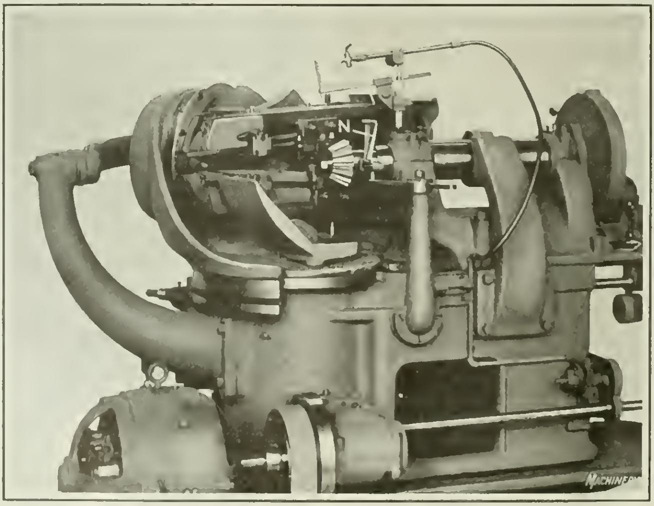


Fig. 1. Gleason 18-inch Bevel Gear Generator

When the machine is at work, the generating arm is slowly oscillated or given a swinging movement upward and downward by means of a cam acting through a slotted elevating arm *D* and adjustable connecting link. This motion is imparted to the gear blank and, through the master and crown gear segments, to the cutting tools. The tools represent the sides of mating crown gear teeth of the same pitch and pressure angle as the gear being cut. They follow lines converging toward the apex of the pitch cone, and, since the rotary motion between the gear blank and the reciprocating tools is like a crown gear revolving in mesh with a finished gear, teeth of the correct curvature are generated.

The diagrams in Fig. 3 show how a roughed out tooth is formed as the gear and tools roll together. Diagram *A* shows the tools at the beginning of the generating motion, diagram *B* the central position, and diagram *C* the completion of the cut. The tools are first swung inward to the cutting position (diagram *A*) by a cam; then arm *C* (Fig. 2) swings upward slowly until the particular tooth being planed rolls around out of contact with the tools, as shown by diagram *C*. During this generating movement, the two planing tools are taking a succession of cuts across each side of a tooth.

Order of Movements for Single- and Double-roll Machines

Most of the Gleason machines designed for cutting gears by a generating process finish a tooth during one rolling or generating motion as just described, but some machines repeat the generating action, and the tooth receives a light finishing cut during the second part of the movement. The first or single-roll method is illustrated at *A*, Fig. 4. After the tools are in the proper position for cutting teeth of the required depth, there is an upward generating motion, during which the sides of a tooth are finished, as explained in connection with Fig. 3. The tools then back out (or the work swings away as on certain other designs of Gleason bevel gear generators), and, after the indexing movement, the tools again feed in to depth; backing out, indexing, and feeding in occur during the downward rolling motion, as the arrows indicate.

Diagram *B*, Fig. 4, illustrates graphically the action of a double-roll type of generator. After the tools feed in to the cutting position, there is an upward generating movement the same as when using a machine of the type referred to in connection with diagram *A*. While the tooth thus formed is accurate enough for practically all purposes, some manufacturers requiring gears of extra fine quality consider it preferable to take a second very light finishing cut. On a double-roll generator this is done (as represented by diagram *B*) by simply reversing the generating motion, thus allowing the tools to pass again across the tooth surfaces while returning to the starting point; the tools then back out and the work is indexed. Most of the Gleason "straight-tooth" generators, and all of those used for spiral bevel gears, are of the single-roll type (diagram *A*).

A third cycle of movements, shown by diagram *C*, and known as a "completing" cycle, may be employed, although this arrangement is seldom used and is adapted only for machines cutting gears of small pitch, which can be finished complete "from the solid," during a single generating movement; the backing out is followed by indexing.

General Procedure in Setting up a Machine

The principal adjustments required in setting up a Gleason generator of the type shown in Fig. 1 will be explained without attempting to cover every step in minute detail. In order to understand the reasons for different adjustments, it is well to remember that the turret or base carrying the tool-slides is adjustable about a vertical axis, which coincides with the horizontal axis of the work-spindle. The gear blank must be so located that an imaginary point representing the apex of its pitch cone coincides with this vertical axis. This central point is known as the "center of the machine." The turret carrying the tool-slides is adjusted about this vertical axis in accordance with the angle of the gear to be cut. Another angular adjustment of the tool-slides is required for the reason that the opposite sides of a bevel-gear tooth converge toward the apex of the pitch cone. To secure this adjustment, the tool-slides at one end are arranged to swivel about a bearing, the horizontal axis of which coincides with the center of the machine.

The mechanism operating the generating arm which carries the master-gear segment must be adjusted to give the arm the right amount of throw, and a suitable master gear must be attached to the arm. A series of master gear segments are supplied with the machine to provide for different angles. The number of strokes per minute made by the tools is regulated by change-gears, and the length of stroke is governed by changing the radial position of the driving crankpin. The indexing movement is also regulated by change-gears selected (by referring to a table) according to the number of teeth in the gear to be cut. After a gear is finished, the machine is stopped automatically by a mechanism that is set according to the number of teeth in the gear. The different adjustments and the general method of arranging the machine for cutting gears of a given size and pitch will now be explained in somewhat greater detail.

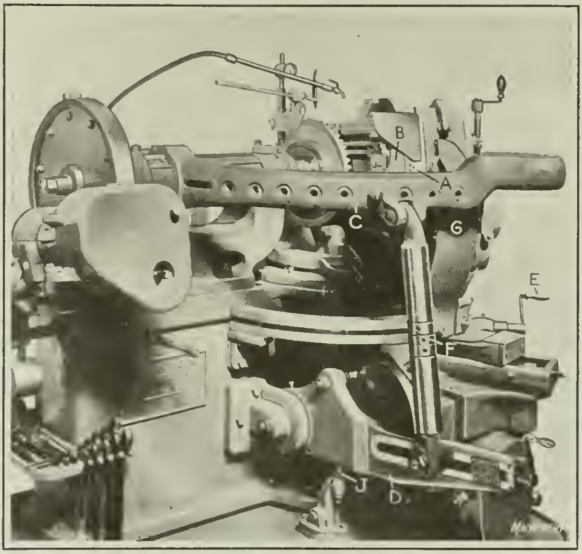


Fig. 2. Rear View of an 18-inch Generator

Tools Used on Bevel Gear Generator

The tools are selected according to the pitch and pressure angle of the gear teeth to be cut. The angle *a*, Fig. 5, of the tool is the same as the pressure angle of the gear. The length *L* must not be less than the tooth depth at the large end, and the width *W* of the point should be at least 0.015 inch less than the width at the bottom of the tooth space measured at the small end.

Fig. 6 illustrates how the tools are set. A gage *A* is held firmly against the tool-slide arm, and tool *B* is first adjusted, by means of adjusting screw *C*, until the point or end just clears the gage. The wedge adjusting screw *D* is then used to shift the tool vertically until the cutting edge is within, say, 0.0005 inch of the gage. The lower tool *E* is set in the same manner, after applying the lower gage to the lower arm.

Angular Position of Tool-slide Arms

The two tool-slides are set at an angle to each other, because of the converging form of the teeth to be cut, by means of suitable graduations. The tooth angle used in making this adjustment is given on a chart; the tangent of the angle may be obtained as follows: Add to one-half the thickness of the tooth at the pitch line the product of the flank depth or dedendum times the tangent of the pressure angle, and divide the result by the cone distance.

The travel of the turret that supports the tool-slides is regulated by adjusting the cam-lever through which this turret is operated. The required angular movement of the turret may be found by subtracting the root angle of the gear from one-half the included angle of the blank and then adding one degree. This turret is set to the root angle of the gear to be cut, adjusting crank *E*, Fig. 2, being used for this purpose after certain nuts have been loosened.

Before making this adjustment, a "double-roll" machine (11-inch and 18-inch) is started and is allowed to run until elevating arm *D* has passed its upper position and has lowered slowly on jack *J*. This jack serves to hold the arm in its mid-position, and is used for certain adjustments to follow. With "single-roll" machines (3-inch and 6-inch) the adjustment for the root angle is made when the generating arm is at about the middle of its "up" roll.

Adjustments of Master Gear and Crown Gear Segments

The gear segment on the generating arm is selected by reference to a chart. Each segment in the series supplied with the machine covers a certain range of pitch cone angles, and the selection is based on the angle of the gear to be

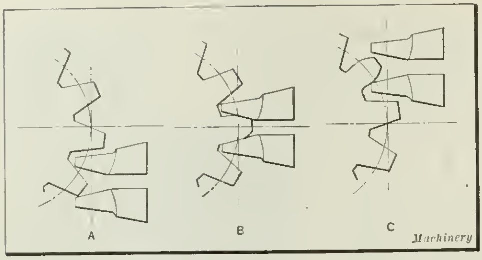


Fig. 3. Diagrams showing the Manner in which Gear and Planing Tools roll together

cut. As Fig. 2 shows, the generating arm has a series of bolt holes so that any gear segment that is used can be located according to its angle. The crown gear must be set according to the block angle, which is the difference between the root angle and the pitch cone angle. Graduations on the crown gear are used for this purpose. A marked tooth on the segment is placed in the center space of the crown gear, and the segment can be centered in the crown gear by adjusting turnbuckle *F*. Just back of the crown gear there is a spring-supported thrust-block that is carried by brace *G*, which also requires adjustment.

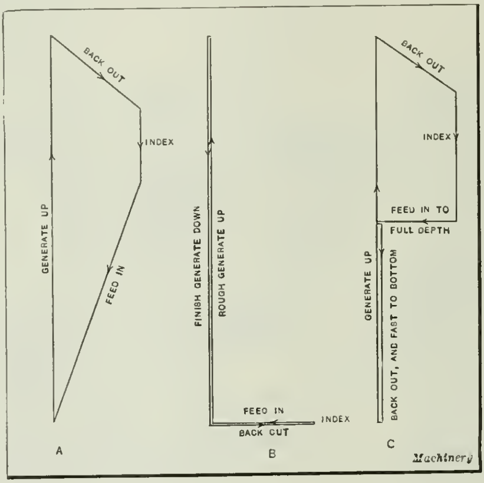


Fig. 4. Three Different Cycles of Movements employed on Bevel Gear Generators

Regulating Extent of Rolling Movement

The rolling or swinging movement of the generating arm is regulated by adjusting the lower end of the connecting-rod along the slotted elevating arm *D*. The diagrams (Fig. 3) illustrate, in a general way, the amount of rolling motion necessary between the tools and the work. When the tools swing in at the proper point, as shown by diagram *A*, and then roll upward with the work until they have stopped cutting, as in diagram *C*, any additional rolling motion is unnecessary.

On the elevating arm *D*, Fig. 2, there are graduation lines to assist in regulating the rolling motion, and numbers indicating the corresponding segment number for each position. To begin with, the connecting-rod can be set according to the number of whatever segment is being used, because this position is based on the greatest pitch cone angle for which the segment is intended. If the pitch cone angle is smaller, the rolling movement can be increased accordingly. The smaller the angle, the greater the amount of roll necessary. The swinging movement is equalized by turnbuckle *F* at the center of the connecting-rod, so that when the cam-lever is resting on jack *J*, the tool-slide frame is in the zero position. This adjustment is checked by starting the machine and noting the angular movement each side of zero.

Endwise Adjustment of Gear Blank

In order to locate the gear to be cut so that the apex of the pitch cone coincides with the center of the machine, the head that carries the work-spindle is adjusted along the bed until a cone distance gage *H*, Fig. 7, shows that the gear blank is in the correct position. With the cam-lever *D* on the jack *J*, Fig. 2, the machine is run until the turret has moved to its extreme outer position. The machine is then operated by hand until the turret has moved in to the face angle. Sliding bar *K* (Fig. 7) of the cone distance gage is next adjusted until the zero lines coincide. The gage is then placed on the tool-slide arm as shown, and after loosening the binder bolts, the work-spindle head is moved up by means of an adjusting crank; at the same time the gage is moved along the arm until the zero lines at the top of the gage pointer *L* meet when the lower end of the pointer is in contact with the top of a gear tooth at the large end.

After one gear of a lot has been set in this manner, the machine is run until the turret stands at the root angle and the generating yoke is about level. This will be at the middle of the down roll for the 11-inch and 18-inch generators, and at the middle of the up roll for the 3-inch and 6-inch sizes. Then the slide on the cone distance gage is loosened, and the gage is placed on the arm with the bottom of the pointer at the outside edge of the gear. The slide at the top is again set so that the zero lines coincide, and this gage setting can be used for the remaining gears when the turret is at the root angle and the arm in about its mid-position. The backing gage *N*, see Fig. 1, is convenient for gears having a pitch angle of less than 45 degrees, which are usually called pinions. After setting the first pinion, the plunger of this backing gage is placed against the back angle of the pinion about half way down the tooth, and it is adjusted until the zero lines of the gage coincide. The gage is then used for setting all the other pinions, and when set in this way the pinions will run flush at the back angles, even though the outside diameters vary, provided the first pinion was correctly set. A gear of accurate outside diameter must be used for the first setting.

Equalizing Stock Removed

The gear to be cut should be so adjusted that practically the same amount of stock will be removed from opposite sides of the roughly formed teeth. This is done simply by centering one tooth between the two tools. In order to turn the gear for centering a tooth, the clutch on the worm-shaft of the index mechanism is disengaged, and one half

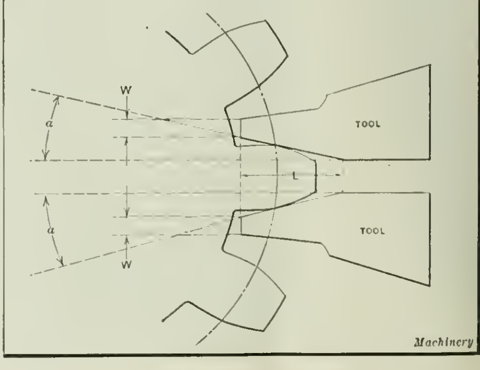


Fig. 5. Angles and Dimensions to be considered in selecting Tools

is shifted relative to the other half. The amount of adjustment is determined by starting the machine and then stopping it when the block angle (or dedendum angle) is at zero, as shown by the crown gear graduations, the cam-lever having been left in the mid-position on its jack, as when adjusting the work-spindle head.

With the crank-plate adjustment slot horizontal, and the crankpin at the forward end of its stroke, both the upper and lower tool-holders are shifted until the tools are about half way through the tooth spaces. Next, with the clutch disengaged, the indexing worm-shaft is turned with a crank until the gear tooth is in contact with the upper tool. A straight line is then drawn across the clutch sections with crayon or pencil. The worm-shaft is next turned in the opposite direction until the tooth touches the lower tool lightly, after which a line is drawn across one side of the clutch opposite the line previously drawn on the other side. The worm-shaft is now turned backward until the single line on one half of the clutch is midway between the two lines on the other half, thus centering the gear tooth between the tools. The clutch sections are then locked together.

After one gear has been set relative to the tools as just described, the stock dividing gage shown at *M*, in Fig. 7, may be used for locating all the other gears. This gage has a swinging pointer, the lower end of which is inserted between two teeth. The gage is set so that the zero lines at the top of the pointer coincide when the lower end is in a tooth space and touching both teeth.

The planing tools should have a cutting stroke equal to the face width of the gear plus 3/4 inch, with an over-travel at the small ends of the teeth of about 1/16 inch. The tools are held in swinging clapper-boxes which provide relief during the return strokes and prevent the tools from dragging and becoming dulled rapidly. These clapper-boxes are returned to the cutting position by friction rods, which slide through adjustable friction boxes.

Time Required for Cutting Bevel Gears

The total time required for cutting bevel gears on generators varies considerably in different plants, because it may be affected decidedly by the method of roughing the gears, as well as by the material of which the gears are made. When gears are stocked out and finished on a generator, the cutting time is greatly increased, although this practice

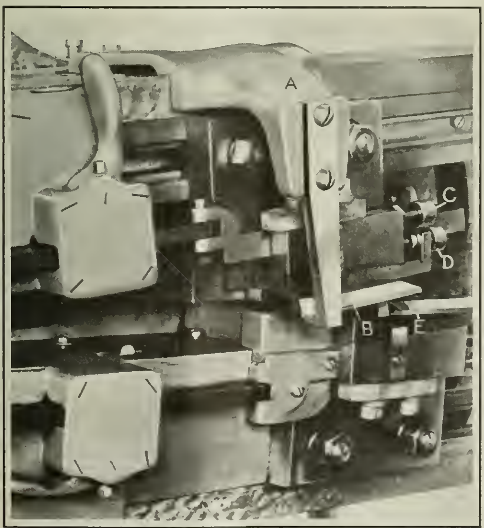


Fig. 6. Gage in Position for setting Upper Tool

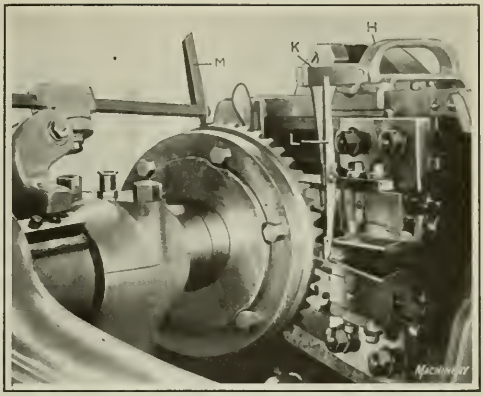


Fig. 7. Gages used for setting Gear in Correct Position for cutting

may be justified under certain conditions, as when gears are cut on a small scale. Even when gears are stocked out on other machines, the total cutting time for gears of a given pitch and material often varies widely, owing to the use of different types of machines. In the large automobile plants where work is done on such an extensive scale that the use of highly specialized roughing machines is warranted, the time for the roughing operation is a relatively small percentage of the total time.

In connection with cutting speeds, it is well to consider the relation between the speed and the period of effective cutter operation between successive grindings. Thus, when establishing an economical cutting speed, it is necessary to take into account the loss of production due to time required for changing cutters and the cost of grinding dull cutters, as well as the increased production obtained by higher cutting speeds.

The following rates of production representing the performance of Gleason generators are not given as records nor as examples that are considered unusual, but rather as average rates which have proved satisfactory in actual practice. These figures relate to the time required for finishing the teeth of gears that have been roughed out on other machines.

Rates of Production for Straight-tooth Bevel Gears

When using a 6-inch generator and cutting differential gears of 5–7 and 6–8 diametral pitch, the time per tooth usually varies from 12 to 15 seconds. In one instance the time for pinions having twelve teeth of 5–7 diametral pitch was 12 seconds per tooth, and the floor-to-floor time, 5 minutes. When using 11-inch and 18-inch generators for cutting steel gears, the rates for different pitches were as follows: 3 diametral pitch, 72 seconds per tooth; 4 diametral pitch, 60 seconds per tooth; 5 diametral pitch, 50 seconds per tooth; 6 diametral pitch and smaller, 36 seconds per tooth.

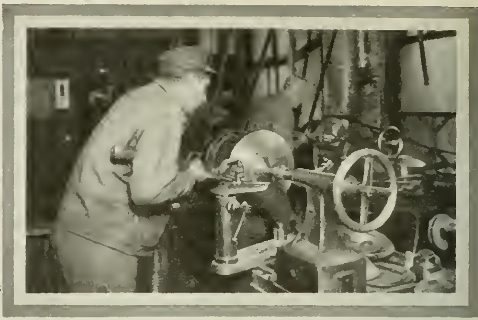
When cutting cast-iron gears, these rates vary as follows: For 3 diametral pitch, 60 seconds per tooth; 4 diametral pitch, 50 seconds per tooth; 5 diametral pitch, 42 seconds per tooth; and 6 diametral pitch and smaller, 30 seconds per tooth.

* * *

An international exposition of the mechanical and electrical industries will be held at Ghent, Belgium, from June to October, 1923. The exposition will be held in the buildings of the Ghent World's Exposition of 1913. It is planned to exhibit practically all classes of machinery, including machine tools, woodworking machinery, and industrial machinery in general. For information, address Comite de l'Exposition de 1923, Royal Casino, Parc, Ghent, Belgium.

Metal Spinning and Spinning Tools

By EDWARD HELLER



METAL spinning is employed mainly for two classes of work: (1) for removing wrinkles formed on shells during the drawing process, and (2) for producing shapes that are too difficult to draw by means of dies or that would cost too much when made in that way. Spinning to remove wrinkles from shells is by far the simpler of the two applications. Deep-drawn shells made of a comparatively light gage metal such as is used in the making of kitchen utensils and certain kinds of electrical goods, are hard to draw without wrinkling unless the part is cylindrical, and even cylindrical shells are at times slightly wrinkled. The quickest and cheapest way of getting rid of such wrinkles is by a spinning operation. Spinning lathes are made in various sizes for practically all kinds of "automatic" spinning, and as they are standard machine tools, a description is scarcely necessary. The tools used in spinning, however, are of interest.

Spinning Outfit for Removing Wrinkles on Steel Shells

A plain spinning outfit used for removing the wrinkles on a steel shell having a rounded bottom is shown in Fig. 3. The spinning chuck *A* is made from 0.85 to 0.90 per cent carbon steel, and the tail-piece *B* is an iron casting. Stem *C* of the chuck is of such size and shape that it is adaptable to many kinds of work and could well be adopted as a standard. The thrust bearing *D* supplied for the tail end could also be standardized, as it may be used with many classes of spinning tools. The bearing proper is held on the tailstock spindle by means of a set-screw. The tail-piece *B* revolves on a projecting stem to which it is held by a set-screw. The projecting stem is stationary, being a pressed fit in bearing *D*, and supports one race of the ball bearing provided in back of the tail-piece.

Spinning is done by means of the tool-steel roll *E* mounted on a hardened and ground shaft *F* which is a pressed fit in the roll and is provided at each end with a roller bearing in bushing *K*. This entire unit is held in the cast-iron holder *G* by two side plates *H*, which are fastened to the holder by means of flat-head screws. The diameter of roll *E* is usually about 5 inches, except when projecting flanges or other obstacles necessitate a larger diameter. The shank of the holder is about 2 inches square, and is finished on the top and bottom sides to insure a good bearing on the lathe carriage.

The space between bushing *K* and shaft *F* is entirely filled with rollers except for an allowance of about 0.001 inch between each roller for lubricant. The shaft and bushings must therefore be made to close dimensions. It is advisable to keep the rollers of a standard size, and so, obviously, the diameters of the shaft and the bushing on the inside will be decimal numbers. The proper shaft diameter can be quickly determined by making use of the formulas and tables of constants given on page 485 of MACHINERY'S HANDBOOK. Taking the bearing in question as an example, it was decided to use 1/4-inch diameter rollers, and the requirements of the job necessitated that shaft *F* be at least 1 inch in diameter. By laying out the bearing it was found that sixteen rollers would be required to surround the periphery of a shaft approximately 1 inch in diameter. Then by using the formula for finding *R* on the page referred to, and using the constant given in the extreme right-hand column for sixteen rollers, it was found that the diameter of shaft *F* would be 1.0314 inches if the rollers touched one another. Next, allowing for a clearance of 0.001 inch between each roller, the actual diameter of the shaft would be

$$1.0314 + \frac{16 \times 0.001}{3.1416} = 1.0365 \text{ inches}$$

The amount of clearance should depend, of course, upon the size of the rollers, the speed at which roll *E* revolves, and the kind of lubricant used.

To make possible the use of a chuck similar to that shown in Fig. 3 on any spinning lathe, an adapter of the type illustrated in Fig. 4 should be furnished for each lathe. The

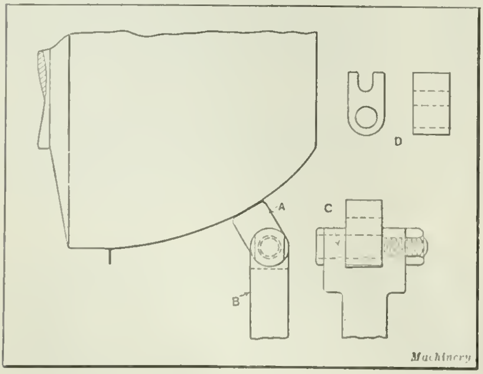


Fig. 1. Tool used for spinning Aluminum Shells

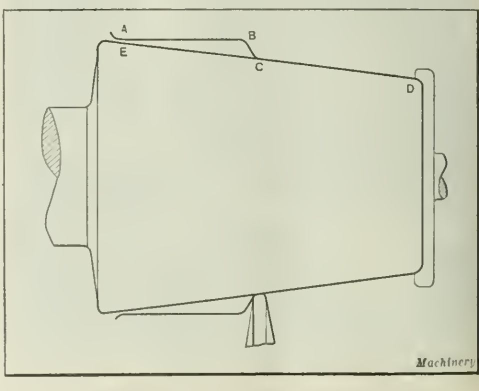


Fig. 2. Work that is partially shaped by Spinning

threads on the extending end of this adapter must agree with those in the head end of the chuck, while the threads in the tapped hole in the adapter should be made to suit those on the machine spindle. By increasing the length of the internally threaded end, the adapter may serve as an extension member.

Spinning Aluminum Shells

The tooling outfit just described is suitable for use in connection with steel shells only. The tools for shells made of aluminum or other soft metals are similar to those for steel shells so far as the chuck and tail-piece are concerned, but the spinning is done with a shoe instead of a roll. An idea of the way in which the operation is accomplished will be obtained by referring to Fig. 1. Shoe *A* is made of tool steel, and hardened. It is held in the jaws of the steel forging *B* by stud *C*. This stud allows the flat end of the shoe to remain tangent to the work at all times. At *D* is illustrated a shoe of recent development that is used on shells polished at some later stage. The first prong or tooth on the shoe that makes contact with the work smooths out the wrinkles, while the second, coming in contact with a comparatively smooth surface, acts as a burnisher.

Completing the Shape of Shells by Spinning

Fig. 2 shows how spinning may be done on water pails or other shells having the open end larger in diameter than the closed end. In drawing a long taper shell of this class it is often necessary to finish the shell partly in one of the operations, perhaps the third or fourth, and then completely finish it in another. The shell, when partly drawn, may follow the outline *ABCD*, and when it is finally drawn the outline may be as shown at *ED*. A shell of this type will wrinkle no matter how carefully the different drawing steps are proportioned, and therefore must be spun. If the preliminary and intermediate draws are so proportioned that the step *BC* is not more than about ½ inch high it is possible to eliminate the final draw by spinning the cylindrical part near the open end to the desired shape and dimensions after the wrinkles in the lower part of the shell have been smoothed out. This method not only eliminates the time required for an additional draw, but also saves the cost of a set of drawing dies.

In spinning to develop shapes that cannot be drawn readily or at a reasonable cost, the work is generally of the type that is larger in diameter at the bottom, or some place intermediate between the bottom and the open end, than at the open end. One way of spinning such work is from the inside, in which case the operation really consists of stretching the metal. However, the general principles of spinning apply in these instances as well. Inside spinning is often resorted to when the difference between the largest and smallest diameters of the finished work is too large to enable spinning to be done from the outside. The shell is then drawn to a diameter about midway between the two extremes, and one section is spun from the outside while the other is spun from the inside.

Example of Inside Spinning

An arrangement of tools for the inside spinning of the lower part of a steel pitcher is shown in Fig. 5. The shell is held in an internal chuck *A* by a tail-piece *B*. The spinning is done by a small roll *D* mounted on a long stiff holder *E*. The holder is fastened to the top of the lathe carriage in the regular manner. Lubricant is supplied to the bushing of roll *D* through a hole drilled along the center of holder *E*, an oil-cup being located near the right-hand end of the holder. The work is shaped by spinning the metal against a large roll *F* mounted on a cast-iron bracket *G* at the front of the machine. The shaft of roll *F* is mounted in roller bearings. Bracket *G* is fastened to a stationary part of the lathe and should be doweled or tongued so that when it is removed it can readily be replaced in the proper position. This equipment can be used for a variety of shapes by simply changing roll *F*.

In designing tools of this class, care must be exercised to insure that there is sufficient space to permit roller *D* to be conveniently inserted and withdrawn from the work and to see that the roll is large enough to do the work efficiently. If the space allowed is too limited for the tool design described, one way of overcoming the difficulty is by using an arrangement similar to that shown at *X*. Here a plate *H* with a ball embedded in the center is substituted for the tail-piece *B*. One end of the offset holder *K* bears against this ball and holds plate *H* in place against the work, while the other end is connected to the tailstock spindle by a sleeve. With such an arrangement there is plenty of room to bring the

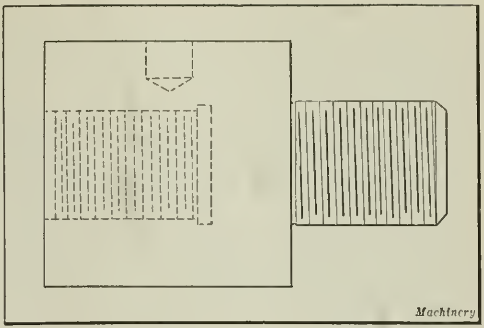


Fig. 4. Adapter which enables a Standard Chuck to be used on any Spinning Lathe

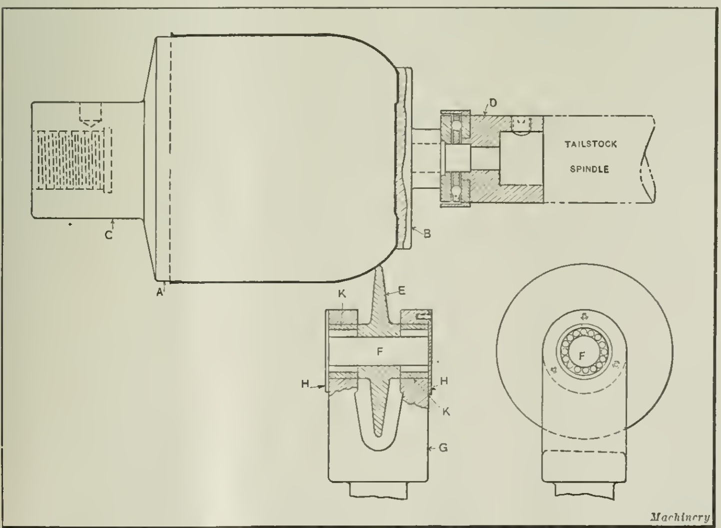


Fig. 3. Plain Tooling Equipment for removing the Wrinkles from Drawn Shells by Spinning

spinning roll against the inside of the work. The offset bar should be made of medium carbon steel and should be as heavy as possible; it should be hardened on the end bearing against the ball in plate *H*.

In using the tools in Fig. 5, roll *F* should be set up so that its axis will be parallel with that of chuck *A* and it should practically touch the chuck, as the slightest gap between the two members will cause pronounced marks on the finished work. This tooling is also intended for steel shells only. On aluminum work roll *F* will do more harm than good. For this reason the spinning of aluminum shells is performed without an outside support, the desired shape being produced by means of a cam. The screw in the cross-slide of the carriage is removed or released, and the slide linked rigidly to a roller or rollers traversing the guiding surface of the cam. As in the case of the roll bracket *G*, the member holding the form cam must be rigidly held to the machine, in such a way that an exact replacement is always possible.

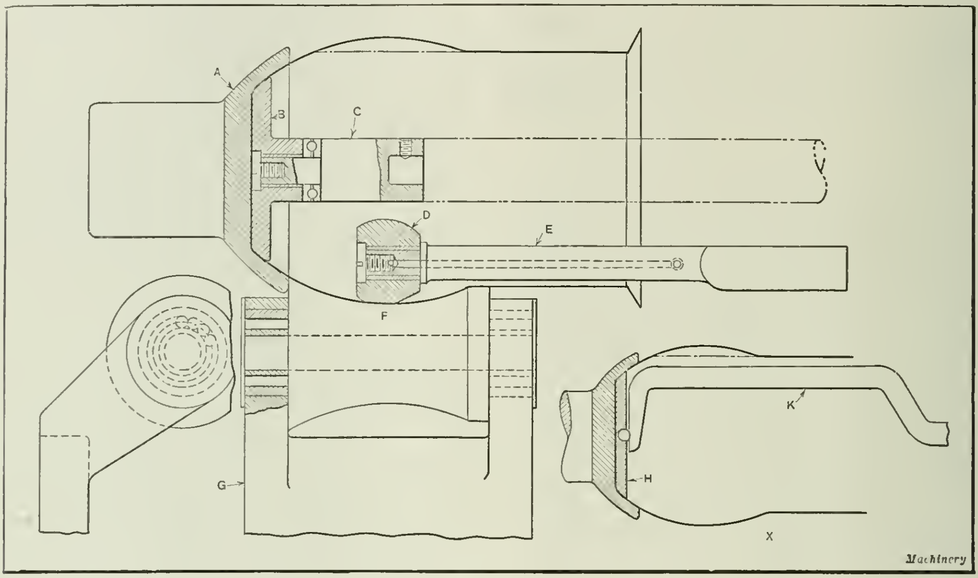


Fig. 5. Tooling Arrangement for Spinning the Lower Part of a Steel Pitcher from the Inside

Bulging the Open End of a Shell

Another application of internal spinning may be made in cases where one part of a shell is to be bulged out as shown in Fig. 6. It will be seen that the shell is held in a pot chuck *A*. The tail-piece has a live part *B* which revolves with the chuck, and a stationary part *C*, which is fastened to the tailstock spindle. A ball bearing *D* is placed between the live and stationary parts, and these two parts are held together by a screw that engages the threads of a tapped hole in the end of a stem on part *C*. The head of the screw seats against the end of the stem and allows part *B* to revolve freely on the stem.

The bulging is done by a roll *E* mounted on a crankshaft *F*, which is swiveled by means of handle *G*. The crankshaft and roller can be made to such dimensions that the work will be finished to the desired diameter when the highest point of the crank is brought directly toward the work, in which position an additional pressure on the handle will move the roll away from the work. On the other hand these parts could be so arranged that the entire throw of the crank is not utilized in producing a bulge of the desired diameter, but then it becomes necessary to provide an adjustable stop on part *C* for the handle to prevent too great a diameter of the bulged section. The first arrangement is more customary, as it enables a uniform product.

Different shapes and diameters of bulges can be formed by changing roll *E* to suit. The tail-piece *C* should be attached in such a manner to the tailstock spindle that convenient operation of handle *G* will be possible. A peculiarity found in work of this kind is that the open end of the shell becomes smaller in diameter after the bulging operation. This fact must be carefully considered in designing the tools.

Principle of True Spinning

Thus far the spinning tools described have been used for either smoothing out wrinkles or for stretching the metal, and while these operations may be classed under the general heading of "spinning," they are not true examples of spinning. The principle of true spinning is illustrated diagrammatically in Fig. 7. A cylindrical shell having the outline *ABCD* is required to be spun to the conical shape *EBCF*. To produce this shape, the spinning roll *H* is first pushed over the spinning chuck *I* along the line *BG* until a dent is made in the shell that resembles a saw tooth. The depth to which this dent can be made depends on a number of conditions, including the diameter of the shell after the final drawing operation, and the gage and quality of the metal from which the shell has been produced. A few trials will suffice to determine to what depth the dent should be made. When point *G* has been reached, the roll is traversed by means of the lathe carriage parallel to the center line of the work, that is, along line *GJ*.

After the work has been shaped along this line, the spinning roll is returned to point *G* and manipulated along line *GK* until another saw tooth has been produced, after which the roll is traversed along line *KL*. This process is repeated until the spinning roll reaches point *E*. Finally, the spinning roll is returned to point *B* and fed the entire distance along line *BE* in order to smooth the conical surface produced by the preceding steps. One of the absolute requirements of such work is that edge *A* of the shell rest slightly on the shank of the chuck so as to form a support while the first notch *BGM* is being formed. After that step there is a sufficient flange formed by the spinning to support the work firmly throughout the remainder of the operation.

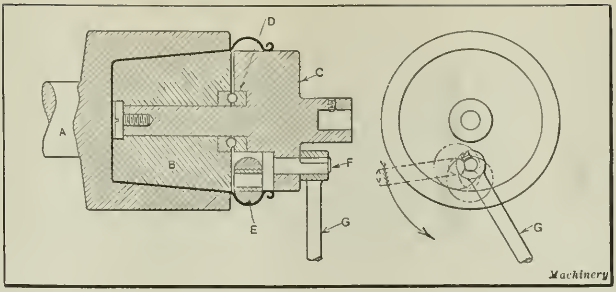


Fig. 6. Producing a Bulge near the Open End of a Drawn Shell

Fig. 8 illustrates the method of spinning a tapered shell intended for use as a coffee pot. The completed shell is represented by the heavy solid line and the preliminary shapes by the dotted lines. This method is known as "offset" spinning. Chuck *A* is made of 0.90 carbon steel and is formed to the shape of the finished part, with the diameter *BC* of the large end slightly smaller than the diameter of mouth *DE* of the work. The tailstock of the lathe is moved off center a distance *FG*, so as to be in line with the center of the shell when the latter is in contact with the front end of the spinning chuck. A plate *H*, ¼ or ⅜ inch thick, is placed at the bottom of the shell prior to mounting the shell on the chuck. This plate fills the bottom of the shell and forms a support over this entire end. The plate is made in two halves which have the corners *J* cut away to facilitate their removal from the shell after it has been spun down.

In order to have edge *K* of the shell supported by the shank of the chuck, the diameter of the chuck shank must be about the same as diameter *BC*. This is an instance in which a standardized chuck might not be convenient, at least not so far as the large diameter is concerned. The tail-plate *L* is of a standard type; it consists of an iron casting, held on a thrust bearing of the style shown in Fig. 3. When the difference between diameters *CM* and *DE* is a trifle larger than can be spun down successfully under average conditions, and when the quantity of work warrants it, the spinning operation may be facilitated by a preliminary shaping of the work, as shown at *N*, with an expanding die. Shells from 4 to 6 inches in diameter, when annealed after the final draw, can be expanded about ½ inch on a side or 1 inch in diameter without difficulty.

"Hot" Offset Spinning

A modification of offset spinning is "hot" offset spinning; this method is resorted to when the difference between the largest and smallest diameters of the finished work is great, and the length of the shell comparatively short. Fig. 10 shows this method applied to the spinning of a large steel tea kettle, and it will be seen that it is quite similar to the method shown in Fig. 8. In this case, however, a semicircular gas burner *A* has been added to the equipment. This burner is made of cast iron. It is about 2 inches deep radially and of a width to suit the work. The interior is cast hollow to form a chamber for the gas and air, which is admitted through a 1¼-inch pipe screwed into the tapped hole *B*. The face of the burner next to the shell is practically covered with holes 3/64 inch in diameter, spaced from ⅜ to ½ inch apart. The inside radius of the burner should be about 1 inch larger than the outside radius of the drawn shell.

The chuck is made in four parts, shank *C* being made of machine steel and the forming end *D* of 0.90 per cent carbon steel. End *D* is made hollow so that it will not conduct the heat away from the shell too rapidly; this construction also reduces the weight hanging on the connecting stud *E*. Stud *E* cannot be hardened, and so is made of a high-grade tough steel. The end cover *F* is also made of carbon steel. Both cover *F* and plate *H* can be replaced as they become worn, but the cover can be shimmed up and refaced a number of times before replacement is necessary.

The method of attaching the burner on the spinning lathe is represented diagrammatically in Fig. 11. The burner is held on bar *A*, which, in turn, is fastened to a horizontal rod supported in bearings *B* close to the floor. A foot-lever *C* and a second lever having a counterweight *D* are mounted on this horizontal rod. The air and gas lines are brought close to the burner, and are connected to it through flexible hose. Shut-off cocks are placed in a convenient position for the operator.

While the operator is placing a shell on the chuck, the burner is held in the position indicated by the dot-and-dash lines by the action of counterweight *D*. When he has finished putting the shell in place, he brings the burner into the working position by depressing foot-lever *C* and securing it under a hook fastened to the floor; this counteracts the tendency of weight *D* to swivel the horizontal rod. The gas and air are then turned on sufficiently to produce a good blue flame. After revolving the work a short time, it becomes red-hot and remains so until the flame is turned off at the end of the operation. The final smoothing-out touches are given to the work after it is again cold.

The limiting factor of hot offset spinning is the difference between the maximum and minimum diameters of the fin-

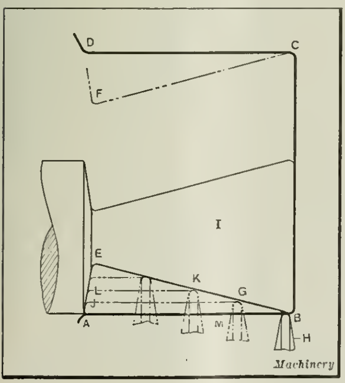


Fig. 7. Principle of True Spinning

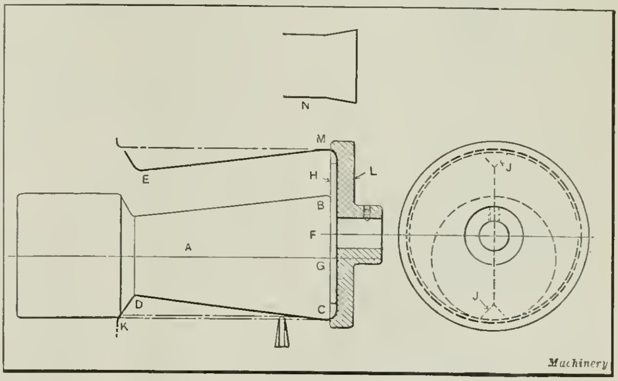


Fig. 8. Arrangement employed for an "Offset" Spinning Operation

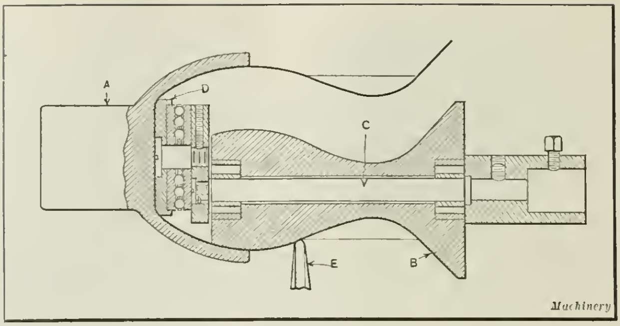


Fig. 9. Spinning a Pitcher by supporting the Form Roll on the Tailstock

ished part. Since the largest diameter of the chuck member *D*, Fig. 10, must be slightly smaller than the smallest diameter of the finished work, and its shape must be similar, it is obvious that if the difference in the diameters mentioned is great, the diameter of stud *E* may be so small that the stud will not have sufficient strength to sustain the job. The smallest diameter of neck that has been found in practice to give satisfactory results is about 1 inch.

Supporting Spinning Form by Tailstock Spindle

Another offset spinning operation is shown in Fig 9. This differs from the others that have been dealt with in that the spinning form is mounted on the tailstock spindle. The headstock spindle is again utilized for driving the shell through chuck *A*. This operation is the second one performed on the water pitcher, the first operation on which was shown in Fig. 5. Tools of the type used in Fig. 9 are employed when the shell is rather long, and consequently the driving means must be positive. The details of construction were decided upon after many trials and tests. The chuck is made of cast iron and the form roll *B* of chrome-nickel steel. The roll is provided at each end of its bore with a roller bearing, the inner race of which seats on the round bar *C*. On the left-hand end of this bar is mounted a member that supports a ball bearing having three circles of balls, so that the revolving work and tail-piece *D* have no effect on the supporting arrangement. The spinning operation, of course, is accomplished by the spinning roll *E*.

* * *

SAVINGS BY RECLAIMING SCRAP

In June MACHINERY an article appeared on the savings made possible by reclaiming a railroad scrap pile. Such reclamation work has proved to bring about considerable savings in other shops as well. The savings naturally vary with the prices of new material. In 1920, when new materials were at peak prices, the savings were the greatest. At the present time, when prices of new materials are considerably reduced, the percentage of savings is evidently much less; nevertheless, a material saving can be obtained by a careful study of the possibilities of reclaiming scrap. When prices were at their peak, the savings in some cases amounted to as much as 75 per cent of the cost of new equipment. In other cases the savings would be only from 15 to 30 per cent, according to the character of the reclaimed article. A material saving as a rule, can be made in the reclaiming of couplings and nipples, where the cost of new material would be comparatively high but the reclaiming cost almost nominal. Hand-trucks, wheelbarrows, and wrenches also present good opportunities for savings by reclaiming. The same is true of couplers, brake-beams, and springs. The important point to observe is to study the cost incident to reclaiming the article, so that more is not spent in trying to save the article than would be involved in the buying of a new part or tool. This mistake is frequently made, and in that case the apparent saving is turned into an item of expense.

* * *

RUSTLESS IRON

A material known as rustless iron, which is said to be suitable for machine construction, has been developed by J. J. Saville & Co., Ltd., Sheffield, England. This rustless iron can be bent cold to an angle of 180 degrees without fracture. The metal is said to take a polish equal to that obtained on electroplated surfaces, and to resist rust or tarnishing without any further attention. It is pointed out that it may be useful for machine tool parts, which by reason of their contact with cutting compounds are subject to corrosion. The material can be cold-worked by stamping, pressing, rolling, drawing or spinning, and can also be drop-forged. The physical properties of the metal are said to be as follows: Tensile strength, 80,000 pounds per square inch; elongation, 25 per cent in two inches; reduction of area, 60 per cent; and a hardness on the Brinell scale equal to 150.

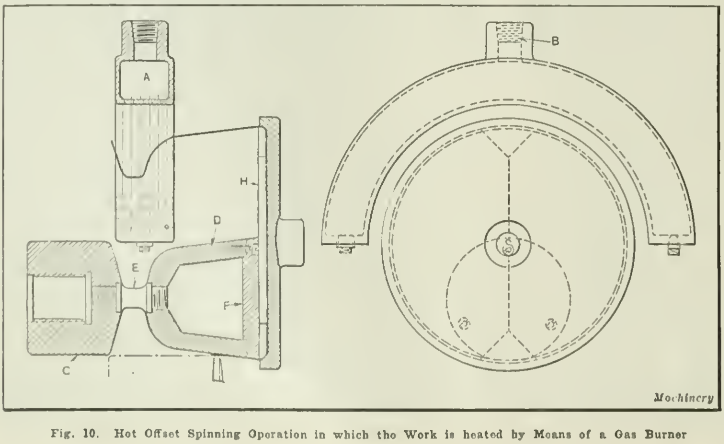


Fig. 10. Hot Offset Spinning Operation in which the Work is heated by Means of a Gas Burner

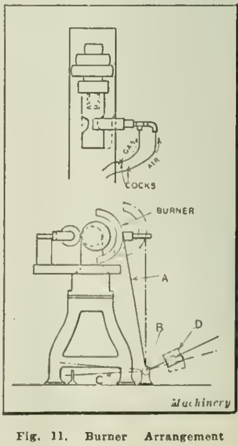


Fig. 11. Burner Arrangement

QUALITY AND COST OF RAILROAD REPAIRS

By WARREN ICHLER

Does the quality and cost of repair work turned out in the roundhouse and the railroad main repair shop today compare favorably with that of former years? It would be extremely difficult, if not impossible, to answer this question with a plain yes or no. The writer, himself a railroad machinist asks the question not so much as an introduction to his own opinions, as to invite the expression of opinions from others who are interested in railroad repair work. If this question were asked at any gathering of railway mechanical officials, both affirmative and negative replies would doubtless be received. The affirmative replies might be expected mainly from the younger officials, who would naturally point out the high mileage and great tonnage records of modern locomotives as a proof of their assertion. Officials inclined to take the negative side of the question would probably cite the increased cost of roundhouse repair work as a basis for their claims. A little study of these methods of comparison will serve to show the fallacies of both.

Comparison of Past and Present Operating Methods

It is probably true that locomotives are making mileage and tonnage records today that are far beyond those achieved ten or twenty years ago; but the present-day locomotive is much better designed and runs over heavier and better rails and bridges than did its predecessors. Grading and ballasting have also been tamped more solidly each day by the heavy traffic. Then again, the locomotive generally receives more attention as regards feed-water treatment than was usual in the earlier days, and it is subject to more rigid inspection rules than it was twenty years ago.

Now, on the other side of the case, we cannot overlook the increasing cost of roundhouse or running repairs between successive shoppings of a locomotive, or general overhaulings of the boiler and machinery. At first thought it would appear that rising repair costs in the roundhouse are an indication of poorer work in the main repair shops, but this is not always true. The more rigid inspections already referred to would tend to increase greatly roundhouse maintenance costs. The fluctuations in the cost of labor and material are factors tending to disturb the uniformity of locomotive maintenance cost, and the "pooling" of engines might also be cited as a practice tending to send the cost of runing repairs skyrocketing. For the benefit of those who may be unfamiliar with this system of engine assignment, it might be noted that under this practice, all engines in freight or switching service are operated on the "first ready, first to go" principle, as distinguished from past practice, where each engine was assigned to a particular engineer and fireman.

This is cited as a cause of high maintenance cost, as it encourages the careless engineman to pass his errors of omission in the matter of lubrication, inspection, etc., on to other shoulders. Where responsibility can thus be shifted, a good deal of minor repair work is neglected, until finally more serious trouble results from this neglect and the engine has to be removed from service to receive so-called "heavy roundhouse repairs," which are of necessity more costly than similar work done in the regular repair shops provided with better facilities.

In an effort to find some reliable means of comparing present-day repair work with that of twenty years past, the writer studied the matter on what might be called a "job for job" basis; that is, the method of handling each special repair job on a locomotive in 1904 was compared with the way such work was handled in 1922. In comparing present-day methods with those of the past, the writer has carefully selected examples that have come within his close personal observation. Only a few of the major operations involved in repairing a locomotive can be dealt with in a short article, but the ones selected are representative of common practice.

Counterbalancing Methods

The problem of counterbalancing naturally comes first as a basic matter in repairing or overhauling locomotives. By "counterbalancing" is meant the adding of weights to one side of a driving wheel to balance the weight of the side-rods, crankpins, and a portion of the reciprocating parts. Everyone is familiar with the solid segment of metal seen on locomotive driving wheels opposite the crankpin, and it is in this segment that the balancing weight is secured. Weight is added or subtracted from this segment, according to certain well-established formulas of design, by changing the volume of the lead cores. It was formerly common practice to test the static balancing of the driving wheels each time the locomotive was shopped for a general overhauling. Today this is rarely done, except when new driving wheel centers are applied. It is still the practice of one large western railway, however, to have the counterbalancing of every engine tested at each shop, but to the writer's knowledge, this is the only instance where this practice is adhered to. A somewhat extended inquiry into this subject served to verify this statement.

Setting Axles Parallel

Another fundamental operation in repairing locomotives is the adjusting of the shoes and wedges to insure parallelism of the driving axles, and to set the driving axles perpendicular to the longitudinal center line of the engine and track. The laying out, planing, and adjusting of these castings and their accessories, call for a high degree of skill, and in former years an error of 1/32 inch in the parallelism of the driving axles after the locomotive was remounted on its wheels, was deemed sufficient to justify a readjustment of the shoes and wedges, whereas an error of 1/16 inch receives scant attention in most shops at present. It may be noted here that the error in perpendicularity to the center line of the tracks generally causes rapid cutting or wearing of the driving wheel tires, while an error in counterbalancing is shown in the riding qualities of the engine and the rapid wear of the side-rod bushings or bearings.

Eliminating Needless Refinements

The writer has purposely refrained from mentioning such operations as the repairing of links and other valve motion parts where the old-time machinist gasps in horror over the present-day practices of peening, wedging, stretching, and twisting the various parts to the semblance of fits, instead of carefully fitting and polishing such parts. This omission is not referred to with the desire to sanction present-day practices or to deride the methods formerly employed. Doubtless many of these refinements were useless. A high polish on non-bearing surfaces never pulled an extra pound of freight a foot, and in many instances a good coat of paint would have served the purpose quite as well as a polished surface. However, somewhere between the extremes of the apparent carelessness of the present and the two expensive carefulness of the past, there must be a middle course which could be adopted, and undoubtedly some railroads are already following such a course.

The writer believes that the quality of repair work on locomotives has deteriorated in certain branches where it should not have been allowed to, and on the other hand there are some cases in which the elimination of needless time-consuming refinements have been a great advantage. With the rapid development of locomotives it is not to be expected that a progressive railroad official would feel it wise to spend large sums in costly repairs and refinements on his older equipment, when it may soon be retired from service. If, however, a clearly defined policy of lengthening the life of present equipment is decided upon, it is probable that there will be a return to the slower and more careful methods of previous years in handling certain classes of work. In fact, from the viewpoint of economy and good mechanical practice, such a course would prove necessary.

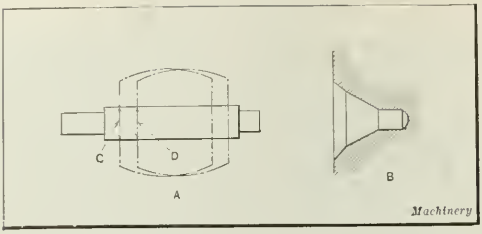


Fig. 1. (A) Diagram illustrating Extreme Positions a Part may occupy on an Arbor; (B) Economical Method of making Centers

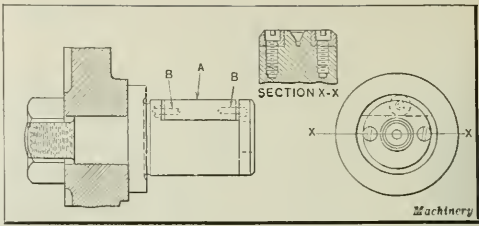


Fig. 2. Quick-acting Type of Arbor on which the Work is securely clamped in Place by Means of a Roller

DESIGN OF WORK-HOLDING ARBORS

By H. P. LOSELY, Industrial Engineer, Detroit, Mich.

Work-holding arbors are generally tapered 0.006 inch in diameter per foot of length, this amount permitting the piece to be held satisfactorily without requiring an excessive pressure to force it on the arbor, thus eliminating distortion and misalignment of the work. The amount of taper may be increased when there is no great demand for accuracy. In designing an arbor for a special job, attention should be given to the maximum and minimum diameters allowed for the hole in the work at the time the latter is to be put on the arbor. The points along the length of the arbor at which the work will be a pressed fit should also be calculated. In Fig. 1 at *A* the two points between which the left end of the work will always be located are indicated by dimensions *C* and *D*. Care should be taken to make the arbor long enough so that it will accommodate the piece in either of the two extreme positions.

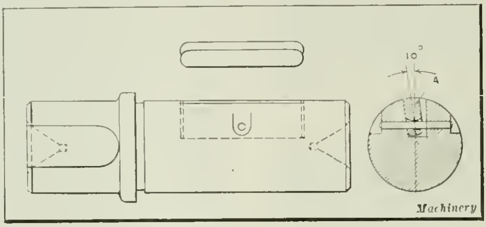


Fig. 3. Another Quick-acting Arbor having a Swiveling Leaf for clamping the Work

In order that the large end of the arbor may be readily distinguished, it is customary to make the turned down portion at this end longer than at the small end and also to provide a flat on the large end for the set-screw of the lathe dog. The ends of the arbor should be hardened, and the centers in the ends lapped to fit 60-degree lathe centers. It is customary to counterbore each center in order to prevent the edge from being damaged; this is more economically accomplished by countersinking with a 90-degree countersink as illustrated at *B*, Fig. 1, or with a center drill. If the tolerance on the work is large, or if it is desired to bring each piece into the same longitudinal position on the arbor on account of the setting of tools on the machine, a properly designed expanding arbor should be employed. Some excellent examples of expanding arbors are given in the chapter on arbors in a book entitled "Tools, Chucks and Fixtures," published by MACHINERY.

Types of quick-acting arbors which are very useful for facing operations are illustrated in Figs. 2 and 3. With the arbor shown in Fig. 2, the work is slipped on and then turned backward a slight amount, the result being that roller *A* is given a slight movement permitted by the size of the holes in which the outer ends of pins *B* are contained. This movement of the roller causes the work to be clamped securely in place. The tool is then fed in, and when finished the blank can be quickly pulled off.

Leaf *A*, Fig. 3, functions similarly to roller *A*, Fig. 2. The leaf in Fig. 3 should be ground while in the position shown. It is, of course, evident that in each case the clamping action of the roller or leaf forces the work into a slightly eccentric position, and therefore this type of arbor can only be used for facing or roughing operations. The arbors are also limited to work where the cut is continuous, as an intermittent release of the cutting pressure, such as occurs in facing gears, is liable to release the roller or leaf and allow the arbor to turn free in the part. However, in their limited field these arbors are great time-savers, being particularly suitable for such work as the facing of gear blanks.

Knock-off arbors for threaded parts are shown in Figs. 4 and 5. The one shown in Fig. 4 is of a common type, collar *A* being provided with lugs to facilitate its rotation relative to the arbor, when an operation has been completed. The collar on the arbor in Fig. 5 is provided with a flange having two recesses instead of the customary lugs. This is a safety feature, which has been adopted to reduce the likelihood of injury to an operator.

* * *

The total number of motor vehicles in France increased from about 100 000 in 1913 to 208,000 in 1921. Of these 93,000 are commercial vehicles. The number of commercial vehicles in 1913 was only 8000.

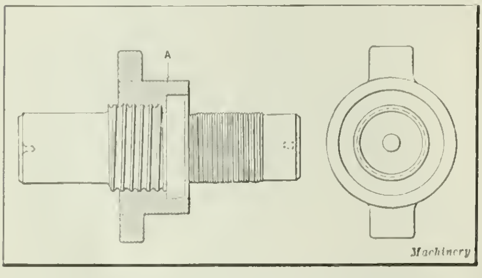


Fig. 4. Common Type of Knock-off Arbor applicable to Threaded Work

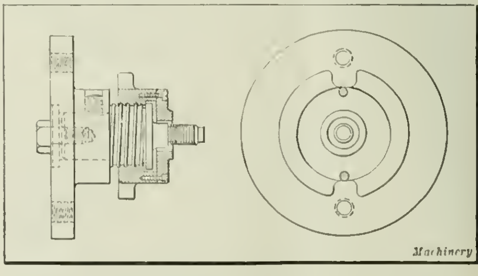


Fig. 5. Knock-off Arbor designed to reduce Danger of Injury to the Operator

Grinding Wheel Nomenclature

By H. A. PLUSCH, Plant Manager, Precision Grinding Wheel Co., Inc., Philadelphia, Pa.

Only two groups of artificial abrasives are used in the production of grinding wheels—aluminum oxide and silicon carbide—but different trade names have been adopted by individual manufacturers to distinguish their products from others. This practice has resulted in much confusion among grinding wheel users. The present article points out to which of the two groups well-known makes of grinding wheels belong, and explains the meaning of terms that are commonly used by ceramic engineers, but that are not always clear to the grinding-wheel user.

GRINDING wheel nomenclature is a source of perplexity to many users of grinding wheels who are not familiar with the processes followed in their manufacture. This confusion, to a large extent, is due to the fact that different trade names are used for wheels made from the same class of abrasive and the same or different symbols are employed to designate wheels of supposedly the same grade. Grinding wheels are made from both natural and artificial abrasives, the chief natural abrasives being emery and corundum. The value of the natural abrasives depends upon the percentage of crystalline aluminum oxide which they contain. Emery has a large percentage of non-cutting elements, and for that reason is used comparatively little in machine grinding. This abrasive in its natural state is in a crystalline form, whereas artificial or synthetic emery (aluminous abrasive) is crystallized in the electric arc furnace.

Artificial Abrasives

Artificial abrasives are produced in electric furnaces either from bauxite or from a mixture of coke, sand, salt, and sawdust, of which the chief constituents are coke and sand. Bauxite is a soft earth, and is the purest form of aluminum oxide found in nature. The oxide crystallizes when bauxite is fused in the electric arc furnace, and because of the abrasive being artificially produced, undesirable elements can be eliminated. It is due to this fact that artificial abrasive wheels have become popular.

Crystalline aluminum oxide ranges in color from white to deep wine color. Wheels made from this abrasive are recommended for grinding materials having a high tensile strength, including the various steels, annealed malleable iron, wrought iron, tough bronzes and tungsten. The trade name "Hy-Tens" given to wheels of this class manufactured by the Precision Grinding Wheel Co., Inc., conveys an idea of the materials that the wheels are intended for. Aluminum oxide grains are hard, tough, and dense, and when fractured leave sharp cutting edges.

The abrasive produced from the coke and sand mixture is known as silicon carbide, and ranges in color from green to a bluish black. The electric resistance furnace is used in its production. Wheels made from this abrasive are more efficient for grinding materials of low tensile strength, such as soft brasses and bronzes, cast and chilled iron, aluminum, copper, marble, granite, leather, and other non-metallic substances. The trade name "Lo-Tens" has been given to silicon-carbide wheels manufactured by the Precision Grinding Wheel Co., Inc. The accompanying table lists the names given by various companies to the aluminum-oxide and silicon-carbide grinding wheels of their manufacture. Silicon carbide is the harder of the two abrasives, but it is quite brittle.

TRADE NAMES GIVEN TO ARTIFICIAL ABRASIVES USED IN THE MANUFACTURE OF GRINDING WHEELS

Manufacturers	Aluminum-Oxide Abrasives	Silicon-Carbide Abrasives
Abrasive Co.	Borolon	Electrolon
American Emery Wheel Works	Corundum	Carbolite
Bridgeport Safety Emery Wheel Co.	Carbo-Alumina	Silexon
Carborundum Co.	Aloxite	Carborundum
Cortland Grinding Wheels Corporation	Oxaluma	Carbora
Detroit-Star Grinding Wheel Co.	Staralox	Staralon
Maxf Grinding Wheel Corp.	Sapphite	Carbo
Norton Co.	Alundum	Crystolon
Precision Grinding Wheel Co., Inc.	Hy-Tens	Lo-Tens
Safety Emery Wheel Co.	Rex	Corex
Sterling Grinding Wheel Co.	Sterlith	Sterbon
Vitrified Wheel Co.	Borofied	Carbofied
Waltham Grinding Wheel Co.	Alowalt	Carbowalt

Machinery

Bonding Processes

The color of both aluminum-oxide and silicon-carbide grinding wheels depends on the material used to hold the abrasive particles together, which is termed the "bond." The exact shade, however, is likely to vary somewhat with wheels of the same bond that are produced in the same heat, and so a slight variation in the shade of two wheels does not necessarily indicate a difference in grade. The four most important bonding processes are known as the vitrified, silicate, elastic, and rubber processes, and these names are applied to the grinding wheels produced by them. The use of different bonds permits the manufacture of wheels of different characteristics to suit all classes of grinding. Vitrified wheels are standard for most grinding operations, the other kinds being used when special conditions are encountered. Probably 80 per cent of all grinding wheels are vitrified. The bond used in this process consists of mineral and clay mixtures, which are fused at a high temperature, either to a glass or a vitrified matrix.

Silicate wheels are bonded by a mixture of minerals and silicate of soda or water glass, and baked at comparatively low temperatures. The wheels made by this process are also known as semi-vitrified. They are superior for tool and similar grinding where only a small amount of material is removed. On account of generating less heat, the danger of drawing the temper from a tool is minimized. Elastic wheels are bonded with shellac and other ingredients, and baked at low temperatures. Wheels made by this process have considerable elasticity, and are suitable where thin wheels are required, or where a high finish is necessary.

Rubber wheels are bonded with special mixtures of rubber, and then vulcanized. Wheels of this class have substantially the same advantages as elastic wheels, except that they can be made harder and thinner to meet more severe conditions. Both elastic and vulcanized wheels are used for cutting off tubing, wire, thin sheets of steel or brass, and parts which are difficult to hold while cutting off with the commonly used tools.

Vitrified wheels can be readily distinguished from the other wheels by their reddish or reddish-brown color, and the clean ringing sound which results when they are tapped. Silicate wheels are easily recognized by their light gray color. Elastic and vulcanized wheels are almost black, but they may be distinguished by their odor when subjected to the friction of a grinding operation or when a small part is burned. Elastic wheels emit an aroma, whereas rubber wheels give off the odor of burning rubber.

The grain or coarseness of a wheel refers to the size of the abrasive particles used in making the wheel. It is designated by the number of meshes to the linear inch through which the abrasive will pass. For instance, a 24-grain wheel is one made from an abrasive which will pass through a sieve having twenty-four meshes to the linear inch. Wheels may be made with the abrasive particles all one size or a combination of sizes. In designating a combination-grain wheel, some manufacturers use special numbers which represent the average grain size, and others give a number indicating the coarsest grain.

The term "grade" refers to the strength of the bond, or the tenacity with which it holds the abrasive particles in the body of the wheel while subjected to grinding pressure. The term has no reference to the hardness of the particles themselves. The grade is determined by pressing the beveled blade of a chisel-like hand tool into the side of the wheel and then giving the tool a turn or twist. The resistence to this twist indicates the grade of the wheel.

The grades range from extra soft to special extra hard. A soft grade designates a bond that breaks down rapidly in the grinding operation, and a hard grade, a bond that has a stronger hold on the abrasive particles. Letters of the alphabet and numbers, or a combination of both, are used for denoting the grade of wheels. Many manufacturers use the letter M to designate a medium-grade wheel, and preceding or succeeding letters to distinguish softer or harder wheels. While every manufacturer's grade M wheel is about the same, an allowance should be made for variations in manufacture. Different grinding results are often obtained by wheels of the same grade but different manufacture.

WIRE-TWISTING FIXTURE

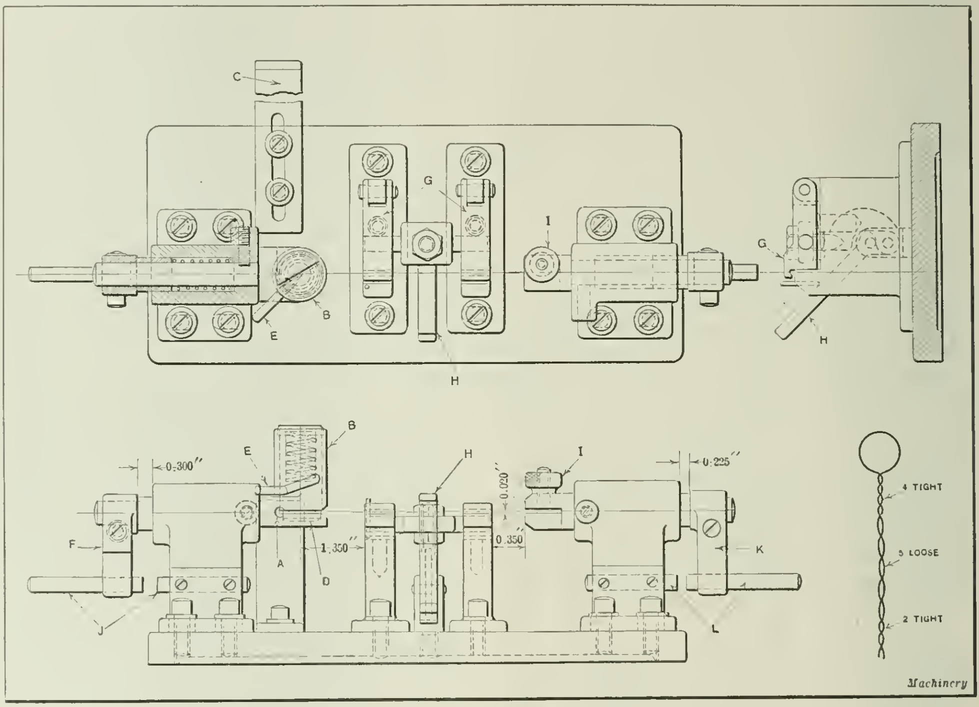
By D. A. NEVIN

The accompanying illustration shows a fixture which may be used for twisting wire into various shapes. The design may be arranged for any desired length or number of twists to suit the requirements. The work (shown in the lower right-hand corner) is made from 0.030-inch diameter copper wire which has four tight turns at the loop end, two tight turns at the opposite end, and five loose turns in the center.

The wire is passed through hole *A* of the fixture, and the length gaged by the adjustable stop *C* at the rear. The middle portion is then looped around the stud *D*, which operates in post *B*, so that when pin *E* is turned in the cam-slot from which it projects, the stud will be raised sufficiently to permit the looped wire to be removed through the slot in the lower part of post *B*, which is an integral part of the spindle to which the crank-arm *F* is attached.

The wire, after being looped as described, is then swung around so that it may be secured by the hinged clamps *G* that operate in unison through the medium of the handle *H*, the manipulation of which actuates a link mechanism. The ends of the wire are secured in a clamp in the footstock by means of the knurled nut *I*.

In making the piece shown in the illustration, the fixture is operated in the following manner: First the crank *F* in the headstock is turned to the right four turns, and then the stop-pins *J* are adjusted to engage at this point. This produces the four tight twists next to the loop. Then the crank *K* in the footstock is rotated twice, also to the right, to produce the twists in this end of the work. The stop-pins *L* are not adjusted at this time, however, for the five loose turns must first be made before these pins are set. The clamps *G* are next released so that the five loose twists may be made by turning the crank *K*. At the completion of this operation the stop-pins *L* are set. A fixture of this kind may be operated with speed after a little practice.



Fixture for twisting Wire by Hand to form Piece shown in Lower Right-hand Corner

Fig. 1. Battery of Power Forcing Presses used in broaching Motor Stators

Broaching Stators on Forcing Presses

THE hole in assembled stators for electric motors is finished in the General Electric Co.'s plant at Rochester, N. Y., by broaching on Lucas power forcing presses, and the production obtained on this job is 550 stators for one operator per eight-hour day. For handling this work a battery of six of these presses is employed, as shown in Fig. 1.

A detail of the assembled stator showing the size of the broached hole is illustrated in Fig. 4. It will be noticed that the hole is held to a tolerance of 0.002 inch on the diameter. A close-up view of one of the presses set up for this operation is shown in Fig. 2, and the details of the section broach used may be seen by referring to the illustration Fig. 3.

The broach is made in seven sections, each having straight teeth, and these sections are assembled on a stem, which is screwed into the shank of the tool. The broach sections are held in place by a collar at the end, which acts as a pilot when the tool is in use. It has been found in this case that the straight-toothed broach gives more satisfactory results than a broach made of spiral-tooth sections, both of which have been tried on this job. After the broaching sections have been assembled, they are ground to a taper of 0.033 inch, starting with the second section from the end and extending to the last few teeth in the section nearest the shank, which have no taper. The design of this tool is such that in enlarging the diameter of the hole approximately 0.026 inch, each tooth takes a cut of about 0.001 inch. The broach is held in the spindle of the machine by means of a pin passing through the shouldered end, so that it may be removed, as is frequently necessary during the course of a day's work. Referring to Fig. 2, it will be seen that the fixture on which the stator is located is set on ground parallels which bring the face of the stator at right angles to the travel of the broach so that a true hole will be obtained. The fixture is counterbored to a slight depth on the top to accommodate the heads of the rivets by which the stator stampings are assembled.

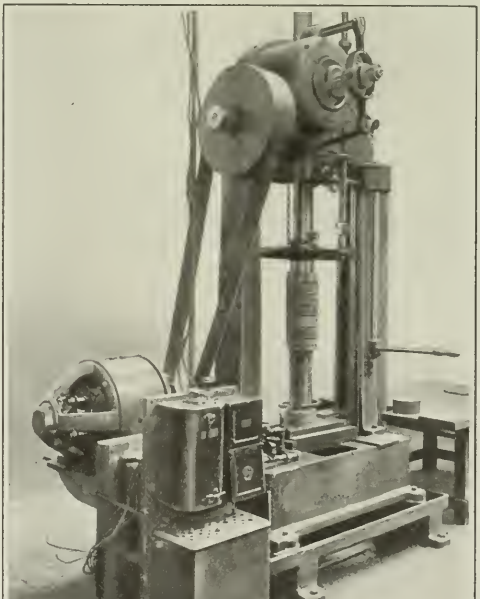


Fig. 2. Set-up of Forcing Press, showing Work and Broach

As the broach enters the stator it is guided by the pilot, and while it is passing through, the stator is advanced on the shank of the broach. This continues until the entire shank is loaded to capacity, as shown in the illustration. When eight stators are on the shank of the tool, the pin that secures the broach to the machine spindle is knocked out and the work

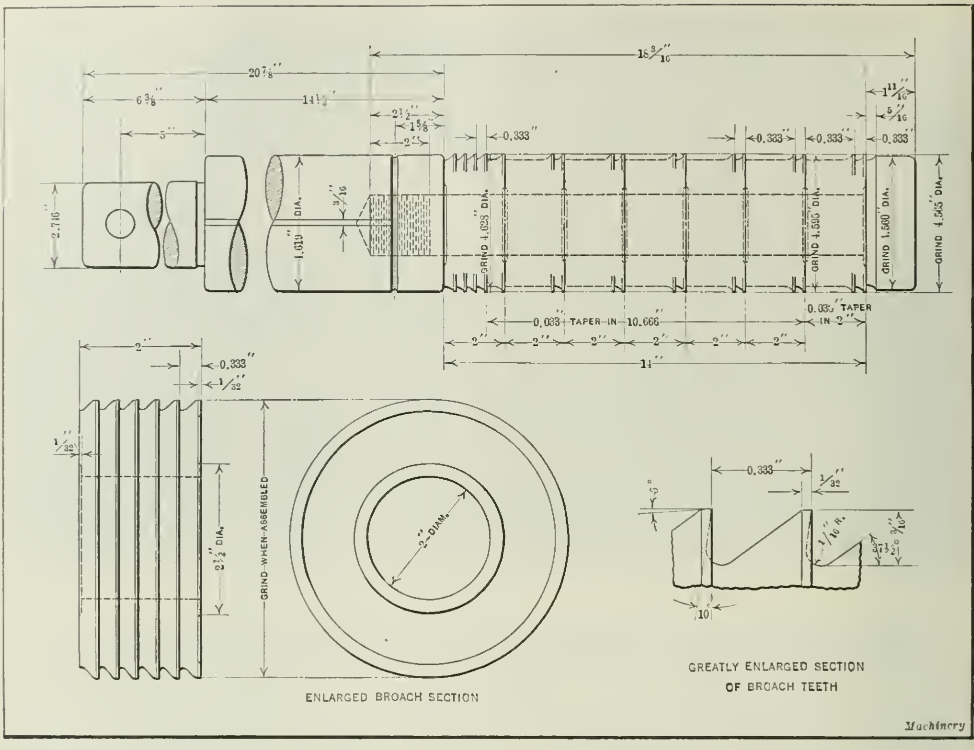


Fig. 3. Broach made in Sections, which is used in finishing the Holes in Stators

slipped off the end of the broach, after which the tool is again ready for use. It is of vital importance that the hole be broached square with the face of the assembled stator, as otherwise the outside diameter would not clean up when subsequently turned. The turning operation is performed on an Adams "Short-cut" lathe, and the work is held by air chucks.

The forcing presses are driven by a 10-horsepower motor which runs at a speed of 1150 revolutions per minute. The tool is lubricated and the chips washed from the teeth by two pipe coils, one above and one below the bolster plate of the machine. The inside of these coils is perforated so that a stream of cutting compound will be delivered to the teeth from above and the accumulated chips washed from the teeth beneath the work-holding jig after the broach has passed through.

These presses are of thirty-ton capacity, and there is a working space of 48 inches between the fixture and the end of the spindle in which the broach is fastened. Under the conditions stated, the broach will give good service for a week or ten days before it is necessary to regrind the teeth. As the larger sections are ground down and become too small for use in the same position on the tool, they are successively moved nearer the pilot end until they become too small for further use.

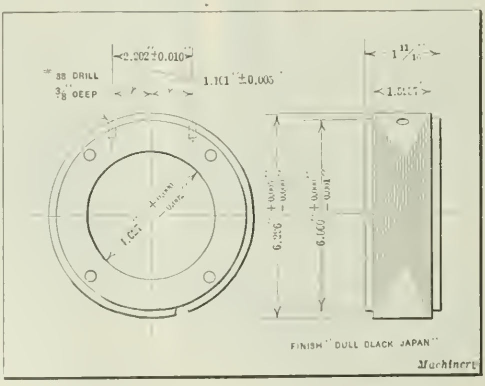


Fig. 4. Stator broached on Forcing Presses

AUSTRALIAN MACHINERY MARKET

The machinery market of Australia is dominated by the United Kingdom and the United States. Of the total imports in 1913, amounting to approximately $21,000,000, about $6,000,000 or 29 per cent came from the United States. By 1921 this had increased to about $16,000,000 or 43 per cent of the total, which was then $37,000,000.

German goods, excluded by Australian war-time legislation, may enter the field again next August. In 1913 machinery imports from Germany reached nearly $2,000,000 or 9 per cent of the total.

The growth in imports from the United States is remarkable in view of the advantages that are enjoyed in the Australian market by the United Kingdom, among which are: (1) substantially heavy preferential tariffs; (2) favorable exchange rates; (3) close political, commercial and financial affiliations. Many importing machinery dealers have intimate connections with Great Britain, some of them actually being branches of British houses. Many Australian industrial establishments are financed by British capital. Three leading banks in Australia are British and the rest have branches in Great Britain, but no American bank has been established there as yet.

The Machine Tool Trade in Japan

By YAMATAKE & CO., Tokyo, Japan

JAPAN buys all classes of machine tools—lathes, turret lathes, milling and drilling machines, gear hobbers and shapers, horizontal boring machines, planers, shapers, slotters, grinders of every description, electric and pneumatic tools, and many special machines. Machines are purchased in all sizes, from the bench lathe to the heavy gun turning lathe, and other machine tools in similar proportion. It is easier to say what machine tools Japan is not buying as yet, that is, machines for quantity production. In this respect Japan is far behind the United States, England, and the more progressive continental countries. A few branches of the Japanese industry have begun to use automatic and other special machines for quantity production, but very few factories have a production large enough to warrant the expense of installing special machinery of this kind.

In woodworking machines the staple types of band, circular and gang saws, planers, etc., form the bulk of the business, although there is some trade in special machines for certain industries.

The Government is the Principal Buyer

The most important buyer is still the government (Army, Navy, State Railways, etc.). The electric, shipbuilding, and general machine-building industries also are large consumers of machine tools. Of course there are numerous other buyers, such as bicycle makers, repair shops of the big sugar, paper, and spinning mills, and many others. The automobile industry is still in its infancy and is likely to be of slow growth. High production cost, a small market and oppressive taxation militate against its success.

The imports of metal-working and woodworking machines in 1920 were valued at 13 650,000 yen (approximately $6,825,000). In addition there is a home industry which in that year produced machines to a value of nearly 10,000,000 yen. The figures for 1921 are not available yet, but doubtless are much below these figures. During the present year, both imports and home production have receded further, as the Government is buying little, and only a few of the private industries are prospering.

VALUE OF MACHINE TOOLS AND METAL-WORKING MACHINERY EXPORTED TO JAPAN IN 1921

Month	Lathes	Sharpening and Grinding Machines	Other Machine Tools	Total of Machine Tools	All Other Metal-working Machinery	Total of Machine Tools and Metal-working Machinery
Jan.	$95,316	$87.432	$57.456	$240,204	$353.457	$593.661
Feb.	44,900	17.938	97,652	160,490	207,948	368.438
March	37,470	4,654	57,250	99,374	159,521	258,895
April	43,179	14,452	6,887	64,518	171,428	235,946
May	9,883	9,658	18,857	38,398	49,675	88,073
June	478	5,689	68,476	74,643	524,776	599,419
July	44,549	6,799	11,115	62,463	66,828	129,291
Aug.	1,320	6,346	7,028	14,694	36,787	51,481
Sept.	8,097	15,974	38,493	62,564	21,416	83,980
Oct.	6,846	11,398	16,767	35,011	26,698	61,709
Nov.	......	8,225	23,578	31,803	33,748	65,551
Dec.	8,990	9,671	26,903	45,564	54,010	99,574
Total	301,028	198,236	430,462	929,726	1,706,292	2,636,475

Machinery

American and British Exports to Japan

In 1920 the United States sent to Japan 10,964,000 yen ($5,480,000), and Great Britain 2,573,000 yen ($1,280,000) worth of machine tools. Import from other countries were insignificant in 1920, but now imports from Germany are appearing on the market again.

Where machines made in the United States are preferred, the makers have won this distinction through modern design, high-class workmanship, and honesty; but many manufacturers in the United States have hurt their reputations in Japan through poor quality of their shipments and disregard of contracts in past boom times. This class of manufacturers will find it difficult to reconquer the market when conditions are better again.

British machines are sold a good deal through force of habit. They were the first in many factories and have given satisfaction; thus the repeat orders go to England, even where other countries can offer better machines. It must be acknowledged, however, that the British machine tool industry is less self-satisfied and more progressive now than it was before the war. When business revives, England will probably put up a good fight for a larger share of the imports. Germany will gradually gain third place in imports, but for several years will lag a long way behind her two big competitors.

Advice of American Manufacturers

In order for American manufacturers to obtain greater trade with Japan they should heed the following advice, which they have heard often but have not always heeded:

1. If you want to do export trade, stick to it. If you intend to engage in export business only as a stop-gap when times are bad in the United States, you will be disappointed and will hurt the reputation of other manufacturers who want to stay in the export trade and treat foreign customers accordingly.

2. Follow the instructions of your buyers minutely even if you do not understand their necessity.

3. Pack twice as carefully as you would do for the home trade. Consider that the packages may be stood upside down for a five-thousand mile trip, and will be thrown about. Will they stand it?

4. Have some *responsible* man check the packing list. Better have it checked twice. A missing tool or cam may make the machine useless for many months, until replaced. Remember that the foreign buyer cannot get your shipping department over the long distance telephone and say what he thinks about its delinquencies, but he remembers your neglect and in the end *you* pay for it in loss of business.

5. If the machine you are selling is complicated and if you are in the habit of sending a mechanic to install it properly for the buyer, consider the position of your foreign buyer who probably has never seen such a machine and has nobody to advise him. Put yourself in his place and work out detailed instructions for his benefit. The same thing will help a dozen foreign customers who would otherwise have trouble and be dissatisfied with your product. Have these instructions made by your technical staff and thoroughly tested by persons not familiar with the machine. The specialist generally omits the most important point since it is an old story to him; but it is one which the buyer does not know.

6. Half of the machines received from the United States arrive badly rusted. This is probably due to the fact that a cheap "export" slush is widely used although it is well known that the best rust-preventing slush is barely good enough to protect a machine coming to the East in the rainy season. The manufacturer hurts his interest dollars for every cent he saves in using cheap rust preventives on his export shipments.

Inspecting by Optical Projection

SCREW thread elements, gear teeth, cutter forms and in fact any profile or contour may be accurately inspected by the projection of an image on a screen. This principle of inspection has been incorporated in several instruments for laboratory and commercial inspection work. The advantages of this method of inspection are rapidity and accuracy. Optical inspection instruments contain mainly a source of light, a system of lenses, and a surface on which the image may be cast. The surface or object to be inspected is placed in the ray of light, usually between two lenses of the optical system. The surface on which the image is cast is often a chart containing a master outline with which the projected image may be compared. This method of comparing the accuracy of contours is largely used in inspecting screw threads.

The application of this system of inspection is limited only by the size of the work and the area of the screen or chart on which the image is projected. Provided the magnification is definitely known it is even practicable to measure the image direct, so that in the case of the pitch of a thread, errors can be determined in terms of actual measurement. Ordinarily, however, the optical projector is used as a comparator.

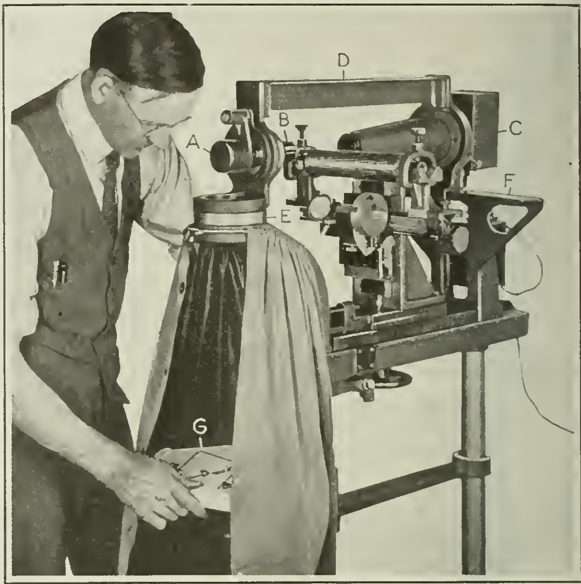


Fig. 1. Adjusting the Optical Instrument for inspecting a Large Screw Thread

During the war, the Bausch & Lomb Optical Co., Rochester, N. Y., developed an optical instrument which proved so satisfactory for the company's own use that it is now being commercially manufactured. It is stated that when using this instrument as a thread comparator it is possible to inspect five hundred screws per hour for external, pitch and root diameter, thread shape, evenness of outline, angle, and width of flat at top and root. This instrument is also used for testing gears to determine tooth form and contact and for a great variety of formed work. The machine differs in two particulars from others in commercial use—first, in the optical system, and second, in the arrangement and type of the thread chart.

General Construction of the Optical Projector

The stand on which the instrument is mounted is furnished with casters so that it may be moved easily from place to place in the shop or laboratory. A feature of the caster mountings is the leveling screw in each foot of the stand, by means of which the instrument may be leveled on an uneven floor. The projector does not require a darkroom, but may be operated successfully in any room, provided the image is not exposed to a direct ray of light, as from a window.

For ordinary sized work the image is projected on a chart which is part of the instrument, the position of which may be varied as required to increase the magnification. For this purpose the chart is attached to a holder. An arm on the holder has bearings on the two uprights of the stand so that the chart may be located vertically in any position. Besides using a chart for comparison, the holder is designed to accommodate a photographic plate holder as well, so that permanent records of the results may be obtained. The image is projected vertically downward to the chart or plate holder and a curtain is draped around it to exclude light and intensify the sharpness of the outline projected. The fact that the screen is part of the instrument itself prevents the vibration which is often a cause of much trouble where an independently supported screen is used.

The work-carrier consists of a compound slide which may be adjusted in three directions by means of handwheels to bring the work into proper position in the optical rays. The adjustment of the work within the field is the means for focussing the image on the screen. The source of light regularly used is a special concentrated single-filament, 6-volt, 108-watt Mazda lamp, which may be lighted by connecting it to a lamp socket. This lamp furnishes a steady illumination and is inexpensive to operate. For extremely careful work the "Tungsarc" lamp is recommended or where greater intensity of light is desirable, such as when projecting gear contours at high magnifications. An arc lamp, however, may cause difficulty in maintaining a steady illumination, due to fluctuations.

Fixed Optical System

The optical system used in the Bausch & Lomb projector is of special design and is shown diagrammatically in Fig. 3. The system is fixed—that is, the illuminating, reflecting, and magnifying units remain in fixed relation to each other and the image is sharply focussed by changing the position of the work in the field instead of by moving any of the optical system units. The source of light is graphically indicated at *A*, from which the rays pass through a condenser consisting of a special lens *B* and a supplementary condenser *C*.

The lens and the supplementary condenser are mounted in a long cone (see Figs. 1 and 2) which keeps them in permanent optical alignment. The lens is contained in a focussing mount by means of which it can be adjusted to direct the beam of light to the focal point of condenser *C*, Fig. 3. This causes a concentrated beam of parallel light rays to issue from the iris diaphragm *D* which is located directly in front of the condenser at the end of the cone. This diaphragm is for adjusting the diameter of the beam of light. The rays pass and intersect the outline to be inspected, the work being positioned within the field as at *E*, and the interrupted rays then pass through the objective lens *F* of a compound microscope.

Beyond the eye-piece *G* of the microscope there is a right-angle prism *H* which reflects the light down and casts the image on the chart or plate, as indicated at *I*. The prism is mounted in a holder *A*, Fig. 1, and may be swung out of the way if it is desired to project the light straight on a large screen instead of vertically downward. This is often necessary in the case of large work requiring high magnification. The compound microscope shown at *B*, is used in place of an ordinary projection lens, and in combination with the prism enables average work to be inspected with the screen or chart as a part of the machine. The advantage of this arrangement is clearly indicated in the illustrations. It also permits the machine to be no larger than would ordinarily be required for the optical system alone.

Selection of Lenses and Eye-pieces

As previously stated, focussing is accomplished by changing the position of the object, not by moving the lenses. The instrument is generally furnished with a 24-millimeter (focal length) objective lens contained in a long tapering mount of small diameter so that it may extend over the top of large diameter gages as shown in Fig. 1. A 48-millimeter objective lens is used where less magnification or a larger field at a greater projection distance is wanted. The eye-pieces regularly employed with these lenses are of 5 and 12.5 times magnification, respectively, and the combinations furnish a wide range of magnification. This equipment permits the projection of threads of 1/3 inch pitch or less and gears of 12 diametral pitch or finer. A chart giving the magnification when the chart holder is set at a specified distance from the prism and when certain combinations of these lenses and eye-pieces are used, is referred to when setting up the machine.

When a vertical screen is used separately from the instrument, as when projecting a large contour, special lenses are employed. These lenses replace the compound microscope which may be completely removed from the instrument and the prism swung aside to permit the projection of the image on the vertical screen. The supplementary condenser *C*, Fig. 3, is also removed together with the iris diaphragm *D*, and the illuminating beam of light is made parallel by the focussing movement of lens *B* which may be moved on a helix by a lever. In connection with the focussing of the lens *B*, the position of the lamp in its housing *C*, Fig. 1, must be adjusted until an image is properly formed on the screen. This adjustment is made after the compound microscope has been removed and before the other lens is installed.

Relation of the Optical System to the Thread Helix when Inspecting Screws

When the apparatus is used as a thread projector, the principle employed is different from that of other optical instruments in that the optical system is arranged so that it can be swung to the helix angle of the thread. The entire optical system at all times is lined up along a single central axis, being held in this relationship by the bar *D*, so that the system may be swung about the swivel bushing *E* which contains a vernier scale. The rear part of the system including the lamp, special lens *B* and supplementary condenser *C*, are supported on an arc-shaped rail along which this part of the system may be slid when adjusting the axis of the light beam at the helix angle of the screw.

This method does not give an image which is geometrically similar to the thread contour in the plane of the screw axis, but one which is geometrically similar to that lying in a plane inclined at the mean angle of helix. The two contours are slightly different, but the error from the true outline of the screw thread is so slight that it is rarely considered of importance. For example, for a 60-degree thread and a helix angle of 5 degrees, the angular correction would be 12 minutes; when the helix angle is 2½ degrees the angular correction would be 2 minutes, 40 seconds. It will be seen that the correction factor may be disregarded for even the most exacting commercial work when the helix angle is 2½ degrees or less; even when the helix angle is 5 degrees, the results will be sufficiently accurate for most commercial work.

This method of projecting the screw thread differs from that incorporated in instruments of other makes which are so constructed that the axis of that part of the optical system which serves for illumination is tangent to the thread helix, while the axis of that part which serves to form the image is perpendicular to the axis of the screw. The purpose of the latter arrangement is to project the section of the screw in the plane of its axis. As a consequence, the image is formed by oblique "pencils" of light passing through the margin or edge of the objective lens. The Bausch & Lomb Optical Co. considers that the result obtained in this way is likely to produce an image not always geometrically similar to the screw thread section, owing to the aberration. The centered optical system incorporated in the instrument here illustrated was adopted for the purpose of eliminating these difficulties. The angular error is a well-defined function of the flank angle and of the mean helix angle and can be calculated for all threads.

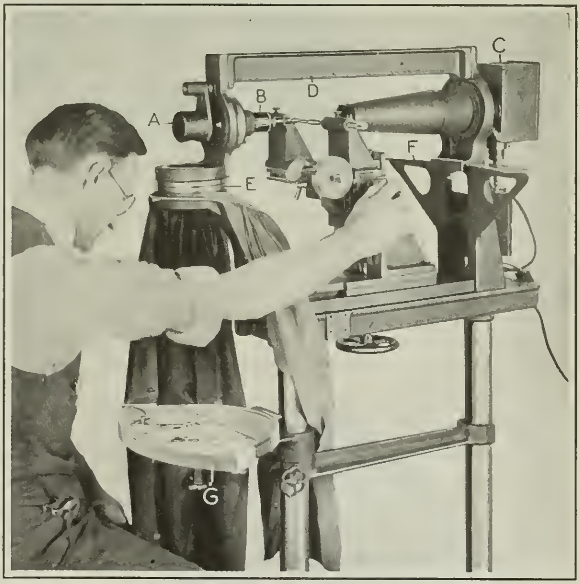


Fig. 2. Measuring the Lead of a Thread Gage

Thread Chart and Photographic Plate Attachments

The adjustable thread chart, Fig. 4, is used for the inspection of threads and is provided with a graduated arc and vernier scale by means of which it can be swung at an angle to bring it into line with the optical system as determined by the reading shown by the graduated scale on swivel bushing *E*, Figs. 1 and 2. A single chart serves for threads of different sizes and various magnifications, because adjustable templets are provided which may be accurately set to any size. These templets have adjustable straightedges which may be set to give the proper width of flat on root or top, corresponding to the pitch of the thread.

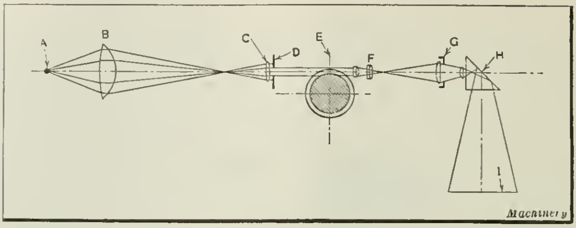


Fig. 3. Diagram of the Optical System

Attachments that Increase the Field of Application

A lead-measuring attachment, which checks the lead to 0.0001 inch, is used when inspecting screw threads. It consists of a dial gage and a micrometer head attached to the side of the cross-slide. This and all other attachments used with the projector are interchangeable on the cross-slide which is machined with a T-slot on the side for convenience in attaching.

A device which facilitates the inspection of screws and which will accommodate work up to 2 inches in diameter, is shown in Fig. 5. This is a universal screw-holder which is attached to the cross-slide in place of the two centers regularly used for centered work. This is very simple in construction and rapid in operation, and its use enables the pitch diameter, root clearance, thread shape, external diameter and accuracy of lead to be quickly inspected. The device supports the screw entirely from the effective diameter of the threads. As many threads as are intended to be subsequently engaged in a tapped hole, are engaged by the blades *A* and *B*. By combining unavoidable errors in lead and diameter, the image on the chart will instantly show whether or not the screw will assemble into the tapped hole.

Other attachments are a sulphur cast attachment by means of which casts may be taken of internal threads; a V-block attachment (see Fig. 1) for holding irregular-shaped pieces, especially lead-screws and similar long threaded work; and a gear attachment. The V-block attachment is simply two blocks each having a vee on the side as well as on top, and a clamping arrangement. The gear attachment, Fig. 6, is also of simple design; it consists of two brackets, each carrying a stud so that gears may be mounted and inspected while in mesh. An indexing pivot can be centered in the tooth spaces, so that as the gears are turned errors in tooth spacing can be detected.

The instrument should be placed in such a way that light will not fall directly on the work chart. A moderately lighted room is satisfactory, so that there need be no inconvenience from working in the dark. To adjust the optical system, the light is turned on, the diaphragm *D*, Fig. 3, opened wide, and the special lens *B* focussed by a lever projecting through the cone in which it is contained. Proper focussing will produce a circle of light about 3/4 inch in diameter on a piece of paper held in the plane of the object. Two screws at the bottom of the lamp housing are then used to centralize this image with respect to the objective lens of the microscope. When this has been done, the set-up remains in this position until it is again required to adjust the system, which should be necessary only when other lenses and eye-pieces are used to obtain greater magnification.

A master gage is then placed between centers (or located in the V-block attachment) and the optical system swung to the helix angle of the thread on the arc-shaped rail *F* in Fig. 1. The setting is read on the graduated swivel bushing *E* and this reading should correspond with that obtained when locating the chart *G* to align it with the axial line of the optical system. To raise or lower the gage, a handwheel underneath the machine is adjusted, while to move the gage horizontally the cross-slide is moved in the manner shown in Fig. 2, by a knob on the right-hand side of the machine.

These adjustments should bring the upper part of the thread into the beam of light where it can be focussed by bringing it back or forth by turning a handwheel at the front of the instrument. A fuzzy outline of the image accompanied by bright line reflections near and parallel to the contour of the thread outline is an indication of poor adjustment, incorrect angular setting of the optical system, or an error in centering the beam of light.

Setting the Universal Chart

Attention is next called to the universal chart, Fig. 4. This should now be rotated so that master lines representing the flanks of the thread coincide with the outline of the image. This determines whether the thread is "leaning" to one side or the other. "Leaning" is one of the most frequent causes of ill-fitting threads and it can be detected at a glance when the image is compared with the flanks of a master thread form. The reading on the graduated arc of the chart should then be compared with that of the

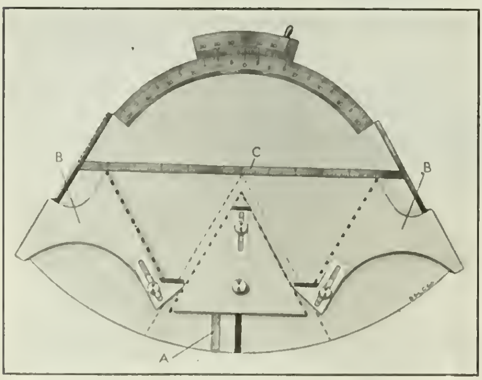


Fig. 4. Adjustable Thread Chart which is Part of the Optical Instrument

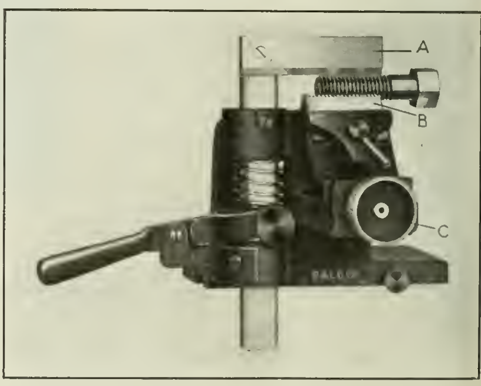


Fig. 5. Universal Screw-holder for Use in Inspecting Machine Screws

vernier on swivel bushing *E*, Figs. 1 and 2, and if they fail to agree it shows that the thread leans—that it is unsymmetrical.

Next determine whether the axis of the gage is parallel to the line of travel of the slide; if it is not, an accurate measurement of lead is impossible. To determine this, adjust the position of the gage so that the image of one end thread will fall on the center templet of the chart. The slide is then adjusted until the edge of the image appears equally distant from both sides of the master lines with a faint thread of light between them. The cross-slide should then be moved in the opposite direction until the thread at the opposite end of the gage casts an image on the chart, bearing the same relation to the master lines as that of the first thread image. If the image from the last thread appears above or below the master outline, it indicates a tapered gage or one that is not true on centers.

It is always advisable as a precautionary measure to rotate the gage by hand after it has been sharply focussed. This may show faults and irregularities in the thread which might otherwise not be detected. Often a gage may be so distorted in hardening that when it is inspected and revolved before the light there will be an irregular movement of the thread image as it travels across the chart. A true helix would show a uniform advance. If the image rises and falls as the gage is being turned, it shows that it is out of round. The most minute irregularities of the thread are thus made obvious.

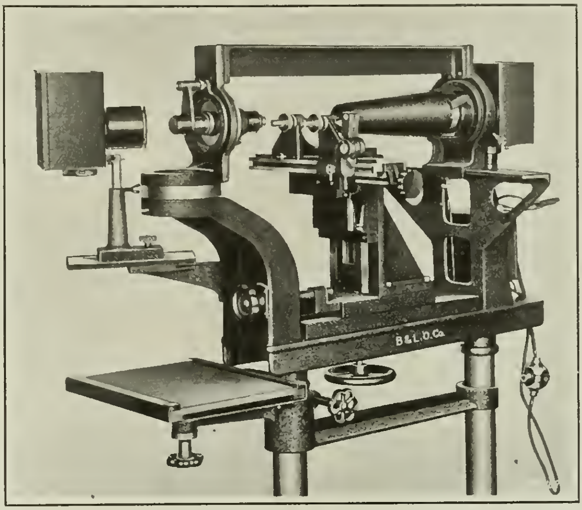


Fig. 6. Instrument equipped with Gear Attachment, Special Optical Arrangement and Photographic Plate Holder

In measuring the lead of a thread, the image of one side of the thread is first made to coincide with one of the master lines on the chart. The dial gage shown in Figs. 1 and 2 is then slid along in the T-slot on the side of the cross-slide until it contacts with the micrometer spindle which is set at zero. The micrometer head does not move; it is attached to the upright support of the cross-slide. The position of the dial gage needle when the spindle is in contact with the micrometer spindle should then be noted and should preferably be at zero to facilitate reading the micrometer.

The cross-slide is then moved back until the image of the next thread (or any other selected thread) is brought up to the same position that the first thread occupied. The micrometer drum is then turned until the spindle advances into contact with the gage spindle and causes the gage to register as before. The micrometer reading is obtained in the regular way. The dial gage merely serves as a reliable zero point and eliminates the sense of touch which often results in errors in micrometer readings.

Use of Optical Instrument to Obtain Actual Measurements

It has been previously stated that actual measurements of screw threads and other parts may be made with the aid of the projector apparatus. To do this the proper objective lens and eye-piece should be selected from the chart prepared by the manufacturers of the instrument, which will give approximately the desired magnification. If a gage 5 inches in diameter having 40 threads per inch is to be measured and the magnification is to be 100 times, a 24-millimeter focal-length lens and a 5-times eye-piece would be used, and the master thread chart would be located about 29½ inches down from the right-angle prism.

To find the exact position of the chart, the centers (similar to the lathe centers) are separated 1/10 inch and they are focussed on a piece of paper on which two reference lines are drawn 10 inches apart. This piece of paper is placed on the chart which is vertically adjusted until the image of the center-points exactly coincides with the reference lines and is sharply focussed. When this condition is obtained the magnification is 100 times.

In obtaining the actual measurements after these adjustments have been made, the thread chart, Fig. 4, is set to one hundred times the actual size of the thread to be compared. To set the chart, the center templet is set to zero on the vertical scale *A*, and the side templets *B* are located so that their edges intersect the scale *C* and indicate one hundred times the actual pitch measurement, which for a forty-threads-per-inch screw, would be 2.50 inches either side of the zero graduation. The auxiliary templets which define the top and the root of the thread are then set by means of a scale on their edges. In the case of a forty-threads-per-inch screw, the width of the flats is ⅛ the pitch multiplied by 100, or 0.314 inch. The chart is then set to the helix angle which in this case is five minutes. To obtain the actual measurement of screw thread elements after the apparatus has been set up to give a definite magnification, divide the width of any space between the image and the master outline by the magnification, which in this case is one hundred, and subtract the quotients from the corresponding standard dimensions.

Inspecting Screws in Quantity

The universal screw-holder, Fig. 5, is used for inspecting automatic screw machine products. The holder is attached to the cross-slide and two pitch blades *B* selected having the required number of threads per inch. One blade is locked firmly in place in an angular position while the other is clamped lightly so that when setting up it may be pushed back and forth without releasing the clamp.

A master thread gage, of the same nominal size as the screw to be inspected, is then laid on the two blades so that it is supported by them. Handwheel *C* is then turned so that the two blades will point radially to the center line of the thread gage. The upper blade *A* clamps the screw in position and is moved up and down by means of a lever and held in place by spring tension. The pressure exerted by this spring is sufficient to cause the unclamped blade to center in the threads of the gage, in which position the blade is clamped. After the holder has been set up, the inspection of screws can be done rapidly. The blades act as a ring gage, only that part of the screw actually used being entered. Adjustments are then made until the top threads of the gage are properly focussed on the comparison chart. Assuming that the chart and optical system has been set up as previously described, the image from this master gage will represent the maximum permissible size of the screw to be inspected. By setting the chart templets to the minimum allowable diameter of the screw, a tolerance zone is established. This working tolerance zone can be quickly established with the adjustable chart arrangement to suit any thread tolerance.

Inspecting Gears with the Projector

With the optical projector it is possible to check the contour of gear teeth, form cutters, etc., and determine at a glance the form, rolling action, center distance, etc., that otherwise would be difficult to ascertain. For handling gears, special brackets (see Fig. 6) are attached to the cross-slide, these brackets having ½-inch diameter studs, over which the gears are placed, using bushings if necessary. The brackets may be positioned so that the gears will mesh; then by rotating them at an even rate the rolling and sliding actions of the teeth may be observed as well as any imperfections in tooth shape. Thickness and height of teeth can be measured to within close limits by employing an adaptation of the method previously described for obtaining actual measurements of screw threads.

The light is passed along the tooth surface at the point of contact (in the case of spur gears) but in this application of the instrument, it is usually advisable to project the image on an auxiliary screen located at right angles to the axis of the optical system and approximately ten feet away. It is important when inspecting the gears with the projector, to see that the face of the gear toward the objective lens is free from burrs at the edge of the teeth. Slight burrs may often erroneously indicate a poor tooth form. It is good practice to locate the face of the gear from which the forming cutter entered in milling the teeth, toward the objective lens. In obtaining the proper center distance, measurements are taken over the studs on which the gears are mounted, using calipers.

The projector is not limited to inspecting spur gears. In the case of spirals, it is necessary to illuminate the face of the gear adjacent to the objective lens by oblique or normal illumination. This is called "opaque" projection. The best results can be obtained from this method of inspection only by having the surfaces of the gear against which the light is directed highly polished so that they will furnish a good reflecting surface. Lapping the surface on a cast-iron plate using fine emery and oil will usually give the desired finish.

The optical arrangement for helical gear inspection, in which the light is reflected to produce the image, is different from that ordinarily used. A special attachment consisting of a lamp housing, is mounted on a bracket bolted to the rear side of the bracket supporting the swivel bushing. The lamp can then be set so that the rays of light from the lamp are directed against the face of the gears or other parts. A 6-volt, 108-watt Mazda lamp is used, fitted with a condenser. The arrangement can be used only with low-power objective lenses.

* * *

FINDING SPIRAL ANGLE OF MILLING CUTTER

By C. A. MACREADY

There are several methods of finding the "spiral" or helix angle of a milling cutter, but the writer believes that the one described in the following will be found the quickest and most convenient. The method described also has the advantage of leaving the work in position to be recut in case this is necessary. The procedure in determining the spiral will be given for the purpose of making the method clear. It should be mentioned that the method is the same regardless of whether the cutter is a new one or an old one that has been annealed and turned down until only the bottoms of the tooth spaces remain.

The cutter is first placed on the arbor and index-centers of a milling machine. An indicator is next clamped between the collars on the milling machine arbor in such a position that the point is in contact with one side of the milling cutter tooth. A piece of sheet metal may be used in place of an indicator if no indicator is available or in cases where a groove or tooth is so shallow that it will not give a suitable bearing surface for the contact point of the indicator. The dial on the table feed-screw must also be in position to record the longitudinal movement of the table, and an index-plate having an indexing circle of, say, twenty holes must be used to record the arc of travel through which the milling cutter tooth is revolved.

Referring to the accompanying diagram, let E represent the milling cutter, F the indicator, B the longitudinal distance through which the milling machine table or milling cutter is moved, and D the arc through which the cutter rotates during the longitudinal movement B.

Let A = number of holes indexed;
B = distance traveled by milling machine table; and
$C = 40 \times$ index circle used, or $40 \times 20 = 800$.

The circle can thus be divided into 800 parts by using the

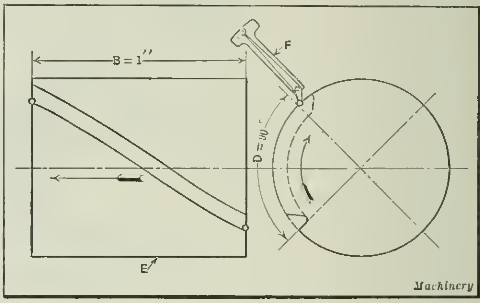


Diagram illustrating Method of finding Spiral Angle of Cutter

20-hole circle. The spiral in inches can now be determined by the formula

$$\frac{C \times B}{A} = \text{length in inches for one complete turn of spiral}$$

Assume that the micrometer dial shows that the table has been given a longitudinal movement B equal to 1 inch, and that the index-plate has been given exactly ten complete turns, the indicator F still registering zero. Then $A = 20 \times 10 = 200$; $B = 1$ inch; and $C = 40 \times 20 = 800$. Substituting these values, we have:

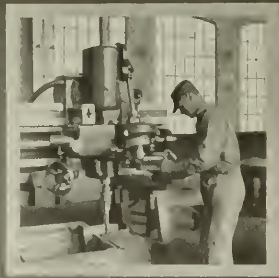
$$\frac{CB}{A} = \frac{800 \times 1}{200} = 4$$

Thus the spiral is found to equal one turn in 4 inches. This is perhaps an ideal illustration of the method, as it will be noted that ten turns of the index-plate or an indexing movement equivalent to 200 holes in the 20-hole circle equals ¼ turn of the work or an arc of rotation D equal to 90 degrees. Now taking a case such as is frequently met with in practice, let it be assumed that A equals 206 (10 turns and 6 holes) instead of 200 as in the previous example. We then have:

$$\frac{CB}{A} = \frac{800 \times 1}{206} = 3.883$$

In this case the lead of the spiral is taken as one turn in 3.89 inches, as this is the nearest spiral given in the table of spirals accompanying the milling machine. The variation from the value 3.89 inches is due in this case to the fact that the index circle used could not register an even number of holes for the arc through which the cutter was rotated.

Letters on Practical Subjects



FEEDING WORK INTO ROTATING CHUCK

The feeder head shown in Fig. 2 was designed by the writer for the purpose of feeding drop-forgings into the rapidly rotating chuck of an automatic turret lathe. The forging for which the feeder head was originally designed is shown in Fig. 1, but the device can be adapted for feeding short-length work of various kinds into a lathe chuck without stopping the machine. For instance, parts made from bar stock of round, square, or hexagon section could be handled readily by a device of this type.

Referring to Fig. 1 it will be noticed that a square boss *A* projects from one side of the drop-forging. In machining this forging, it is necessary to insert the boss *A* in a square hole in the chuck. The machining operations required were as follows: Face one side; turn and thread the edge; and back-face a portion of the side from which the square boss projects. After several methods of chucking the work had been proposed and rejected as impracticable, the writer suggested that the work be put in the chuck without stopping the machine. It was first thought that this was impracticable, as it was believed that the square boss on the forging would have its corners knocked off in the effort to make it enter the revolving chuck jaws. If the work had been held stationary, this undoubtedly would have been the case, but the feeding head permits the work to revolve at the same speed as that of the chuck with just sufficient frictional drag at the entering position to cause the work to slip until the square corners of the boss match the hole in the spring jaws of the automatic chuck.

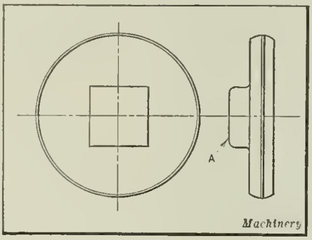


Fig. 1. Type of Forging handled by Device shown in Fig. 2

If the forgings are pressed against the chuck too hard at first, there will be no slipping and the forging will not enter the chuck unless it happens to be in the correct position at the instant of contact. To obtain a light pressure at first when the work is being made to enter the chuck a light spring *D* of long stroke (Fig. 2) is used. A stronger spring *E* comes into operation near the end of the turret head stroke which holds the forging firmly against the chuck during the closing action of the jaws. A small spring *F* at the end of the spindle provides pressure between the spindle and the sleeve *B* at the cup end that holds the forging. This causes a frictional drag that is sufficient to make the feeder head revolve at a little slower speed than the chuck until the work has been properly entered.

As the revolving element is acted upon by two springs, it is provided with a sleeve *B* which holds the springs and which is free to slide back and forth in bushing *C*. Bushing *C* is held in turret bracket *H*, and a key *J* in the bushing prevents sleeve *B* from revolving. The small finger springs *G* hold the forging in the feeder head cup of spindle *A*. These finger springs open and release the forging on the backward stroke of the turret. If the friction drag spring *F* is screwed up too tight, spindle *A* will not turn and the forging will then slip inside the finger springs *G*. While this will permit the work to be loaded into the chuck it subjects the finger springs to undue

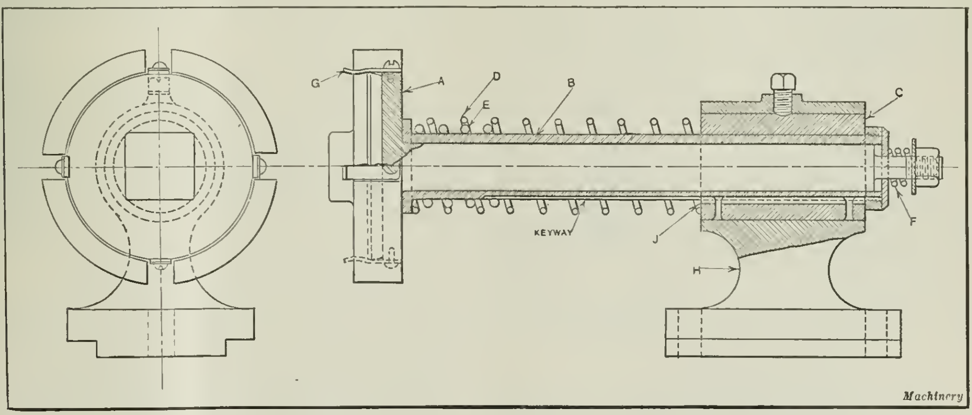


Fig. 2. Device designed for feeding Drop-forgings into a Rotating Chuck

wear due to the rough scale on the forgings. Several machines were equipped with feeder heads that were not provided with revolving spindles but depended on the slipping of the finger springs to obtain the desired results. This arrangement, however, was not so satisfactory as the design illustrated.

Lyells, Va. W. R. WARD

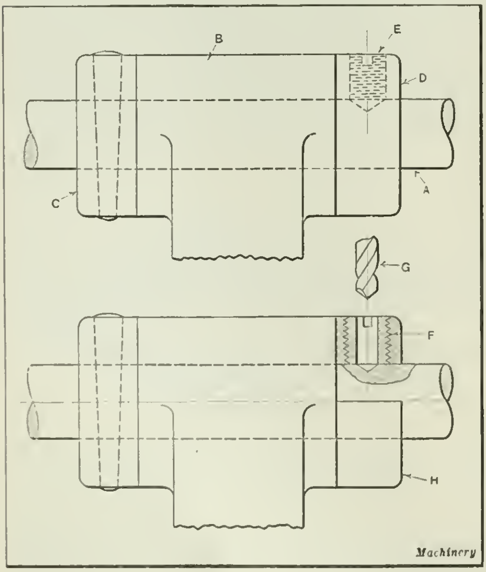
SPOTTING A SHAFT FOR A COLLAR SET-SCREW

In the upper view of the accompanying illustration is shown a shaft *A* which runs in a bearing *B*. The shaft is held in position by two thrust collars *C* and *D*. The thrust collar *C* is pinned to the shaft, while collar *D* is held in place by a conical pointed set-screw *E*. Shaft *A* is spotted to receive the point of the set-screw after the shaft is assembled in the bearing. The writer has frequently encountered this construction, and in most cases has found it difficult to locate collar *D* properly on the shaft by the methods generally employed.

It is quite common practice to spot the shaft with the tap drill used to drill the set-screw hole in the collar, the procedure being first to drill the collar with the tap drill and then use the collar as a drill jig for spotting the shaft. After being tapped, the hole will not always line up properly with the spot on the shaft. Thus considerable end play between the collar and the bearing often results, which must be taken up in some manner. In order to overcome this difficulty, a number of spotting bushings like the one shown at *F* were made up from headless screws. These bushings were made of different sized screws from 3/16 inch up.

The holes in the bushings *F* were made as large as they could be without weakening the bushings so much that they would be likely to break during the hardening operation. These jigs or bushings were all provided with slots to receive the blade of a screwdriver. By placing the spotting bushing *F* in the tapped hole of a collar *H*, which is to be used on the shaft, and then bringing the drill *G* down through the hole in the center of *F*, the shaft can be spotted very quickly and as accurately as it could be done with a more expensive tool or jig.

Bridgeport, Conn. A. H. PONELEIT and A. BIRCHALL

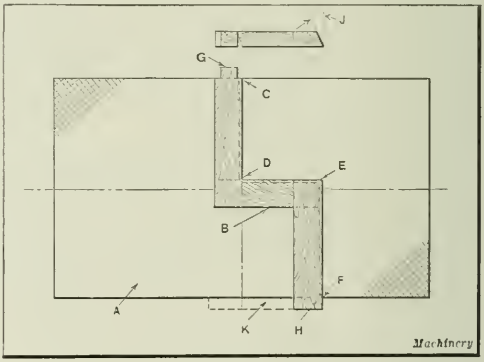


Method of spotting a Shaft for locating a Collar Set-screw

STOPPING-OFF PIECE FOR FLOOR-PLATE PATTERNS

Patterns for diamond-checked floor-plate castings of standard size are kept in stock by some companies. When plates of special shape or design are required, it is common practice to use a pattern of standard size in making the mold, and employ a stopping-off piece to cut the mold down to the desired size and shape. If a floor-plate is required of a size larger than any provided by standard patterns, blocks are added to one of the regular patterns to obtain the desired size. In no case should a regular pattern be cut if it can be avoided. When patterns provided with stopping-off pieces are to be sent away to a foundry where the molding operations cannot be observed, it is necessary to provide some means of insuring the proper location of the stopping-off pieces. Chalk marks on the pattern showing the location of the stopping-off piece are not to be relied upon, as they wear off quickly.

The best plan is to make the stopping-off piece with ends that project beyond the edges of the floor-plate pattern, as shown in the accompanying illustration, and attach temporary blocks or prints to the edges of the pattern. The pieces attached to the pattern should correspond to the projecting ends of the stopping-off piece, so that they will leave pockets in the mold into which the ends of the stopping-off piece will fit. In order to prevent the stopping-off piece from being reversed in the mold, one of its ends should be made smaller than the other. The corresponding print or



Stopping-off Piece for Floor-plate Pattern

block attached to the pattern should, of course, also be made smaller. By this arrangement it would be impossible for the molder to reverse the position of the stopping-off piece, which he might easily do if the ends were made flush with the sides of the pattern.

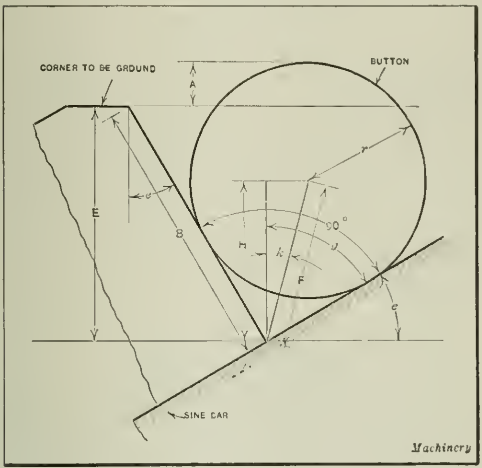
In the illustration, *A* represents a floor-plate pattern of standard size, and *B* a stopping-off piece designed to stop off the casting along line *CDEF* so that the floor-plate will have the shape indicated at the left of the stopping-off line. After making a mold of the complete floor-plate in the usual manner, the stopping-off board is put in place on the mold, with the projecting ends *G* and *H* in the pockets formed by the corresponding pieces attached to the plate pattern. The space to the right of the stopping-off piece is then filled in with molding sand to the top of the board, after which the latter is removed, thus completing the mold.

In order to obtain a close fit between the edges of the cast-iron floor-plates, a slight bevel is given to the stopping-off board along the stopping-off line. The angle at *J*, although somewhat greater than that used in actual practice, serves to indicate the method of beveling the stopping-off piece. In order to prevent the stopping-off piece from pressing down too hard on the check impressions in the mold, a large block, such as indicated by the dotted lines at *K*, is sometimes attached to the pattern in place of the smaller blocks. Corresponding blocks attached to the stopping-off piece then serve to support the weight of the stopping-off board, so that the check impressions will not be disturbed.

Kenosha, Wis. M. E. DUGGAN

CHECKING A TOOL-ROOM JOB

This article describes a method of determining when an angular corner of a block is so formed that one side of the block will have a given width B, as indicated in the illustration. The procedure is to mount the work on a sine bar as shown, with the sine bar set at the angle to which the corner of the block has been ground. The button is set on the sine-bar and in contact with the work.



Method of checking a Tool-room Job

The known dimensions are as follows:

c = angle to which corner of block is ground;

B = width of side of block; and

r = radius of button.

With these dimensions it is required to find the difference in height between the corner of the block and the top of the button, as indicated by dimension A.

By trigonometry we have

$$E = B \cos c \quad \text{and} \quad F = r \operatorname{cosec} 45 \text{ degrees}$$

Then

$$g = 90 \text{ degrees} - c \quad \text{and} \quad k = g - 45 \text{ degrees}$$

By trigonometry

$$H = F \cos k$$

and

$$H = r \operatorname{cosec} 45 \text{ degrees} \cos k = 1.4142\, r \cos k$$

Then

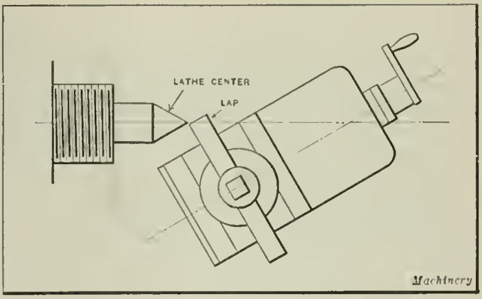
$$A = H + r - E \text{ or } E - (H + r)$$

The value taken depends upon whether the top of the disk is above or below the top of the machined corner. In the case illustrated the top of the disk is above the top of the machined corner so that $A = H + r - E$.

Flint, Mich. W. G. HOLMES

TRUING UP A LATHE CENTER

In order to face both ends of a piece of work held between centers on a lathe, it is usually necessary to reverse the piece, or turn it end for end. It is often found, however, that the work will not run true after its position has been reversed. This is usually because the headstock center does not run true. The amount that the center runs out may be so small that it cannot be detected unless a very sensitive indicator is used, and yet it may be sufficient to cause considerable inaccuracy in the work. It is very difficult to keep the centers absolutely true, and it has been the writer's experience that even after a center has been ground with a toolpost grinder, it will still run out from 0.00025 to 0.0005 inch.



Method of truing up Lathe Center with Cast-iron Lap

It is hard to tell just what causes this inaccuracy, as in the cases noted there was apparently no play or shake in either the lathe spindle or the grinder spindle. As a test, a center thus ground was indicated, and the spindle marked at the point corresponding with the high spot on the center; then another center was ground, using exactly the same set-up. In the case of the second center the position of the high spot was between 90 and 100 degrees from the point marked on the spindle in the first instance. This test would seem to show that the inaccuracy was not due to the spindle hole running eccentric with its outside diameter. It would be interesting to receive some comments as to the reason for the inaccuracy recorded by these tests.

The writer has found, however, that the inaccuracy referred to may be corrected in the following manner: After removing the grinder a cast-iron lap is clamped in its place, as shown in the illustration. No cutting compound is used, the structure of the cast iron being such that the desired result is obtained without the application of any abrasive. A few drops of oil applied to the lap and a little pressure of the lap on the center is all that is required. The compound slide, of course, is left in the same position that it occupies when grinding.

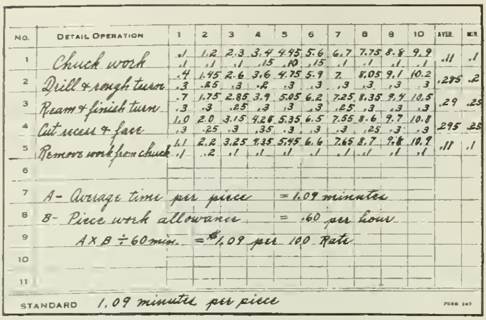
Cleveland, Ohio WILLIAM WILSON

OBSERVATION TIME-STUDY TICKET

The $8\frac{1}{2}$- by 11-inch observation sheet ordinarily employed in recording time-study data for use in setting piece-rates is well adapted for cases involving a comparatively large number of operation details. However, when there are but few details that require studying, a small size observation ticket such as shown in Figs. 1 and 2 will be found more convenient and economical.

Ordinarily, if the time-study man makes a trip to the shop without his large pad of observation sheets (as often happens) and is called upon to make an observation, he must return to his office for the pad. But if he is provided with a small size pad like the one described in this article, he will invariably carry it in his pocket ready for use. In ruling up the small sheets, the writer had this point in mind, and accordingly made the size about 6 by 4 inches so that a pad made up of the sheets could be easily carried in the pocket.

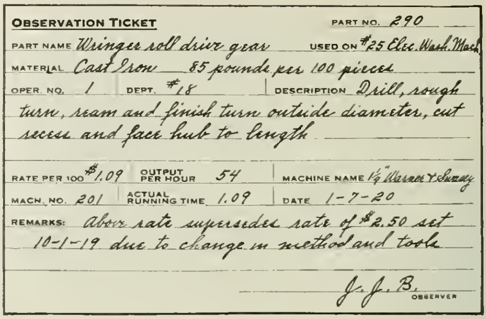
To those not familiar with the piece-work system, the following description of the procedure in making a time-study and recording the necessary data may be of interest. Let it be assumed that the rate-setter is called into the shop to make a time-study of a certain piece of work. It should be mentioned here that the observation ticket is made up in pads with the side marked "Detail Operation" (as shown in Fig. 1) to the front. The rate-setter first lists the detail



No.	Detail Operation	1	2	3	4	5	6	7	8	9	10	Aver.	Min.
1	Chuck work	.1	1.2	2.3	3.4	4.45	5.6	6.7	7.75	8.8	9.9	.11	.1
		.1	.1	.1	.15	.10	.15	.1	.1	.1	.1		
2	Drill & rough turn	.4	1.45	2.6	3.6	4.75	5.9	7	8.05	9.1	10.2	.295	.2
		.3	.25	.3	.2	.3	.3	.3	.3	.3	.3		
3	Ream & finish turn	.7	1.75	2.85	3.9	5.05	6.2	7.25	8.35	9.4	10.5	.29	.25
		.3	.3	.25	.3	.3	.3	.25	.3	.3	.3		
4	Cut recess & face	1.0	2.0	3.15	4.25	5.35	6.5	7.55	8.6	9.7	10.8	.295	.25
		.3	.25	.3	.35	.3	.3	.3	.25	.3	.3		
5	Remove work from chuck	1.1	2.2	3.25	4.35	5.45	6.6	7.65	8.7	9.8	10.9	.11	.1
		.1	.2	.1	.1	.1	.1	.1	.1	.1	.1		
6													
7	A- Average time per piece = 1.09 minutes												
8	B- Piece work allowance = .60 per hour												
9	A × B ÷ 60 min. = $1.09 per 100 Rate												
10													
11													

STANDARD 1.09 minutes per piece

Fig. 1. Time-recording Side of Observation Ticket



OBSERVATION TICKET PART NO. 290

PART NAME Wringer roll drive gear USED ON #25 Elec. Wash. Mach.

MATERIAL Cast Iron 85 pounds per 100 pieces

OPER. NO. 1 DEPT. #18 DESCRIPTION Drill, rough turn, ream and finish turn outside diameter, cut recess and face hub to length

RATE PER 100 $1.09 OUTPUT PER HOUR 54 MACHINE NAME 1½" Warner & Swasey

MACH. NO. 201 ACTUAL RUNNING TIME 1.09 DATE 1-7-20

REMARKS: above rate supersedes rate of $2.50 set 10-1-19 due to change in method and tools

J. J. B. OBSERVER

Fig. 2. Reverse Side of Ticket shown in Fig. 1

operations, as shown in the illustration in the left-hand column, and then proceeds to make a time-study on ten pieces of work.

This is done by taking continuous readings with the stop-watch. For instance, on the first piece the stop-watch registered 0.1 minute for the chucking operation, and 0.4 at the end of the second operation, which is that of drilling and rough-turning. After recording the stop-watch readings for ten pieces of work, the time for each detail operation is obtained by subtracting the stop-watch reading for the preceding operation from that of the operation under consideration. The actual time for the detail operation is then placed in the lower half of the space opposite the name of the operation and in the column used for that particular piece.

The average time for each detail operation is then calculated and placed in the column provided for it. The minimum time is also filled in as shown. The piece-rate is set on the work by the formula on the lower half of the ticket. After this has been done, the opposite side of the ticket is filled in as shown in Fig. 2, and the record cards made out and sent to the shop. The observation tickets are then filed away for future reference.

Aurora, Ill. JOHN J. BORKENHAGEN

SPECIAL SCREW MACHINE CHUCK

The screw machine chuck shown in the accompanying illustration was designed to be operated by means of the draw-rod mechanism of the screw machine. The clamping is accomplished without any longitudinal movement of the collet, and the work is located against a stop-member which is independent of the collet. This construction prevents the threads of the work from binding on those of the collet when the latter is released.

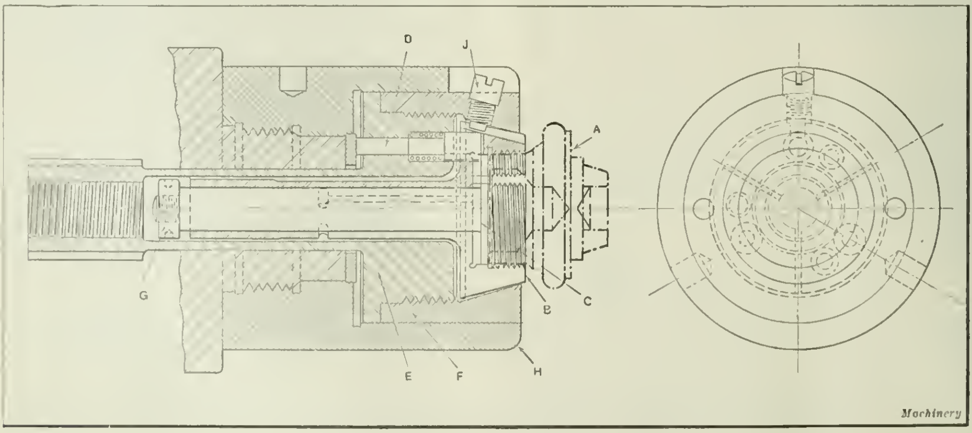
The work *A*, shown by the heavy dot-and-dash lines, is threaded into the collet *B*, and bears against the stop *C*, the thrust being transmitted against the spindle of the machine through the medium of the three spring-actuated plungers *D*. The plungers *D* are located in the collet-closing sleeve parts *E* and *F* which are threaded together. The collar *G* retains the stop *C*. The collet *B*, the closing sleeve *F*, and the chuck cap *H* are keyed together by the screw *J*.

Waynesboro, Pa. D. A. NEVIN

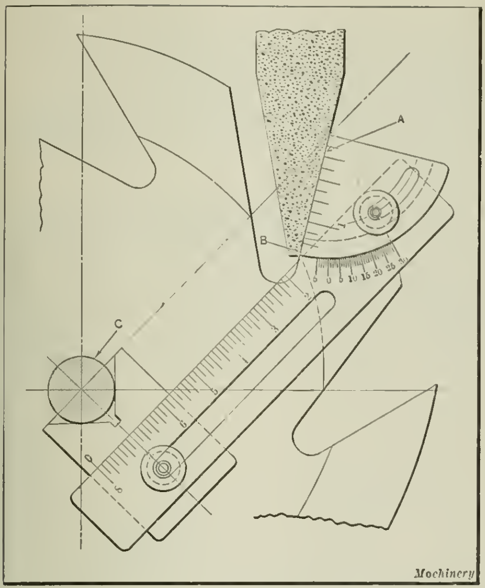
SETTING GRINDING WHEELS FOR SHARPENING HOBS

The wear to which grinding wheels are subject in operation is generally distributed unevenly over the working surface of the wheel. This is very noticeable in wheels used for form and angle grinding. In grinding gashes or flutes of hobs, the wheel is usually worn away fastest at the largest diameter as the wheel is weakest at this edge and has much more metal to remove. In form cutter and hob grinding, it is the general practice to make such allowances in truing the grinding wheel and setting the machine as will compensate for this uneven wear.

In sharpening hobs by grinding the tooth faces with the wheel set as indicated in the illustration, the wear on the wheel is less at point *A* than at the periphery *B*. Therefore if the grinding face is trued and set to grind work on a radial line, the finished surface will have a negative rake.



Special Screw Machine Chuck, operated by the Draw-rod Mechanism



Testing Angle of Wheel set to grind Hooked-tooth Cutter

This results from the more rapid wear near the periphery of the wheel, which actually changes the angle of the grinding face.

In order to produce a tooth having a radial face, it is necessary to set the wheel to grind "hooked" or "under-cut" a certain amount to allow for abrasion. To produce a hooked tooth having an under-cut of 8 degrees, for instance, it is necessary to set the wheel to a somewhat sharper angle, say, 9 or 10½ degrees. If this allowance is correct, the face of the tooth will have approximately the desired angle. No definite data regarding the amount of allowance, however, can be given, as this depends on too many variables. By measuring the tooth face angle after grinding, and then comparing this measurement with the angle of the grinding wheel face at the beginning of the operation, an operator soon learns what allowance to make for wheel abrasion. The allowance naturally depends upon the hob being ground, the kind of wheel used, and the kind of grinding machine employed. In order to reduce the allowance to a minimum, it is necessary to use a wheel of the correct grade and grain, and also to run the wheel at the correct speed, and employ a machine having well lubricated bearings of ample size.

A soft wheel will be worn away very rapidly when mounted on a light weight machine which allows considerable vibration, while a hard fine wheel will be abraded less rapidly. The hard wheel, however, is likely to burn the work, and has a comparatively low production rate. Again, if the wheel is too soft and is run at too low a speed, with a feed that is too small, or if the depth of cut is too heavy, the hob may actually turn the wheel down faster than the wheel can grind the hob. The difficulty in evolving a formula for determining the amount of allowance for wheel abrasion is therefore evident.

In form and angle grinding, it is necessary to have some means of gaging or testing the angle of the grinding surface of the wheel before and after the grinding operation. A gage that has proved exceptionally useful for this purpose is shown in the accompanying illustration. This gage makes it unnecessary to have separate radial setting gages and templets for hobs of different diameters and tooth forms. Another advantage is that the gage can be adjusted to include the allowance required to compensate for wheel abrasion.

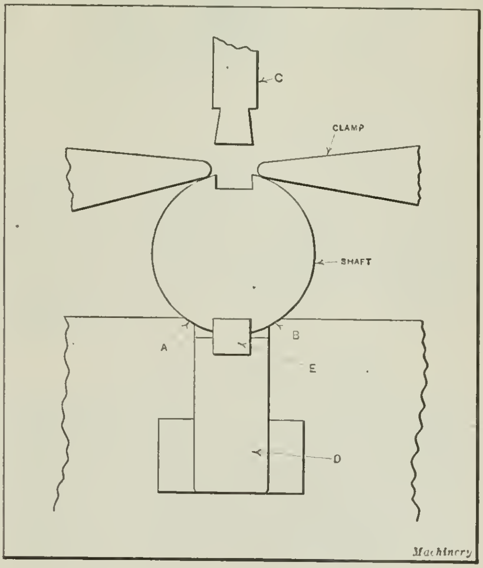
The capacity of the gage is for hobs and form cutters from 2 to 8 inches in diameter, and from 5 degrees negative rake to 30 degrees positive rake. This gage may be used on a hob or formed cutter grinder with the hob in position, as the measurements are taken from the tailstock center shown in cross-section at *C*. In the illustration the gage is shown set to test the angle of a grinding wheel for an 8-inch hob having an extreme hook or rake of 30 degrees, and a cutting face 1⅜ inches deep. This angle is not recommended; it merely illustrates the maximum angle to which the gage may be set. In applying the gage, the table of the machine is adjusted so that the tailstock center which supports the hob is directly under the center of the grinding wheel. The V-end of the gage is placed against the center *C* and the protractor edge swung upward into contact with the wheel as illustrated. Thus the gage may be employed for setting wheels to grind straight, left- or right-hand spiral flutes.

Bridgeport, Conn. HARRY E. HARRIS

CUTTING KEYWAYS IN LONG SHAFTS

The writer was recently confronted with the problem of cutting two ⅜-inch keyways diametrically opposite each other and extending the full length of a shaft 21 feet long. The shaft was 1¾ inches in diameter and the two ⅜-inch keyways were required to be spaced exactly 180 degrees apart. The accurate spacing of the keyways was necessary, as the shaft was required to be a good sliding fit in the broached holes of twenty-five steel gears. These gears, when assembled on the finished shaft, were required to slide the full length of the shaft.

The accompanying illustration shows diagrammatically the method devised by the writer for locating and holding the shaft on the planer bed. The table of the largest planer available was 20 feet long, but by allowing the shaft to overhang a little at each end it was found possible to take a cut of the required length. The first step was to plane a small bevel on the edges *A* and *B* of one of the planer T-slots so as to get a true surface on which to lay the shaft. The shaft was then clamped in place in the trued-up slot. The cutting tool *C* was set central with the shaft by means of a



Cutting Keyways in Opposite Sides of a Long Shaft

dial indicator, clamped to a small parallel which was held first against one side of the shaft and then against the other, the tool being adjusted until the indicator registered the same on each side. The first keyway was then cut to the required depth.

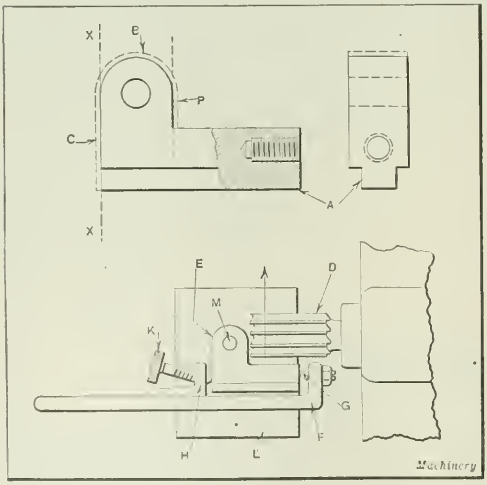
The shaft was next removed, and a cast-iron block *D*, about 4 inches long, was driven down into one end of the planer T-slot. Then, without shifting the cutting tool a slot or keyway was cut in the cast-iron block, after which the key *E* was carefully fitted in the slot and the shaft put back in place on the planer table. The keyway of the shaft, fitting over the key *E*, served to locate the shaft in the proper position for cutting the second keyway. The finished shaft was found to be a good fit in the broached holes of the gears and no trouble was experienced in sliding any of the gears the full length of the shaft.

Cleveland, Ohio CHARLES OWEN LEWIS

MILLING A CURVED SURFACE WITH AN END-MILL

Work that goes through the shop in a hurry is likely to suffer from too much haste, and when the parts are assembled it may be found that they will not fit properly. The writer saw a case of this kind a short time ago. The work that was wanted in a hurry consisted of a small brass casting like the one shown at *A* in the illustration. About 100 of these pieces were made up on very short notice to be shipped as soon as possible. Through an error in making the pattern the castings had an excess amount of stock at *B*, *C* and *P*, so that when an attempt was made to assemble the parts serious interference was encountered. There was no time to make a form cutter, and nothing was available in the tool-crib that was anywhere near the size that was required.

The work was done rapidly in the following manner and rushed to completion. The portion *C* was milled away on



Milling a Curved Surface with an End-mill

line *X-X* by holding the work in a vise mounted on a hand milling machine. While this was being done by another man the writer found a cast-iron plate *L* and drilled a couple of holes in it so that it could be fastened to the milling machine table. A drill rod plug *M* of suitable size was driven into plate *L*. A $\frac{1}{4}$- by 1-inch strap *F* was bent as shown, and a pointed pin *G* inserted at one end. A short piece of stock was bent and fastened at *H* so that the thumb-screw *K* could be applied to this end of the work to clamp it to the handle.

The work *E* was placed on the stud *M* and an end mill *D* used in the spindle of a hand milling machine. The table was fed forward in the direction indicated by the arrow to finish the side of the work at *P*. The lever *F* was then pulled around by hand to generate the curved surface at *B*. By this makeshift method the work was gotten out in time for shipment and within a sufficient degree of accuracy to meet requirements. ALEX DOWEL

ALIGNING STOCK GUIDE OPENING IN STRIPPER PLATE

The proper alignment of the stock guide opening in the stripper plate of a progressive die is often a puzzling problem, and few diemakers have any definite method of accomplishing this. If the stock guide is not properly aligned,

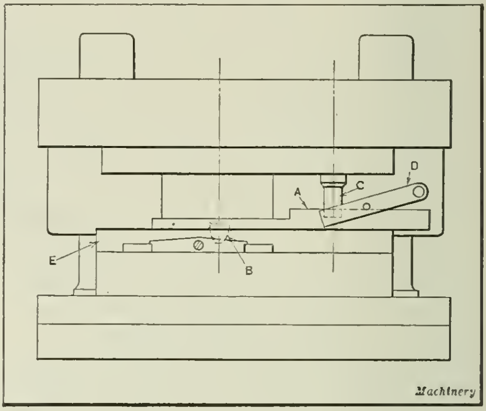


Diagram showing Method of aligning Stock Opening in Stripper Plate

the stock will be pulled over by the pilots. The accompanying illustration shows a simple method of obtaining accurate alignment. With this method a strip *A* having an offset is used. The thin end of this strip is located against the pilot *B*, and the heavy end is placed against the corresponding perforating punch *C*. A pair of small parallel clamps *D* may be used to hold the strip *A* in position.

After clamping the strip in place, the die is closed, as shown in the illustration, and a line scratched on the stripper plate *E*, using the edge of strip *A* as a guide. This line makes it a very simple matter to set up the work properly for machining the opening for the stock. The accurate location of the stock guide slot by this method will save many broken pilots and eliminate much repair work. When this method is employed the die does not need to be finished on any of its sides to facilitate laying out the work as it is commonly done. On work that does not require great accuracy, it is simply necessary to lay a templet on the die and drill the required holes.

The offset strip *A* is also of value in testing the alignment of dies which do not function properly. For this work, a line is first scribed on the stripper plate, as previously described. The stripper plate is then mounted on an angle plate, where it is aligned in a horizontal position, using the scribed line as a guide. The parallelism of the stock opening with respect to the scribed line is tested by running an indicator along the edge of the stock opening. If it is found necessary to remachine the stock opening in a shaper or milling machine, the scribed line is simply transferred to the opposite side of the plate by means of a surface gage while the stripper is mounted on the angle-plate. The vise of the machine can then be swung to whatever angle is required to machine the opening parallel with the scribed line

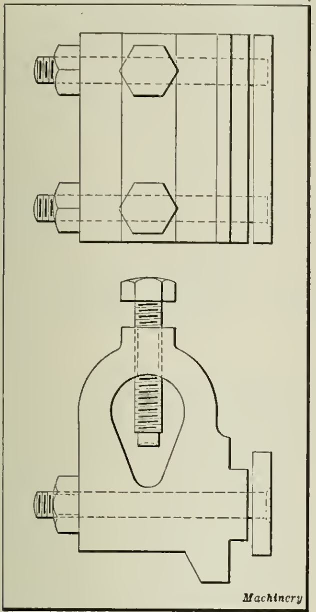
St. Louis, Mo. HARRY B. HANSEN

Shop and Drafting-room Kinks

BORING-BAR HOLDER

The accompanying illustration shows a boring-bar holder designed for use on a lathe. It is clamped to the compound rest, and a slot of special shape is cut in it so that boring-bars of various diameters can be accommodated and held in place by the screws. The simplicity of the construction and the range of work for which it may be used will be apparent to those familiar with the use of a device of this kind. The substantial construction and method of attaching this device make it well suited for heavy work.

E. W. Cable
Butte, Mont.

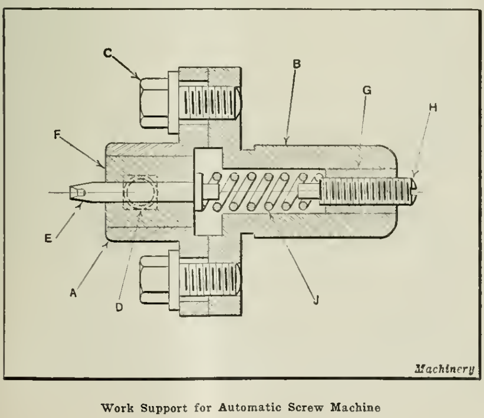


Holder for Boring-bars of Various Diameters

SCREW MACHINE WORK SUPPORT

An adjustable work support for an automatic screw machine is shown in the accompanying illustration. This support has proved useful in tooling up a No. 00 B & S machine for handling small work, the hole in the end of support *E* being 1/16 inch deep and 0.028 inch in diameter. Parts *A*, *B*, *C*, and *D* are standard products of the Brown & Sharpe Mfg. Co. Parts *A* and *B* must, of course, be machined to receive the other parts of the tool-holder.

The tool-steel piece *F* is hardened and ground to a snug fit in part *A*. The tool-steel support *E* is also hardened and ground and is a sliding fit in part *F*. Brass bushing *G* is a driving fit in part *B*. Spring *J* is adjusted by screw *H*. The size of the wire used for the spring depends upon the kind and size of stock being operated on. E. W. L.

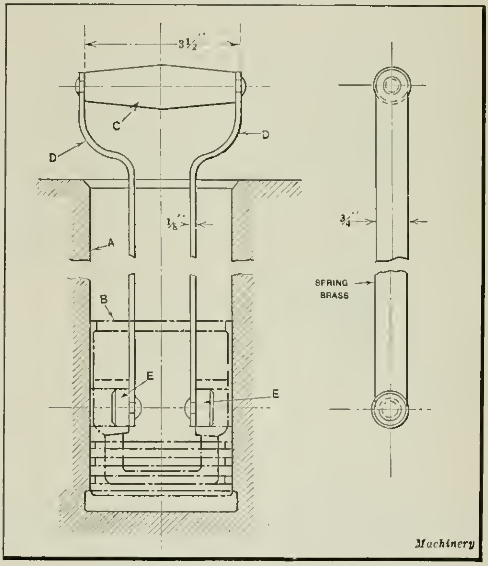


Work Support for Automatic Screw Machine

TONGS FOR FITTING PISTONS IN CYLINDERS

The tongs shown in the accompanying illustration are designed to facilitate sliding a piston up and down in a cylinder block when fitting the piston to the cylinder bore. The cylinder bore is shown in section at *A*, while the piston is represented by dot-and-dash lines at *B*. The tongs are made up of a handle *C* and two straps *D* made of spring brass. To the end of each of the spring straps is riveted a small plug *E*. These plugs are made about 0.005 inch smaller than the wrist-pin hole so they can be easily inserted. In attaching the tongs to the piston, it is only necessary to press the two straps together, insert the ends in the piston, and then allow the straps to spring back so that the plugs *E* will enter the wrist-pin holes.

Pittsburg, Pa. William Owen



Tongs used in fitting a Piston in a Cylinder

HOLDER FOR PENS

Lettering and ruling pens, as well as writing pens, may be kept in first-class condition when not in use, by thrusting them into a jar of BB shot which has been moistened with castor oil. The oil-covered surface of the shot supplies just enough oil to prevent ink from drying on the pens, thus eliminating the principal cause of corrosion or rust. When kept in such a holder, the pens will be shiny and clean each time they are removed and wiped for use.

Auburndale, Mass. Frank H. Jones

Questions and Answers on Practical Subjects

TANGENCY PROBLEM

P. L. W.—Referring to the accompanying diagram, please show how to calculate the radius r of a circle which passes through point C of square $ABCD$ and is tangent to the sides AD and AB? The dimension a of the square is known.

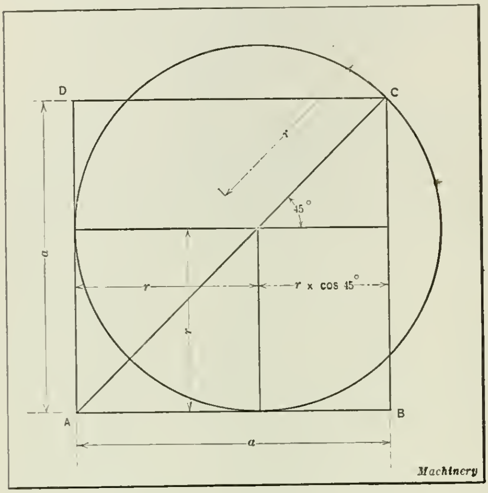


Diagram used in solving Tangency Problem

A.—Referring to the diagram,

$$a = r + r \times \cos 45 \text{ degrees}$$
$$= r\,(1 + \cos 45 \text{ degrees})$$

Hence

$$r = \frac{a}{1 + \cos 45 \text{ degrees}}$$

SIZE OF TAP DRILLS

H. S. A.—What is the correct relation between the diameter of a tap and the drill which precedes it, and to what extent is the size affected by different materials?

A.—There is some variation in the practice of different manufacturers even when tapping the same general class of work, but as a general rule, in manufacturing practice, the drilled holes are large enough to allow for a tapped thread having a depth equal to about three-fourths of the standard depth. On certain classes of work, one-half of the standard thread depth is considered sufficient. So far as strength is concerned, threads tapped to one-half the standard depth are satisfactory; in fact, a bolt subjected to an axial load will break instead of stripping the threads; this applies to a U. S. standard thread inserted in an ordinary cold-punched nut.

When tapping soft material such as copper, drawn aluminum or Norway iron, the holes should be somewhat larger than in the case of harder crystalline materials such as cast metal. If the holes in the soft tough materials are too small, the tops of the threads are likely to be torn off, so that the effective depth of the thread is really less than it would be if the hole were originally larger. Generally speaking, it is safer to drill tap holes too large rather than too small, because three-fourths of a full bearing will give all the strength required.

DESIGNER'S PROBLEM

C. K.—Please show how to find angle x in the accompanying diagram. This angle is required in working out the design of steel wheels.

A.—To find angle x as indicated in the diagram, first draw lines AB, AD, and EB. We now have two right-angle triangles, ACD and ECB.

Now

$$AB = \sqrt{AF^2 + FB^2}$$
$$\text{Sin } a = \frac{AD}{AC} = \frac{EB}{CB}$$
$$AC + CB = AB$$

Therefore,

$$\text{Sin } a = \frac{AD + EB}{AB}$$
$$\text{Sin } b = \frac{AF}{AB}$$
$$\text{Angle } e = 180 \text{ degrees} - (a + b)$$
$$x = 90 \text{ degrees} - e$$

Substituting the numerical values given in the diagram, we have

$$AB = \sqrt{3.75^2 + 3.1875^2} = 4.92165$$
$$\text{Sin } a = \frac{3 + 1.625}{4.92165} = 0.93972$$
$$a = 70 \text{ degrees } 18 \text{ seconds}$$
$$\text{Sin } b = \frac{3.75}{4.92165} = 0.76194$$

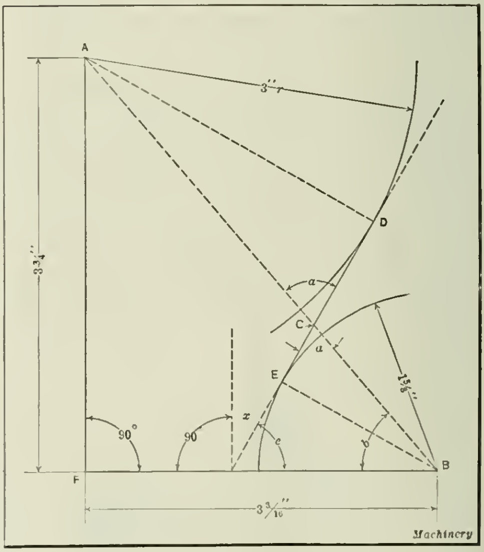


Diagram for solving a Designer's Problem

$$b = 49 \text{ degrees } 38 \text{ minutes } 9 \text{ seconds}$$

Therefore

$$e = 180 \text{ degrees} - (70 \text{ deg. } 18 \text{ sec.} + 49 \text{ deg. } 38 \text{ min. } 9 \text{ sec.})$$
$$= 60 \text{ degrees } 21 \text{ minutes } 33 \text{ seconds}$$

and

$$x = 90 \text{ degrees} - (60 \text{ deg. } 21 \text{ min. } 33 \text{ seconds})$$
$$= 29 \text{ degrees } 38 \text{ minutes } 27 \text{ seconds}$$

ALLOWANCES FOR SHRINKAGE FITS

By A. DESIGNER

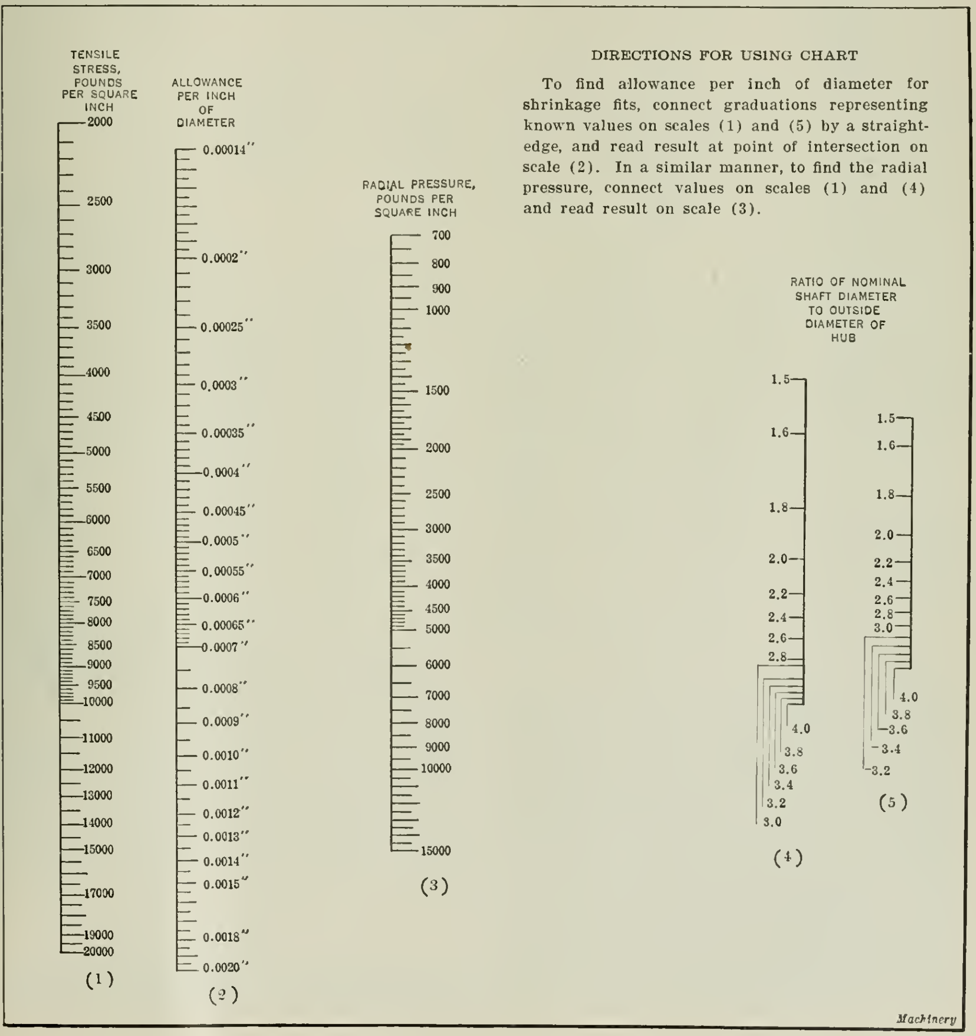
In calculating shrinkage fits, there are two main factors to be considered. The first and most important is the stress in the hub at the bore, which depends chiefly upon the shrinkage allowance. If the allowance is too large, the elastic limit will be exceeded and permanent set will occur; or, in extreme cases, the ultimate strength of the metal will be exceeded and the hub will burst. The second factor may be referred to as the intensity of the grip of the fit, which depends chiefly upon the thickness of the hub; the greater this thickness, the stronger the grip, and vice versa.

The formulas given in MACHINERY'S HANDBOOK on page 886 for determining the allowance per inch of diameter to be made for shrinkage fits, have been used in developing the accompanying chart. This chart is for use when the hub is of cast iron and the shaft of steel. A similar chart (not shown) has also been worked out by the author for use when both the hub and the shaft are of steel. Besides giving the allowance per inch to be made, the chart also gives the radial pressure resulting from the intensity of the grip of the fit, the formula being obtained from MACHINERY'S Reference Book No. 89.

To illustrate the use of the chart, let us assume that we have a cast-iron hub and a steel shaft, the internal and external diameters of the hub being in the ratio of 1 to 1.5. The tensile stress in the hub, which is of cast iron, may be taken as 4000 pounds per square inch. The problem is to determine the amount of allowance per inch for a shrinkage fit. First lay a straightedge across the chart, connecting 4000 on the tensile stress scale with the ratio 1.5 on the scale marked (5). Then on scale (2) read the allowance per inch, which in this case is between 0.00029 and 0.0003 inch. In practice, the latter value would no doubt be used.

The magnitude of the radial pressure exerted by the fit is next desired. The formula for this is $P = TC$, where P = radial pressure; T = tensile stress of the material used; and C = a constant which is dependent upon the ratio of the external and internal diameters. Then, by connecting the

CHART FOR DETERMINING ALLOWANCE PER INCH OF DIAMETER FOR SHRINKAGE FITS AND THE RESULTING RADIAL PRESSURE WHEN THE HUB IS CAST IRON AND THE SHAFT STEEL



tensile stress, 4000 pounds in this case, with the same ratio, 1.5 on scale marked (4), we read, on scale (3), 1400 pounds as the radial pressure exerted by the fit.

A little study of the chart will disclose some interesting facts that are not so apparent when use is made of tabulated values. For example, if we increase the tensile stress in the hub to 6000 pounds per square inch, maintaining the same diameter ratio, the resulting allowance per inch of diameter is increased to 0.00044 inch and the radial pressure correspondingly increased to approximately 2100 pounds. On the other hand, if we, arbitrarily, adopt an allowance of say 0.001 inch per inch of diameter, it is found that with the same ratio the tensile stress is jumped up to 13,500 pounds per square inch and the radial pressure is increased to 4700 pounds per square inch.

It can readily be seen that the determination of the allowance for this class of fits should be given careful thought in order to prevent the ultimate strength of the material and its elastic limit from being exceeded. To approach the danger point too closely invites trouble. It will be evident that the chart can be worked inversely, that is, if the allowance is known, the radial pressure or tensile stress can be determined. It is necessary, however, that two of the factors be known, or assumed, in order to find the third.

* * *

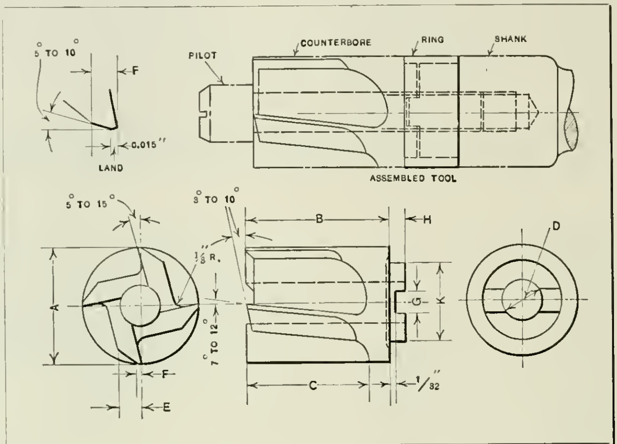
In equipping a plant and in buying new machinery, great care is usually taken to see that the best machine for the purpose is obtained. The buying of small tools and tooling equipment is not always done with the same care; yet small tools very largely determine manufacturing costs. In plants where quantity as well as quality of the product is the main consideration, the same care should be given to obtain the most effective tooling equipment as is given to the selection of machine tools. As a rule, it requires more definite knowledge of machining methods and of tools available in the market to properly select a tooling equipment than it does to select a machine tool. In some shops, all tools are passed upon by a special department, whether the tools are bought from the outside or designed and made in the tool-room of the shop. Such a tool ordering and inspection department insures uniformity and makes it possible to have someone who is constantly looking out for the quality and type of tooling equipment used. This system can also be extended to the care for the entire tooling equipment.

COUNTERBORES OR SPOT-FACING TOOLS WITH INTERCHANGEABLE CUTTERS

By EDWARD H. TINGLEY
Research Engineer, Delco Light Co., Dayton, Ohio

The counterbores or spot-facing tools described and illustrated in this article were developed for use in the plant of the Delco Light Co., Dayton, Ohio, where they have been employed for a long time with marked success. In working out the design of the various members composing these tools, especial care was taken to eliminate certain sources of trouble found to exist in the usual type of counterbore. For instance, the pilots of regular tools frequently become loose and when this happens the workmen usually rough up the pilot stem and drive it back into place. Naturally this treatment often causes the pilot to run out of true with the body of the counterbore. Then again many counterbores are broken by the workmen in their efforts to press the pilots in hard enough to make them stay in place. It is the elimination of troubles of this kind that has made the new tools so successful.

TABLE 1. DIMENSIONS OF COUNTERBORES OR SPOT-FACING TOOLS



No.	A	B	C	D	E	F	G	H	K
1	0.750	1 1/8	3/4	0.312	7/32	1/16	0.255	5/32	0.624
2	0.7812	1 1/8	3/4	0.312	7/32	1/16	0.255	5/32	0.624
3	0.8125	1 3/16	13/16	0.312	7/32	1/16	0.255	5/32	0.624
4	0.8437	1 3/16	13/16	0.312	7/32	1/16	0.255	5/32	0.624
5	0.875	1 5/16	7/8	0.312	7/32	1/16	0.318	3/16	0.686
6	0.9062	1 5/16	7/8	0.312	7/32	1/16	0.318	3/16	0.686
7	0.9375	1 3/8	15/16	0.312	7/32	1/16	0.318	3/16	0.686
8	0.9687	1 3/8	15/16	0.312	7/32	1/16	0.318	3/16	0.686
9	1.000	1 7/16	1	0.312	7/32	1/16	0.318	3/16	0.874
10	1.0625	1 7/16	1	0.312	7/32	3/32	0.318	3/16	0.874
11	1.125	1 11/16	1 1/8	0.312	7/32	3/32	0.318	3/16	0.874
12	1.1875	1 11/16	1 1/8	0.312	7/32	3/32	0.318	3/16	0.874
13	1.250	1 13/16	1 1/4	0.437	9/32	3/32	0.380	7/32	1.061
14	1.375	1 13/16	1 1/4	0.437	9/32	3/32	0.380	7/32	1.061
15	1.500	2 1/16	1 1/2	0.562	11/32	1/8	0.380	7/32	1.249
16	1.625	2 1/16	1 1/2	0.562	11/32	1/8	0.380	7/32	1.249
17	1.750	2 5/16	1 3/4	0.562	11/32	1/8	0.380	7/32	1.499
18	1.875	2 5/16	1 3/4	0.562	11/32	1/8	0.380	7/32	1.499
19	2.000	2 5/16	1 3/4	0.562	11/32	1/8	0.380	7/32	1.499

Machinery

The complete tool consists of a counterbore, a pilot, an adapter ring and shank, as shown in the assembly view that accompanies Table 1. The data in Tables 1 and 2 give the various dimensions of all the parts required in covering a wide range of sizes.

It will be noted that many dimensions of these parts are the same for different sizes. This makes the parts interchangeable and also reduces the total number of parts actually required. These counterbores are comparatively inexpensive to manufacture, as very little tool steel is necessary. The tool can be disassembled easily at any time by simply unscrewing the pilot.

It will be noted that the flutes of the cutter shown in connection with Table 1 follow the path of a right-hand helix, which gives the cutting edges a positive shear. The flutes may, of course, be cut to conform to a left-hand helix, or spiral, when conditions require a cutter having a negative shear. Thread N (see Table 2) is made rather a loose fit for the thread in the shank of the tool. This permits the accurately turned body section M to center the pilot exactly in the cutter.

* * *

The most important news in the automobile field has been the \$80,000,000 merger of manufacturers of automobiles, trucks, and parts under the name of the Associated Motor Industries, with factories in seven states.

REMOVING DENTS FROM METALLIC SHELLS

By A. EYLES, Foreman Sheet Metal Worker
Lancashire & Yorkshire Railway, Manchester, England

The article relating to the removal of dents from metallic shells, which appeared on page 101 of October, 1921, MACHINERY, was of great interest to the writer, because removing and straightening out dents in metallic shells, closed cylindrical vessels, automobile lamps, brass musical and scientific instruments, tubing, sheet-metal parts of damaged automobiles, etc., is an important part of the work in the sheet-metal shop where the writer is employed. The following practical hints for removing and straightening out the dents on metallic objects may be of interest to readers employed in various branches of engineering:

In general practice, it is found best to anneal the metal in the immediate vicinity of the damaged part, in order to insure an equal flow and to minimize any possibility of cracking. If the shell or vessel is made from copper, the damaged part should be annealed by being heated to a dull red color, and then instantly plunged into cold water. Copper or brass shells should never be annealed in a freshly made coke fire. The blast should be turned on until the fire is incandescent, as otherwise the sulphur in the coke will affect the quality of the copper. Again, it is not advisable to work thin copper while it is hot. Iron and mild steel shells can be worked on much better when hot, but it may be ruinous to work on copper in a similar manner; this also applies to aluminum, brass, and zinc articles.

Methods of Annealing

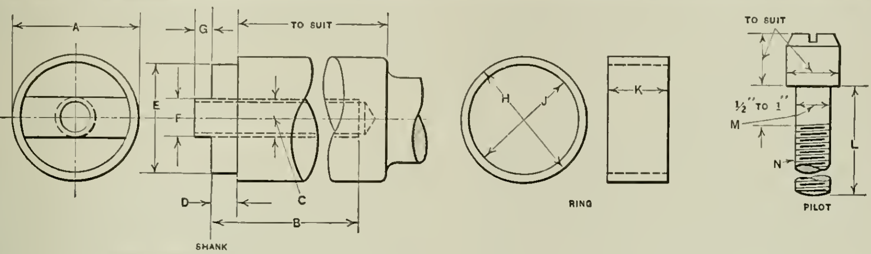
Brass shells require very careful annealing in order to prevent the metal from being overheated and becoming brittle. Some kinds of brass will even crumble while in a red hot state if touched with a hammer. As regards the method or rate of cooling brass after it has been annealed (the metal must not be heated above a dull red color) the writer invariably finds that on hard worked or hardened sheet brass, such as is generally used for intricate stampings, spinnings, etc.; the most favorable conditions are obtained when the metal is cooled slowly in the atmosphere.

Aluminum shells require less annealing than brass shells. The metal should be heated to a very dull red color (which is perceptible only in the dark) and then cooled slowly. A suitable annealing temperature varies from 700 to 900 degrees F., depending on the thickness of the metal and the length of time it is subjected to the heat. Metallic shells, etc., made from tin and terne-plates, and electroplated ware cannot be satisfactorily annealed, as their protective coatings will be destroyed by the heat.

Removing Dents from Thin Shells

If the shell is made from very thin sheet metal and if there is no means of working from within, a piece of stout wire should be soldered to the shell in the center of the dent. After the solder has set, the wire can be given a strong pull so that the metal will be pulled outward. The wire can then be melted off. A wire bent to form a handle will be found to be a useful tool for this work, and it can be kept on hand ready for the next job. Sometimes when the dent is not eliminated satisfactorily by this method, a few light blows with a flat-faced bright hammer delivered around the dent will greatly improve the appearance of the piece. If a polished brass article has been dealt with, such as a brass musical or scientific instrument, very fine emery cloth should be used to remove every trace of solder, afterward rottenstone and oil, or tripoli and oil should be used, finishing off with dry powdered lime. Buffing is used, of course, whenever highly polished surfaces are required.

TABLE 2. DIMENSIONS OF COUNTERBORE SHANK, RING, AND PILOT



	Shank							Ring			Pilot		
No.	A	B	C	D	E	F	G	H	J	K	L	M	N
1	3/4	1 1/4	5/16–18	1/4	0.625	0.250	1/8	3/4	0.625	7/16	1 7/8	0.311	5/16–18
2	25/32	1 1/4	5/16–18	1/4	0.625	0.250	1/8	25/32	0.625	7/16	1 7/8	0.311	5/16–18
3	13/16	1 1/4	5/16–18	1/4	0.625	0.250	1/8	13/16	0.625	7/16	1 15/16	0.311	5/16–18
4	27/32	1 1/4	5/16–18	1/4	0.625	0.250	1/8	27/32	0.625	7/16	1 15/16	0.311	5/16–18
5	7/8	1 1/4	5/16–18	1/4	0.687	0.312	5/32	7/8	0.687	15/32	2 1/16	0.311	5/16–18
6	29/32	1 1/4	5/16–18	1/4	0.687	0.312	5/32	29/32	0.687	15/32	2 1/16	0.311	5/16–18
7	15/16	1 1/4	5/16–18	1/4	0.687	0.312	5/32	15/16	0.687	15/32	2 1/8	0.311	5/16–18
8	31/32	1 1/4	5/16–18	1/4	0.687	0.312	5/32	31/32	0.687	15/32	2 1/8	0.311	5/16–18
9	1	1 1/4	5/16–18	11/32	0.875	0.312	5/32	1	0.875	9/16	2 3/16	0.311	5/16–18
10	1 1/16	1 1/4	5/16–18	11/32	0.875	0.312	5/32	1 1/16	0.875	9/16	2 3/16	0.311	5/16–18
11	1 1/8	1 1/4	5/16–18	11/32	0.875	0.312	5/32	1 1/8	0.875	9/16	2 7/16	0.311	5/16–18
12	1 3/16	1 1/4	5/16–18	11/32	0.875	0.312	5/32	1 3/16	0.875	9/16	2 7/16	0.311	5/16–18
13	1 1/4	1 5/8	7/16–14	11/32	1.062	0.375	3/16	1 1/4	1.062	19/32	2 3/4	0.436	7/16–14
14	1 3/8	1 5/8	7/16–14	11/32	1.062	0.375	3/16	1 3/8	1.062	19/32	2 3/4	0.436	7/16–14
15	1 1/2	2	9/16–12	3/8	1.249	0.375	3/16	1 1/2	1.250	5/8	3 3/16	0.561	9/16–12
16	1 5/8	2	9/16–12	3/8	1.249	0.375	3/16	1 5/8	1.250	5/8	3 3/16	0.561	9/16–12
17	1 3/4	2	9/16–12	3/8	1.499	0.375	3/16	1 3/4	1.500	5/8	3 7/16	0.561	9/16–12
18	1 7/8	2	9/16–12	3/8	1.499	0.375	3/16	1 7/8	1.500	5/8	3 7/16	0.561	9/16–12
19	2	2	9/16–12	3/8	1.499	0.375	3/16	2	1.500	5/8	3 7/16	0.561	9/16–12

Machinery

If the shell has an opening at one side large enough to permit a suitable tool to enter, the dent or bulge can be straightened out by hammering, the projecting dent inside the shell being hammered back by placing the shell on an iron stake and manipulating the hammer so that while the dent rests on the stake the blows will be delivered on each side of it, or around it. Persistent and judicious hammering will force the dent out until the original shape is restored.

Filling up Dents

In some cases it is more economical to load the dent up with solder and smooth it with a file or scraper, and sandpaper, or to solder a patch of metal over the damaged part, after which the soldered part can be filed or ground down until the shell resumes its original appearance. The indented surfaces to be soldered and the adjacent metal must be thoroughly cleaned before attempting to solder. When a patch is employed, it should be held down during the soldering process, say with an old file, which should not be removed until the solder is firmly set. All traces of the flux used for soldering should be thoroughly washed off to avoid subsequent corrosion of the metal.

Removing Dents from Tubing and from Spherical Shells

Another method of eliminating dents in metallic shells of small diameter, such as tubing, etc., is to obtain a number of steel balls, highly polished, and equal in diameter to the inner diameter of that part of the shell or tubing which is undamaged. Anneal the damaged part, as previously explained, and then drive the balls throughout the entire length of the shell or tube. A little powdered black lead sprinkled among the balls in the shell will facilitate the work. Obviously, if the balls can be made to pass through the shell, the latter will be restored to its original shape. If steel balls are not available, hard wooden balls may be used; but these, of course, will not produce as good a job if stout metal is being handled.

Dents on tubing such as used in the manufacture of microscopes, telescopes, etc., can be removed by laying the tube on the surface of a piece of hard wood, and, with either a burnisher or a round piece of hard wood, rubbing the inside of the tube over the indentations, which will quickly bring the indented surface up level.

In some cases, it is possible to remove a dent from a spherical shaped shell by lightly hammering the outer edge of the dent with a smooth-faced hammer until the indentation disappears. The degree of success of this operation will depend, of course, on the thickness and characteristics of the metal, and the skill of the workman. Dents from 6-inch copper floats have been eliminated by this method.

Removing Dents from Car Roofs

The writer has recently been employed in removing dents from the metal roofs of a number of all-metal railway vehicles. The roof material was sheet aluminum, 0.080 inch thick, and the indentations in many cases had a surface of 500 square inches. For this work a hard wood block provided with a handle and shaped to conform with the curved part was used. This block was employed on the inside of the vehicles for forcing the aluminum upward. The dents were removed by carefully manipulating the wooden block and judiciously hammering the metal on the outside of the roof to get the metal to flow from one point to another. To secure a smooth surface and to harden and stiffen the metal, the surface was finished off with a flat-faced bright hammer over a smooth iron tool.

Another unusual job was the straightening out of the dents on a number of aluminum closed cylindrical vessels, 4 feet long by 2 feet in diameter and 0.128 inch thick, with riveted joints and flanges attached. The vessels were badly damaged, and it was therefore necessary to take one of the dish-shaped ends out of the vessel. The dents and buckled parts were easily straightened out with a wooden mallet over an iron stake, after the metal had been annealed well, the surface being smoothed by hammering with a smooth faced hammer.

To make the vessels air-tight again, ¼-inch aluminum rivets of the cup-head type were used, together with a suitable layer of canvas and paint carefully placed between the cylinder portion and the dished end. Sometimes when removing dents from sheet-metal automobile parts, special iron blocks of different radii are necessary. Good results are usually obtained by holding a suitable iron block on the inside and striking on the outside with a flat-faced bright hammer. In all cases, when removing dents from metal surfaces, care must be taken to bring the hammer flat on the face of the work every time, particularly so when smoothing or planishing the metal surface; otherwise, "half-moons" will appear, and it will be impossible to obtain a perfectly smooth and level surface. Success in using the hand hammer in smoothing or planishing metal surfaces can only be acquired by practice, and written instructions are useless without practice.

* * *

MAKING JOURNAL BRASSES

By M. E. DUGGAN

When only a few journal brasses of the type shown in Fig. 1 are required it is common practice to make a single pattern from which to produce the castings, but if a large number are to be produced, a double pattern is usually made to permit molding, casting, and machining the brasses in pairs. When a single pattern is employed the pouring is done with the mold lying flat or so that the casting will be in the position indicated by the lower view in the illustration Fig. 1.

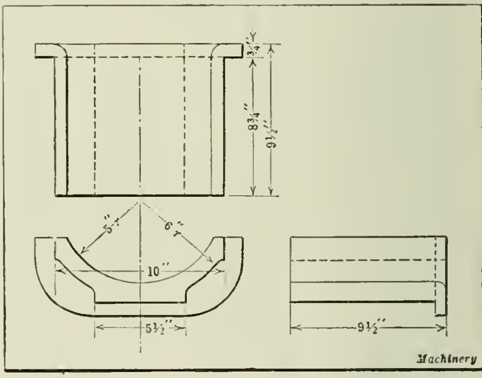


Fig. 1. Journal Brass to be produced

Four different methods of tying or connecting two single patterns to form a double pattern are shown in Fig. 2. In this illustration, corner sections of the four differently constructed patterns are shown grouped about a common center, so that the construction details of the four types can be easily compared. The section of the pattern shown in the upper left-hand corner is attached to the mold board *F*. This type of pattern is objectionable, because when the drag flask with the pattern inside is rolled over and the mold completed ready to draw the pattern, the view is obstructed by the mold board, thus forcing the molder to depend on his sense of feeling when drawing the pattern.

Another objection to this pattern is that the castings produced by its use could not be bored out in the shop without cutting through the tie-sections. In one instance a pattern made in this way was returned to the patternmaker with the request that the tie-piece be so changed that the brasses could be bored in pairs without cutting through the tie-

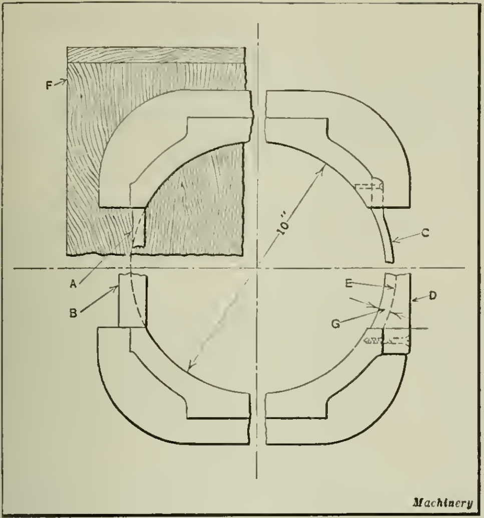


Fig. 2. Four Methods of tying Single Patterns together for casting Journal Brasses in Pairs

pieces. The change was made by simply adding more material to the outside of the tie-pieces, thus increasing the thickness as shown in the lower view at *B*. This method of correcting the pattern was not satisfactory, as it left too much metal to be removed from the brasses by the boring operation.

The pattern shown in the upper right-hand corner is provided with a tie-piece *C* made of finished brass and attached to the wooden pattern by screws. It will be noted that this piece is very thin and that it is made circular in form and set back from the inner surface of the bore slightly so that the boring tool will not touch the tie-pieces when the castings are being bored. The only objection to this method of tying the two single or half patterns together is that the wood-screws will become loosened after a time.

The writer believes that the most satisfactory method of tying the half patterns together is that illustrated in the lower right-hand corner. This method meets every requirement of the molder and machinist. With this type of pattern the two half patterns are connected at each side by hard wood blocks. The lower section of one of these blocks is shown at *D*. They are made flush with the flange and form both the pattern and the core-print. These blocks are carefully fitted to the pattern, and are secured in place with glue and screws. The inner circular surface of the blocks can be made flush with the bore of the pattern or cut back to give clearance for the boring tool. The dry sand core used in this case is made the same shape as block *D* except that its inner surface is cut back as indicated by the dotted line *E* so that the thickness of the tie-piece connecting the two halves of a journal brass casting made from this mold is represented by dimension *G*. In some shops, it is the practice to cut the tie-sections out after the brasses have been bored, and finish machining the parts separately, while in other shops as much of the machining work as possible is performed before cutting the halves apart.

* * *

MARCONI RECEIVES JOHN FRITZ MEDAL

The John Fritz medal, one of the highest distinctions bestowed by the engineering profession in this country upon a fellow engineer was awarded to Guglielmo Marconi. the inventor of wireless telegraphy, at a meeting held in the Engineering Societies' Building, New York City, July 6.

LATHE SET-UP FOR VARYING LEAD

By O. S. MARSHALL

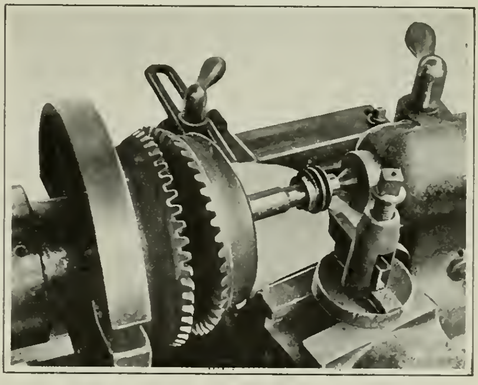
The usual method of obtaining the correct lead when cutting screw or worm threads is to have the right combination of simple or compound gearing between the lathe spindle and the lead-screw. If the occasion arises for cutting some lead for which gears do not happen to be available, it is the usual practice to make or buy one or more gears which will give the required ratio. At least one manufacturer provides his lathe (through the English and the metric gear combinations and an accompanying chart) with a means of cutting a great variety of fractional leads. This is satisfactory where an elaborate equipment is not objectionable. In some cases, however, more simple and less expensive equipment must be used. Then any modern engine lathe provided with a taper-turning attachment will be found to give equally accurate results without the use of other gears than those normally provided.

Cutting Fractional Leads

The necessity of cutting fractional leads frequently occurs in connection with the machining of helical gears having an extreme helix angle which may often approach that of a coarse lead-screw. Such gears may resemble a worm in appearance except for their tooth form. When, as frequently happens, the lead is finer than can be generated on a milling machine, the engine lathe can be used with perfectly satisfactory results. The limit of milling machines in the matter of short leads is generally 0.600 to 0.670 inch. It is inadvisable to undertake anything finer than this on the milling machine, and unless a regular gear-hobbing machine and a suitable hob is in stock—which is improbable—the engine lathe is naturally the machine to use.

A job repeatedly performed on an engine lathe, which is described in the following, will serve to illustrate the method. The work in this instance is a helical gear which is shown mounted on lathe centers in the accompanying illustration. The pitch diameter is 1.652 inches, and the helix or lead 0.3144 inch. The gear is 10 pitch and has one tooth only, of spur gear form. It resembles an ordinary worm, but is calculated strictly according to helical-gear formulas, which require close adherence to the correct angular relationship with the pitch diameters when the center distances are not susceptible of alteration.

The reader must keep clearly in mind the significance of the terms "pitch" and "lead" as applied to helical gears, and not confuse them with similar terms applied to either worms or screws. The helical gear shown in the illustration has the appearance of a worm, as previously mentioned, and it functions like one, but it meshes with another 10-pitch helical gear. This gear has twenty-five teeth and a pitch diameter of 2.534 inches. The helix angle of the 25-



Lathe Set-up for obtaining Variation in Lead tooth gear is 3 degrees 28 minutes, while the helix angle of the single tooth gear to be cut is 86 degrees 32 minutes.

Setting up the Engine Lathe

It is first necessary to determine if the engine lathe will function satisfactorily in performing work for which a milling machine cannot be used because of its limitations in cutting fine leads. The engine lathe is handicapped, however, in the matter of cutting excessively coarse leads. As it is not permissible or good practice to pass a "drunken" thread, it is essential to provide some means of driving the work uniformly throughout every part of its rotation. This is done by the use of a pair of bevel gears, so cut that they will allow a variation of about 5 degrees in their pitch-cone relationship and still operate smoothly when in mesh as shown.

If gears such as those shown are not easily obtainable, a simple plate with six or eight holes drilled to receive driving studs may be attached to the regular driving plate of the lathe. A special flanged arbor provided with corresponding pins is employed to carry the work. The number of driving pins used will depend upon the degree of refinement required in the work. The greater the number of pins used, the more complete will be the elimination of minute inequalities in the lead.

The next step is to determine the lead or helix of the blank and note its nearest approach to some lead which the lathe will cut with its regular gears. The gears selected should give a lead shorter than the one to be cut but as near to that of the required helix as possible. The reason for this will appear in the following: The lead of the helical-gear tooth is 0.3144 inch and is found by the regular formulas for helical gear design. The engineering department ordinarily supplies this detailed information, including the properly calculated angle at which to set the taper attachment.

Referring to the screw plate of the lathe, we find that 3 1/4 threads per inch corresponding to a lead of 0.3077 inch is the nearest approach to the required lead of 0.3144 inch. The angular setting of the taper bar is therefore 11 degrees 51 minutes. The tailstock of the lathe with the center distances adjusted to receive the arbor on which the work is mounted must next be set parallel with the angular setting of the taper guide. An indicator should be used in connection with a straight arbor placed between centers to insure the accuracy of this setting. The compound tool-rest must also be set to approximately the corresponding angle to permit feeding the tool in during the cutting operation, as the regular cross-slide cannot be used for this purpose when the taper attachment is employed.

The reason for gearing the lathe to cut the nearest shorter lead is that by so doing the least possible set-over of the tailstock will be required. In this respect it should be borne in mind that the amount of set-over on a lathe is limited. The shorter the arbor the better, provided it allows sufficient working space. When the lathe is set up as described, and put in operation, a compound movement is imparted to the tool; that is, the lathe carriage is traversed along its fixed pathway, and at the same time the taper attachment serves to control the movement of the tool along another line, as in ordinary taper turning, except that no taper is given the work since the centers of the work-holding arbor are parallel with the angular setting of the taper guide. In other words, the cutting tool travels farther in relation to its work under these conditions than it would without the use of the taper guide, and no set-over of the tailstock. The mechanical conditions are those of the right angle triangle, in which the lathe carriage moves along the base line and the tool along the hypotenuse—conditions which are readily understood by anyone familiar with machine shop practice.

The formula for determining the angular setting of the taper attachment is simple, and is given here for the convenience of those who do not possess the usual handbooks containing this information. If the lead also is desired, it may be found by first multiplying the pitch diameter by 3.1416 and then multiplying this result by the cotangent of the tooth angle. The cosine of the angle to which the taper-turning attachment is set is obtained by dividing the lead for which the lathe is geared by the required lead. After the cosine has been obtained in this way, the corresponding angle is found by referring to a table of trigonometrical functions.

* * *

INDUSTRIAL CONDITIONS IN FRANCE

By MACHINERY'S Special Correspondent

Paris, July 10

The industrial situation in France remains rather unsettled. Iron and steel production is greatly below normal; only about one-third of the blast-furnaces are in operation. On the other hand, there is less unemployment than in the past, but work has not been resumed to such an extent that manufacturers are warranted in buying new stocks of raw materials. Briefly, while there is an improvement, it is very slight and it is not steady.

The greatest improvements are noted in the automobile manufacturing field and in the making of radio apparatus—a development largely due to the broadcasting of concert programs from the Eiffel tower. Weather reports are also broadcasted throughout France by means of radio.

Reductions in wages have caused a number of strikes, one of the more important of which is in the metal-working field in the Lille section. This strike was due to a reduction of 25 centimes per hour, and as a result 9000 men went out on strike. In the Havre section a reduction of 10 per cent in wages has caused a strike of 10,000 metal workers. Most of these strikes in the past have ended by an acceptance of the reduced wages, but with a postponement of two or three months in the application of the lower wage rate.

Government statistics indicate that during the first five months of 1922 there was a considerable decrease in the value of imports over the corresponding period of 1921; and the total amount of exports was 378,000,000 francs in excess of the imports.

The machine tool market is very dull. The war stocks and machines generally are in the hands of dealers who are disposing of them only at a very slow rate. Some manufacturers have organized their own sales service to dispose of their excess stocks of machine tools. A few of the machine tool plants are shut down on account of the present difficulties.

Some examples of prices in the small tool field may prove of interest. Carbon steel 10-millimeter twist drills (approximately 3/8 inch) are sold at 4 francs (present exchange, 34 cents); same size, high-speed steel, 8.80 francs (75 cents); one-inch size, 20.90 francs ($1.77) for carbon steel, and 57.50 francs ($4.89) for high-speed steel drills. The two-inch sizes sell at 95 francs ($8.08) and 180 francs ($15.30) respectively.

* * *

PRICES OF GERMAN MACHINE TOOLS RISING

A recent letter from a machine tool dealer in Scandinavia indicates that the prices of German machine tools are gradually rising in Germany's foreign markets. This dealer states that these prices have now reached the world price level, and in many instances they are above the prices of machine tools built in other European countries. Scandinavian machine tool dealers now look more hopefully toward the future. While at present all the Scandinavian countries suffer from a severe industrial depression, it is expected that when industrial activity returns, there will be a fair market for machine tools other than those of German make.

QUENCHING SMALL PARTS

By E. B. NICHOLS

Difficulties are frequently encountered in quenching small parts that weigh only a few pounds per hundred pieces. The main problem is to keep the parts properly separated in order to prevent excessive heating of the quenching liquid before it reaches the interior of the mass. The next point is to keep the bath of a uniform temperature so that successive batches or pieces will be cooled at the same rate. The perforations in a basket intended to receive or hold small parts must necessarily be very small. For this reason proper circulation of the liquid is seldom obtained in the usual type of quenching basket. One of the objectionable features of the usual type of basket is that the perforations in the bottom are covered up when the basket receives the first batch of work. Thus instead of coming in contact with the work, the cool incoming liquid is forced to pass around the basket and up the side of the cooling tank to the overflow.

To overcome these difficulties, the special basket in Fig. 1 was designed. This basket was used in a tank in which the cooling medium enters at the bottom from the source of supply at a pressure just sufficient to agitate the liquid at the top of the tank. The liquid then passes through tube *A*, out under the conical shaped head *B* to the top of the basket and over the edges of the tank to the overflow. When the parts are dumped into the basket they must pass through a column of liquid two feet deep which is maintained at a uniform temperature. The mass of parts breaks up on striking cone *B*, and continuing on its way downward meets the incoming liquid from under the cone while it is passing to the bottom of the basket where it comes to rest around the central tube. Uniform temperature conditions are thus maintained so that every part receives the same treatment.

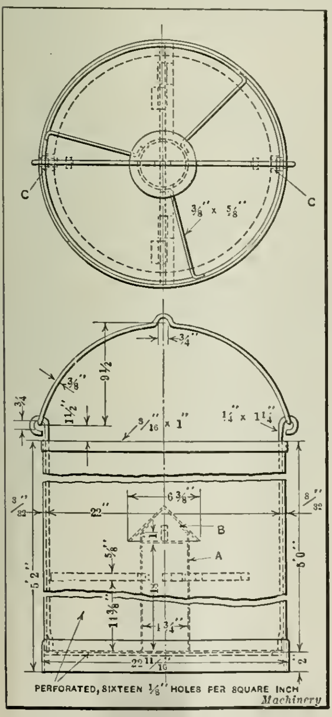


Fig. 1. Sheet-iron Basket for quenching Small Parts

As it would be difficult to remove the contents of this basket in the regular manner, the bottom was made in two halves hinged in the middle and held by latches *C*. The bottom halves swing down when the latches are released.

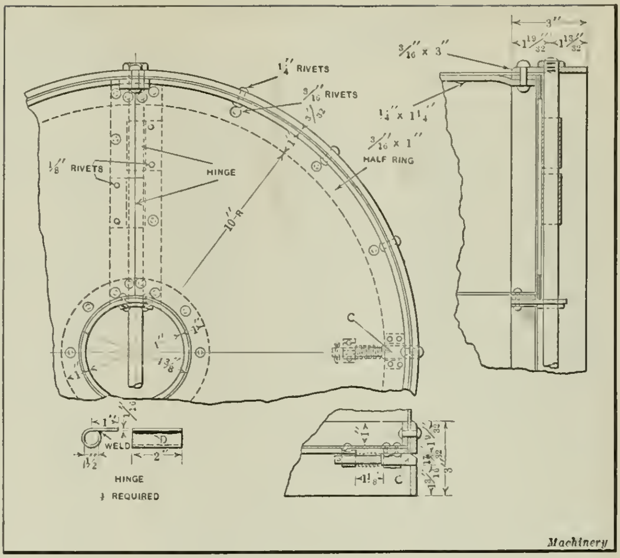


Fig. 2. Details of Hinged Bottom of Basket shown in Fig. 1

Fig. 2 shows the details of the hinges and latches *C*. The latches are made flush with the outside of the basket to prevent them from being accidentally disengaged or damaged by contact with the circulating coils of the tank. A rod placed against the end of the latch and given a light blow forces the latch from engagement with the slot in the side of the basket. This permits the bottom to swing downward so that the quenched parts will drop out.

The hinges for the bottom of the basket are attached by rivets. A detail of one of these hinges is shown in the lower left-hand corner of Fig. 2. The cylindrical part of the hinge is formed by rolling up one end of the flat stock and welding it at *D*. Baskets of this kind have proved very satisfactory and have been in constant use for the last five years.

* * *

CONSOLIDATED MACHINE TOOL CORPORATION OF AMERICA

A news item in July MACHINERY mentioned the formation of the Consolidated Machine Tool Corporation of America through a combination of the Newton Machine Tool Works, Inc., Philadelphia, Pa.; Hilles & Jones, Wilmington, Del.; Betts Machine Co., Rochester, N. Y.; Colburn Machine Tool Co., Cleveland, Ohio; and Modern Tool Co., Erie, Pa. To this list has been added the Dale Machinery Co., Inc., New York and Chicago; and the Ingle Machine Co., Rochester.

Officers of the corporation have also now been chosen. W. H. Marshall, formerly president of the American Locomotive Co., is chairman of the board of directors; C. K. Lassiter formerly vice-president of the American Locomotive Co. is president. The vice-presidents are H. J. Bailey, president of the Hilles & Jones Co.; H. W. Breckenridge, vice-president of the Colburn Machine Tool Co.; H. W. Champion, president of the Newton Machine Tool Works, Inc.; J. J. Dale, president of the Dale Machinery Co.; and A. H. Ingle, president of the Betts Machine Co. and the Ingle Machine Co. O. D. Miller is treasurer of the new corporation and R. R. Lassiter, secretary.

The board of directors includes, besides W. H. Marshall, chairman, C. K. Lassiter, H. J. Bailey, B. J. Baker, H. W. Breckenridge, Lawrence Chamberlain, H. W. Champion, J. J. Dale, T. Allen Hilles, A. H. Ingle, and F. D. Payne. The general offices are at 17 E. 42nd St., New York City.

STUDY MAKES MORE EFFICIENT MECHANICS

By JIM HENDERSON

No mechanic will ever attain a high state of proficiency if he neglects to acquire and retain those rudiments of arithmetic that are essential to a more thorough understanding of the fundamentals of mechanical engineering. Too many workmen of today are apparently content with the limited knowledge required to enable them to perform the actual operations of cutting metal to bring a piece of material to the specified shape and dimensions. Without the application of mathematics the study of engineering would be virtually impossible, and without a fair knowledge of the first principles of arithmetic, even the simplest mechanical operations would be difficult to perform. Many men fail to realize the importance of acquiring the technical or theoretical principles of mechanics as a means of simplifying the solution of their shop problems. The fact that a boy has been able to obtain only a limited public school education should not deter him from aspiring to a more thorough knowledge of the science upon which his work is based.

It is probably true that modern methods of manufacture often eliminate the necessity for the workman to use the learning of his younger days in the production of the work upon which he is engaged. This condition, however, must be accepted and must be recognized by every workman as one that will gradually place the machine tool operator in a position relatively the same as any part of the machine that he is called upon to serve. The actual thinking and planning of his duties is becoming a problem in the solution of which the workman has little to do, owing to the so-called "efficiency methods" that are constantly being adopted in mechanical industries. These systems, however, unless operated on a comprehensive cooperative basis, must eventually crush the individual initiative in factory employes, so that their tasks become more a subject of observation and application than the concentration of reasoning powers for successful achievement. It is obvious, therefore, that if a workman aspires to a higher position, where his brain will relieve his hands of the labors of former days, he must acquire the knowledge that will enable him to apply these potential but often dormant faculties.

Many young men, and not a few that are advanced in years, refrain from the study of technical journals or handbooks because of the general use of formulas in such textbooks, believing that a comprehensive knowledge of algebra is required before these formulas can be used. A brief study of a formula will demonstrate to the average mechanic that the only requirement is a well grounded learning in the elementary principles of arithmetic and a patient application of these fundamental rules. Of course, there are many formulas that necessitate a wider knowledge of mathematics than those possessed by ordinary mechanics, but persistent study and practice in working out the simpler problems will gradually develop the reasoning powers to such an extent that, eventually, the difficulties will not appear so formidable.

To achieve, one must continue to strive, as the prize is invariably given to the winner, and in these days of rapid progress and development no man can hope to succeed and at the same time be content to sit still and let the boat drift with the tide. Seldom does the current flow in the right direction, and in order to reach a haven where the "going" requires less effort, it is necessary to get out the oars and pull against the stream, and the harder you pull the sooner you will be in a position to watch the others as they drift indifferently or struggle to free themselves from undesirable though oftentimes unavoidable environment.

Many men today are wasting their time and energies in commenting on the other fellow's job—a factor that cannot but detract from the ability to do justice to their own. Those men who are continually envying the other fellow and his "soft job" will rarely ever find themselves in a similar position, as with few exceptions these so-called "soft jobs" are the result of previous concentration, study, and hard work. Therefore, it is imperative, and also quite obvious, that the ambitious young mechanic who hopes for greater remuneration or a more responsible position, must use every means to fit himself for the wider duties that call for a thorough knowledge of the work upon which he is temporarily engaged, together with the fuller technical understanding that is essential to the successful filling of the job higher up.

* * *

COOPERATION IN STANDARDIZATION

The Division of Simplified Practice has been established by Mr. Hoover in the Department of Commerce with a view to cooperating with manufacturers and engineering societies in engineering standardization work. The American Society of Mechanical Engineers and the American Engineering Standards Committee are among the engineering bodies cooperating with the Department of Commerce in this work. It is not the intention of the Division of Simplified Practice to duplicate the engineering standardization work now being done through the agency of the American Engineering Standards Committee, but to develop a special field of broad usefulness by reducing the number of sizes and by simplifying the varieties of manufactured articles in common use. Secretary Hoover has invited the cooperation of all engineering and trade societies for determining what simplification in manufactured products is most needed and most desired at this time. Members of engineering societies who have suggestions with regard to simplifying the varieties of manufactured articles in common use, or the standardization of sizes in general for manufactured articles, are requested to communicate with either the Division of Simplified Practice of the Department of Commerce, Washington, D. C., or the American Engineering Standards Committee, 29 W. 39th St., New York City.

* * *

STATISTICS OF THE MACHINE TOOL INDUSTRY

The accompanying tables have been prepared from statistics compiled by the Bureau of Census of the Department of Commerce. Table 1 shows the distribution of the machine tool industry in the different states in 1919, the percentages given being based on the value of the product of the machine tool shops in each state. It will be seen from this table that Ohio produces nearly 30 per cent of the machine tools in the country. The New England states together produce nearly 35 per cent, Massachusetts and Rhode Island leading, with Connecticut a close third. The three states, Ohio, Massachusetts, and Rhode Island produced in 1919 over one-half of the machine tools built in the country.

TABLE 1. DISTRIBUTION OF MACHINE TOOL INDUSTRY IN DIFFERENT STATES IN 1919, BASED ON THE VALUE OF THE PRODUCT

State	Per Cent	State	Per Cent
Ohio	29.5	Delaware	1.200
Massachusetts	11.0	Kentucky	0.500
Rhode Island	10.5	Minnesota	0.400
Connecticut	8.7	Maryland	0.300
Pennsylvania	7.9	Missouri	0.210
Illinois	7.1	New Hampshire	0.110
Michigan	6.0	California	0.036
Vermont	4.5	Washington	0.031
Wisconsin	4.4	Maine	0.008
New Jersey	3.2	Iowa	0.004
New York	2.4	Kansas	0.001
Indiana	2.0	United States	100.000

Machinery

TABLE 2. VALUE OF PLANTS AND PRODUCT OF THE MACHINE TOOL INDUSTRY IN 1919

State	Number of Plants	Value of Land, Buildings, and Equipment	Taxes Paid	Cost of Materials	Cost of Fuel and Power	Value of Product	Value Added by Manufacture
Ohio	102	$56,626,865	$6,294,723	$16,731,367	$745,468	$62,554,169	$45,077,334
Massachusetts	46	32,446,551	1,072,132	6,532,701	376,062	23,442,547	16,533,784
Rhode Island	13	25,036,802	1,723,094	3,368,170	325,796	22,301,290	18,607,324
Connecticut	33	20,380,557	1,040,390	4,548,245	374,721	18,435,449	13,512,483
Pennsylvania	32	21,869,376	1,967,759	4,516,253	251,782	16,797,040	12,029,005
Illinois	28	14,323,537	593,090	4,582,312	173,097	15,008,096	10,252,687
Michigan	31	14,438,803	619,855	3,789,355	182,818	12,656,492	8,684,319
Vermont	6	11,041,881	1,434,642	2,817,119	110,016	9,609,745	6,682,610
Wisconsin	24	10,865,674	1,044,683	2,456,188	142,270	9,414,820	6,816,362
New Jersey	14	7,343,687	936,220	2,345,341	75,241	6,767,671	4,347,089
New York	29	7,351,076	306,956	1,231,764	73,181	5,027,880	3,722,935
Indiana	15	4,315,557	206,788	1,303,228	71,107	4,259,463	2,885,128
All other states	30	4,999,477	598,570	1,826,291	84,415	6,125,496	4,214,790
United States	403	231,039,843	17,838,902	56,048,334	2,985,974	212,400,158	153,365,850

Machinery

Table 2 shows that the value of the land, buildings, and equipment of the plants engaged in machine tool manufacture in the United States was about $231,000,000, and that the total value of the product was $212,000,000. The machine tool industry in that year paid nearly $18,000,000 in taxes.

Table 3 shows that nearly $75,000,000 was paid in wages to office and shop employes, and $9,500,000 in salaries to officials. The total number of people engaged in the machine tool industry was nearly 62,000.

TABLE 3. NUMBER OF EMPLOYES, SALARIES AND WAGES IN MACHINE TOOL INDUSTRY IN 1919

State	Number of Plants	Persons Engaged in the Industry					Salaries and Wages		
		Proprietors and Firm Members	Salaried Officers Superintendents, and Managers	Office Employes	Average Shop Employes	Total	Officials	Office Employes	Shop Employes
Ohio	102	29	663	1565	13,855	16,112	$2,511,242	$2,028,768	$17,071,620
Massachusetts	46	22	274	942	6,471	7,709	925,899	995,451	7,610,041
Rhode Island	13	2	142	463	7,169	7,776	536,253	661,396	8,702,410
Connecticut	33	2	208	629	5,472	6,311	926,324	669,478	7,247,888
Pennsylvania	32	17	163	549	3,671	4,400	717,680	936,704	5,141,121
Illinois	28	6	145	417	3,273	3,841	650,595	646,123	4,410,243
Michigan	31	5	137	347	3,196	3,685	663,481	547,780	4,408,088
Vermont	6	....	39	250	2,024	2,313	290,747	479,571	2,550,347
Wisconsin	24	6	158	244	2,352	2,760	711,431	499,472	2,836,033
New Jersey	14	4	113	391	1,678	2,186	349,188	586,792	1,519,552
New York	29	12	106	155	1,590	1,863	398,641	201,312	1,825,120
Indiana	15	6	114	116	1,228	1,464	478,508	136,472	1,383,825
All other states	30	21	71	118	1,132	1,342	331,963	156,585	1,472,681
United States	403	132	2333	6186	53,111	61,762	9,491,952	8,545,904	66,178,969

Machinery

Table 4 shows a comparison of the sizes of machine tool building plants in 1919. This table shows that 13 per cent of the number of plants (representing the largest shops) produced 69 per cent of the product, while 45 per cent of the plants (representing the smallest) produced only 3 per cent of the product. The total number of shops was 403.

This is the first time that statistics as complete as these have been compiled for the machine tool industry, and the Bureau of Census has performed a valuable service in preparing a complete record of the important facts relating to this basic industry.

SAFETY CODE FOR FOUNDRIES

The American Engineering Standards Committee has approved a national safety code for the protection of industrial workers in foundries. This code is a revision of that developed by the American Foundrymen's Association and the National Founders' Association who are joint sponsors of the new code. The code has been worked out by a committee composed of four representatives of makers of foundry equipment and owners of foundries, four governmental bodies, two technical societies two insurance organizations, and a representative of foundry employes. Copies of the code may be obtained from the American Engineering Standards Committee, 29 W. 39th St., New York City.

The American Engineering Standards Committee has also approved a national electrical safety code as proposed by the Bureau of Standards, which covers the generation, distribution and utilization of electricity for power, light and communication. It constitutes one of the most important steps yet taken in safeguarding electrical installations.

TABLE 4. COMPARATIVE SIZES OF MACHINE TOOL BUILDING PLANTS IN 1919

Value of Lands, Buildings and Equipment	Number of Shops	Total Number of Shop Employes	Number of Employes per Shop	Value of Product	Product per Employe	Average Value of Product per Shop	Per Cent of Total Value of Product in Industry
Over $1,000,000	52	35,525	683	$146,142,000	$4100	$2,310,000	69
$500,000 to $1,000,000	41	7,235	176	27,856,000	3869	679,000	13
$100,000 to $500,000	134	8,162	62	31,760,000	3873	238,000	15
Less than $100,000	176	2,186	12	6,642,000	3030	38,000	3
Total of all shops	403	53,111	132	212,400,000	4000	531,000	100

Machinery

The Machine Tool Industry

THE improvement in the machine tool industry, although slight, is none the less definite. The average orders of seventy-nine firms in this field, during the month of June, amounted to 25 per cent of the shipments for the first three months in 1920—the period which had been taken as a standard for purposes of comparison. Seven of these firms reported a business of over 50 per cent; and eighteen, or about one-fourth of the number, of over thirty per cent. These comparisons are made on a dollars and cents basis. When the lower prices of machine tools at the present time are considered, it is evident that the actual volume of machines sold reaches higher percentages than those mentioned.

There is a great difference in the activity, however, according to the line of machines being built. Grinding machines are among the types in greater demand than most other lines. There has also been a good market for small automatic screw machines due to the activity in the radio field, but this demand is now falling off somewhat. Orders for special machines for high production are in evidence to a greater extent than orders for standard lines of machine tools; the automobile industry has been largely responsible for this. Service stations and garages have also been among the important customers of the machine tool industry. The automobile repair shop business has also afforded an outlet for a considerable part of the second-hand machine tools that have been on the market.

One of the encouraging signs is the brisk demand for grinding wheels, indicating that the metal-working industry as a whole is resuming its activity. Some grinding wheel plants state that the demand is much above the pre-war figure, and in one instance, at least, the plant is running at full capacity.

In the special machinery field business is fairly active, some shops in this class being occupied at approximately 60 per cent of their capacity. Most of the business in this field is domestic, but some orders are being booked from Japan, Australia, and South America. The trade with Europe is small, although recently some special machinery has been ordered from England.

Generally speaking, the conditions in the machine tool and accessories field are somewhat less active in New England than in the middle western states, due, no doubt, to the proximity of the latter to the automobile industry. In New England, second-hand machinery is still in greater demand than new machines, whereas a Cleveland dealer states that the tide has turned in that district and that new machines are sold in excess of used equipment. One of the main difficulties with which machine tool builders have to contend is the spotted condition of business, one month being quite good and giving a fair promise of continually increasing business, while during the following month business falls off, keeping the average for the year down. The greatest activity is naturally noted in the plants directly or indirectly supplying the automobile shops. Plants so engaged are frequently running to capacity, and a few are even farming out part of their work.

Prices of Machine Tools

Several machine tool manufacturers have announced increases in their prices, and it is expected that there will be a general advance in machine tool prices. The reductions that have been made during the past eighteen months are entirely too great to remain permanently in effect. Labor rates and material costs have not been sufficiently reduced to warrant the prices that have been quoted—prices that in many instances were quite far below replacement costs.

General Activities in the Machine Shop Field

The screw products shops are well occupied. A few months ago very low prices were quoted for screw products, but this condition is now improving. The sheet metal stamping shops in the Middle West are generally fully occupied; in New England, they are running at from 50 to 80 per cent.

Several machine tool builders who have embarked upon the manufacture of other lines of machinery in order to divert some of their shop capacity have been quite successful in their new ventures. Among the products that are thus turned out in machine tool plants are road-building machines, concrete block machines, domestic washing machines, auxiliary steam turbines, electric fans, and air conditioners. The interest in road-building throughout the country has created great activity among manufacturers of this line of machinery, and makers of excavating machines and steam shovels are fully occupied.

In the small tool field the conditions are gradually improving, even if not so rapidly as was at one time believed would be the case. Most of the manufacturers of small tools are working at from 30 to 40 per cent capacity. Practically the same condition exists in the measuring tools.

Conditions in the Gear-cutting Shops

Gear-cutting shops in the Pittsburg district operate at from 40 to 50 per cent capacity, but competition makes it difficult to obtain a satisfactory price for the product. This refers to shops engaged in general gear-cutting, rolling mill gears, and mine gearing. The shops devoted to automobile gears are running to capacity, and some are said to have difficulty in meeting the demand for early deliveries. In the Cleveland district the shops employed in general job work run from about 40 to 70 per cent capacity. Gearing for heavy machinery is beginning to be ordered again, indicating increased business of heavy machinery builders.

The Automobile Industry

In the automobile field the past three months have shown an unusual activity. In May over 231,000 passenger cars and nearly 25,000 trucks were built. The figures for June were, in round numbers, 240,000 and 30,000 respectively; and while there was some decrease in the July production schedules of passenger cars, the drop was not more than 20 per cent, while the production of trucks increased.

The continued demand for automobiles has revealed an unexpected purchasing power on the part of the general public, and some makers have found it impossible to supply their dealers immediately with cars to meet the demand. Ford production naturally has led all the rest with considerably over 100,000 cars a month for several months. The total production of passenger cars for the first six months of the year is about 1,100,000, and of trucks, about 120,000. There are at present 177 manufacturers of passenger cars in the United States and 230 manufacturers of motor trucks.

The Studebaker plants have been working to capacity for some time past. Plans for a considerable increase in machining equipment and output are under way. It is said that when the plans now laid have been consumated, the Studebaker South Bend plant will be capable of producing 500 cars a day. This will, of course, require a large amount of machine tools, some of which are now being bought.

New Machinery and Tools

The Complete Monthly Record of New American Metal-working Machinery

The New Tool descriptions in MACHINERY are restricted to the special field the journal covers—machine tools and accessories and other machine shop equipment. The editorial policy is to describe the machine or accessory so as to give the technical reader a definite idea of the design, construction, and function of the machine, of the mechanical principles involved, and of its application.

Liberty Combination Planer and Slotter

PLANING and slotting operations on locomotive frames are usually cumbersome jobs because of the size of the work and the necessity of setting up the work on both a planer and a slotter or shaper for the performance of the operations. The time consumed in making one of these set-ups is eliminated with the combination planer and slotter presented in the accompanying illustration. This machine has recently been developed by the Liberty Machine Tool Co., Hamilton, Ohio. Another advantage of this machine is the saving of floor space, this being an important factor owing to the size of the machines necessary for handling work of this class. The machine has two cross-rails near the middle of the bed; one supports a planer head and the other carries a slotter head. The cross-rail for the slotter head can be swiveled entirely out of the way when the machine is being used for planing work that requires the raising of the planer cross-rail to its highest position. The machine has a duplex control by means of which the different moving parts may be operated from either side of the bed. The planer and slotter units are individually motor-driven. Although the machine was designed primarily for finishing locomotive frames, it is adaptable to other jobs.

Construction of the Planer Unit

The parts embodied in the planer unit are identical to similar parts included in the standard 36-inch planer built by

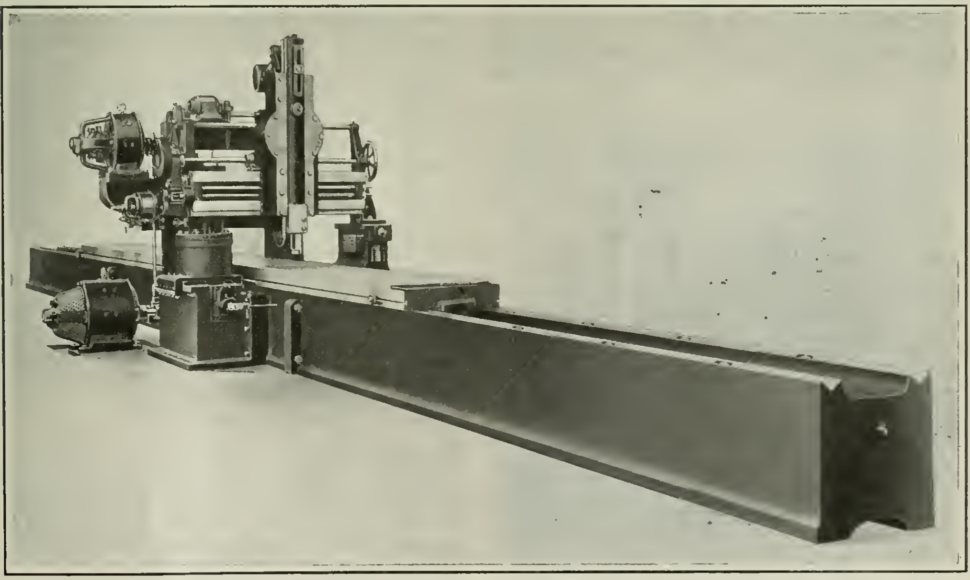


Fig. 1. Liberty Combination Planer and Slotter developed to reduce the Machining Time of Locomotive Frames

the same company. This unit is arranged with a reversing motor-drive, which gives the necessary range of speeds. Although only one head is shown on the cross-rail, two may be furnished on this member, and side-heads may also be provided on the housing faces. The bed is of box construction and has a closed top between the vees. The latter are fitted with automatic oiling rollers to insure proper lubrication of the bearing surfaces.

The rollers may be readily removed to facilitate the cleaning of pockets. The table T-slots are planed for the solid, and the holes provided for clamping work on the table are reamed. The cross-rail is of sufficient length to allow two heads to have a full traverse across the table. The cross-rail elevating screws are supported on ball bearings and are adjustable from the top.

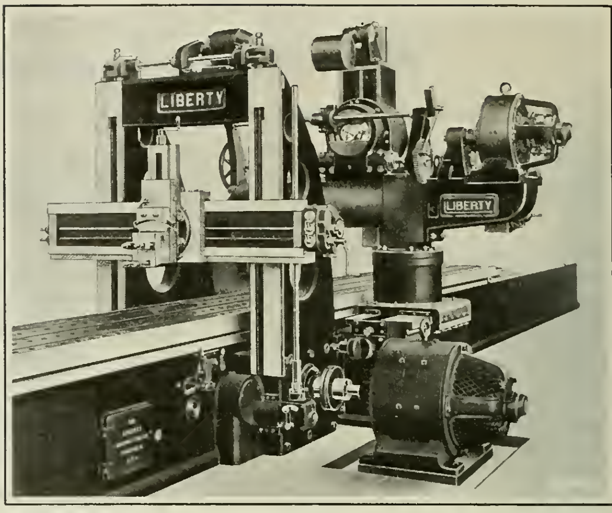


Fig. 2. Close-up View showing Front of Planer Unit and Back of Slotter Unit

The heads are made right- and left-hand for close range, and may be swiveled to any position up to 90 degrees, graduations indicating the angularity of a setting. The heads have automatic feeds in all directions, which are operative from either end of the cross-rail. Micrometer adjustments are provided on all vertical and horizontal feed-screws. The cross-rail elevating mechanism is located on the top brace and is controlled by means of a long handle at the side of the housing. This handle is employed to engage or disengage a saw-tooth clutch when raising or lowering the cross-rail. The handle must be held in order to keep the mechanism in operation and, therefore, any obstruction interfering with a movement of the cross-rail will cause the clutch to be instantly disengaged, thereby avoiding any breakage of parts.

When side-heads are attached to the housings, they can be moved to a position below the top of the table when not in use. Patented feed micrometer collars and control handles are conveniently located on these heads and they may also be swiveled through an arc of 90 degrees. This planer has a patented feeding arrangement by means of which the operator can control or change the rate of feed of the cross-rail heads without stopping the machine or disturbing the feeds of either side-head. Similarly, he can change the rate of feed of the side-heads without disturbing the rate of feed of the cross-rail heads. Feeding movements may take place either on the cutting or on the return stroke. All feeds may be disengaged by placing a handle in a neutral position.

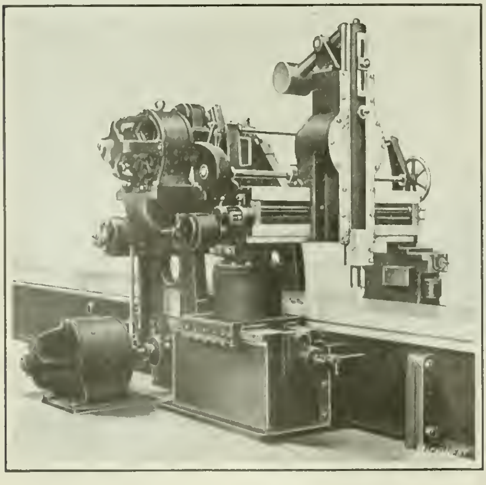


Fig. 3. Illustration in which the Details of the Slotter Unit may be clearly seen

The Slotter Features

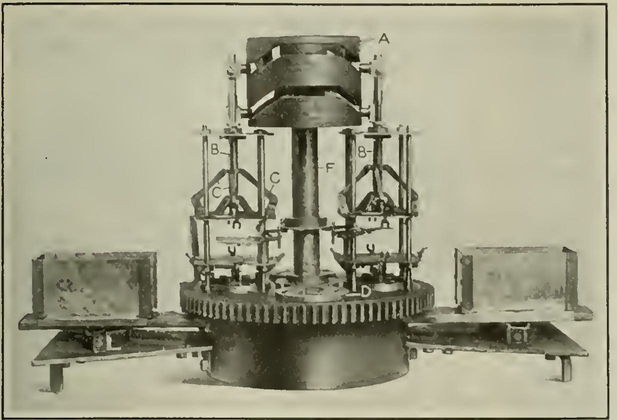
The slotter unit is driven by a variable-speed motor which gives the necessary range of speeds to the ram. Two additional small motors provide power for quickly moving the cross-rail and the ram head. This unit has a 24-inch travel lengthwise relative to the machine, for which movement there is an automatic feed and rapid traverse in both directions. One end of the cross-rail is mounted on a column upon which it may be swiveled, by the rotation of a screw, either forward or backward along the bed to any angle within the limits of locomotive frame work. Clamps provide for holding the cross-rail securely in any angular setting. As previously mentioned, the cross-rail can also be swiveled entirely out of the way to permit the use of the planer unit for machining high work.

The ram head has an independent automatic feed and a rapid traverse in both directions. The ram is driven by worm gearing through a crank disk and connecting-rod, and is properly counterbalanced. The stroke is adjustable for both position and length. A special tool-bar is provided for circular feeding and for machining fillets. The table of the machine is held stationary when using the slotter unit, and is rapidly advanced to the next position after a cut has been completed, by the operation of a pendant switch.

Some of the principal dimensions of the machine are as follows: Maximum width between planer housings, 37 inches; maximum height under planer cross-rail, 37 inches; length of table, 38 feet; width of table, 30 inches; length of bed, 69 feet; miximum stroke of slotter ram, 14 inches; and maximum travel of slotter cross-rail, 24 inches. The weight of the machine is approximately 69,000 pounds.

W-J AUTOMATIC DIE-CASTING MACHINE

An automatic die-casting machine of a continuous rotary type which has been developed by the W-J Die Casting Machine Co., 1120 Marshall Field Annex, Chicago, Ill., to effect increased production rates in the manufacture of die-castings, is here illustrated. This machine consists of a rotating table on which are mounted four sets of cages which carry dies of any required form. Diametrically opposed to each



W-J Automatic Die-casting Machine developed to permit High Rates of Production

other are two melting pots from which a charge of molten metal is delivered to each die as it passes either pot. It will thus be apparent that two castings are produced in each of the four dies during each revolution of the table, or, in other words, eight castings per table revolution. The machine can be driven at the rate of two revolutions per minute, and at this speed, a production of 960 castings per hour will be obtained. At the time the photograph was taken, the melting pots were not in place in their cases on the slides which extend from the machine base, the die-carrying cages and their auxiliary mechanisms had been removed from two of the table stations, and the dies were not in place on the cages shown.

As each station of the table approaches one of the melting pots, the die members at that station are automatically closed and the melting pot advanced to them. A nozzle on the pot enters a socket on the die, after which the necessary amount of metal to fill the die is forced into it either by compressed air or by the action of a plunger. The melting pot then recedes, the die opens, and such core-pins as may be required, withdraw. A knock-out pin next pushes the casting from the upper die member, so that it falls on a tray that is automatically brought into position beneath it. As the table continues its rotation, a pair of revolving brushes passes between the die members and loosens any particles of dirt adhering to them. Finally, a jet of compressed air is blown on the die members to remove any foreign matter that may still remain on their faces. By this time the die cage approaches the second melting pot, and the cycle of movements which occurs is similar to that outlined.

As previously mentioned, each set of dies consists of two members, the upper one of which is movable and the lower stationary. The closing of the upper members on the lower ones preparatory to casting a part is accomplished through cam *A* which has two grooves around its periphery. Rollers which run in the upper grooves are secured to rods attached to the upper dies, and as a die set approaches either of the two melting pots its roller runs down a decline in the groove and causes the upper die to be pushed down upon the lower one. Simultaneously, the roller in the lower groove runs down a decline somewhat longer than that on the upper groove. This roller is secured to a sleeve *B* which in turn is connected to a link mechanism that provides for pushing core-pins into the four sides of the upper die. If vertical core-pins are required, they are pushed straight down through the die. The amount that each core-pin is advanced into the die may be adjusted.

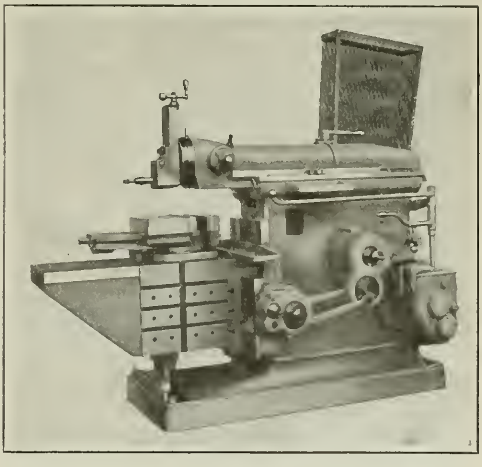
Provision is also made for introducing core-pins into the lower die member. Mounted at each of the four table stations is a plate cam *D* in which four spiral grooves are machined. Each of the cams is carried on a stem that projects through the table and carries a lever. As the table rotates, this lever strikes a dog which causes rotation of the cam. The pins which run in the cam grooves have their lower ends guided by straight grooves, and as each pair of pins slides in its groove, a link is rocked to push a core-pin into the lower die. There are four sets of rocking links to provide for introducing a core-pin into the four sides of this die.

After either melting pot has been advanced to a die, it rotates with it a sufficient length of time, after the nozzle of the pot has been properly inserted, to allow enough metal to be forced into the die. Thus it will be evident that the mechanism which actuates the melting pots must furnish a combined rotary and in-and-out movement.

For shops handling a moderate volume of work, a machine can be built with one melting pot and two sets of dies, or the machine illustrated can be provided with only one melting pot and two sets of dies. An important feature of this machine is that different castings may be produced at the same time by having suitable dies in the cages. Water is circulated continuously through the dies to keep them at the proper temperature. Gas jets heat the metal in the pots and maintain it at the desired temperature. Other gas flames preheat the compressed air which forces the molten metal into the dies. When a plunger and a cylinder are used for this purpose, these parts are also heated by gas flames to prevent solidifying the metal in the cylinder.

HENDEY CRANK SHAPER

A crank shaper equipped with a speed gear-box to permit a single-pulley or constant-speed motor drive has been recently introduced on the market by the Hendey Machine Co., Torrington, Conn. Except for the gear-box this machine is of the same general design as the cone-pulley shaper previously described in MACHINERY. Eight strokes ranging in geometrical progression from 6 to 102 per minute are obtainable, four of these speeds being secured through the gear-box,



Hendey 24-inch Crank Shaper equipped with a Speed Gear-box and four by means of back-gears. The speed box gears run in oil, and the driving and gear shafts in ball bearings. The gears of the gear-box are shifted by the manipulation of a ball handle lever about H-slots in the gear-box cover. The speed gears are made of alloy steel and are heat-treated. The length of ram stroke may be varied from 2 to 24 inches.

The driving pulley transmits power to the machine through a patented clutch which also serves as a brake when moved in the opposite direction to that in which it is shifted for driving. This clutch is controlled by the long horizontal lever which extends to the front of the machine on the right-hand side. The lever has a short movement which provides a quick starting and stopping feature to the ram that is especially of value in setting tools and taking measurements. The lever control also simplifies the meshing of the back-gears and the manipulation of the gear-box lever.

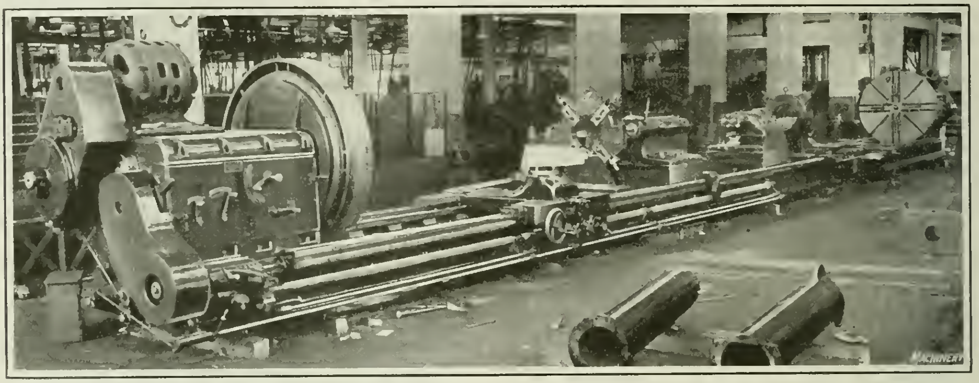
All adjustments of the patented cross-feed mechanism are obtained at the end of the cross-rail. The amount of feed can be varied while the machine is in motion, a dial indicator showing the amount of feed. The feed can be started, stopped, or reversed while the machine is in operation. The feeding movement takes place on the reverse stroke of the machine. The cross-feed screw is provided with a dial graduated in thousandths of an inch. The machine may be furnished with or without a power down-feed by means of which the machine may be fed at any rate from 0.005 to 0.060 inch per stroke, in increments of 0.005 inch. The machine is set for the different rates of feed by means of a graduated dial. Some of the important specifications of the machine are as follows: Horizontal table travel, 30 inches; vertical table travel, 14¾ inches; minimum distance from ram to table, 4 inches; dimensions of table top, 17 by 24 inches or 17 by 42 inches when equipped with an extension as illustrated; dimensions of table side, 17½ by 18 inches; and approximate weight of machine, 5700 pounds.

BETTS-BRIDGEFORD DOUBLE-HEAD ENGINE LATHE

In shops where large machines are installed for handling heavy work, such equipment frequently remains idle a great part of the time, owing to the unsuitability of the machine for handling smaller work. In bringing out the double-head engine lathe here illustrated, the Betts Machine Co., 400 Blossom Road, Rochester, N. Y., has provided the machine with two heads, two carriages and two tailstocks, so that when the entire length of the machine is not required for a job, the two ends may be operated as individual machines. This lathe has a lead-screw on each side of the bed; one lead-screw extends the entire length of the machine and the other is one-half that length. From this it will be obvious that the two carriages are fed from opposite sides of the bed. This lathe was primarily designed for turning heavy crankshafts and long propeller shafts. It has a swing of 72 inches and a bed length of 76 feet.

When the lathe is required for long work, one of the tailstocks is removed from the bed and the other is traversed to a position close to the headstock opposite the one with which this tailstock is employed. By doing this, the maximum distance between centers may be utilized. When the machine is required for shorter work which can be accommodated in somewhat less than one-half the maximum distance between centers, the second tailstock is replaced on the bed end to end with the first after the latter has been traversed approximately to the middle of the bed. In this way the machine is quickly converted into two entirely independent lathes each having a swing of 72 inches and a maximum distance between centers of 27 feet. As the machine is readily convertible from a long lathe into two shorter lathes or vice versa, it will be seen that economies of floor space may be effected.

The headstocks are alike in construction, being triple back-geared and provided with bronze bearings throughout. These bearings are chain-oiled from individual reservoirs. Twelve spindle speeds in geometrical progression are controlled by levers conveniently located at the front of the headstocks. These speeds are obtained through sliding hardened steel gears. A friction clutch and brake is incorporated in the driving mechanism of each headstock and operated from its respective carriage thus allowing the machine to be started or stopped instantly. In addition to the lever on the carriage, a secondary lever on the headstock supplies a means of operating this clutch and brake. A power rapid traverse is provided for both carriages and this is controlled by levers on the aprons. The aprons are of a double-wall construction and the gears are of steel. The machine is driven by two 50-horsepower motors mounted on the headstocks and controlled by automatic starters.



Betts-Bridgeford Double-head Engine Lathe which may be operated as One Long Machine with a Carriage and Tailstock removed, or as Two Individual Machines with these Members in Place

PRATT & WHITNEY ODONTOMETERS

An instrument known as the "Odontometer," manufactured by the Pratt & Whitney Co., Hartford, Conn., for testing the accuracy or uniformity of gear tooth profiles and spacings of the teeth in production work, was described in MACHINERY for July, 1921. This company has now announced a number of improvements in the design of the instrument, and are placing on the market two additional odontometers for testing larger and smaller gears. The original instrument was for use with gears from 3 to 10 diametral pitch, whereas the instrument shown in Fig. 1

Fig. 1. Pratt & Whitney Odontometer for testing Spur and Helical Gears from ¾ to 4 Diametral Pitch

covers a range of from ¾ to 4 diametral pitch and that in Fig. 2. from 10 to 24 diametral pitch. The latter odontometer and that illustrated in the previous article may both be provided with stands to facilitate the testing of gears or pinion-shaped cutters. When either instrument is thus mounted, the gear is placed on the surface plate on the post of the stand and is rolled past the instrument. The actual cutting edge of cutters is tested so that errors of any nature are detected.

The principle upon which the new odontometers are based, is the same as that of the instrument previously described. In effect an odontometer is composed of a section of a straight-sided rack having two parallel effective faces, one fixed and the other movable. A third face, set at an angle to the two working faces, is used to hold the fixed working face in contact with the flank of the gear tooth. The fixed registering surface is at *A*, Fig. 1, and the movable indicating surface at *B*. The third surface *C* holds surface *A* in contact with the involute profile of the gear tooth. Surfaces *B* and *C* are adjustable so that gears of various pitches can be tested with the same instrument. The indicating surface *B* is mounted on two thin flat springs *D*, which act as pivots, free from backlash. The dial indicator is actuated by a lever having a ratio of 5 to 1, each division of the dial representing a movement of 0.0002 inch of surface *B*. The instrument is used to test the uniformity of mating gears.

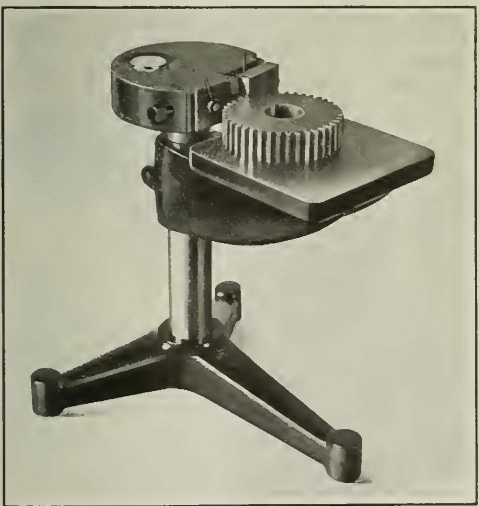
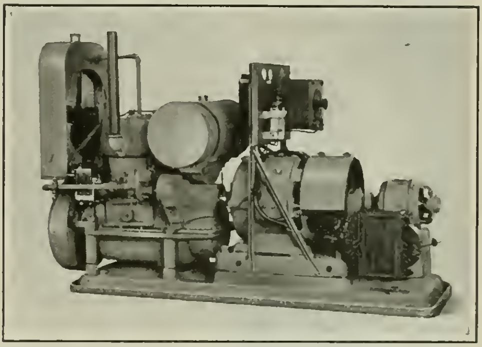


Fig. 2. Odontometer for Gears from 10 to 24 Diametral Pitch

WESTINGHOUSE GASOLINE-DRIVEN WELDING EQUIPMENT

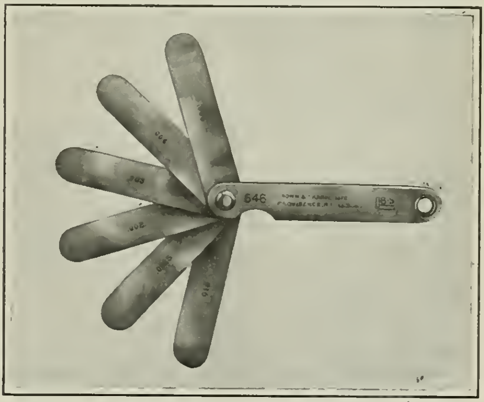
A welding equipment developed for use where electric power is not available for driving a motor has been placed on the market by the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. This equipment is made in both stationary and portable models. It consists essentially of a Westinghouse single-operator direct-current welding generator geared to a Doman 4-cycle, 2-cylinder, low-speed, marine-type gasoline engine. The generator has a rated capacity of 175 amperes and a maximum capacity of 225 amperes, at 1750 revolutions per minute. It is designed to operate at arc voltage and to inherently stabilize the arc and supply a substantially constant current of different values over the working range of 90 to 225 amperes. It is said to be easy for the operator to strike and maintain the arc and to obtain the deep penetration and thorough fusion necessary for satisfactory welding. The shaft of the generator is attached to the exciter by means of a flexible coupling. The control panel is mounted directly over the generator.



Westinghouse Welding Apparatus driven by a Gasoline Engine

BROWN & SHARPE THICKNESS GAGE

A thickness gage having six blades 0.0015, 0.002, 0.003, 0.004, 0.006, and 0.015 inch in thickness, respectively, which may be used individually or together for measurements up to 0.0315 inch, has been added to the line of mechanics' tools made by the Brown & Sharpe Mfg. Co., Providence, R. I. It is shown in the accompanying illustration. The blades are

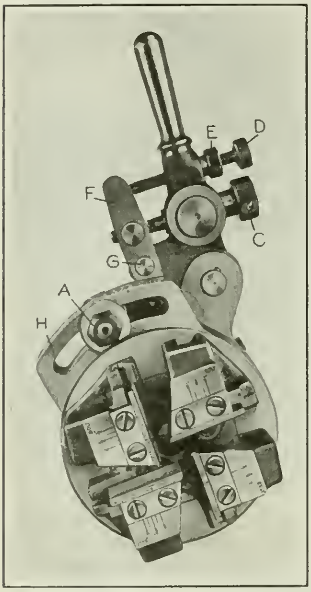


Brown & Sharpe No. 646 Thickness Gage

accurately ground to the specified thickness. The protecting blade has an eyelet that provides for hanging the gage on a carrying ring or on a hook. This gage will be found of value by automobile mechanics and owners for setting valve tappets, distributor points and spark plug gaps, fitting pistons, and making shims for eliminating rattle.

LANDIS STATIONARY DIE-HEAD

A stationary die-head equipped with a micrometer attachment which is particularly valuable when cutting threads of special form requiring one or more roughing cuts and a finishing cut, is a recent product of the Landis Machine Co., Inc., Waynesboro, Pa. It is possible to set this die-head so that the same amount of metal is left at all times for removal in the finishing cut. The head is graduated to suit both right- and left-hand threading of bolts and pipe. These graduations are placed on the closing ring above the circular slot. To adjust the die-head for cutting threads of a given size, the clamping nut *A* in the accompanying illustration is first loosened with the left hand, and then the closing ring is swiveled by the right hand to the proper graduation. Closer adjustment can then be made by means of the micrometer attachment. This is accomplished by first loosening lock-nut *E*, and then turning the micrometer screw *C*. This screw is turned in the counter-clockwise direction to increase the diameter to which the chasers are set, the turning of the screw causing the upper part of link *F* to swing toward the left about center *G*. This action pulls the closing ring *H* toward the right. If the micrometer screw *C* is turned in the clockwise direction, the movement of link *F* toward the right results in a decrease in the diameter of the chaser setting. After making the micrometer adjustment the stop-screw *D* should be set against the link *F* and locked in place by means of the lock-nut *E*.



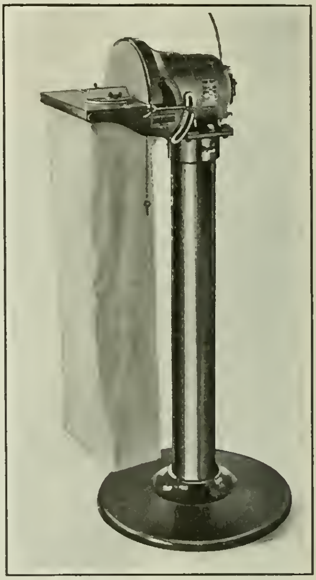
Landis Stationary Die-head with Micrometer Adjustment

To adjust the chasers for taking a roughing cut, the micrometer screw *C* is turned in the counter-clockwise direction until the desired setting has been obtained, the stop-screw *D* being left in its originally located position. A number of roughing cuts can then be made by adjusting the die-head after each cut, again turning screw *C* to effect this adjustment. After the roughing cuts have been completed, the micrometer screw should be revolved until link *F* comes against the stop-screw *D*. The die-head is then set for taking the finishing cut.

This die-head can be applied to turret and engine lathes, hand screw machines, and other types of threading machines in which the work revolves and the threading head remains stationary. For application to a turret lathe, the die-head is equipped with a shank that fits the sockets of the turret. Application to the cross-slide of the engine lathe is made by means of a special knee bracket having a boss machined to fit a counterbored hole in the back of the die-head. It is necessary to provide a special dead center that will fit bores in both the bracket and the die-head. Work may also be gripped in a chuck and threaded without the use of centers when the shape of the part necessitates this form of support.

SYRACUSE PORTABLE MOTOR-DRIVEN DISK SANDER

A 9-inch motor-driven disk sander mounted on a pedestal as illustrated in order to provide an equipment readily portable about the shop has been brought out by the Syracuse Sander Mfg. Co., Inc., 1232-1234 S. State St., Syracuse, N. Y. The sander is driven by a 1/6-horsepower enclosed motor having an attached switch. Current may be received from a lamp socket. The sander can be swiveled on top of the pedestal so as to bring the disk toward the light. The table tilts 45 degrees below horizontal and 15 degrees above it, a graduated plate indicating the angularity of a setting. The table is secured in a set position by tightening a thumb-screw. An angle gage graduated in degrees is furnished. The disk is covered with emery cloth on one side for sanding metal parts and with garnet paper on the opposite side for wood work. Dust from the work is sucked into the canvas bag attached to the under side of the table. The operator is thus relieved of all the annoyance occasioned by flying dust. This sander is also supplied without a pedestal for mounting on benches.


Syracuse 9-inch Disk Sander

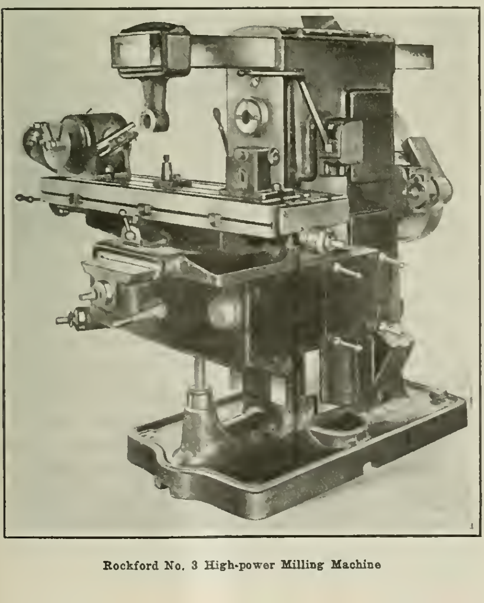
ROCKFORD NO. 3 HIGH-POWER MILLING MACHINE

The Rockford Milling Machine Co., Rockford, Ill., has brought out a No. 3 high-power milling machine of the single-pulley type which differs in certain respects from the No. 3 machine previously described in the technical press. The use of driving shafts is entirely eliminated for conveying power to the knee. The transmission is all enclosed in the knee casting which projects on the right-hand side of the column and has an unusually wide bearing surface. A long gear is located in a vertical position in that part of the transmission housing which extends over the bearing face just referred to. Throughout the range of the movement of the knee, the long gear is always in mesh with the feed reverse and quick-return gears, which are located inside of the column directly behind the plane of the bearing face. This long gear also connects through a pair of bevel gears with a second long gear, located horizontally at the side of the knee and meshing with the gears operating the knee, saddle and table. It will be seen, therefore, that the entire feed drive is through gears which are always in mesh, and that there are no connecting shafts.

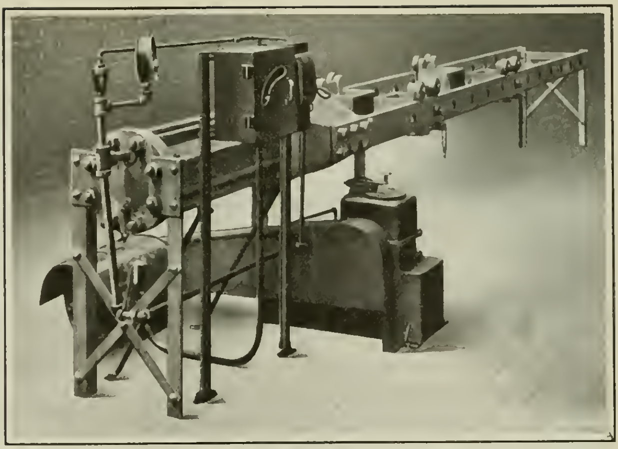
A feed-controlling lever, which determines whether the transverse or vertical feed is engaged, is located on the left-hand side of the knee within easy reach of the operator. This lever is provided with a dial on which are plainly marked the transverse and vertical positions of engagement as well as the neutral position, in which neither feed is engaged. The vertical and transverse feeds can also be controlled by a lever on the left-hand side of the knee near the column and within convenient reach of the operator when standing back of the table for such operations as boring. The shaft connecting this lever with the feed-control box extends through the back flange of the knee and projects to a point where it reaches the dogs of the automatic stop mechanism. On the side of the column there is a long vertical boss on which dogs may be adjusted to contact with the feed-bar and disengage the vertical feed at any predetermined point. This boss also has permanent safety stops for disengaging the feed within safety limits.

This machine, like the former design, has the rectangular over-arm and a column of the conventional box form enclosing practically the entire working mechanism. The splash system of lubrication is employed, each individual unit comprising an oil chamber where all gears run constantly in an oil bath. Either belt or motor drive can be supplied, a single constant-speed pulley mounted on Hyatt roller bearings being used for belt-driven machines. When a motor is used, it is mounted on a heavy pedestal bolted to the rear of the column and base, and it drives through a high-speed silent link chain provided with safety guards.

The machine table has automatic longitudinal and cross-feeds of 34 and 12 inches respectively, and there is an automatic vertical feed of 20 inches. Sixteen speed changes are provided ranging from 12 to 350 R. P. M. and 12 feed changes ranging from ½ inch to 16 inches per minute.



Rockford No. 3 High-power Milling Machine



Oilgear 25-ton Horizontal Press on which the Speed of Ram Travel may be changed instantly

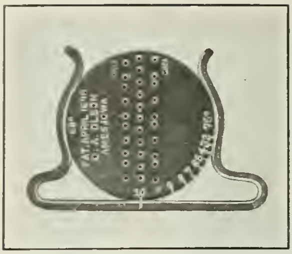
OILGEAR HORIZONTAL PRESS

A horizontal hydraulic press equipped with an "oilgear" control by means of which a wide range of ram speeds is made possible, has just been brought out by the Oilgear Co., 60-64 Twenty-seventh St., Milwaukee, Wis. The machine has a capacity of twenty-five tons at pressing speeds of from ¼ to 6 inches per minute. The maximum speed of the ram while traveling to the work is 37 inches per minute, and the maximum return speed, 56 inches per minute. The speed of ram traverse may be changed instantly by operating a small control lever conveniently located on top of the pump housing at the front of the machine. It is said that the ram stroke begins without shock and is made without pulsation. Suitable overload relief valves permit the ram to be driven at full speed against a stop without danger of injuries resulting to the machine parts or the work.

The pump is driven by a constant-speed two-horsepower motor located at the rear of the head end of the machine, as illustrated. The stops are of a V-shape and can be located along the machine frame as desired, being held in place by steel pins. The center of the ram is located 32 inches above the floor, and the distance between stop supports is 24 inches. The maximum stroke of the ram is 30 inches. At full capacity, a pressure of 800 pounds per square inch is exerted on the piston head, the cylinder being 9 inches in diameter. All working parts are lubricated automatically and no adjustments are necessary to keep the press in operating condition. This machine has been used for such work as assembling wheels on axles of saw-mill carriages and heads into pipe rollers. It is adaptable to many other jobs.

"AMES" LETTERING INSTRUMENT

For reducing the time consumed in placing guide lines on drawings when lettering titles and notes, the O. A. Olson Mfg. Co., 706 Wilson Ave., Ames, Iowa, has placed on the market the instrument shown in the illustration. This device consists of a nickel-plated tempered steel frame which retains a transparent celluloid disk that may be swiveled in the frame. The disk has three parallel rows of taper holes which furnish a means for quickly drawing guide lines without the necessity of first locating them by means of a scale. In laying out the guide lines, the instrument is placed with the base in contact with a T-square or straight edge, and then pulled alternately to the right and to the left by means of a pencil placed in the holes of the disk, the pencil being, of course, shifted from one hole to the next after each movement to and fro. The vertical height between the



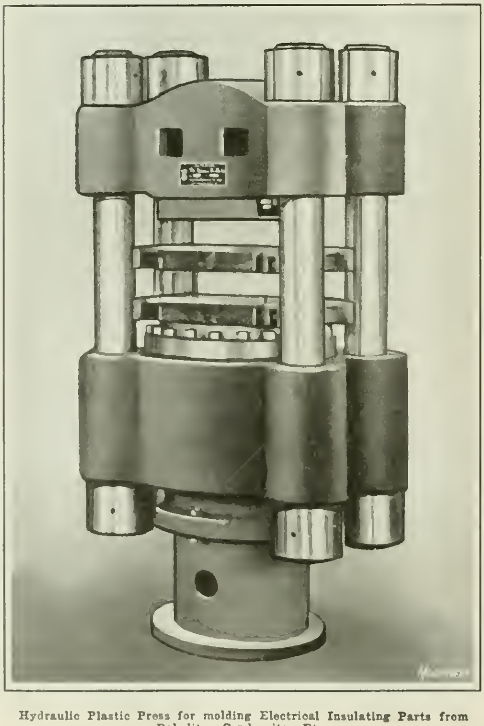
"Ames" Lettering Instrument

guide lines may be regulated by swiveling the disk in the frame. As the middle row is equally spaced, cross-section lines can be drawn uniformly. Slanting lines for letters may be quickly drawn after placing the instrument with an open and a closed end in contact with the straightedge.

HYDRAULIC PLASTIC MOLDING PRESSES

A line of hot- and cold-plate presses designed for producing small electrical insulating parts from bakelite, condensite and other non-conducting compositions, is now being built by the Hydraulic Press Mfg. Co., 84-88 Lincoln Ave., Mount Gilead, Ohio. Many of the parts which the presses are capable of producing are used in the construction of radio apparatus. There are three styles of presses: A double-opening, square-platen press which is intended for removable dies, and on which the upper plates are used for heating the material being molded, and the lower ones for cooling it; a single-opening square-platen press also intended for use with removable dies and in batteries of three, two machines of which are provided with hot plates, and the third with cold plates; and a single-opening rectangular-platen press for fixed dies, which is arranged for alternately heating and chilling the same plates.

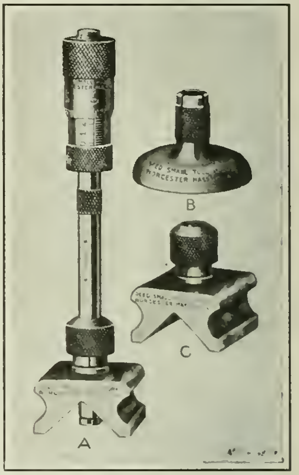
In the molding operation, the material is first heated to make it plastic and then pressure is applied to cause the material to conform to the die. For this part of the process, the hot plates are heated either by the circulation of steam, by gas flames, or by electrical resistance units. In the second part of the operation, the material is cooled while still in the die and under pressure. This is accomplished by chilling the plates by the circulation of water. Some materials may not require the procedure outlined. The pressure is applied in the upward direction. Each machine is equipped with four strain rods.



Hydraulic Plastic Press for molding Electrical Insulating Parts from Bakelite, Condensite, Etc.

REED INSIDE MICROMETER WITH HEIGHT-GAGE ATTACHMENT

An inside micrometer which may be furnished with base attachments for converting it into a height gage or instrument for detecting misalignment between surfaces has recently been placed on the market by the Reed Small Tool Works, Cherry and Vine Sts., Worcester, Mass. The micrometer is regularly supplied with five rods and a spacer that enable the taking of measurements from 2 to 7 inches, but additional spacers may be furnished for taking measurements up to 32 inches. The minimum setting of the micrometer permits the measuring of the smallest-sized automobile cylinders. The spindle has a ½-inch movement. The measuring rods are fitted with hardened tool steel anvils which are adjustable for wear, the rods being interchangeable on the threaded stud at one end of the micrometer head. The rods may be used singly or in combinations. A detachable handle adapts the micrometer to use with both right- or left-hand work.



Reed Micrometer with Height-gage Bases

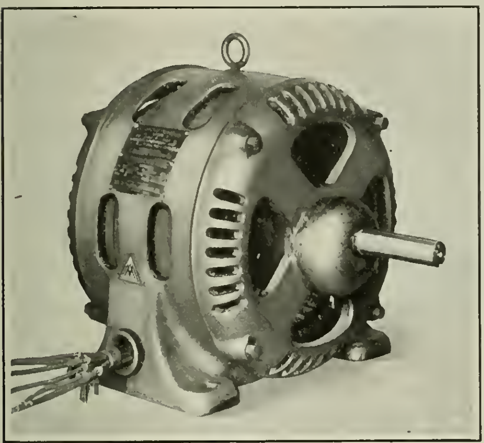
The micrometer can be quickly transformed into a height gage or misalignment detecting instrument by using the attachment shown at *C* and a rod. The micrometer is shown mounted on the attachment at *A*. The rod is inserted downward through the attachment until the anvil rests on the surface from which the measurement is to be taken, after which the quick-clamping knurled nut on the attachment is tightened by means of the fingers to hold the measuring rod firmly in position. When so arranged, the instrument is particularly useful in obtaining the height of projections and the locations of bushings in jigs, in measuring from the bottom of a groove to other surfaces in planer work, and in setting planer tools. The V-groove in the bottom of the base adapts the instrument to use with cylindrical parts as in measuring the distance between shafts for detecting misalignment. By inserting a drill rod in the base and attaching a standard indicator to this drill rod, a surface gage will be obtained that will be found useful in straightening shafts or in checking variations in the distance between surfaces. A scriber can be clamped to the rod.

The round base attachment shown at *B* is intended mainly for adapting the micrometer to ordinary height-gage applications. The upper end of the base is split vertically and may be adjusted to produce a friction on the measuring rod. This adjustment provides for eliminating side play should any wear take place on the parts from constant use. It also holds the base and the measuring rod together as the instrument is lifted from one surface to another.

WATSON MULTI-SPEED ALTERNATING-CURRENT MOTOR

A line of multi-speed alternating-current motors which afford speeds of 600, 720, 900, and 1200 revolutions per minute are now being introduced on the market under the trade name of "Watson," by the Mechanical Appliance Co., Milwaukee, Wis. Until recently the standard 4-speed windings for alternating-current motors gave 600, 900, 1200 and 1800 revolutions per minute on 60-cycle circuits, the two higher speeds being twice the two lower speeds. On this line of motors the narrower speed gap has been obtained by using an independent winding on the stator for each speed. In this manner speeds approaching those of direct-current motors are made possible.

The motor is of the squirrel-cage type and is said to carry a full rated load indefinitely without a temperature rise exceeding 40 degrees Centigrade, or a 25 per cent overload



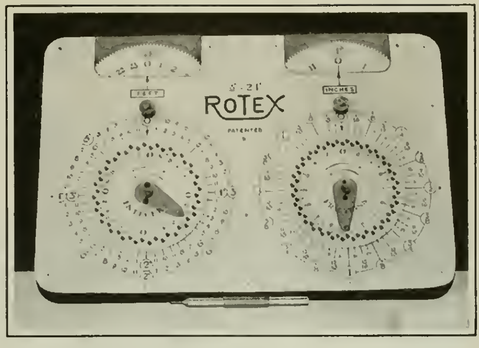
Watson Multi-speed Alternating-current Motor which may be run 600, 720, 900 and 1200 Revolutions per Minute

for two hours without a temperature rise of more than 55 degrees Centigrade. The motor is furnished for constant horsepower, constant torque, or any combination of both in two, three, or four speeds, for 60-cycle circuits. This motor may be supplied for both automatic and remote control. The speed range adapts the motor for driving some machine tools which previously could only be driven by direct-current motors.

LEINERT RAPID CALCULATOR

A rapid calculator for adding and subtracting feet and inches has been placed on the market by W. Leinert, 410 W. 23rd St., New York City, under the trade name of "Rotex." It will be seen from the illustration that the device has two circular scales, one of which is divided into forty-eight equal parts, and the other into sixty-four. The former is used in adding or subtracting integers of feet and inches, and the latter in dealing with fractions of an inch. The graduations of the scales are marked with black figures in clockwise sequence for use in adding, and with red figures in counter-clockwise sequence for use in subtracting.

Within each scale is a circular rotative disk that is graduated at its periphery to correspond with the graduations of the scale. Each disk is mounted on a pinion which engages a gear that may be seen in the slots near the top of the device, there being a provision for readily disengaging the gear and pinion. The disks have perforations that furnish a means for rotating them with a stylus supplied for the



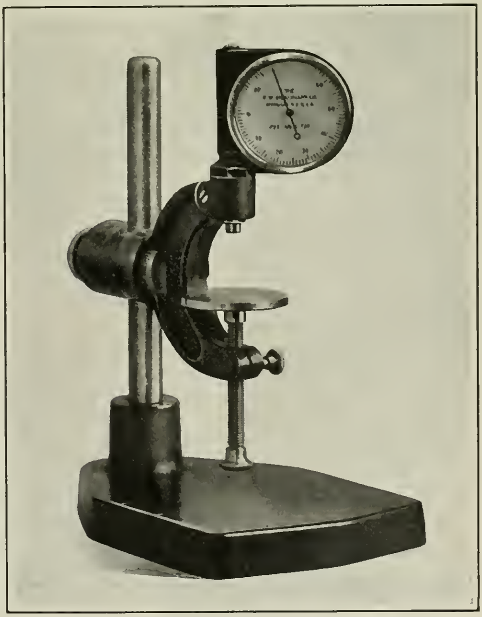
"Rotex" Calculator for adding and subtracting Feet and Inches

purpose. A rotative celluloid pointer mounted co-axially with each disk serves to indicate the last item of a calculation, in case of an interruption.

In using this calculator for adding sums, the disks are turned from the zero mark in a clockwise direction to proper divisions on the fixed scale having black figures. In subtracting, the disks are turned counter-clockwise to the proper divisions having red figures. The result in feet and inches is read at the zero marks. At each complete rotation of the right-hand gear a buzzer signals to indicate that a total of 12 inches should be transferred to the integer scale.

HORSTMANN INDICATING CALIPER

An indicating caliper having a head which may be swiveled about a complete circle and remains fixed in any desired position without the use of clamps, is now being manufactured by F. W. Horstmann Co., 196-210 Coit St., Irvington, N. J. The caliper may be supplied mounted on a stand as illustrated, or without this accessory. Except for the swivel head, the instrument is of the same design as the standard caliper made by the company. The dial graduations read



Horstmann Indicating Caliper with a Swiveling Head to thousandths of an inch. The caliper is made in six sizes from 1 to 6 inches and each size has a range of 1 inch. It may be clamped on the post of the stand either in a straight or tilted position. Although the stand is sufficiently heavy for supporting ordinary work, holes may be drilled in the base for fastening to a bench to prevent it from tipping over. When used with a stand the caliper may be supplied with a larger anvil than is furnished on the instrument when it is intended for hand use. The caliper illustrated is equipped with the larger anvil.

* * *

NEW MACHINERY AND TOOLS NOTES

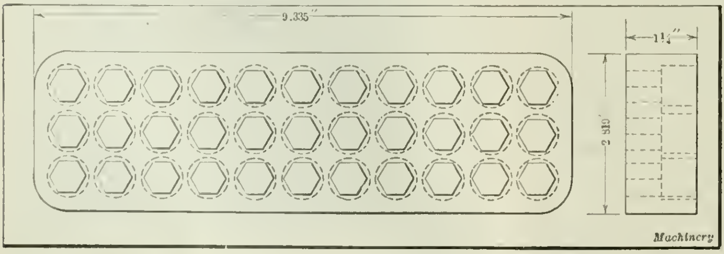
Lathe Sub-head: Hendey Machine Co., Torrington, Conn. An attachment for the standard lathes of this company's manufacture known as a "sub-head," designed to facilitate the cutting of worms, threads, hobs, etc., having unusually long leads. The attachment fits the inner vees of the lathe and is driven by special gearing attached to the spindle nose which gives a six to one reduction in speed relative to the lathe spindle. The faceplate turns on a hollow spindle, thus permitting the use of a dead center. The attachment is made for all Hendey lathes from 12 to 24 inches inclusive.

Magnetic Chucks: O. S. Walker & Co., Inc., Worcester, Mass. A line of magnetic chucks of the rectangular type for horizontal use, designed primarily for grinding machines made by the Diamond Machine Co., Providence, R. I., and the Norton Co., Worcester, Mass., but equally well adapted for other makes of similar capacity, as well as for planers and milling machines. The chucks are plain in style and have working surfaces ranging from 13¾ by 24 inches to 15 by 71½ inches. The range in weight is from 290 to 1150 pounds.

* * *

DRILLING HEXAGONAL HOLES IN A MOLD FOR BAKELITE PARTS

The cost of making a mold for producing small bakelite insulators in quantities of thirty-three at a time was greatly reduced through the use of hexagonal drills manufactured by the Watts Bros. Tool Works, in machining the holes in which the insulators are molded. These insulators measure 0.580 inch across flats and ⅜ inch in thickness. They are used in large quantities by the electrical industry. From the illustration it will be seen that the holes are arranged in parallel rows. The center to center distance between any adjacent holes of a row is 0.8145 inch, and the depth of the hexagonal portion of each hole, ⅝ inch. The tolerance on the dimension across the flats of a hole was 0.001 inch. The mold was machined from Ketos tool steel, and hardened and ground to fit a steam jacket. It has been estimated that twenty-eight days would be required to make this mold if the hexagonal holes were produced by drifting and filing after round holes had been drilled. This method would ordinarily have been applied to this work, because the mold had to be made in one piece. However, by drilling the hexagonal holes by means of the hexagonal drills and a jig plate, the mold was made in three days.



Construction of Mold for producing Bakelite Insulators, the Hexagonal Holes of which were machined by employing Hexagonal Drills

NEW BOOK ON INTERCHANGEABLE MANUFACTURING

Principles of Interchangeable Manufacturing. By Earle Buckingham. 254 pages, 6 by 9 inches; 211 illustrations. Published by The Industrial Press, 140-148 Lafayette St., New York City. Price, $3.

The purpose of this book is to present a complete and comprehensive treatise dealing with the subject of interchangeable manufacturing as a whole. Such a book has not heretofore been available to those interested in interchangeable manufacturing in the machine building and metal working fields, although many articles dealing with various phases of interchangeable manufacturing have appeared from time to time in the technical press.

The development of interchangeable manufacturing is closely interwoven with many distinctly American manufacturing methods and processes and every large American industry has contributed its share to the progress made along this line. Different plants working independently have often achieved the same results by widely different methods. The author has attempted to define and emphasize the underlying basic principles, using specific examples only when necessary to illustrate the application of these principles in actual manufacturing processes. The information upon which this treatise is based has been gathered from many manufacturing plants, both large and small, in this country and in Canada; but the author mentions especially the Pratt & Whitney Co., Hartford, Conn., with whose cooperation this treatise has been written. The author has seen every method discussed in successful operation, some in one plant, and some in another. For more than ten years he has been in constant touch with many of the detailed manufacturing problems that arise in the production of interchanegable mechanisms in large quantities. During the war his activities in many manufacturing plants in connection with ordnance work made it apparent to him that the absence of common methods of interpretation of drawings, tolerances, and specifications, the lack of uniform gaging methods and misunderstanding of many of the factors of interchangeable manufacturing, presented an urgent need for a complete treatise on this subject.

In the arrangement of the material available on the subject of interchangeable manufacturing, the general principles involved in the industrial application of this method of production have been taken up first, and a separate chapter has then been devoted to the definition of the terms used, so that there will be no misunderstanding as to the meaning of the terms occurring later in the book. The influence of interchangeable manufacturing processes on machine design and the purposes of models are then dealt with, followed by a complete and minute discussion on the dimensioning of drawings intended for use in interchangeable manufacturing. This is followed by a discussion of the principal elements that govern mechanical production, the equipment required for interchangeable manufacturing (including machines, jigs and fixtures); the gaging equipment necessary; and the principles of inspection and testing.

Special chapters are also devoted to the subjects of manufacture for selective assembly, and methods used in small quantity production on an interchangeable basis. An entire chapter deals with the service factor in interchangeable manufacturing, because no manufactured machine is purchased for itself alone, but for the service it is supposed to render.

PERSONALS

R. D. Shields has been appointed assistant general manager of the Ohio Machine Tool Co., Kenton, Ohio. Mr. Shields has been chief engineer of this company for several years and will continue in that capacity.

Edward R. Abbott, formerly New York representative for the Taft-Peirce Mfg. Co., is now with the DuPont Engineering Co., Wilmington, Del., as sales representative for their Wilmington shops recently opened to contract work.

L. C. Bullington, who has been assistant to the manager of the Power Department of the Westinghouse Electric & Mfg. Co., has been made assistant manager and will have charge of the general work of the Power Department.

J. G. Benedict, general manager of the Landis Machine Co., Waynesboro, Pa., sailed July 8 for a combined business and pleasure trip abroad. Mr. Benedict will be gone for about two months and his itinerary will include England, France, Holland, Belgium, and Germany.

Charles H. Bluske has been appointed district sales manager of the Los Angeles office of the Economy Fuse & Mfg. Co., Chicago, Ill. The Los Angeles office is at 1304 Maltman Ave. Mr. Bluske was formerly connected with the Pacific States Electric Co. of Los Angeles.

P. J. Connor, formerly traveling representative for the International Machine Tool Co., Indianapolis, Ind., manufacturer of the Libby turret lathe, and recently connected with the Essley Machinery Co., Chicago, Ill., is now engaged, in an engineering capacity, with the Haynes Stellite Co. with headquarters in New York.

S. Glen Vinson, secretary and general manager of the Ideal Electric & Mfg. Co., Mansfield, Ohio, sailed recently for the Orient where he will make a survey of business conditions. Mr. Vinson will visit all the larger cities in Japan, China, Philippine Islands, and India. He expects to return to the United States about October.

R. S. Gildart of Cleveland, Ohio, has become advertising manager of the General Fireproofing Co., Youngstown, Ohio. Mr. Gildart was formerly director of publicity for the American Malleable Castings Association, Cleveland, prior to which he was advertising manager for the P. B. Yates Machine Co., Beloit, Wis., and the Kelvinator Corporation, Detroit, Mich. The General Fireproofing Co. is engaged in the manufacture of steel office furniture, filing equipment, concrete reinforcements, etc.

C. F. Ford, for several years with the Chicago Pulley & Shafting Co. has recently become connected with the engineering sales force of the W. A. Jones Foundry & Machine Co., Chicago, Ill., manufacturer of speed reducers and power transmission machinery. Mr. Ford will be located in the near future in Minneapolis as manager of the company's branch there. Some years ago Mr. Ford was transmission engineer for the W. A. Jones Foundry & Machine Co., and acted in that capacity over an extended period.

W. H. White has been appointed New York representative of the Mahr Mfg. Co., Minneapolis, Minn. He will have offices at 56 Murray St., New York City. The Mahr Mfg. Co. manufactures the "Mahrvel" line of oil-burning equipment, rivet forges, torches, and furnaces. Mr. White until recently was associated with the Mushet Steel and Taylor Iron interests in the United States and Canada. His experience in the iron and steel business during the last ten years will be useful to him in dealing with heat-treating problems.

* * *

OBITUARY

W. H. Holland, president and general manager of the Sibley Machine Co., 8 Tutt St., South Bend, Ind., who died Wednesday, June 14, was prominently identified with many manufacturing companies in South Bend and northern Indiana, and had also several other business interests, serving as vice-president of the Citizens' National Bank of South Bend. He was also president of the Motor Casting Co., president of the Elkhart Iron Works, president of the Clover Leaf Mfg. Co., vice-president of the South Bend Bait Co., and a director of the American Earth Works. Mr. Holland was born in Florena, Neb., June 4, 1866. He came to South Bend with his parents when five years old, and at the age of fourteen he started to work at the Sibley & Ware Mfg. Co. Mr. Holland is survived by his wife and his daughter, Mrs. Bernard Voll of Cambridge, Mass.

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TRADE NOTES

Albro-Clem Elevator Co., 500 Erie Ave., East, Philadelphia, Pa., announces that it has moved its district sales and service office in New York City to 165 Broadway.

Economy Fuse & Mfg. Co., Chicago, Ill., announces that the Pittsburg sales office of the company has been moved from 2223 Farmers Bank Bldg., to 1006 Peoples Bank Bldg., at Fourth Ave. and Wood St.

Marvin & Casler Co., Canastota, N. Y., manufacturer of Casler boring heads and chucks announces that it has taken over the manufacture and selling of the castellating and hexing machine designed by the Manufacturers' Consulting Engineers of Syracuse, N. Y.

S. & S. Machine Works, 4522 Lexington St., Chicago, Ill., has been formed by E. V. Swangren, formerly vice-president and superintendent of the F. J. Littell Machine Co., and W. N. Stevenson, formerly secretary and chief engineer of the same company. The partnership has been formed for the purpose of engaging in engineering and machine shop work.

Bastian-Blessing Co., W. Austin Ave. at La Salle St., Chicago, Ill., manufacturer of Rego welding and cutting apparatus has taken over the entire output of the St. Paul Welding & Mfg. Co.'s line of soldering equipment, trucks, preheaters and acetylene generators. The St. Paul Welding & Mfg. Co. will be the service distributors of Rego welding and cutting equipment and supplies at St. Paul, Minn.

Haberkorn & Wood is the name of a partnership formed by A. C. Haberkorn, formerly Detroit branch manager of Manning, Maxwell & Moore, Inc., and the Biggs-Watterson Co., and E. E. Wood, formerly sales manager of the Jones & Lamson Machine Co. An office and warehouse have been opened at 620 E. Hancock Ave., Detroit, Mich. The firm will handle a line of machine tools, cutting oils and compounds, as well as permanent mold aluminum alloy castings.

COMING EVENTS

August 28-September 2—Annual Safety Congress of the National Safety Council in Detroit, Mich. Secretary S. J. Williams, 168 N. Michigan Ave., Chicago, Ill.

September 4-9—Annual meeting of the American Chemical Society at Pittsburg, Pa. Further information may be obtained from R. S. Clark, office of the secretary, Carnegie Institute of Technology, Pittsburg, Pa.

September 11-15—Sixteenth annual convention and fourth annual exhibition of the Association of Iron and Steel Electrical Engineers at Cleveland Public Hall, Cleveland, Ohio. John F. Kelly, secretary, Empire Building, Pittsburg, Pa.

September 11-16—Eighth national exposition of chemical industries in the Grand Central Palace, New York City. Managers, Charles F Roth and Fred W Payne, Grand Central Palace, 46th St and Lexington Ave., New York City.

October 2-7—Annual convention and exposition of the American Society for Steel Treating in Detroit, Mich., General Motors Bldg. Secretary, W H Eiseaman, 4600 Prospect Ave., Cleveland, Ohio.

October 26-27—Automotive production meeting of the Society of Automotive Engineers to be held in Detroit. Further information may be obtained from the Society of Automotive Engineers, 29 W. 39th St., New York.

December 4-7—Annual convention of the American Society of Mechanical Engineers, in the Engineering Societies Bldg., 29 W. 39th St., New York City. Calvin W. Rice, secretary.

December 7-13—National Exposition of Power and Mechanical Engineering at the Grand Central Palace, New York City. Charles F. Roth, manager, Grand Central Palace, 46th St., and Lexington Ave., New York.

SOCIETIES, SCHOOLS AND COLLEGES

New York University, New York City, announces two series of lectures which will be given at the University, one on the Geology of Commerce and Industry, and one on the Commercial Geology of the Metals. Further information may be had by writing the secretary of the School of Commerce, New York University, Washington Square, or to Dr. Ernest R. Lilley, New York University, University Heights, New York City.

Pennsylvania State College, State College, Pa. Bulletin describing a course in Industrial Organization and Administration, which will be held at the State College from August 28 to September 9, under the direction of Professor Edward J. Kunze, assisted by Professors J. O. Keller and P. P. Henshall of the Department of Industrial Engineering. Complete information may be obtained by addressing Professor Edward J. Kunze, State College, Pa.

NEW BOOKS AND PAMPHLETS

Trade Standards in the Pump Industry. 21 pages, 6 by 9 inches. Published by the Hydraulic Society, 50 Church St., New York City.

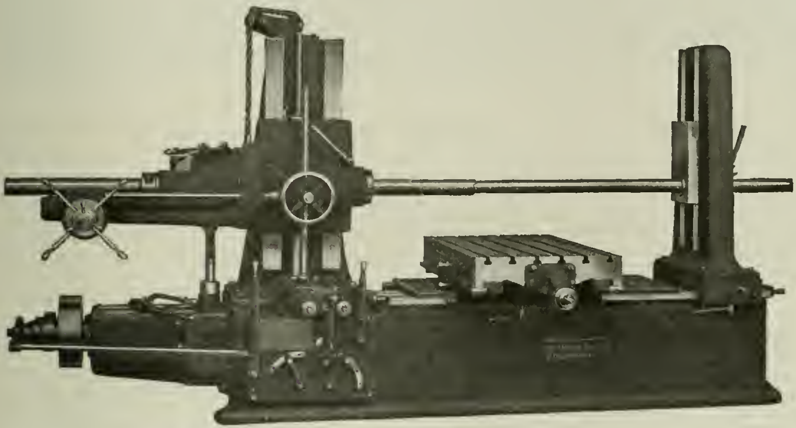
Interference Methods for Standardizing and Testing Precision Gage-blocks. By C. G. Peters and H. S. Boyd. Scientific Paper No. 436 of the Bureau of Standards, Washington, D. C. 36 pages, 7 by 10 inches. Published by the Superintendent of Documents, Government Printing Office, Washington, D. C. Price, 10 cents.

Metallographic Etching Reagents. By Henry S. Rawdon and Marjorie G. Lorentz. Scientific Paper No. 435 of the Bureau of Standards, Washington, D. C. 41 pages, 7 by 10 inches. Published by the Superintendent of Documents, Government Printing Office, Washington, D. C. Price, 15 cents.

Distance lends enchantment to—lots of things but NOT to the

"PRECISION"

Boring, Drilling and MILLING MACHINE



The closer you get, and the more you know it, the better you like it; it has no tricks to plague you either before or after you get familiar with it, which does not take long, because

IT IS SIMPLE

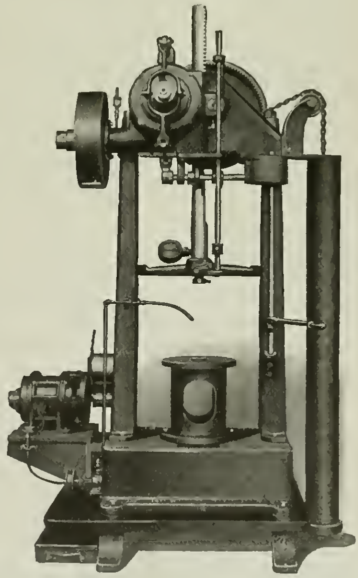
Almost like SLEIGHT OF HAND is the ease and quickness with which our new

Vertical Push-Broaching Machine

handles the broach.

"A SIMPLE TWIST OF THE WRIST" DOES THE TRICK

Less floor space—More production



LUCAS MACHINE TOOL CO. NOW AND ALWAYS OF **CLEVELAND, OHIO, U.S.A.**

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry. Societe Anoyme Belge, Alfred Herbert, Brussels. Aux Forges de Vulcain, Paris. Allied Machinery Company, Turin, Barcelona, Zurich. Benson Brothers, Sydney, Melbourne. V. Lowener, Copenhagen, Christiania, Stockholm. R. S. Stokvis & Zonen, Rotterdam. Andrews & George Company, Tokyo, Japan.

How to Make Commercial Type Radio Apparatus. By M. B. Sleeper. 159 pages, 5¼ by 7¾ inches. Published by the Norman W. Henley Publishing Co., 2 W. 45th St., New York City. Price, 75 cents.

A man who builds and designs his own radio equipment often wishes to compare it with the equipment of commercial design, and it is for this purpose that this guide book has been issued, which gives information in compact form on commercial type radio apparatus. The book describes in detail many commercial types of transmitting spark and vacuum tube sets, both telephone and telegraph, and receiving equipment of all kinds. There are ninety-eight illustrations, which make it easy for the experimenter to follow the descriptions.

Notes on Mechanical Drawing. By Rolland S. Wallis. 64 pages, 6 by 9 inches; 87 illustrations. Published by the Engineering Extension Department, Iowa State College, Ames, Iowa. Price, 50 cents.

This is a supplement to the drawing courses conducted by the Engineering Extension Department of the Iowa State College. It gives a general survey of the principles of mechanical drawing, reviewing the instruments required and their use, and devoting considerable space to freehand lettering as well as lettering produced by drawing instruments. It then briefly reviews the standard methods of projection, dimensioning, and the drawing of simple machine details. It closes with a useful chapter on drafting-room geometry.

Industrial Unionism in America. By Marion Dutton Savage. 344 pages, 7½ by 5 inches. Published by the Ronald Press Co., 20 Vesey St., New York City. Price, $2.25.

In this book, as stated in the preface, an attempt has been made to describe unionism, with its many variations, and to consider the direction in which organized labor seems to be moving. The author has assumed on the part of the reader some knowledge of the many reasons for the existence of the labor movement. No attempt has been made to justify or condemn the fact of organization among the workers. The subject matter is divided into three main heads as follows: Industrial Unionism within the American Federation of Labor; Revolutionary Industrial Unionism including Workers of All Industries; and Independent Industrial Unionism.

Iron and Steel. Pamphlet published by the Bureau of Education of the United States Department of the Interior, Washington, D. C. Sent free on application.

This pamphlet contains an outline of a reading course on the manufacture of iron and steel, including information on blast furnaces and treatises on the metallurgy of steel. The pamphlet is prepared by the American Library Association for the Bureau of Education of the United States Department of the Interior. It lists fourteen books, which form a course covering the whole iron and steel industry. Among the books included are "Iron and Steel," published by The Industrial Press, 148 Lafayette Street, New York City, which contains a complete outline of the entire subject of the manufacture of iron and steel of different kinds—wrought iron, open-hearth steel, bessemer steel, tool steel, high-speed steel, electric steel, steel castings, gray iron castings, malleable iron, etc.

Handbook of the Electric Power Club. 284 pages, 4 by 7 inches. Published by the Electric Power Club, 1017 Olive St., St. Louis, Mo.

This is the fourteenth edition of the handbook of the Electric Power Club, an association of manufacturers of electric power apparatus and control equipment, organized for the standardization, improved production, and increased distribution of electrical machinery and apparatus. The handbook covers substantially all of the standardization thus far accomplished by the Electric Power Club and its predecessor, the American Association of Electric Motor Manufacturers, which was organized in 1908. The handbook contains a mass of valuable information for those who use electric power apparatus. For example, it contains information relating to pulley sizes, belt speeds, methods of gearing motors, etc. It should be of especial value in connection with the providing of motor drives for machine tools and industrial machinery in general.

Steam Turbines. By William J. Goudie. 804 pages, 8½ by 5½ inches. Published by Longmans, Green & Co., 55 Fifth Ave., New York City. Price, $10.

This is the second edition of Professor Goudie's book on steam turbines. As it was considered that a mere revision would not bring the book thoroughly up to date, it has been almost entirely rewritten. While the general scheme of the first edition has been followed, the addition of new material has increased the number of chapters from sixteen to eighteen. The thermodynamic portion is based on Callendar's characteristic equations for steam and four diagrams giving the properties of superheated and supersaturated steam are included. A new chapter has been added on mechanical reduction gears, with special reference to marine turbines. The section on critical speeds of rotors has been extended to include the multiple bearing case. Improved methods of dealing with the condition curve, reheat factor, internal efficiency, and also new methods of provisional design have been developed. The book is intended for the use of engineers engaged in the design or operation of steam turbines, as well as for engineering students.

Radio Experimenter's Handbook. By M. B. Sleeper. 143 pages, 6 by 4 inches. Published by the Norman W. Henley Publishing Co., 2 W. 45th St., New York City. Price, $1.

The purpose of this book is to answer the practical problems that confront those who are beginning to experiment in the radio field. All deeply theoretical and mathematical discussions have been omitted, and the apparatus considered is limited to simple and practical instruments capable of receiving signals from broadcasting stations as well as from radio telegraph stations. The material is divided into sixteen chapters as follows: What is the Use of Having a Radio Station?; What Makes the Wireless Work?; Apparatus Used in Simple Damped Wave Transmitting Sets; Setting up and Operating a Damped Wave Transmitter; Apparatus Used in Simple Damped Wave Receivers; Setting up and Operating a Simple Damped Wave Receiver; Radio Antennas and Grounds; Advanced Damped Wave Receiving Apparatus; How Does an Audion Work?; Damped Wave Audion Receiving Apparatus; Advanced Damped Wave Audion Receiving Apparatus; What is an Undamped Wave?; Undamped Wave Telegraph and Telephone Transmitters; Undamped Wave Receivers; the Audion Amplifier; Radio Rules and Regulations.

Production Engineering and Cost Keeping. By William R. Basset and Johnson Heywood. 311 pages, 6 by 9 inches; 117 illustrations. Published by the McGraw-Hill Book Co., 370 Seventh Ave., New York City. Price, $3.50.

The purpose of this book is not only to give practical assistance to production managers, foremen and cost accountants of machine shops, but also to furnish higher executives with a knowledge of the best in shop management practice. The principles and practice recommended have been developed in the course of years of actual installation of improved production, engineering, and cost keeping systems in metal trades plants. While no system, however successful in one shop, can be applied in its entirety in another shop, the underlying principles of management are essentially the same. A better idea of the contents will be obtained from the following chapter headings: What Production Planning Does; Purchasing as a Tool of Production; Need for Systematic Stock Keeping; Engineering the Product; Tool Issue; Laying out the Machines; the Central Control of Production; Controlling the Work in the Shop; Planning in the Jobbing Shop; the Fundamentals of Correct Time Study; Setting the Standard; Setting Piece Rates; Special Cases of Time Study and Rate Setting; Time Study on Automatic Machines; What a Cost System Can Do for You; the Fundamentals of Cost; Fixed Charges; Departmentalizing the Overhead Expense; Analyzing the Labor Costs; Accounting for Supplies; Getting the Overhead into the Finished Product; Handling Abnormal Expense; Gathering the Final Costs; the Statement of Condition and the Operating Statement; What Does it Cost to Sell?; Graphic Methods of Control.

NEW CATALOGUES AND CIRCULARS

New Departure Mfg. Co., Bristol, Conn. Folder entitled "New Departure Ball Bearings Win."

Monitor Controller Co., Baltimore, Md. Folder illustrating and describing the expansion unit of the Monitor thermaload starter.

Reading Chain & Block Corporation, Reading, Pa. Folder illustrating and describing the company's new "Everedy" electric hoist.

Ingersoll Milling Machine Co., Rockford, Ill. Bulletin entitled "The Ingersoll Adjustable Rail Milling Machine," illustrating and describing this machine and showing operations performed on it.

Hendey Machine Co., Torrington, Conn. Folder illustrating and describing the Hendey sub-head-stock, the primary purpose of which is to permit the chasing of screw threads having unusually long leads.

Jas. Clark, Jr., Electric Co., Louisville, Ky. Jasco Driller, a periodical published by the company, illustrating and describing its products and giving instructions for the care and maintenance of portable electric drills.

Newton Machine Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa. Bulletin No. 57 illustrating and describing the company's radius-link grinding machine. The folder gives a table of general dimensions and specifications.

Schutte & Koerting Co., Philadelphia, Pa. Catalogue entitled "Koerting Fuel Oil Burning Systems," describing mechanical fuel oil-burning systems and fuel oil-burners in which the oil is atomized by low or high pressure air and steam.

W. C. Lipe, Syracuse, N. Y. Catalogue illustrating and describing in detail the Lipe automatic gear tooth chamfering machine, and showing some of the work done on it. Complete instructions for operating the machine are also included.

Brown Instrument Co., Philadelphia, Pa. Catalogue of resistance thermometers, explaining the theory of resistance thermometry, and illustrating and describing the various types of instruments made. The advantages and applications of each type are indicated.

Birdsboro Steel Foundry & Machine Co., Birdsboro, Berks County, Pa. Booklet illustrating and describing the Jackson belt lacer, showing clearly both the type of belt chains that results from the use of this belt lacer, and the method in which the belt lacer is applied.

Western Tool & Mfg. Co., Springfield, Ohio. Catalogue 19 of expanding mandrels, tool-holders, lathe dogs, C-clamps, shop furniture, emery wheel dressers, and vises. The catalogue is profusely illustrated, showing all the tools and devices manufactured, and giving complete lists of sizes and prices.

American Nickel Corporation, Clearfield, Pa. Bulletin No. 101 entitled "American Nickel—Its Properties and Uses." The bulletin gives a resume of the properties of the nickel products of the company and a list of purposes for which it is recommended, and contains a number of useful tables.

Acme Motor Truck Co., Cadillac, Mich. Catalogue for 1922, of Acme motor trucks, illustrating and describing seven models of the company's make. The catalogue is profusely illustrated, and gives complete description of the separate models; it also shows the construction of the prominent features of the Acme trucks.

Van Keuren Co., 362 Cambridge St., Boston, 34, Mass. Catalogue of modern measuring tools, illustrating, describing and giving prices of combination precision gage-blocks, gage-block accessories, plug gages, measuring wires for screw threads and profiling gages, lapped steel surface plates and light-wave measuring outfits.

Condensite Co. of America, Bloomfield, N. J. Catalogue entitled "Condensite in the Automotive Industry," illustrating and describing the various purposes for which condensite is used in automobile construction. Also catalogue treating of "Halowax Oil" in the rubber industry. This oil is used in the treatment of fabric to improve the bonding of rubber to it.

Kelly Lubricator Corporation, 107 N. Franklin St., Syracuse, N. Y. Folder illustrating and describing Auto-vac ball feed lubricators manufactured by the company for automatic, positive and economical lubrication. These lubricators are used on various types of machine tools and line-shafting. Loose-pulley lubricators are also illustrated and described.

General Welding & Equipment Co., 74 Brookline Ave., Boston, Mass. Catalogue entitled "Modern Welding and Cutting," illustrating and describing the "Gewe" automatic welding machines and automatic cutting machines. The automatic welding machine described is an entirely new design, having a self-feeding welding torch; numerous illustrations, showing the application of the apparatus, are included.

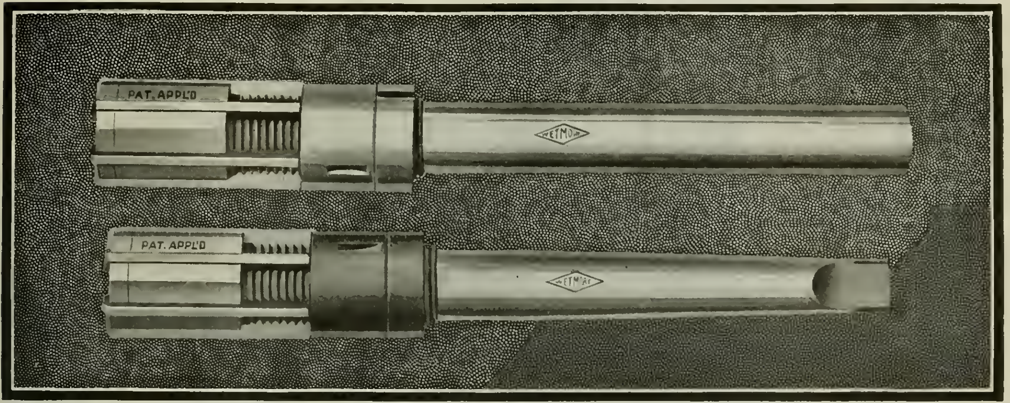
Philadelphia Gear Works, 1124 Vine St., Philadelphia, Pa. Catalogue for 1922 covering generated spur, bevel and spiral gears, rawhide and micarta pinions, worms and worm-gears, racks and lead-screws, speed-reducing units, sprockets and "Diamond" chains. In addition to the information about the company's product, the book contains a great deal of information on gearing, and a number of tables and formulas of use to gear designers and shop men.

Link-Belt Co., 910 S. Michigan Ave., Chicago, Ill. Catalogue entitled "Link-Belt Power Hoe," describing a new patented improved drag scraper, intended for use in storing and reclaiming materials. Bulletin describing the Link-Belt crawler crane, the newest machine that has been brought out by the Link-Belt shops in Chicago. This crane complete, without bucket, weighs twenty-two tons, and lifts safely ten tons at a 12-foot radius and three tons at a 30-foot radius.

Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. Bulletin entitled "Arc Welding in Electric Railway Shops," known as Leaflet No. 1824. This publication describes the many advantages of arc welding, and gives figures showing the savings made possible by reclaiming worn out parts. The increased technical knowledge regarding the arc welding operation has extended the scope of the process, and the improvements in welding equipment, many of which are described in this bulletin, have greatly increased welding efficiency.

Colburn Machine Tool Co., Cleveland, Ohio. Bulletin B-103 entitled "Colburn Heavy-duty Boring and Turning Mills." This bulletin gives a very complete description of the new design of Colburn boring and turning mills together with halftone illustrations of the machines on which different parts are named for ready identification. A number of detail views of the most important mechanisms of the machines are also included, showing clearly the method of control and operation. A phantom view of the machine illustrates in a very good manner the lubricating system.

Metals Coating Co. of America, 495-497 North Third St., Philadelphia, Pa. Catalogue entitled "Schoop Metal Spraying Process," illustrating and describing the process and apparatus used for simultaneously melting and atomizing any of the commercial metals, impacting them on any surface so as to apply thereby a coating of any commercial metal on any surface according to the requirements. The catalogue completely illustrates and describes the process and the apparatus used in connection with it, and shows in addition the photographs of a number of applications in actual practice.



At Last! A Guaranteed Machine Reamer

—in Sizes *Under One Inch*

Last February we announced the perfection of Wetmore Expanding Machine Reamers—all sizes under one inch. Their reception by manufacturers was immediate. They filled a long-felt want. Since February, we have been kept busy supplying the demand for these small reamers of *guaranteed quality and accuracy.*

These new Wetmore Expanding Small Machine Reamers range in size by thirty-seconds from ⅝" to 31/32", inclusive—both straight and taper shank. In expanding these small reamers, there are no unnecessary screws to be loosened, because the expansion is taken care of by a cone nut and lock nut in rear of blades. The straight blades are held securely by a special method, exclusive to Wetmore Expanding Reamers.

These Wetmore "little fellows" typify the high standards of workmanship and materials that have made Wetmores *standard* in so many of America's largest plants. Here are some of the advantages of the general line of Wetmore Expanding Reamers:

Adjustments to the thousandth of an inch can be made in less than a minute. In fact, the Wetmore is the quickest and easiest adjusting reamer made. Cone expansion nut keeps blades always parallel with axis.

Solid, heat-treated alloy steel body guaranteed against breakage.

Left Hand Angle Cutting Blades that prevent digging in, chattering, and scoring of the reamer while backing out. Shearing effect of blades increases life of cutting edge.

No grinding arbor required for regrinding. Wetmore Reamers can be reground on their original centers.

Write for your copy of the Wetmore Hand-book—a valuable reference work for precision tool users. Sent free, postpaid, on request.

Wetmore Reamer Company

60-64 27th Street **Milwaukee, Wisconsin**

Manufacturers of Expanding Reamers and Cylinder Reaming Sets, Arbors, Blades and Thread Gouges

REPRESENTATIVES

Mr. W. R. Wyatt,
50 Church Street,
New York, N. Y.

Devlin Supply Company,
2220-22 Chestnut Street,
Philadelphia, Pa.

Mr. E. E. Ehrenfeld,
444 Little Building,
Boston, Mass.

Kemp Machinery Co.,
215 North Clavert Street,
Baltimore, Md.

The W. Bingham Company,
Cleveland, Ohio.

Sword Bros. Company,
625-29 Seventh Street,
Rockford, Illinois.

The E. A. Kinsey Company,
Indianapolis, Indiana.

Wyman-Taylor-Ward Co.,
403 Real Estate Exchange Bldg.,
Detroit, Mich.

Doermann-Roehrer Company,
318 East Third Street,
Cincinnati, Ohio.

James T. Winterling Co.,
209 Alpine Avenue,
Pittsburgh, Pa.

The R. C. Neal Company,
76 Pearl Street,
Buffalo, N. Y.

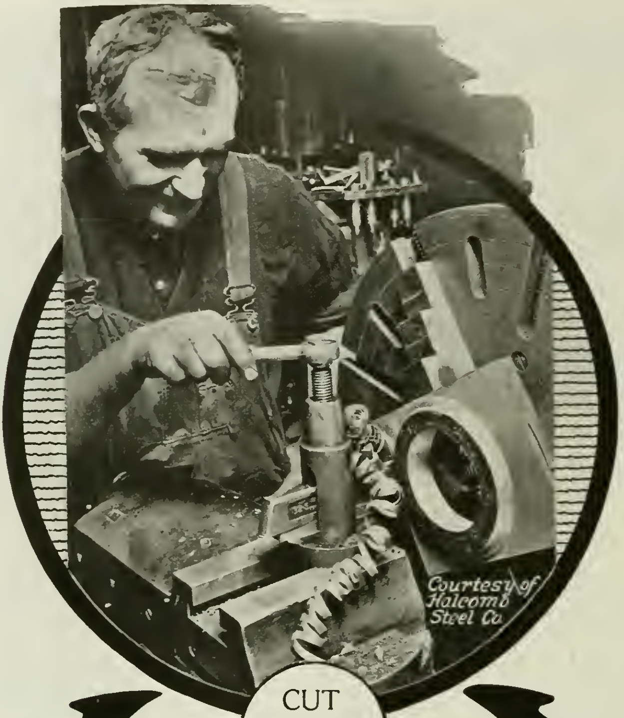
Western Iron Stores Company,
Milwaukee, Wisconsin.

R. H. Jones Company,
Minneapolis, Minn.

A. E. Chadwick Co.,
549 West Washington Blvd.,
Chicago, Illinois.

WETMORE EXPANDING REAMERS

"THE BETTER REAMER"

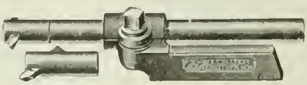


CUT
CUTTING
COSTS

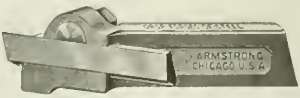
ARMSTRONG TOOL HOLDERS

Armstrong Tool Holders are used in nearly all machine shops and are one item of equipment which you can actually SEE saving money for the owner.

Turning and Shaper Tool



Boring Tool



Right Hand Side Tool

SAVE

High Speed Steel
Time
Grinding Wheels

Increase
Production

Specify
ARMSTRONG

Catalog free

Left Hand Cut-off Tool

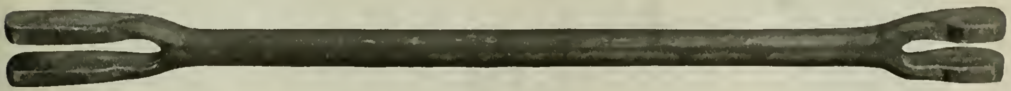
Threading Tool

Planer and Shaper Tool

ARMSTRONG BROS. TOOL CO.
"THE TOOL HOLDER PEOPLE"
313 N. FRANCISCO AVE. CHICAGO, U.S.A.

AJAX

(Trade Mark Registered)



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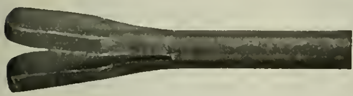


B

WELDLESS Bottom Connections at Rate of 300 per 9 Hours

Weldless Bottom Connections are being produced by an Ajax Upsetting Forging Machine and Ajax Hot Saw more rapidly and economically than the inferior welded rods.

Bottom connections have been made for years by welding forged jaws or "U" pieces onto rods of the required length. Production seldom exceeds 125 or 150 complete rods per day and defective welds cause frequent breakages.

Weldless bottom connections are, as the name implies, made from one solid bar of steel of the required size without weld. The stock used is brought to good forging heat on the end and given a preliminary upset A in the forging machine. It is then passed to the hot saw for slitting B and returned to the forging machine, where the jaw is formed in a single operation. All this is done without re-heating.

A crew of three men produce more than 600 ends, i. e., 300 complete weldless rods, in a 9-hour day without difficulty, ***cutting the labor cost in two and yet giving a superior product.***

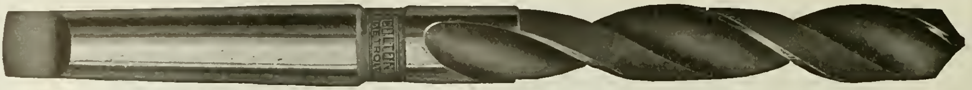
For producing jaws and "T" head forgings the Ajax Hot Saw and Burring Machine is a most valuable auxiliary to the Upsetting Forging Machine. Write for our descriptive Bulletin No. 28-A.

THE AJAX MANUFACTURING CO.

621 Marquette Building
CHICAGO, ILL.

CLEVELAND, OHIO

1369 Hudson Terminal
NEW YORK CITY



Colton-Detroit Twist Drills

You Are Buying Holes—or Drills?

If you buy a motor car, you are really buying mileage. If you buy Colton-Detroit Twist Drills you are buying holes—the most holes per dollar of cost.

You have never had drills like Colton-Detroits. They are not milled—they are forged from special steel in accurate dies. Match them with what you are now using.

Colton-Detroit quality at fair prices is something you can't overlook. Point for point, there is no drill value on the market superior to Colton-Detroit. Ask for facts.

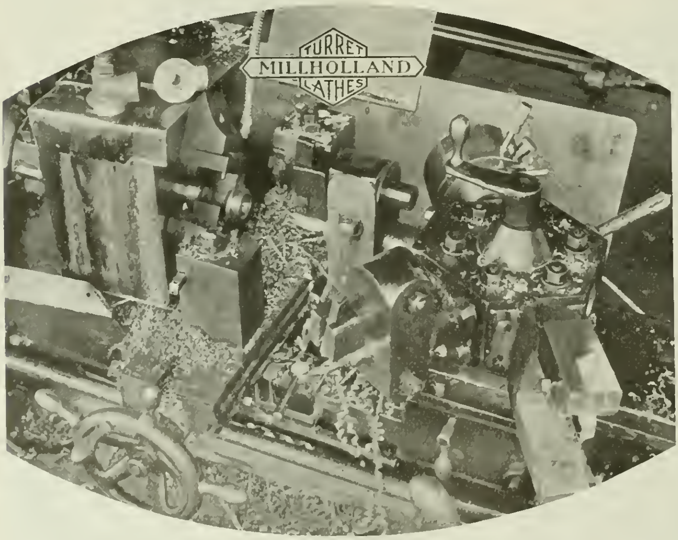
ARTHUR COLTON COMPANY, Detroit, Mich.

2618 Jefferson Avenue, East

REPRESENTATIVES: **Buffalo:** P. F. Fosnight, Ellicott Square Bldg. **Chicago:** H. E. Barton Tool Co., 106 S. Jefferson St. **Milwaukee:** General Sales Agency, 3205 Vine St. **New York City:** F. A. Brady, Inc., 30 Church St. **Pittsburgh:** W. E. Nagle & Son, Jenkins Arcade Bldg. **Philadelphia:** Wenson Tool Company, 745 North Sixty-third St. **San Francisco:** L. G. Henes, 75 Fremont St. **Los Angeles:** L. G. Henes, 218 East Third St. **Cincinnati:** Advance Tool Co., Canal and Jackson Streets.

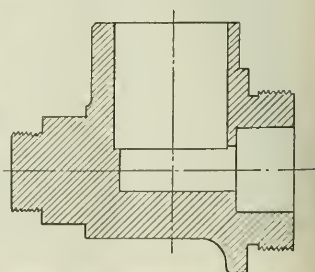
3 Chuckings—8 Minutes

Finished All Over on a MILLHOLLAND TURRET LATHE Tooled for Production by Millholland Engineers!



A drop forged steering wheel lock body machined from the solid on a No. 4 Millholland turret lathe, tooled for production by Millholland Engineers.

Let us tell you how we would handle similar pieces of your own work.



MILLHOLLAND MACHINE COMPANY

1102 West 23rd Street INDIANAPOLIS, IND.

ATKINS

METAL CUTTING SAWS

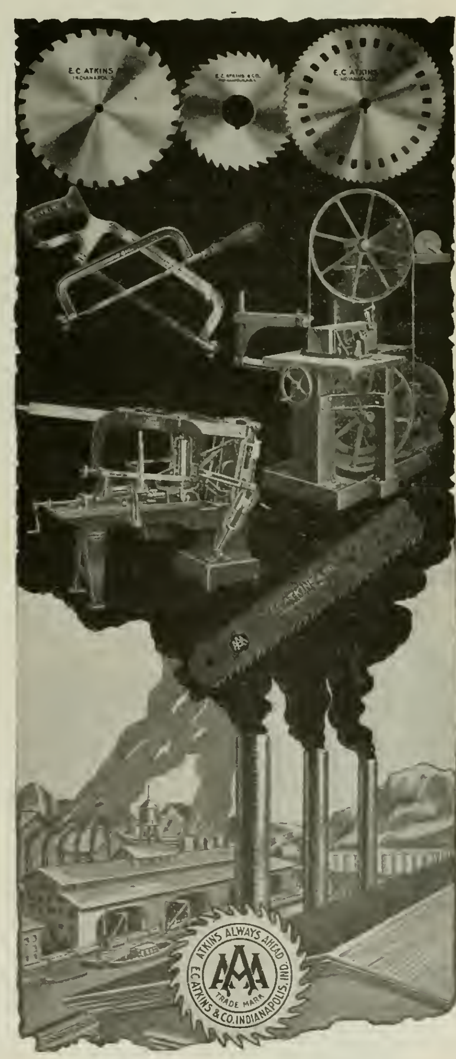
Are You Cutting Your Metal Economically?

If you are not equipped with an Atkins Metal Band Saw or a Kwik-Kut Metal Cutting Machine, you are overlooking an important factor in production, These machines are the most efficient for cutting iron, steel and other metals, fast, smooth and accurately. Write us for prices.

CIRCULAR METAL CUTTING SAWS. We make Circular Metal Cutting Saws of the best material and temper; they will cut your steel quickly without undue strain or effort. Send for complete treatise on Circular Metal Cutting Saws.

HACK SAW BLADES AND FRAMES. We manufacture the most complete line of Hack Saw Blades for hand frame use and solicit a trial order for Atkins Non-Breakable Blades. They will prove that they are the cheapest you can buy in the long run. We also manufacture All Hard Blades for hand frames and AAA Power Blades for Hack Saw Machines as well as Solid and Adjustable Hack Saw Frames for shop use.

SCREW SLOTTING AND MILLING SAWS. Send us your specifications and we will quote you our lowest current prices for quick delivery.



E.C. ATKINS & CO.

ESTABLISHED 1857 THE SILVER STEEL SAW PEOPLE

Home Office and Factory, INDIANAPOLIS, INDIANA

Canadian Factory, Hamilton Ontario

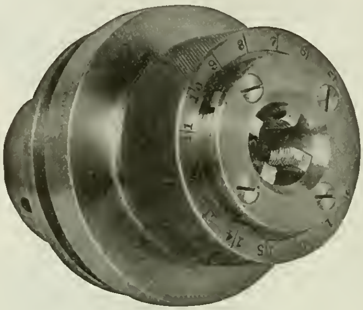
Machine Knife Factory, Lancaster N.Y.

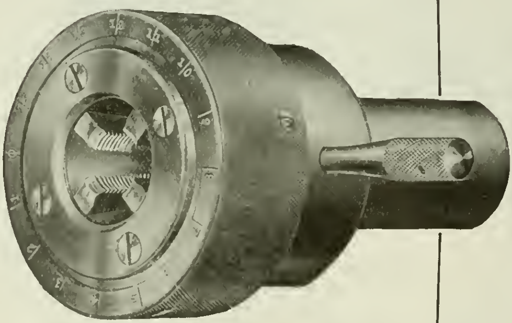
Branches Carrying Complete Stocks In The Following Cities:

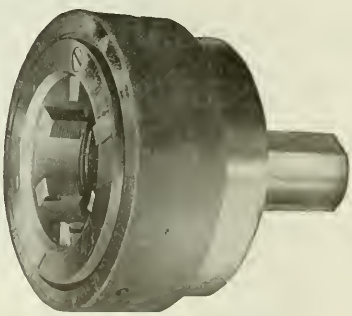
Atlanta	New Orleans	Seattle
Memphis	New York City	Paris, France
Chicago	Portland, Ore.	Sydney, N. S. W.
Minneapolis	San Francisco	Vancouver, B.C.

Murchey Service

Correct Tooling for Profitable Threading







Murchey Collapsing Taps and Expanding Die Heads are production tools; dependable, simple, easily adjusted, long lived, *accurate.* They give profitable service on all classes of threading work.

If you are "tooling up for production" send for the catalog of our standard tools. If your work includes special threading operations send us a blueprint or sketch and we will develop the tool to handle it.

Murchey Machine & Tool Company

34 Porter Street, Detroit, Michigan

CLEVELAND OFFICE
6523 Euclid Ave.

NEW YORK OFFICE
99 Warren Street

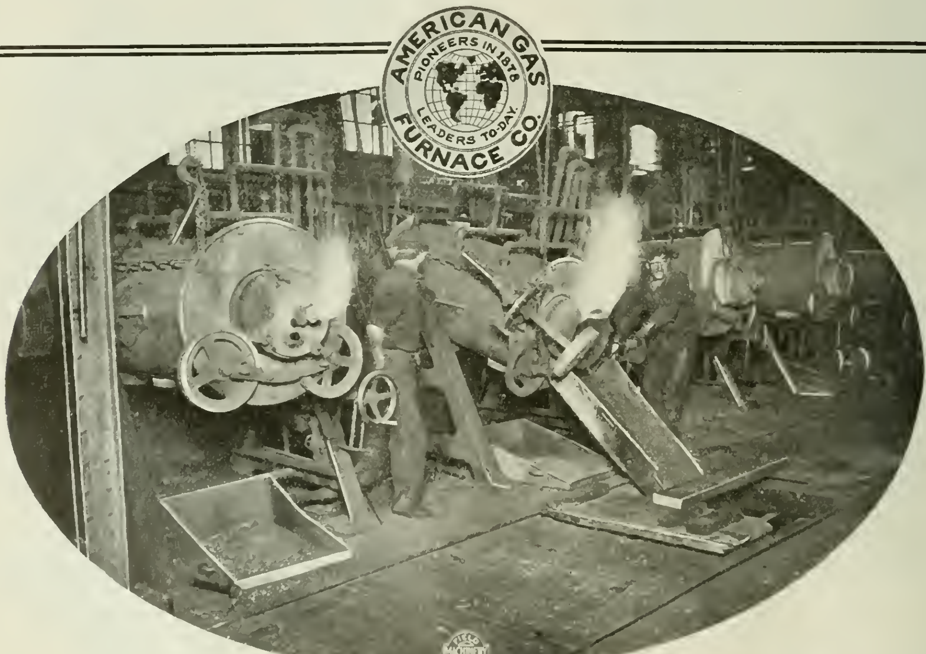
Parts for Baldwin Chains Are Carbonized in

American Rotary Gas Furnaces

Before the Baldwin Chain & Manufacturing Company, of Worcester, Mass., installed this battery of American Gas "Rotaries," pins, rollers and other parts for its famous chains were packed for several hours in containers, placed in a furnace, and afterwards quenched. For the last four years, however, they have been merely loaded into the revolving retort of American Gas Furnaces—about 350 lbs. per load—and rotated for 2½ hours; then tipped into a quenching tank, as shown. Gas burning between the retort and the interior of the furnace brings the work rapidly to the correct temperature and automatic heat control maintains it at uniform temperature throughout the entire operation; while from carbon gas, passing through the retort, carbon is absorbed by the tumbling pieces to a more uniform depth on all surfaces than could be obtained by the old method.

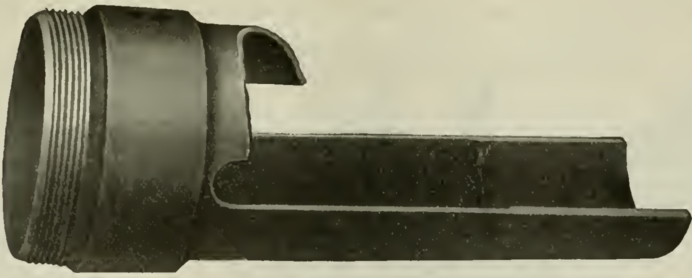
There are eight of these machines in the "Baldwin" installation—clean, compact, easy to operate and entirely dependable. American Gas Furnaces cover all heat treating requirements—from tool room to rolling mills—and our service department will be glad to discuss their respective advantages in connection with your work.

Our line includes: Gas Furnaces, Carbonizing Furnaces and Machines, Pressure Blowers, Heating Machines, Automatic Heat Controllers, Forges, Cylindrical and Oven Furnaces and every type of Gas Blast Furnace and Heating Machine for Industrial Uses.



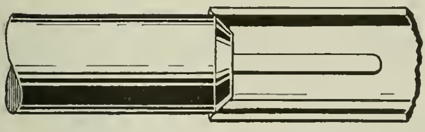
AMERICAN GAS FURNACE COMPANY

Main Office and Works: ELIZABETH, NEW JERSEY

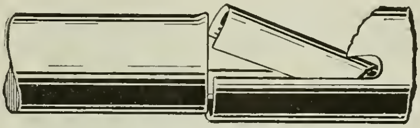


This feed finger was broken by a burred rod

This accident stopped production for 25 minutes and caused a loss of $12.50 for replacing feed finger. It would not have happened with Bridgeport Ledrite Brass Rod because all Ledrite rod is chamfered on the ends.



The Ledrite chamfered end eliminates danger of broken feed fingers.



This shows how a burred rod broke a feed finger.

Ledrite Rod as made by Bridgeport Electric Furnace processes, in addition to being chamfered at both ends, is the best free-cutting composition, a composition which is accurately maintained by testing. No screw machine spindle speed is too high for Ledrite Rod. Ask for our Brass Rod Book No. 1439.

BRIDGEPORT BRASS COMPANY, Bridgeport, Conn.

"Bridgeport" BRASS CO. U.S.A. TRADE MARK

Bridgeport Ledrite Brass Rod It's Tested

2319

Rickert-Shafer Automatic, Positive Opening, Adjustable Die Heads

Accurate Threads in Any Quantity—Right Up to the Shoulder—and Fast

Made in 21 sizes — 1/16" to 9" Capacity

Standard in many shops.
Bulletin V Explains.

Wheel hubs for automobiles, water tight pump bodies for motors and studs for auto cylinder heads are among the many threaded parts, all subject to thread gage inspection, which are regularly cut with R-S Die Heads. They are used also for steering gear pinions, carrier screws and other parts in which the thread must run up to the shoulder. Even brass castings can be threaded to advantage the R-S way—gage valve stems for 2″ at 60 per hour; and hose bibs, 25,020 between grinds.

RICKERT-SHAFER CO.
612 W. 12th St., Erie, Pa., NEW YORK OFFICE: 50 Church Street

BRANCH OFFICES: 380 Rockefeller Bldg., Cleveland, Ohio; 117 North Jefferson St., Chicago, Ill.; 50 Church St., New York, N. Y.; 222 West Larned St., Detroit, Mich.; 414 Elm St., Cincinnati, Ohio; 807 Iroquois Bldg., Buffalo. N. Y. AGENTS: Stocker-Rumely-Wachs Co., Chicago, Ill.; Strong, Carlisle & Hammond, Cleveland, Ohio; Michigan Metal Supply Co., Detroit, Mich.; Peter Frasse & Co., New York City, N. Y.

PEBBLES AND SAND IN

GLOBE TUMBLING BARRELS

To Polish Clothes Hooks

It takes 12 hours to polish these cast-iron clothes hooks—but the polishing medium is very inexpensive, the labor cost scarcely to be considered, and the hooks are as smooth as though buffed. This photograph was obtained at the Norwalk Lock Company, South Norwalk, Conn., where clothes hooks are only one of the many things profitably polished, in GLOBE Tumbling Barrels.

Send us a sample to polish for you. Get the details of methods, costs, etc.

THE GLOBE MACHINE & STAMPING CO., 1250 West 76th St., Cleveland, O.

Also Manufacturers of Sheet Metal Stampings, Dies and Tools

Foreign Representatives: J. Horstmann, 81-83 Rue Saint Maur, Paris, France; 48 Rue Juliette-Recamier, Lyons, France.

U-LOY STEELS

From the Electric Furnace

A heavy switch is thrown—electricity of enormous power is released. An arc forms between the electrodes and the charge. Soon melting takes place.

So intense is this arc that it refines steel to a higher degree of purity than any other method. The injurious effects of sulphur and phosphorus are reduced to a minimum. Impurities are removed. Greatest freedom from surface and sub-surface defects is insured. In purity, uniformity and homogeneity U-LOY Electric Furnace Steels are far superior to even the best open hearth steel.

Perhaps U-LOY Electric Furnace Steels would improve your product—*no matter what it may be.*

UNITED ALLOY STEEL CORPORATION
CANTON, OHIO

New York, Syracuse, Cleveland, Chicago, Detroit, Buffalo, San Francisco, Indianapolis, Portland

Open Hearth and Electric Furnace U-LOY Steels are furnished in:—

Blooms, Slabs, Billets, Plates, Bars, Rods. Bars Hot Rolled, Cold Drawn and Heat Treated to specifications

For—

Railroads
Automobiles
Edged Tools
Farm Implements

Toncan Metal

Anti-corrosive
Roofing, Siding,
Enameling Stock
Electrical Sheets

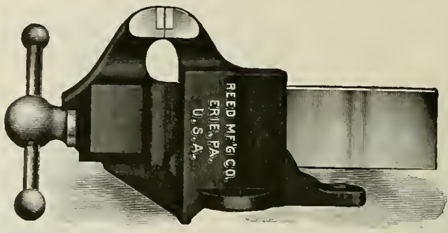
One of our four Electric Furnaces pouring at night. A most fascinating and interesting sight

PARKER VISES

"Grip Like a Grizzly"

—because they have reserve strength ALL OVER! Renewable tool steel jaws, a steel "backbone" in the slide, a solid underportion, and a swivel that grips like the jaws! *Uniform sturdiness* has kept "Parkers" in the great U. S. and Canadian shops for over 80 years. Send for Feature Folder No. 5.

THE CHARLES PARKER COMPANY
Master Vise Makers, MERIDEN, CONN., U. S. A.



A Workman Can Produce More While Using a

REED VISE

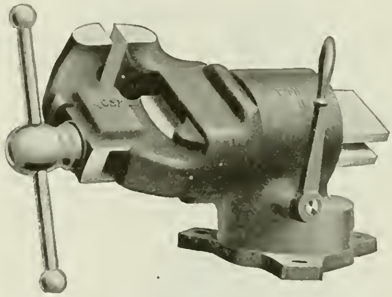
That's because the Reed is R-I-G-I-D, and does not give or spring under working stress.

A Reed is also easy working and so simple it does not require special attention to operate.

Of all the qualities a vise should possess RIGIDITY is probably most important. That's why we pay so much attention to *Rigidity.*

Send for Proof of Superiority

REED MANUFACTURING CO.
ERIE, PA.

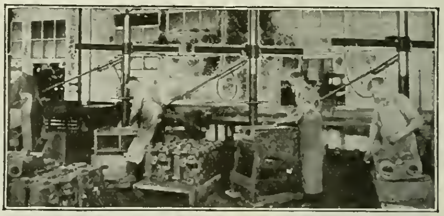


"YOST"

Yost service means most service. Yost Solid Vises with Stationary or Swivel Base match every need. If you have never used one, you have a treat in store. They survive every test, stand the stress of severe service and give unusual satisfaction.

Yost Vises are all fine tools of distinctive quality and long life. There are thousands of users ever eager to proclaim Yost satisfaction to others—talk to these men in your town—or write for particulars.

Yost Manufacturing Company
MEADVILLE, PA.

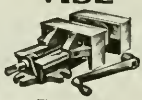


ANDERSON PNEUMATIC SCRAPERS

Skilled scrapers lose their skill toward quitting time—it's fatigue that cuts production. Anderson scrapers substitute air power for human muscle, yet maintain the quality of hand work. Write for catalog.

ANDERSON BROS. MFG. CO., 1910 KISHWAUKEE STREET ROCKFORD ILLINOIS

DRILL VISE



Three Sizes

With and Without Jig Attachments Often used on miller, shaper or planer.

Send for circulars

Other Tools
Drill Speeders
Knurl Holders

The Graham Mfg. Co.
Providence, R. I.

Great Britain — Burton, Griffiths & Co.
France, Italy, Switzerland, Spain and Holland, Fenwick Freres & Co.

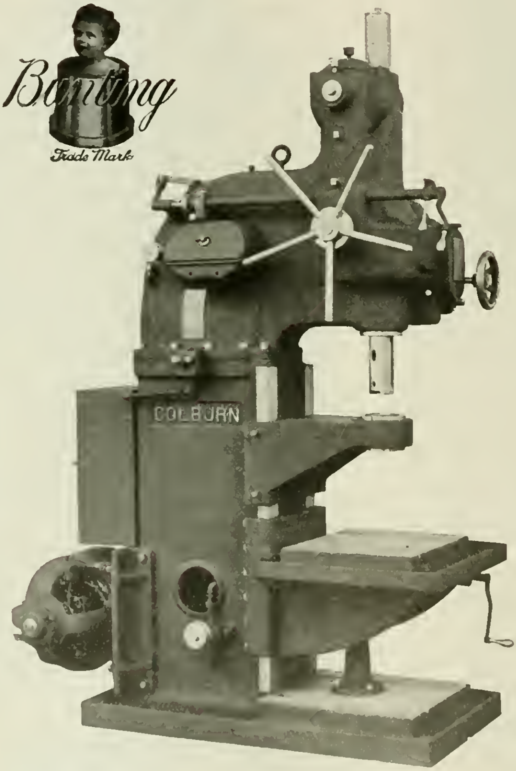
TAPS AND REAMERS

First-class Tools and Prompt Deliveries

REIFF & NESTOR CO., Lykens, Pa.

Colburn Relies on Bunting

Bunting
Trade Mark



The good name of Colburn relies on Bunting Bushings to uphold the Colburn standard of quality and performance.

The Colburn Machine Tool Company is one of many that have found Bunting Bushings eminently worthy of confidence.

We have 150 different sizes of completely finished Bunting Bushings always in stock. They fit almost any requirement. They cost less and are always ready.

Write for Stock List "G"

The Bunting Brass & Bronze Company

748 Spencer Street, Toledo, Ohio

New York
Grand Central Palace
Vanderbilt 7300

Chicago
722 S. Michigan Ave.
Wabash 9153

Cleveland
1362 East 6th St.
Main 5991

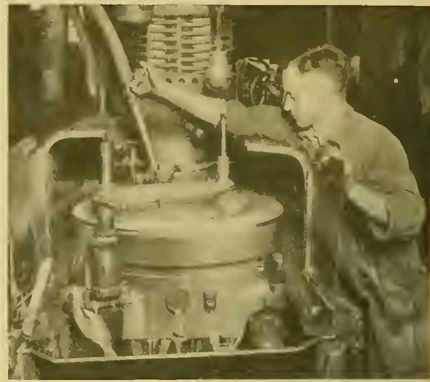
San Francisco
198 Second St., cor. Howard
Douglas 6245

Boston
36 Oliver St.
Main 8488

Grinding in the Industries

The second of the series of five grinding articles to be published under the general title "Grinding in the Industries" appears in the editorial pages of this number of MACHINERY. This series will show by actual examples the remarkable development of grinding practice in our big industries, including the automotive, small tool, railway, foundry and steel mill.

The advancement in the modern art of grinding has been so fast that intensive study must be given every new machine, improvement or method. The advertising which follows this page is the grinding machine, grinding wheel and grinding accessory manufacturers' contribution to further general knowledge of the most up-to-date methods in this rapidly developing field. In these specially prepared advertisements you will find data, pictures and examples of grinding work that will probably cause you to get out a pad and pencil and work up some figures of your own, and when an advertisement does this it has accomplished its mission.



The Right Abrasive, a Sufficient Wheel
Stock, Experienced Men Mean

Grinding Wheel Service

There are two main reasons for the success of Norton grinding wheels on every kind of grinding and under the many varieties of conditions:

1. Different kinds of abrasives, different bonding processes, and a great variety of grains and grades from which to select the wheel that will perform properly.

2. Knowing how to select the abrasive, the process and the grain and grade.

Briefly there is a Norton wheel made of the right abrasive for every condition of grinding; there are in the Norton Administration Building great quantities of data accumulated from experiences of demonstrators under many conditions, and there are Norton men who have a knowledge of grinding that enables them to select wheels of correct abrasive, bond and grain and grade.

You may be operating with a tremendous waste if you are using the wrong wheels on the job.

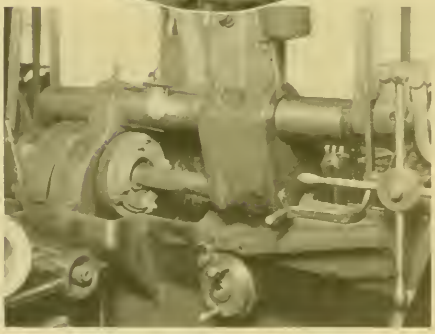
NORTON COMPANY

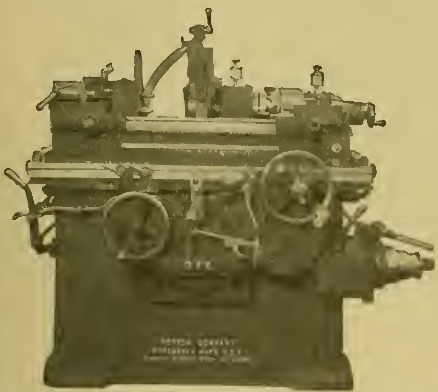
Worcester, Mass.

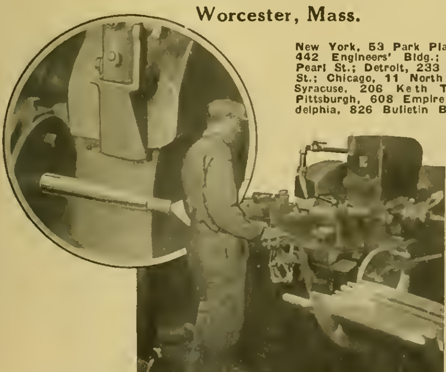
NEW YORK	CHICAGO	DETROIT
53 Park Place	11 North Jefferson St.	233 West Congress St.

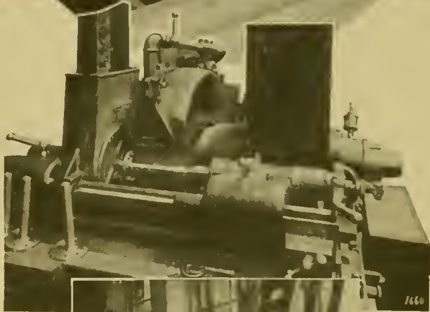
Norton Company of Canada, Limited,
Hamilton, Ontario.

R-156

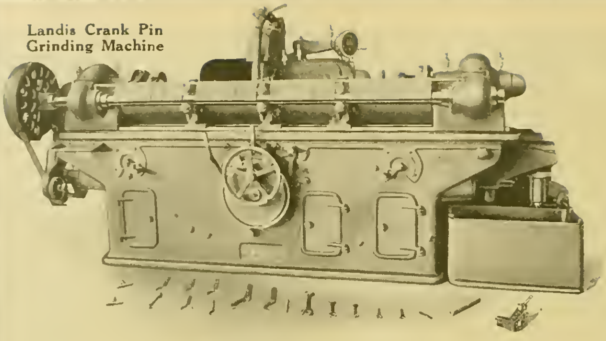


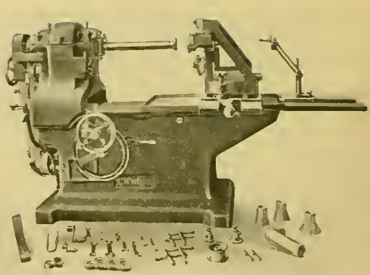




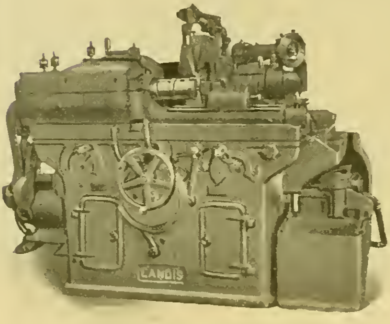


Landis Crank Pin Grinding Machine

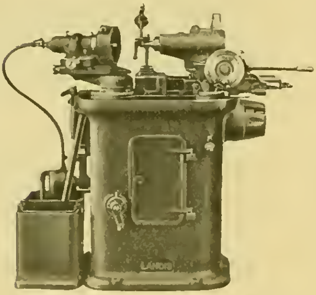




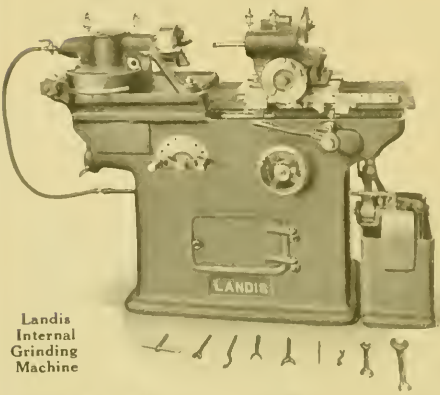
Landis No. 5 Cylinder Grinding Machine



Landis Piston Grinding Machine



Landis Ball Race Grinding Machine



Landis Internal Grinding Machine

Landis

Ten efficient grinding machines, each made for a different purpose and each fulfilling that purpose to the utmost satisfaction.

This group of representative machines is only a small part of the Landis line.

Grinders of every kind to handle every conceivable

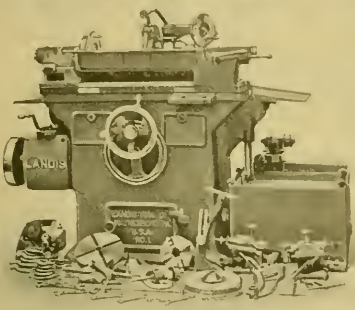
LANDIS TO

WAYNESBORO,

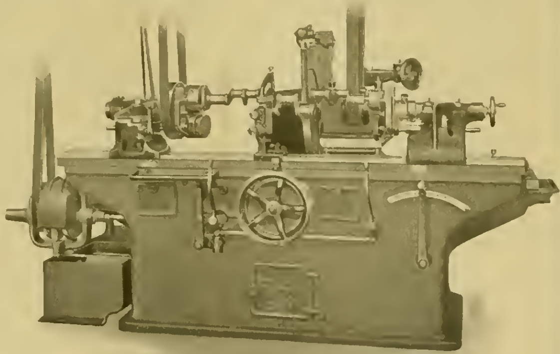
DOMESTIC AGENTS: Hallidie Machinery Co., Seattle; Harron, Rickard & McCone, San Francisco and Los Angeles; Seeger Machine Tool Co., Atlanta; Southern Machinery Sales Co., Houston.

CANADIAN AGENTS: F. F. Barber Machinery Company, Toronto; Williams & Wilson, Montreal; A. R. Williams Machinery Co., Nova Scotia, New Brunswick, Manitoba and British Columbia.

LANDIS



Landis No. 1 Universal Grinding Machine



Landis No. 4-A Special Grinding Machine

Leaders

class of grinding work; designed and built by experts to meet every demand of modern grinding methods.

Landis Grinding Machines are always efficient, always profitable.

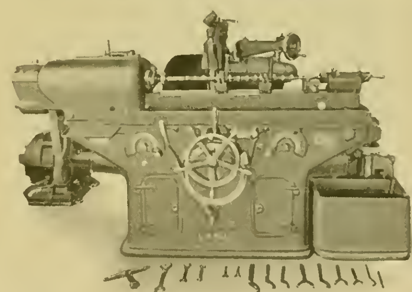
Send for a catalog. Get the details of all our machines.

OL COMPANY

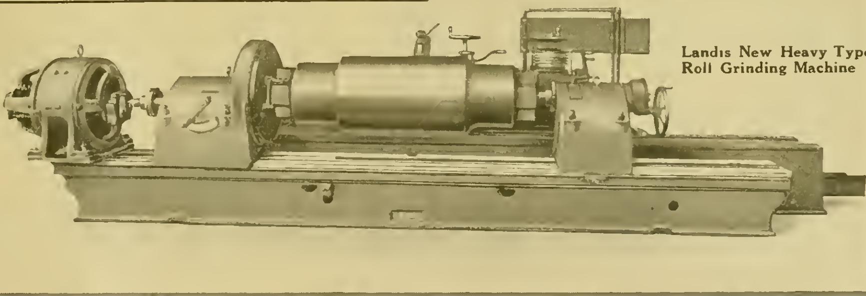
PENNA., U. S. A.

FOREIGN AGENTS: Allied Machinery Co., Paris, Turin, Barcelona, Brussels, Zurich and Lisbon: Andersen, Meyer & Co., Ltd., Shanghai; Andrews & George Co., Ltd., Tokyo; Benson Brothers, Sydney and Melbourne; Burton, Griffiths & Co., London; Wilh. Sonesson & Co., Ltd., Malmo and Copenhagen.

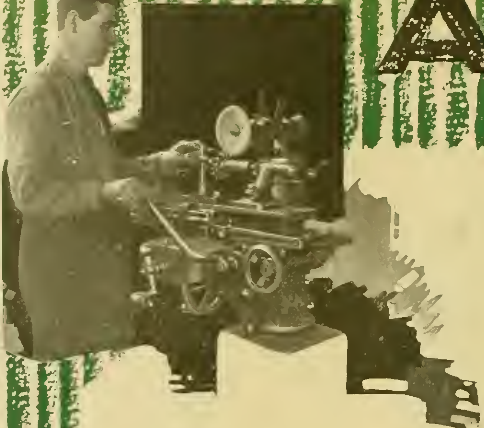
Landis Plain Grinding Machine



Landis Cam Grinding Machine



Landis New Heavy Type Roll Grinding Machine



ALOXITE "AA"

The Wheel for

The Aloxite "AA" wheel represents the greatest advancement in grinding wheels for tool-room work that has been made in years.

It is a wheel of unprecedented freedom of cut—a wheel that stays sharp, stands up to its work and cuts cool.

It is a wheel that responds admirably to the control of the operator taking light cuts or heavy cuts, within the range of practical tool-room work, without burning or distorting the piece. Another advantage in using Aloxite "AA" wheels is found in the fact that they can be made in very soft grades and still they will not wear away rapidly. Aloxite "AA" wheels will increase tool-room production because they will turn out better work—quicker.

It wasn't possible to make such an ideal tool-room wheel from the ordinary aluminous abrasive. Many months of exhaustive research and study told us this. The development of a new abrasive was necessary so Aloxite "AA"—the abrasive for tool-room wheels—was the result.

"A

The Carborundum Company, Niagara Falls, N. Y.

New York, Chicago, Boston, Philadelphia, Detroit, Cleveland, Pittsburgh

ALOXITE "AA"

the Tool-Room

This new abrasive is 98½ to 99 per cent pure alumina and its crystals are one hundred times larger than those of the average aluminous abrasive.

Because of the almost total exclusion of impurities from the abrasive grain, Aloxite "AA" wheels cut without drag or creating undue friction.

Because of the extraordinary size of the Aloxite "AA" crystals, each grain in the wheel is a definite fragment broken from the larger mass, thus assuring a grain with a sharper, cleaner fracture, again resulting in a cleaner, cooler cutting wheel.

Then, too, Aloxite "AA" wheels have an open, porous structure. Each grain gets a real chance to cut—to penetrate the work, removing the stock amazingly quick and leaving a uniform finish.

For the grinding of alloyed and high speed steel reamers, cutters, drills, hob mills, and similar tools, for work on hardened steel surfaces, for all of the internal work on bushings, bearings, gauges, etc., Aloxite "AA" is distinctively the wheel for tool-room work—a wheel of astonishing performances.

Try Aloxite "AA" in your tool-room. You have never had a wheel so genuinely efficient.

A"

The Carborundum Company, Niagara Falls, N. Y.

Cincinnati, Grand Rapids, Milwaukee,
Manchester, England.

"PRODUCTION"

POLISHING and FINISHING MACHINES

(Patented)

This machine will do all grades of cylindrical finishing from ordinary one pass work to the finest buffing on brass, etc., using special felt belts.

The centerless feed gives speed. Why not let us tell you what "Production" machines will do for you? Write for descriptive data.

PRODUCTION MACHINE CO.

GREENFIELD, MASS., U. S. A.

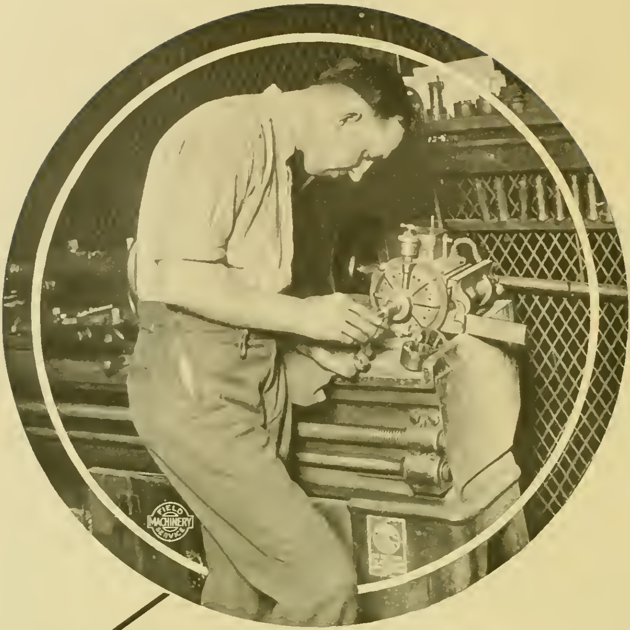
Motch & Merryweather Machinery Co., Cleveland, Pittsburgh, Cincinnati. Cadillac Machinery Co., Detroit, Mich. Marshall & Huschart Machinery Co., Chicago, Milwaukee. Allied Machinery Company of America, New York City, N. Y. (Export.)

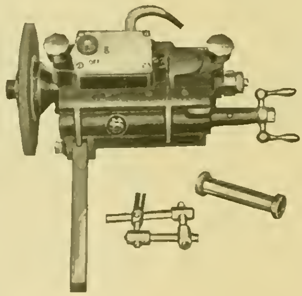
40 Seconds to Pass a 10 Foot Tube Through this Machine —No Centering, No Chucking —Just Feed Automatically

This is one of three "Production" Polishing and Finishing Machines in the Hartford, Conn., plant of the New Haven Sherardizing Company. The process of Sherardizing iron or steel consists in coating the metal with a zinc veneer to prevent rust and corrosion.

The New Haven folks do a lot of this work, particularly on tire formers for shaping and making inner tubes.

These moulds are made in various diameters from seamless steel tubing—those in the picture are 3¼″ diameter by 10 feet long. They are placed in a channel guide and automatically fed against the surface of the swift-moving "Production" belt. The action rotates the tube and polishes at the same time. Different grit belts perform different polishing operations on each tube. It requires 40 seconds for a tube to go through the "Production" polisher once, and you get a uniform mechanical finish always the same—no chatter—no flats.

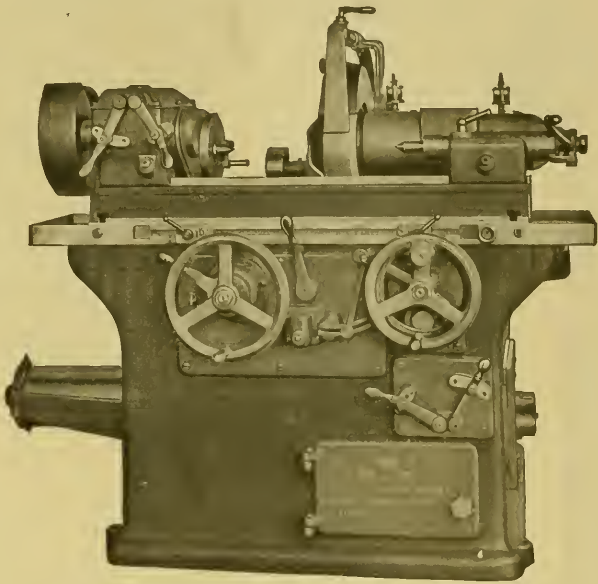




FITCHBURG GRINDING MACHINE CO.

FITCHBURG, MASS., U.S.A.

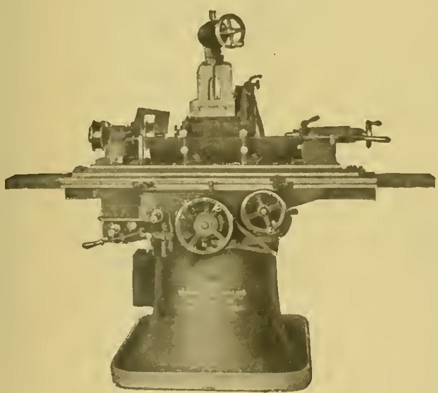
Fitchburg 8" x 20" Plain Cylindrical Power Feed Grinding Machine.



Also made

4" and 12" x 20"
8" and 12" x 36"
8" x 54"
12" x 54"

Power Feed or Hand Operated and self-contained for single pulley or electric motor drive.



Bath Universal Grinding Machines for Cylindrical, Surface, Internal, Disc, Tool and Cutter Grinding.

Built in Three Sizes:

No. 1, 10" x 20" using wheel 10" x ¾"
No. 2, 10" x 25" using wheel 12" x 1½"
No. 2½, 10" x 36" using wheel 12" x 1½"

UNIVERSAL GRINDING MACHINE CO.

FITCHBURG, MASS., U.S.A.

CINCINNATI

PORTABLE ELECTRIC TOOLS

GRINDERS

BENCH—FLOOR—TOOL POST—AERIAL

The greatly increased use of portable electric grinders shows that this type of grinding machine is the most economical on a host of jobs. The greatly increased sale of "Cincinnati" Portable Electric Grinders shows that this make is the recognized leader in the field.

Catalog sent on request.

THE CINCINNATI ELECTRICAL TOOL CO.,

1507 Freeman Avenue — Cincinnati, Ohio

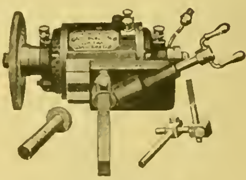
New York, 50 Church Street — Detroit, Murphy Bldg. — Philadelphia, 1220 Real Estate Trust Bldg.

Los Angeles, 510 Equitable Bldg. — Chicago, 518 Peoples Gas Bldg.

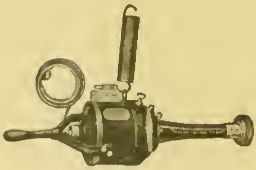
San Francisco, 918 Hearst Bldg.

Bench Grinder
In ½, 1, 2 and 3 H.P.

Used throughout the world since 1902

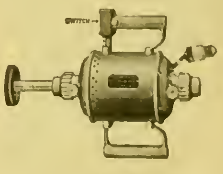


Tool Post Grinder
In ¼ and ½ H.P.



Aerial Grinder
½ and 1 H.P.

Floor Grinder
½, 1, 2 and 3 H.P.



Hand Aerial Grinder
In ¼, ½ and 1 H.P.

Once More BESLY Grinding Beats Milling

Photo and data concern the production problems at Platt Iron Works, Dayton, Ohio, where the application of Besly Grinding is being extended as fast as is practicable.

520

Six to One

is the latest official record of its output as compared to milling on the valve decks for steam pumps here shown in process of grinding. This is a surfacing job and not more than eight to ten per hour were produced on the miller, whereas the "Besly" tripled production at the first go and soon showed that 60 per hour was a reasonable output to expect.

This machine has been four years at the Platt Works where additional "milling" jobs are being transferred to the grinding department as fast as the simple fixtures necessary can be designed and built. Many require no fixtures at all, for the Besly Geared Lever Feed Table (Patented) with which the machine is equipped has many features which facilitate setting up without further equipment—among them a highly sensitive hand feed adjustable by micrometer stop screws graduated to .001″. Top of table may be tilted 30° from horizontal and has vertical adjustment as well. It is provided with T-slots and may be further equipped with angle plates and a Universal Bevel Protractor.

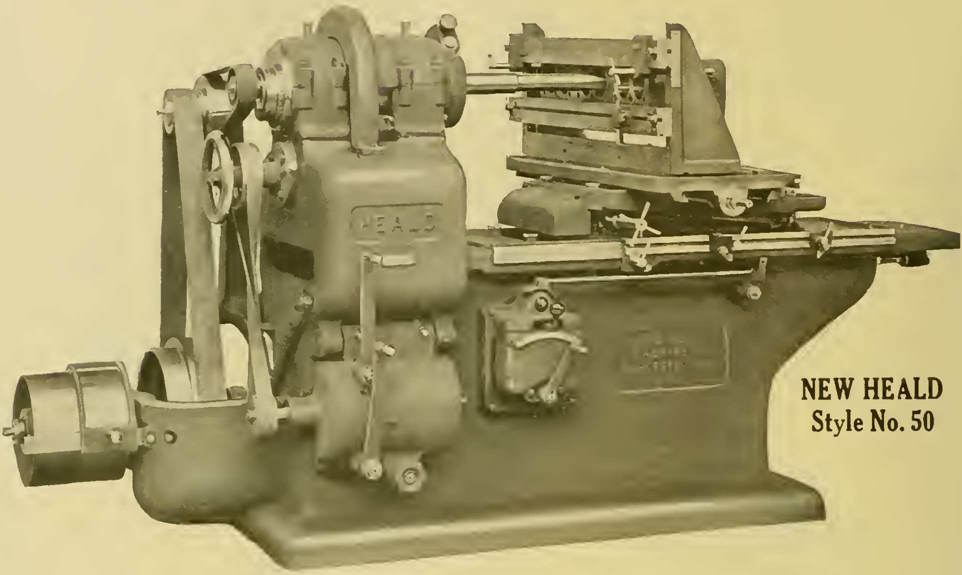
Besly Grinders require no skill to operate — another saving to their credit—and maintenance cost is negligible. Details in Catalog—Advice on receipt of specifications or samples of "that expensive job."

BESLY
CHICAGO

CHARLES H. BESLY & COMPANY

120-B N. CLINTON STREET CHICAGO, ILL., U. S. A.

Buyers of Motor Cars Now



NEW HEALD
Style No. 50

Simple – Massive—Large Capacity—Practically Gearless —Unlimited range of speeds for the table which can be reversed or stopped at any point without shock or noise.

The general buying public and motor mechanics are fast becoming thoroughly educated and convinced of the merits of a ground cylinder in comparison with one that has been bored and reamed. Sales agents everywhere have found that the preference is for cars with ground cylinders.

While it is a well-known and accepted fact that all high grade auto manufacturers finish their cylinders by grinding, few realize how many of the less expensive car builders are also using this operation to give greater efficiency to their motors.

Such manufacturers as Dort, Essex, Gardner, Grant, Hupmobile, Jewett, Rickenbacker, etc., have long realized its advantages and now find it to be a big factor in their sales arguments. Taking all the car manufacturers, both pleasure and commercial, about 90% finish their cylinders by grinding.

THE HEALD MACHINE COMPANY, 16 New

BRANCHES: New York, 839 Singer Bldg.; Philadelphia, 1302 Stephen Girard Bldg.; Chicago, 26 South Jefferson St.; Detroit, 400 Marquette Bldg.; Cincinnati, 705 Provident Bank Bldg.; Cleveland, 721 Engineers Bldg.; St. Louis, 710 Pontiac Bldg.; Milwaukee, 947 41st St.
AGENTS: Eccles & Smith Co., 69 First St., San Francisco, Calif. Eccles & Smith Co., 241 S. Los Angeles St., Los Angeles, Calif.. Eccles & Smith Co., 46 Front St., Portland, Oregon. Eccles & Smith Co., 309 Maynard Bldg., Seattle, Wash. Salt Lake Hardware Co., Salt Lake City, Utah. The Russell Hardware Co., McAlester, Okla. F. E. Satterlee Co., 118-120 Washington Ave., N., Minneapolis, Minn. G. Norman Baughman Co., Florida Ave. and Jackson St., Tampa, Florida. Young & Vann Supply Co., 1725-31 First Ave., Birmingham, Ala. Oliver H. Van Horn Co., 518 Camp St., New Orleans, La. The Walraven Co., 36-38 West Alabama St., Atlanta, Ga. Greensboro Supply Co., Greensboro, N. C. Smith-Courtney Co., Richmond, Va. Krueger Machinery Co., San Antonio, Texas. Crow Burlingame Co., Little Rock, Ark. The Faeth Co., 1117 West Eighth St., Kansas City, Mo. Western Automobile Supply Co., Omaha, Neb. George F. Foss Machinery Co., 305 St. James St., Montreal, Canada. H. W. Petrie, Ltd., 131-147 Front St., West, Toronto, Ont. Hamilton Machinery Co., 201-208 Market St., Chattanooga, Tenn. South Western Sales Co., Phoenix, Arizona.

Insisting on Ground Cylinders

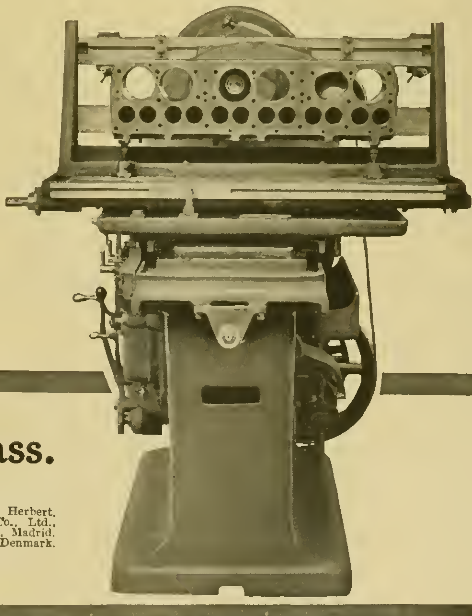
It is interesting to note that Chandler have just equipped with Heald machines and will hereafter furnish motors with ground cylinders.

Undoubtedly a good share of the reason why the public is insisting on ground cylinders is due to the fact that there are 1400 Heald machines in this country doing nothing but regrinding and fitting new pistons and rings. This has without question been a tremendously big item in educating motor owners to the advantages of ground bores in regard to economy and efficiency of operation, and is especially true with those whose cylinders were originally bored but have been reground for they can more easily appreciate the difference.

Level-headed engineers and mechanics in such plants as Rolls-Royce, Packard, Pierce Arrow, Cadillac, Locomobile, Peerless, Stutz, Winton, Cunningham, etc., realize that only by grinding can a true, round hole be obtained and one which will be absolutely at right angles to the flange, giving a perfect bearing to the piston.

They have also unanimously agreed upon the Heald Machine as the best to do this work. Heald machines have been for seventeen years used expressly for grinding cylinders and the latest model, Style No. 50, is especially desirable for manufacturing purposes. It is unusually heavy and rigid, self-contained, with an hydraulic drive for the table enabling the operator to get any speed, from nothing up to the maximum, or can be reversed and stopped at any point without shock or noise.

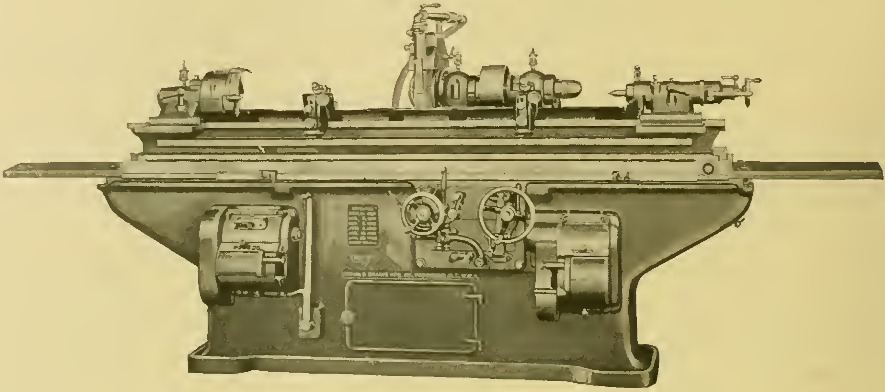
The illustration below shows the Heald No. 50 grinding the bores of a Hudson Super-six. Note the massiveness of the bed and width of the table.



We would like to furnish you with a bulletin fully explaining the new Heald Machine. How many shall we send to take care of all your interested executives?

Bond Street, Worcester, Mass.

FOREIGN AGENTS: Alfred Herbert, Ltd., England. Societe Anonyme Alfred Herbert, France, Switzerland. Societa Anonima Italiana, Alfred Herbert, Italy. Horne Co., Ltd., Japan. Henri Benedictus, Brussels, Belgium. American Mchy. Syndicate S. A. E., Madrid. Sindicato de Maquinaria Americana, Bilbao, Spain and Portugal. Oscar Ericsson, Denmark. Messrs. Carrick-Wedderspoon, New Zealand.



BROWN & SHARPE PLAIN GRINDING MACHINES

A new angle on the Economy of Grinding

Quantities of jobs demanding either high accuracy or smooth finish and now being completed on automatics or turret lathes can be finished with greater economy by grinding.

By giving pieces an allowance for grinding, production is increased on the automatics, turret and engine lathes which are no longer held to the feeds and speeds necessary for high accuracy and smooth finish.

The grinding machine keeps pace with this increased production and turns out smoother, more accurate work than can be secured by other methods.

Thus Quantity is increased and Quality improved by finishing work on a grinding machine.

For a truer surface, more uniform size, and a smoother finish at less cost use Brown & Sharpe Grinding Machines.

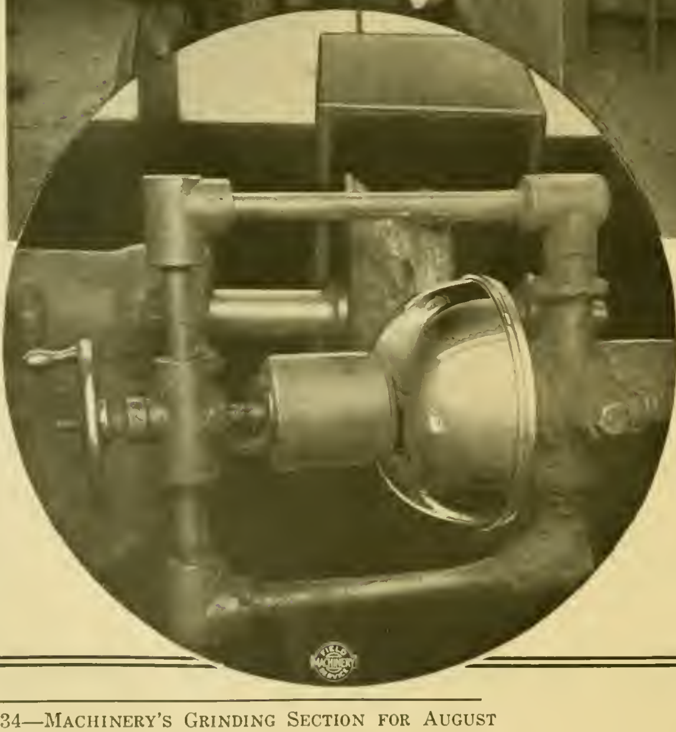
Send for Catalog No. 137 describing our complete line of grinding machines.

AUTOMATIC BUFFING MACHINES

Eighteen—Busy All the Time

Competition is keen in the aluminum ware business and every saving in production costs means lower prices and better sales. In this case the Automatic Buffing installation has not only reduced manufacturing expenses and about doubled production, but has improved the quality of work.

The work shown is a colander—output 800 in 9½ hours—one operator, two machines.



Let us give you further details—tell you something about the wide range of work possible with our new machine.

THE AUTOMATIC
BUFFING MACHINE
COMPANY
BUFFALO N. Y., U. S. A.

EC OMY **ECONOMY** EC OMY

TRADE MARK REG. U.S. PAT. OFF.

GRINDING LUBRICANT

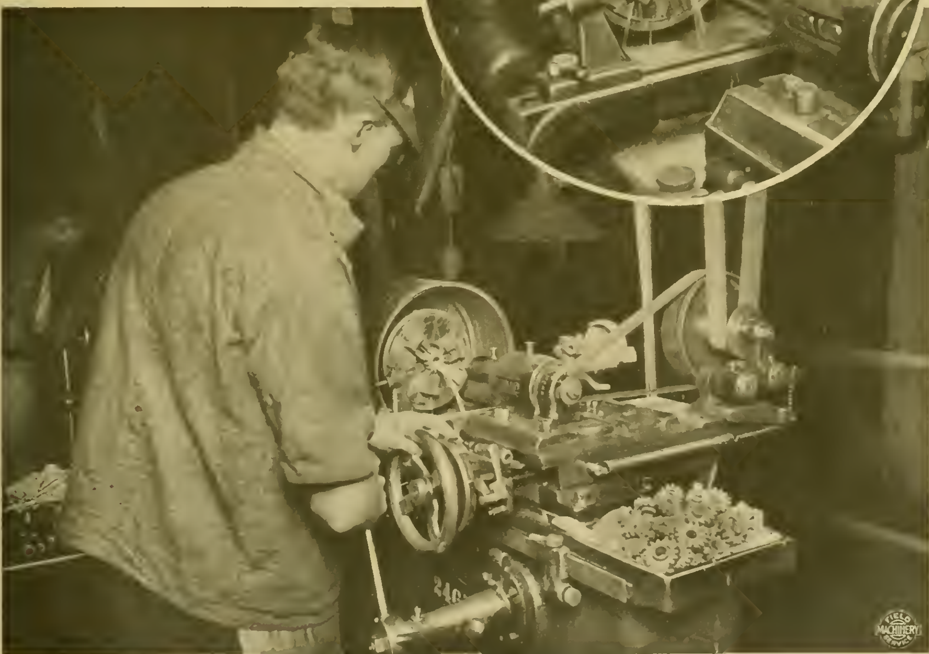
"Economy" Clinches All Arguments

This "close-up" in a famous motorcycle manufacturing plant shows the internal grinding of clutch pinions. A 3/4″ hole is being ground to size. The grinding wheel is 5/8″ diameter and to attain a suitable surface speed it naturally makes more revolutions than would a larger wheel. It is also true that any given point on the wheel makes contact with the work more often than any point on a larger wheel. There is more wear with the small wheel and therefore greater tendency to clog; *but it does not clog* for the Grinding Lubricant is "Economy."

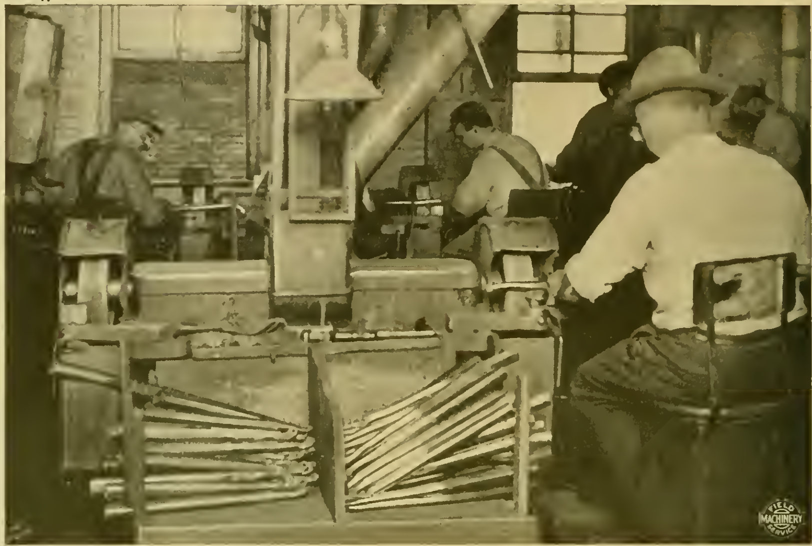
"Economy" is the efficient lubricator. It prevents clogging. It keeps the wheel and work cool. It earns its name by its thrift. This is not an isolated case—"Economy" will do as much for you as it does for others.

Write for Particulars

THE WHITE & BAGLEY COMPANY
Worcester Mass., U. S. A.



Divine Polishing Service



Finishing Top-Bow Sockets

The Brewer-Titchner Corporation, Binghamton, N. Y., manufactures automobile hardware. Among its products is the bow socket for one-man type automobile tops. Compare the quality of this socket with the article used a few years ago on five and six-bow tops. Brewer-Titchner has achieved a triumph in this socket. It is made in two pieces. One piece is No. 20 gage sheet steel formed to the desired cornucopia shape, and the other a steel forging. The two are welded together.

In a welding operation of this character there is considerable surplus metal and scale on the surface. This must be removed and that is just where *Divine Brothers' Polishing Service* comes in. For 5 years ten spindles in this shop have been equipped with Divine Wheels—14″, compress canvas, charged with grain 36 alundum. Production is fast and the work high-grade.

Let us tell you more about Divine Polishing Service.

DIVINE POLISHING SERVICE

Divine Polishing Service consists of:—

1—*Studies of polishing problems of all kinds.*

2—*Recommendations* based on thirty years' engineering experience.

Everything For The Polishing Room

Engineering Department

DIVINE BROTHERS COMPANY, Utica, N. Y.

Metal Finishing Engineers

—And All the Way Between

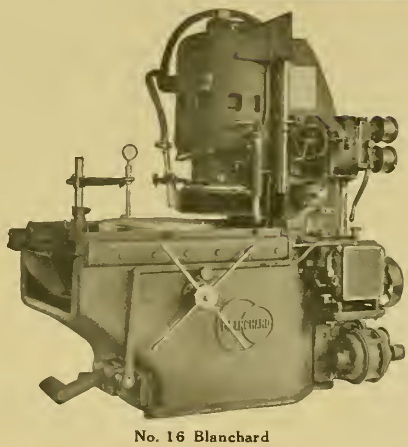
The Blanchard Grinder, almost since its inception, has been used for grinding ball races. This industry was one of the first to realize the production possibilities of the Blanchard Grinder; and now, there is scarcely a concern which manufactures ball or roller bearings and does not use this machine.

Roller Race 21½" O. D.

These small ball races are ground 875 at a time upon the 26″ one-piece steel magnetic chuck.

One man operating the machine produces 700 pieces per hour; but, with improved facilities for washing and handling, one man and helper turn out 3600 pieces (7200 surfaces) per hour.

Ball Race ⅝" O. D.



No. 16 Blanchard
High Power Vertical Surface Grinder
Direct Motor Drive Type

This story is not complete unless the new No. 16 Blanchard Automatic Surface Grinder is mentioned. This new machine, illustrations of which are not yet available, is designed for large quantity production of pieces 6″ diameter or smaller.

On rings of medium size, the Automatic with one operator produces approximately twice as many pieces per hour as the standard No. 16 Blanchard Grinder with operator and helper.

A Better Product for less Money

The Blanchard Machine Company

64 State Street

CAMBRIDGE, MASS.

REPRESENTATIVES: UNITED STATES: Henry Prentiss & Co., Inc., Motch & Merryweather Mchy. Co., Marshall & Huschart Mchy. Co., W. E. Shipley Machinery Co., Kemp Machinery Co., Robinson, Cary & Sands Co., Berger & Carter Company, The Hendrie & Bolthoff Manufacturing & Supply Co. CANADA: Williams & Wilson, Ltd., F. F. Barber Machinery Co., GREAT BRITAIN: C. W. Burton, Griffiths & Co. FRANCE: Aux Forges de Vulcain. ITALY, SWITZERLAND, BELGIUM, SPAIN and PORTUGAL: Allied Machinery Co. of America. SWEDEN: A. B. Rylander & Asplund.

FAFNIR

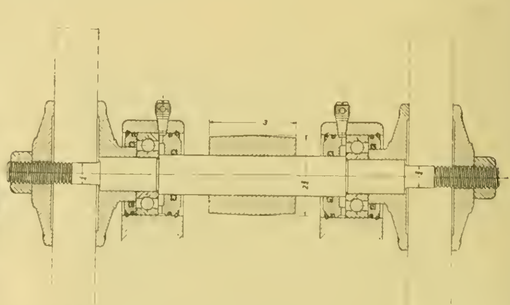
Fafnir Ball Bearing Tool Grinders are made to run all the time—right from the main line.

You know how it is with tool grinders;—everybody uses them, nobody takes care of them, but everybody kicks if they aren't in good condition. They are usually left running, almost never oiled, the bearings wear and they become an infernal nuisance.

You can relieve yourself of all this trouble and worry by buying *Fafnir Ball Bearing Tool Grinders.* The spindle is mounted on alloy steel *Fafnir Ball Bearings.* They are designed to be run constantly from any line of shafting without counters or loose pulleys; they require only a few drops of oil once in several weeks, and will last indefinitely.

Our new catalog of *Fafnir Industrial Ball Bearings* is now ready for distribution.

The Red Dragon Line



THE FAFNIR BEARING COMPANY

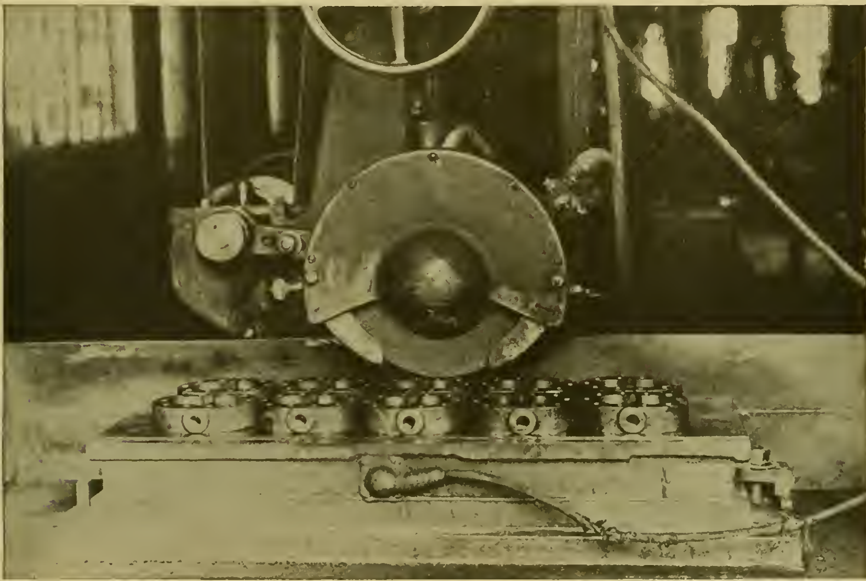
Conrad Patent Licensee

DETROIT Office: 752 David Whitney Bldg.
CLEVELAND Office: 1016-1017 Swetland Bldg.

New Britain, Conn.

CHICAGO Office: 537 So. Dearborn St.
NEW YORK Office: 5 Columbus Circle.

Grinding Metal-to-Metal Joints on a
DIAMOND SURFACE GRINDER



Above is a typical "Diamond" Surface Grinding job, handled with true "Diamond" efficiency throughout—bodies for high pressure oil pumps, rough and finish ground on both sides, 10 at a time, at the rate of 10 completed bodies in 90 minutes.

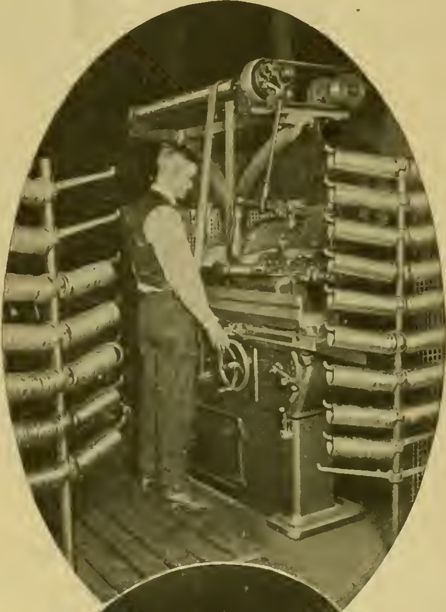
No gaskets are used in joining the bodies to the backs and the joint must withstand a pressure of 1000 lbs., so limits are necessarily very close—.015″ of metal being removed by the roughing cut and .0015″ in finishing. Material is gray cast iron and the pieces are 5½″ by 4″ overall.

The "Diamond" Line is complete: Surface Grinders in many styles and sizes, Face Grinding Machines—a complete range; Water Tool Grinders, Disc Grinders, Floor Grinders, Swing Frame Grinders and Polishing Machines—a machine for every grinding need. Catalog on request.

DIAMOND MACHINE COMPANY
PROVIDENCE, RHODE ISLAND

MODERN

Grinding Piston Rings is a Two Man Job Here; But They Find it Profitable, at That



At the Burd High Compression Ring Company's plant, Rockford, Ill., this Modern Grinder is used regularly 10 hours every day on the same job—rough and finish grinding 3″ by 3/16″ piston rings, *44 at a time.*

Speed is 126 ft. per minute; so fast, in fact, that it keeps one man busy loading and unloading duplicate arbors while another gives his entire attention to the machine.

The first operation removes 0.005″ of stock, and is performed at the rate of 3600 rings per day. Finish grinding reduces the diameter from 3.015″ to 2.995″ —allowing 0.001″ for heat expansion— and output is 3200 in the ten hours.

Modern Grinders have made similarly interesting records in many fields. Powerful, rigid, and smooth-running, they assure unfailing accuracy and a profitable output on any grinding operation within their broad and practical range.

Let us tell you about them.

MODERN TOOL COMPANY

ERIE PENNA., U. S. A.

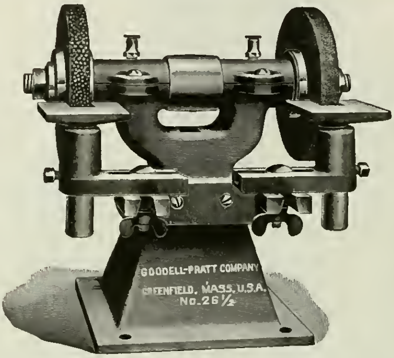
Main Office and Works: SECOND AND STATE STS.

Sales Agents in the United States: Walter H. Foster Co., 50 Church St., New York City, N. Y.; Sherritt & Stoer Company, 2006 Market St., Philadelphia, Pa.; Brown & Zortman Machinery Co., Pittsburgh, Pa.; Charles A. Strelinger Co., 149 Larned St., East, Detroit Mich.; E. L. Essley Machinery Co., 551-557 Washington Boulevard, Chicago—Branches, Milwaukee, Wis., Moline, Ill.; Manning, Maxwell & Moore, Inc., Railway Exchange Bldg., St. Louis, Mo.; Herberts Machinery & Supply Co., 401 East 3rd St., Los Angeles, Cal., and 140 First St., San Francisco, Cal.

Foreign Representatives: Leo C. Steinle, Inc., 1 Earl St., Westminster, London, S. W. 1, England; Glaenzer & Perreaud, 18 and 20 Faubourg du Temple, Paris, France; Rylander & Asplund, Stockholm, Sweden; C. Civita, Milan, Italy; The Yamatake Company, Tokyo, Japan; Rudel-Belnap Machinery Co., Ltd., 9 Wellington St., East Toronto, and 139 McGill St., Montreal, Canada.

GOODELL-PRATT

1500 GOOD TOOLS



Polishing and Grinding Heads

Every shop, small or large, has use for little Polishing and Grinding Heads in many places. Our line of these useful little devices has so many different styles that every user can find one adapted to his needs.

The Frames are made of iron with hollow Bases so that they will be as light as possible. The Spindle Holes are reamed and counterbored. Both Spindles and Collars are lathe turned so that they will run accurately.

All sizes of these machines are provided with adjustable Boxes. The Pulleys will all take flat Belts, but the smaller sizes are grooved in order that round Belts may be used if desired.

A number of these Polishing Heads are provided with three jawed Chucks which greatly increase their field of usefulness.

All iron parts are finished in red and black enamel; steel parts are polished.

Full specifications of these Heads in our No. 14 Tool Book; complete copy of which we will be glad to send you upon request.

Goodell-Pratt Company

GREENFIELD *Toolsmiths* MASS., U. S. A.

An Economical General Purpose Grinder

A machine that's universally adjustable and equipped with a wide variety of attachments; that can swing a piece 9″ by 16″ if need be and provides 3 work speeds and 2 wheel speeds, instantly available.

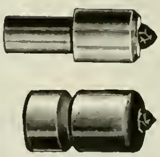
Universal vise has three swivels; elevating and cross travel screws have micrometer dials and head swivels through 180°. Table surface is 4¼″ x 25″. Let us tell you the rest.

WOODS
Universal Tool and Cutter Grinder

Made in Three Sizes

Woods Engineering Company
ALLIANCE OHIO, U. S. A.

FRANCIS DIAMOND GRINDER TOOLS



High Quality Stones Correctly Set

Diamonds are indispensable for truing fine grinding wheels; make sure you get the pick of the market by sending for an assortment of Francis Diamond Grinder Tools for selection.

Circular and Price List on Request

FRANCIS & CO., 50 State St., Hartford, Conn.
Established in 1799 First National Bank Bldg.

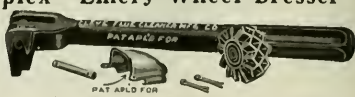
GRINDER

Knee Type **Ring Wheel**
For Flat Surfaces

THE GRAHAM MFG. CO., Providence, R. I.

The "Duplex" Emery Wheel Dresser

ONCE USED ALWAYS USED



CLEVELAND FLUE CLEANER MFG. CO.
524 Frankfort Ave., N. W. CLEVELAND, OHIO

A New Idea!

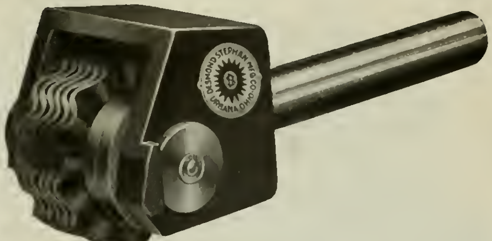
The Desmond Roller Bearing Dresser is the nearest perfect substitute for Diamonds ever devised. Our seventeen years experience in manufacturing Grinding Wheel Dressers and selling Diamonds should qualify us to speak with authority on this subject.

We will gladly send one on approval and you can judge for yourself.

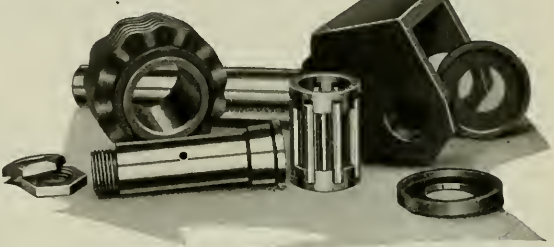
The cutters are fastened on a bushing revolving on a roller bearing which in turn revolves on a pin ¾″ diameter. Construction that not only practically eliminates wear on the bearings but greatly increases the life of the cutters. The bearings are dust-proof and easily oiled.

It is a member of our complete Dresser line consisting of

Diamonds **Desmond-Hex**
Diamo-Carbo **Desmond-Huntington. 3 sizes**
Magazine **Sherman**



DESMOND-STEPHAN ROLLER BEARING GRINDING WHEEL DRESSERS



Price $12.50

Send for Circulars and More Details

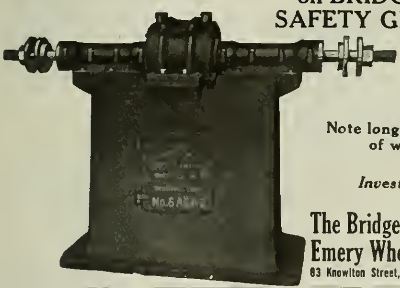
The Desmond-Stephan Mfg. Company

URBANA, OHIO, U. S. A.

The Canadian Desmond-Stephan Mfg. Co., Ltd., Hamilton, Ont., Canada. Alfred Herbert, Limited, Coventry, England.

Tire Rims

Are Successfully Ground on BRIDGEPORT SAFETY GRINDER No. 6 A. C. A.



Note long overhang of wheel

Investigate

The Bridgeport Safety Emery Wheel Co., Inc.
83 Knowlton Street, BRIDGEPORT, CONN.

THOMPSON

UNIVERSAL GRINDING MACHINES

SEND FOR BULLETIN No. U-13

THE THOMPSON GRINDER CO.
SPRINGFIELD - - - - OHIO

HAND SNAGGING GRINDER

(Electric)

Light Weight, - - 20 pounds
Large Wheel, - - - - 7″ x 2″
High Power, - - ¾ H. P. Max.

FORBES & MYERS, 178 Union St., Worcester, Mass.

Athol Bench Grinders

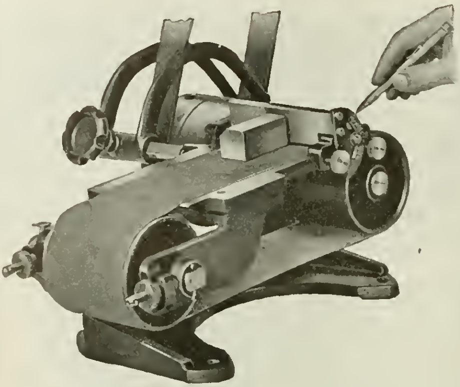
Practical machines for keeping reamers, counterbores, etc., in condition and for rough grinding small machine parts, castings and forgings.

No. 21 has adjustable rests—readily removed—and patent oil cups for bearings; takes 6″ wheels, occupies 9⅝″ by 5″ of floor space and weighs 13 lbs.

New ATHOL Catalog No. 35 Describes the Whole Line.

Athol Machine & Foundry Co.

Athol, Mass., U. S. A.



Coats Emery Band Grinder

For producing a straight-line finish on all kinds of small metal parts and castings made of iron, steel, brass, gun-metal, also for grinding and polishing bone, fibre and horn goods, vulcanized rubber, celluloid, wood and similar materials.

COATS MACHINE TOOL COMPANY, Inc.
112 West 40th Street
New York

Grinding Wheels

DETROIT-STAR GRINDING WHEEL CO.

Are You Using the Right Abrasive?

Grain, grade, shape and size are not the only things to be considered in selecting grinding wheels. The type and quality of abrasive have equal if not greater effect on the cost and quality of output.

Steel and steel alloys require a sharp, friable abrasive; and our 50 years' experience has revealed nothing in this line as satisfactory as

"STARALOX"

Catalog Number 9 Explains

Detroit-Star Grinding Wheel Company
Established 1872
Detroit Michigan

Marschke Grinders and Buffers

"Economy" Buffers
Two Sizes—3 and 5 H. P.

The spindles of these machines are equipped with four sets of S K F Ball Bearings — motor bearings being entirely independent of outboard bearings. Arbors are 48 inches to take 1 or 1¼ inch wheels; wheels are 40 inches apart and the bases occupy 20 by 23 inches of floor space.

Foot Lever Starter Saves Time and Power

The No. 12 Grinder
Two Styles—A. C. and D. C.

The hoods on this machine are equipped to adjust themselves automatically when the steady-rest is adjusted to the wear of the wheel. Exhaust fan is equipped with S K F Ball Bearings, is belted direct to the motor and starts automatically with it. Foot pedal starter takes 4 seconds to start motor—stops instantly.

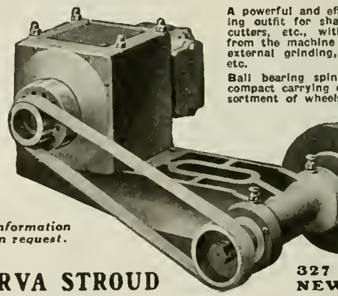
More Details on Request

Marschke Manufacturing Co.
Indianapolis, Indiana
U. S. A.

R.V TOOL POST STYLE GRINDERS

A powerful and efficient portable grinding outfit for sharpening dies, milling cutters, etc., without removing them from the machine and for internal and external grinding, retouching, trueing, etc.

Ball bearing spindles, 1 H.P. Motor, compact carrying case and complete assortment of wheels. Use it anywhere.



Weight 22 lbs.
Speed 4,000 to 12,000 R. P. M.

Information on request.

ARVA STROUD 327 BROADWAY NEW YORK CITY

Emery Wheel Dressers

Two Sizes Nos. 1-2

CUTTERS

We make the regular Huntington (Pattern) for all sizes.
Roughing for Nos. 1 and 2. Paragon for No. 1 only.

GEO. H. CALDER CO., Lancaster, Pa., U. S. A.

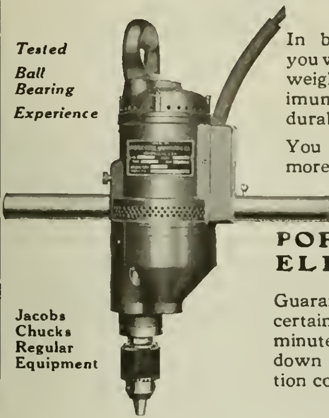
BADGER TOOL COMPANY

Grinding Machinery
Supplies and Accessories

E. B. GARDNER, President R. D. GARDNER, Treasurer
BELOIT, WISCONSIN, U. S. A.

Light in Weight But Heavy in Power

Tested Ball Bearing Experience



In buying a drill you want minimum weight with maximum power and durability.

You get all that and more in the

PIONEER PORTABLE ELECTRIC

Guaranteed to drill certain depth per minute, thus cutting down your production cost.

Jacobs Chucks Regular Equipment

BUY THE PIONEER

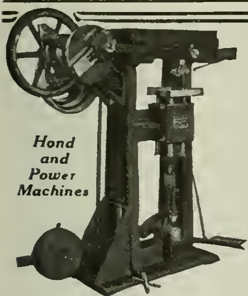
"It Will Do the Work"

Louisville Electric Mfg. Co.

INCORPORATED

C. E. WILLEY, President J. B. McFERRAN, Sec'y-Treas.

LOUISVILLE, KENTUCKY, U. S. A.



Hond and Power Machines

Noble & Westbrook Marking Machines

Mark in an artistic manner articles of nearly any shape or size that will take an impression from a steel stamp. Taps and Twist Drills can be marked at the rate of 700 to 1000 per hour. These machines are flexible enough to mark parts that vary in thickness up to 1/16 of an inch. This feature combined with the rolling method of marking relieves the steel stamps of that strain which is not provided for in other methods of marking. We also make **Stamps for Every Marking Purpose**

The Noble & Westbrook Mfg. Co., Hartford, Conn.

"Improved Marking Devices"

Broaching Machines and Broaches

Our **years** of **experience** in the successful manufacture of broaching equipment assures you of the most **up-to-date** and **progressive** methods.

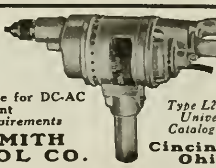
May we not quote? Write for catalog

J. N. LAPOINTE CO. of New London, Conn.

PORTABLE ELECTRIC DRILLS and GRINDERS

Complete line of sizes suitable for DC-AC and Universal Current

Tested to U. S. Navy requirements



Type L2U-¼" Universal Catalog No. 9

THE NEIL & SMITH ELECTRIC TOOL CO. Cincinnati Ohio

CLARK AUTOMATIC DRILL

On a great many ships of the U. S. Navy, as well as in ship yards, CLARK DRILLS are regular equipment, because they give heavy-duty service with absolute precision.

The New CLARK AUTOMATIC DRILL will give you the same endurance and accuracy in hard continuous use, with the addition of light weight.

Wherever there is an electric socket—direct or alternating current—CLARK AUTOMATIC DRILL is ready for instant use, even in the closest places.

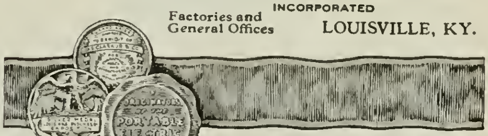
Write for catalog of CLARK EQUIPMENT—a complete line of motors, dynamos and drills, buffers, grinders—both portable and bench type—with built-in motors.

CLARK "BLUE RIBBON" ELECTRICAL EQUIPMENT is designed by the originator of portable electric drills to reduce production costs.

Jas. Clark, Jr. Electric Co.

INCORPORATED

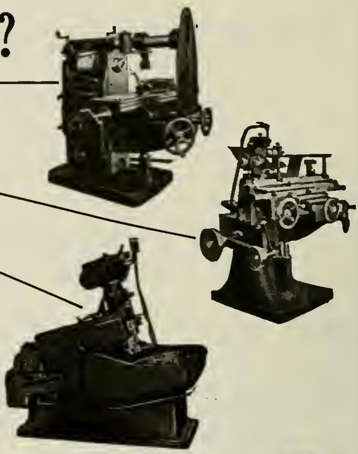
Factories and General Offices LOUISVILLE, KY.



"First in the Field"

MILLERS **OHIO** GRINDERS

Which Do You Need?



"Tools in Which Every Ounce Works"

The "Ohio" group forms a complete Milling department in itself. Ohio Plain and Universal Milling Machines, endorsed by years of satisfactory performances in many well known toolrooms and shops; Ohio Tool and Cutter Grinders stimulate output generally by keeping all the tools in the shop in condition and handle odd jobs of cylindrical precision grinding on the side; and the Ohio Tilted Rotary which has effected such sweeping reductions in the cost of production milling that it is rated indispensable in railway shops, automobile factories, machine shops and other places using large quantities of duplicate parts.

Without doubt you'll find the solution of your milling problem in one of these machines.

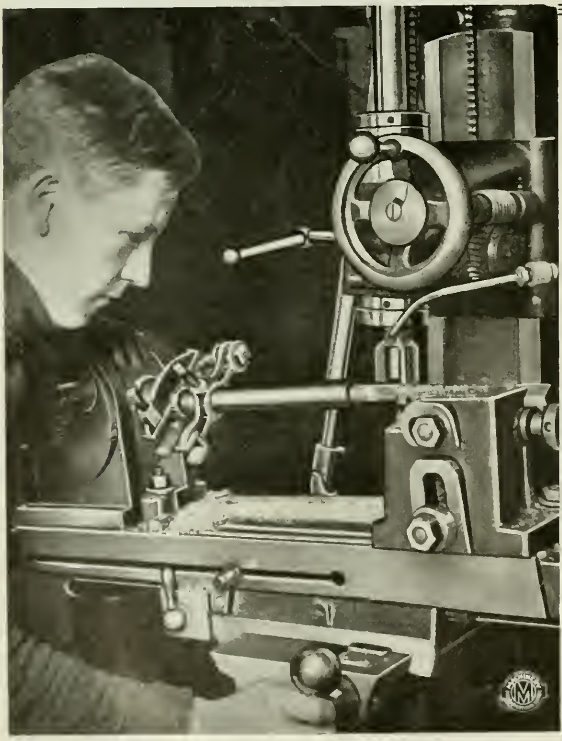
O. S. Terlein Says—

Bulletin "B" outlines the activities of the Tilted Rotary and explains how our service department helps manufacturers who avail themselves of its almost unlimited field of usefulness.

Write for your copy today

The Oesterlein Machine Company

CINCINNATI, OHIO, U. S. A.



Tool Work on Production Basis

Nearly everybody familiar with machine tools knows about the Knight Miller's adaptability for precision work. But here is something unusual. The picture shows the Knight doing tool work on a *manufacturing basis*. The photograph is shown through courtesy of the McCrosky Tool Corporation at Meadville, Pa.

The work in progress is milling a "square" on a chrome nickel steel arbor for an "Ideal" reamer. The "square" measures 23/64″ one way and .447″ the other at the small end. It tapers, gradually reducing from the full ¾″ diameter of the piece. The table is swung 8 degrees from the horizontal in order to produce the proper taper.

Let us tell you more about Knight Milling and Drilling Machines and what they can do

W. B. KNIGHT MACHINERY CO.

3920 West Pine St. ST. LOUIS, MO.

AGENTS: Coats Machine Tool Co., Ltd., London, England. Eccles & Smith Co., San Francisco, Pacific Coast. Lynd-Farquhar Company, Boston, Mass. Manning, Maxwell & Moore, Inc., New York, Chicago, Philadelphia, Buffalo, Milwaukee and New Haven. Somers, Fitler & Todd Co., Pittsburgh, Pa. Strong, Carlisle & Hammond Co., Cleveland and Detroit. Vonnegut Machinery Co., Indianapolis, Ind. Allied Machinery Company of America, France, Spain, Portugal, Italy, Switzerland, Norway, Sweden, Denmark, and Belgium. Yamatake Company, Japan.

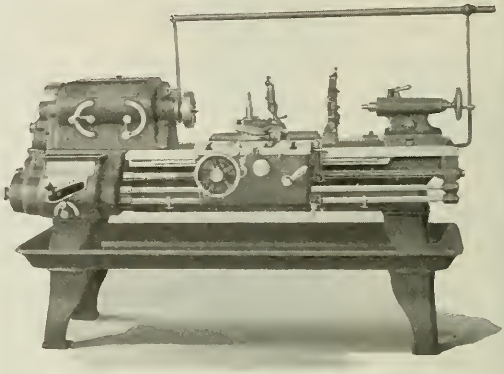
"SUNDSTRAND" 14-Inch Tool Room Lathes

Meet Every Modern Tool Room Need

Designed to secure more and better work with less effort and at lower cost; to assure accuracy; to handle a wide variety of work.

These machines combine all the best features of modern tool room lathe design with certain exclusive advantages which owners and operators alike are quick to appreciate. They make unusual records for convenience, quality and cost of service wherever they are installed.

Let us tell you more about them.

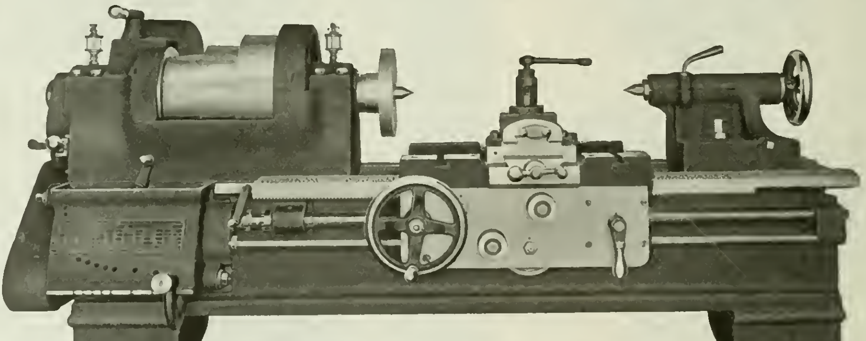


Specifications include 12 spindle speeds; 48 changes of feed and thread — 1 ½ to 92 threads including 11 ½; feeds of 6 to 368 per inch; 15" swing, etc.

ROCKFORD TOOL CO., 2400 Eleventh Street, Rockford, Ill.

Aumen Machinery Co., 107 E. Lombard St., Baltimore, Md.; Cadillac Machinery Co., Beaubien and Lafayette Sts., Detroit, Mich.; Dale Machinery Co., Inc., 541-7 Washington Blvd., Chicago, Ill.; Dale Machinery Co., Inc., 17 East 42nd St., New York City; E. A. Eddy Machinery Co., Eddy and Clifford Sts., Providence, R. I.; Herberts Machinery & Supply Co., 3rd and San Pedro Sts., Los Angeles, Calif.; Herberts Machinery & Supply Co., 140 First St., San Francisco, Calif.; Hess-Schenck Co., Cleveland, Ohio; William C. Johnson & Sons Machine Co., 1001 North Sixth St., St. Louis, Mo.; M. D. Larkin Supply Co., 501-503 East Third St., Dayton, Ohio; Mid-West Machinery Exchange, 1314 East 15th St., Kansas City, Mo.; McMullen Machinery Co., 64-66 Ionia Ave., S. W., Grand Rapids, Mich.; Mid-West Machine Tool & Supply Co., 321 East Fourth St., Davenport, Iowa; F. E. Satterlee Co., 118 Washington Ave., N., Minneapolis, Minn.; William K. Stamets, Jenkins Arcade Bldg., Pittsburgh, Pa.; Homer Strong & Co., Inc., 301 State St., Rochester, N. Y.; Homer Strong & Co., Inc., University Bldg., Syracuse, N. Y.; Sales Limited, 313 Duncan Bldg., Vancouver, B. C.; Swind Machinery Co., Widener Bldg., Philadelphia, Pa.; Charles A. Strelinger Co., Ltd., Windsor, Ont.

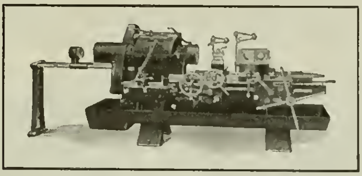
FLATHER LATHES



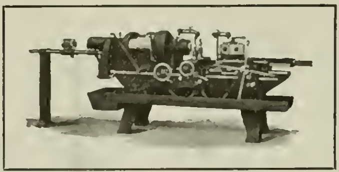
The cut shows the Flather 16" Double Back Geared Engine Lathe, rigid, powerful, accurate; equipped with a quick change gear mechanism which gives an almost unlimited range of feeds and threads; carefully balanced, with the metal distributed to resist all strains; simple in design —and equipped with the most desirable modern features of a lathe of this type. A *real* Flather Lathe—get the details.

Other sizes, several types, 14" to 26". Send for a set of circulars.

FLATHER & CO., Incorporated, Nashua, N. H., U. S. A.



FOSTER UNIVERSAL TURRET LATHES—3 SIZES



FOSTER SCREW MACHINES—5 SIZES

W. A. Barker Wrenchless Chucks Every Movement and Moment Productive

FOSTER MACHINES

The wide adaptability of every machine of the Foster line lends itself to the keen competitive demands of industry today.

Foster machines meet the exacting requirements necessary for turning out high grade work with the maximum of economy, and everywhere they are used their steady and reliable operation proves this.

Give our engineers some of your problems. It gives us the opportunity to prove our statements.

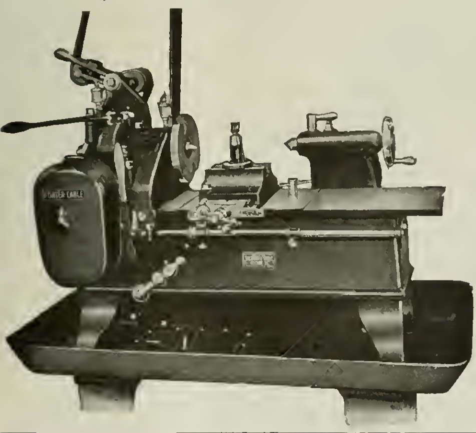
FOSTER MACHINE CO., Elkhart, Indiana

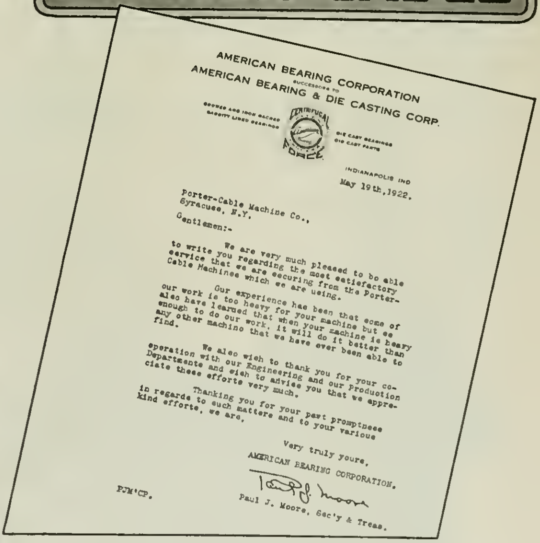
PORTER-CABLE

An Endorsement from a Field Where There Are Many P-C Manufacturing Lathes

We gratefully acknowledge Mr. Moore's endorsement of P-C Manufacturing Lathes. We make no claim of universality for them; but we *do* say that work for which they are suited they do "better than any other machine........".

Let us tell you more about them.





AMERICAN BEARING CORPORATION
SUCCESSORS TO
AMERICAN BEARING & DIE CASTING CORP.

INDIANAPOLIS IND

May 19th, 1922.

Porter-Cable Machine Co.,
Syracuse, N.Y.

Gentlemen:-

We are very much pleased to be able to write you regarding the most satisfactory service that we are securing from the Porter-Cable Machines which we are using.

Our experience has been that some of our work is too heavy for your machine but we also have learned that when your machine is heavy enough to do our work, it will do it better than any other machine that we have ever been able to find.

We also wish to thank you for your co-operation with our Engineering and our Production Departments and wish to advise you that we appreciate these efforts very much.

Thanking you for your past promptness in regards to such matters and to your various kind efforts, we are,

Very truly yours,
AMERICAN BEARING CORPORATION.
Paul J. Moore
Paul J. Moore, Sec'y & Treas.

PJM'CP.

THE PORTER-CABLE MACHINE CO.
SYRACUSE, N. Y., U. S. A.

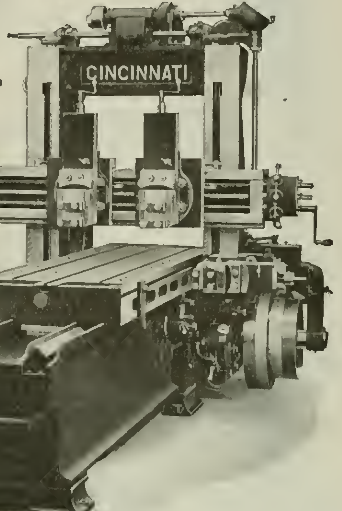
CINCINNATI

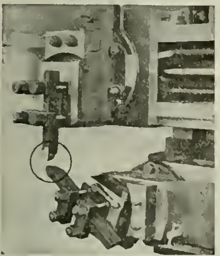
PLANERS *Original Thru out* BORING MILLS

SELF-SATISFACTION

is a rust—it dulls brilliance. The world wants new ways of doing old things. Cincinnati Planers fulfill these wants with Rapid Power Traverse, Forced Lubrication, Herringbone Gears, Box Table, Box Arch, Rugged Strength and Accuracy.

Standard Sizes 22" to 120"
Open-Side Planers 30" to 72"





Write for the catalog.

The Cincinnati Planer Co.

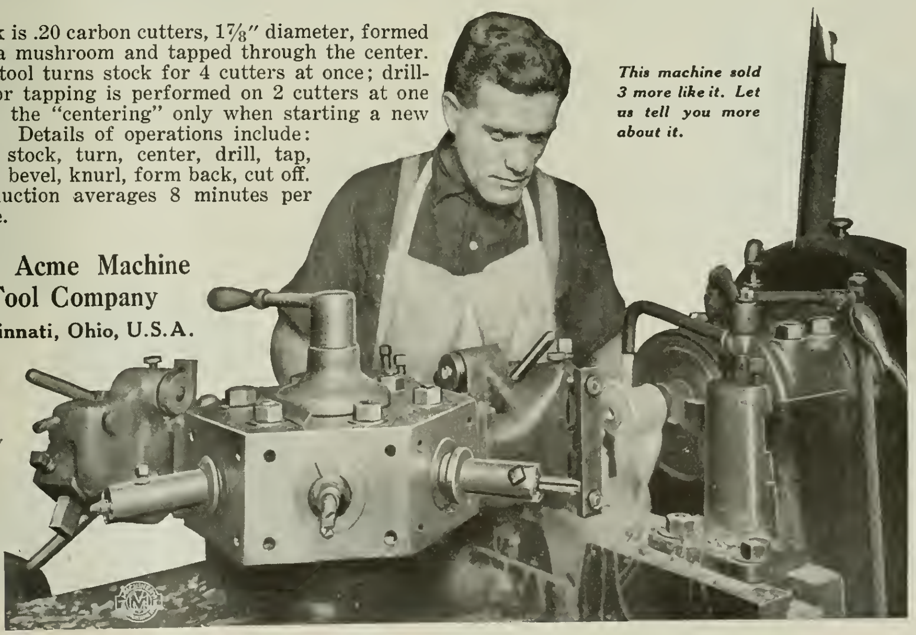
Cincinnati O., U. S. A.

Manufacturers of Planers and Boring Mills

Another Example of the Methods and Results Which Recommend

CINCINNATI-ACME TURRET LATHES

Work is .20 carbon cutters, 1⅞" diameter, formed like a mushroom and tapped through the center. Box tool turns stock for 4 cutters at once; drilling or tapping is performed on 2 cutters at one time, the "centering" only when starting a new bar. Details of operations include: feed stock, turn, center, drill, tap, form bevel, knurl, form back, cut off. Production averages 8 minutes per piece.



This machine sold 3 more like it. Let us tell you more about it.

The Acme Machine Tool Company

Cincinnati, Ohio, U.S.A.

Agents in all leading cities in this country and abroad

Spinning Rivets that Hold!

GRANT RIVETERS

Quickly, easily, *noiselessly* spinning tight or loose rivets on all classes of work in practically every metal; operating profitably in small local shops, fitting readily into the production schemes of big factories with world wide reputations for efficient equipment.

Simple, easily operated and never out of order; profitably productive machines that do not require skilled operators—Grant Riveters are popular wherever they are used.

Let us rivet a few samples for you—and submit production estimates

Grant Manufacturing & Machine Co.

BRIDGEPORT N. W. Station CONNECTICUT

Let Us Tell You All About

The Mueller Radial

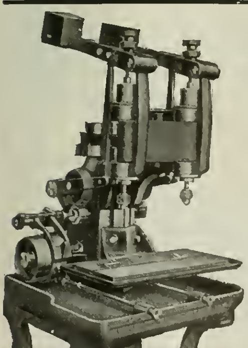
and about its records for speed and endurance; for big drilling output and low cost per hole—due to its exclusive I-Beam Column and other exclusive features.

"IT'S A LEADER"

The Mueller Machine Tool Co.

RADIAL DRILLS AND LATHES

Cincinnati Established 1902 Ohio, U. S. A.



The Kingsbury Automatic Sensitive High Speed Ball Bearing Drilling Machine

The adjustable non-positive pressure feed drives the very small drills to capacity without forcing them to the breaking point.

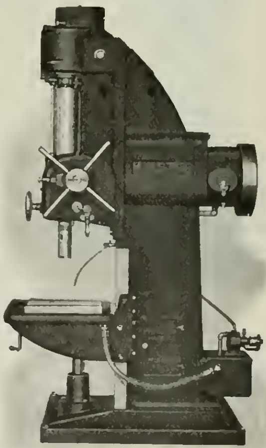
Let us send you details and estimate on your work.

KINGSBURY MFG. CO.
KEENE, NEW HAMPSHIRE

Minster Hi-Duty Drills

Powerful—Productive—Profitable

The weight, power and operating convenience of Minster Drills make them the ideal machines for heavy drilling in solid steel; while the balanced construction and fine adjustments (so easily made) make these big machines equally valuable on finer work. A working range that with great capacity guarantees them an exceedingly profitable investment in any big machine shop.



Three sizes—to drive drills to 2", 2½", 3¼" in solid steel.

The Minster Machine Co.

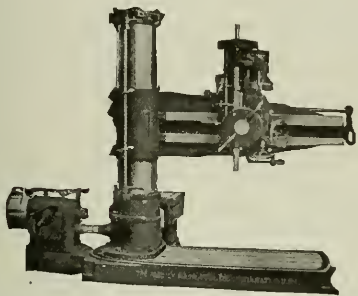
MINSTER *Get a list of Minster Agents* OHIO

FOSDICK DRILLING MACHINES

Always Better than the Work Demands

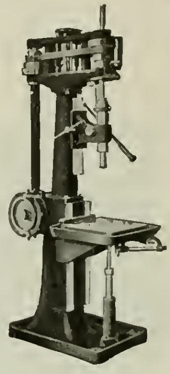
In the 34 years of our drill manufacturing experience we have consistently kept Fosdick Drills just a little ahead of the standard requirements for machines of this type—always ready to meet the advancing standards in drilling practice.

The cuts show:—the Fosdick High Speed Ball Bearing Sensitive Drills, 16″ to 24″ swing, in combinations of one to eight spindles; Fosdick Radial Drills, made in sizes ranging from 2 to 6 feet.



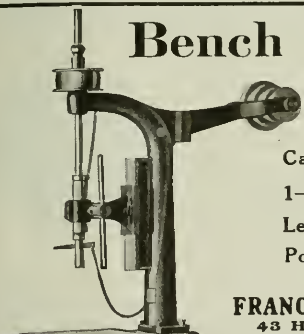
FOSDICK

If you need a drill—send for the details of the Fosdick Line.



THE FOSDICK MACHINE TOOL COMPANY
CINCINNATI, OHIO, U. S. A.

Bench Drills



Capacity ½″
1—4 Spindles
Lever Feed
Power Feed

FRANCIS REED CO.
43 Hammond St.
WORCESTER, MASS.

Sliding Head Upright Drills

Horizontal Boring Mills

THE ROCKFORD DRILLING MACHINE Co
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Exclusive Advantages

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"HOLE HOG"

A profitable production unit that pays its way in saved time, saved effort, saved patience and increased efficiency.

DRILLS, REAMS, BORES HOLES IN LINE

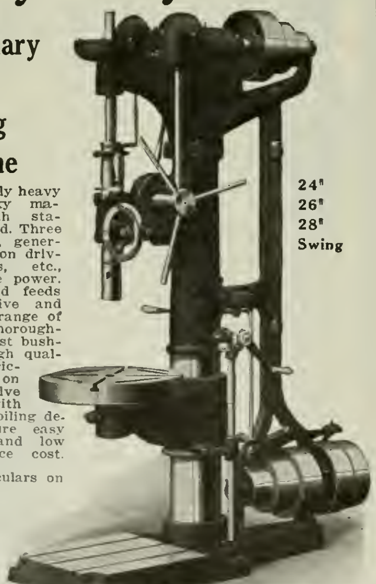
MOLINE TOOL COMPANY, Moline, Ill.

Sibley Heavy Pattern

Stationary Head Drilling Machine

An unusually heavy and stocky machine with stationary head. Three step cones, generous ratios on driving gears, etc., give ample power. Speeds and feeds are selective and cover the range of machine thoroughly. Die cast bushings of high quality anti-friction metal on main drive bearings with improved oiling devices insure easy running and low maintenance cost.

Full particulars on request.



24″
26″
28″
Swing

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SIBLEY MACHINE COMPANY
8 Tutt Street SOUTH BEND, IND., U. S. A.

Seventeen Years Without Repairs!

THE "GIANT" Keyseater

Send for a detailed description of the machine; let us give you other records for service and tell you something about production and operating costs.

Installed seventeen years ago, in constant operation and *no repairs!* Some record in these days of strenuous production. Working records like this are made possible by simple, durable construction and easy operation. Accuracy is assured by the work holding method. The grooved post which holds the work by its bore also forms a guide for the tool bar supporting it through its entire length and preventing spring.

"GIANT" Keyseaters are made in eight sizes; long wearing, profitable machines whether used for production manufacturing or single operation work.

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843 Water St. Saginaw, Mich.

FOREIGN AGENTS: Burton, Griffiths & Co., London, England. Aux Forges de Vulcain, Lyons and Paris, France. V. Lowener, Christiania, Norway and Stockholm, Sweden.

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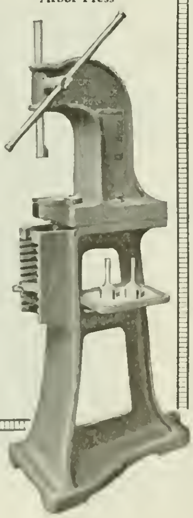
Tools You Need

Mandrel

The use of solid mandrels in toolroom and repair shop is a survival of cut-and-try methods which have no place in modern practice.

Nicholson Expanding Mandrels make your operator's time almost wholly productive; assure an instant fit by means of a simple wedge-like expansion as positive, time saving and efficient as the action of Nicholson Arbor Presses in pressing out arbors, punching, bending, broaching, etc. Let us tell you all about them.

Arbor Press



W. H. Nicholson & Company
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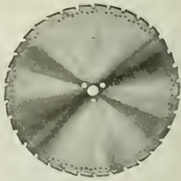
HUTHER BROTHERS' SAWS

Help You Meet Lower Prices In Times of Depression



Huther Brothers' Inserted Tooth Milling Saws have the ability to lower production costs, and they are daily proving it in the hands of users. Huther inserts can be worn down to 3/16" from the heel before replacing. This allows 1¾" wear—a cutting service that is not surpassed. Inserts are replaced at small expense.

Send for your copy of complete catalog.

HUTHER BROS. SAW MFG. COMPANY, Inc.
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BARNES
SAWS FOR METAL
BAND MANUFACTURED BY **HACK**
DETROIT **W.O.BARNES CO.** MICHIGAN

Lea Simplex Cold Saws

Economy in cold sawing is just as important as in any other machine shop operation—our booklet gives valuable information on this subject and tells all about the results obtainable with Lea Simplex Cold Saws. Send for it.

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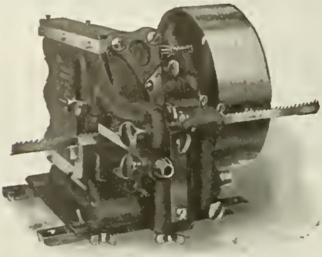
Also Manufacturers of Cut Gears, Special and Bridge Operating Machinery and Earle Centrifugal Pumps



SAW COSTS REDUCED

MODEL K—FILES, SETS AND JOINTS BAND SAWS
➔ IN ONE OPERATION ⬅

No other machine performs these two operations at one time.
This saves a second machine, the extra handling of the Saw and

ONE-HALF THE TIME SAVED

Over other mechanical methods and

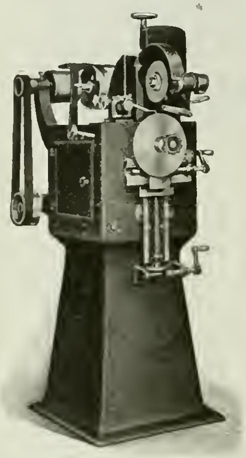
1/40 THE TIME REQUIRED FOR HAND WORK

In use by practically all large saw makers and manufacturers.

THE WARDWELL MANUFACTURING COMPANY

108 Hamilton Ave. *Metal Cutting Circular Saw Grinders and Filers, Hack Saw and Metal Cutting Band Saw Grinders, Lap Grinders, Circular Saw Setters, etc.* Cleveland, Ohio.

For Cutting Off Metal Plates, Bars, Discs or Rolls, for Slotting and all kinds of Metal Sawing



Use metal cutting saws whose teeth are properly shaped and spaced for the work, automatically and uniformly maintained as the saw wears down. Skilled operators not required with our automatic grinders for keeping metal cutting saws up to highest efficiency.

High cost for ruined saws now eliminated.

Saws properly fitted will cut faster, last longer, never break or crack. Old saws formerly discarded now reclaimed and made good as new.

Our automatic sharpeners will add at least 50% to your sawing service.

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Machinery Company of America

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The HIGLEY

COLD METAL SAW

Catalog furnished by

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SCHERR AUTOMATIC SAW SHARPENER

Costs Little—Saves Much

Capacity for saws 1½" to 6" in diameter, 3/32" thick.

An inexpensive machine that pays big dividends. Get a circular for details and *price*.

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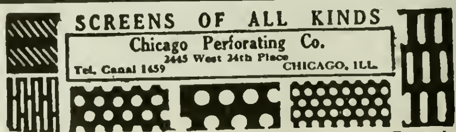
Peerless HIGH SPEED **Hack Saw Machines**

Unequalled for fast, accurate, economical cutting of bar steel. The new UNIVERSAL SHAPING SAW will do your hack sawing, also many slotting, shaping and other operations.

Peerless features—overbalanced saw frame—Automatic lift and positive feed control—Greater production with less blades.

Peerless Machine Co., 1611 Racine St., Racine, Wis.



STAR Hack Saws

HACK SAWS OR WAGES?

Have you figured out just when it pays to save saws and when to save wages on hack sawing?

This and many other practical points are covered in our interesting new book on the "Use of Hack Saws." It shows you how to select the right blade for given work and conditions and helps you find the right speed and pressure after the blade is selected. Shows you the causes and remedies for blade breakage, crooked sawing, and rapid dulling of teeth.

A book that will help you get better results from your sawing. Written by Mr. George N. Clemson and embodies his 35 years' experience in making and using hack saws.

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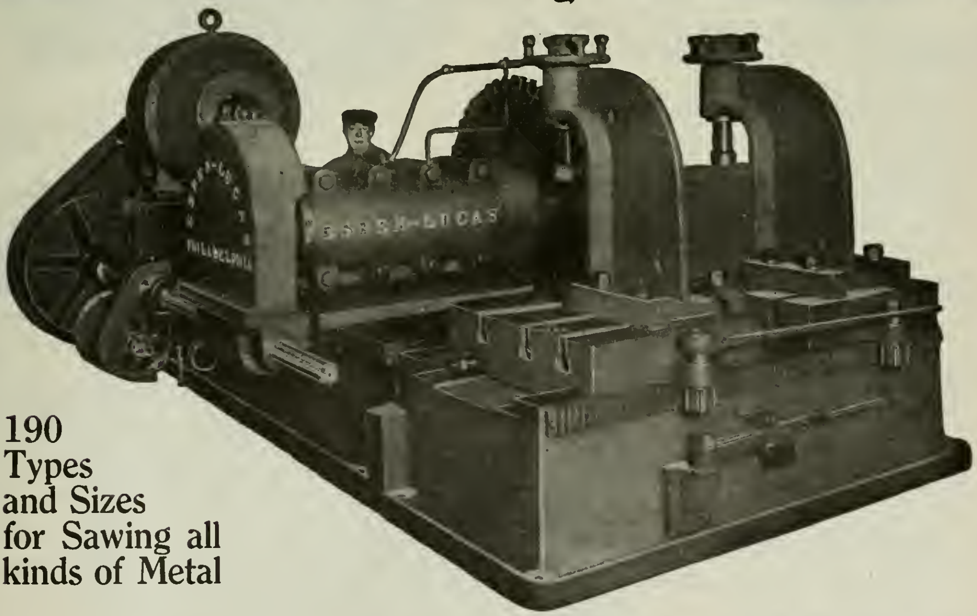
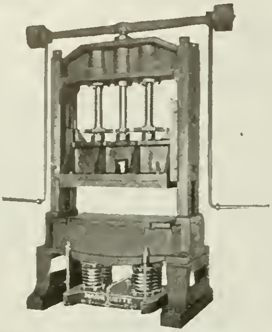
One of the Fastest Cold Sawing Machines in the World



190 Types and Sizes for Sawing all kinds of Metal

THE ESPEN-LUCAS MACHINE WORKS, Front and Girard Avenues PHILADELPHIA, PA.



EFFICIENT PRESS EQUIPMENT MEANS EFFICIENT STAMPINGS

The picture shows a TOLEDO SCREW PRESS equipped with four Marquette Pneumatic Die Cushions at the plant of the TOLEDO MACHINE & TOOL COMPANY for the trying out of sheet metal drawing dies of large size.

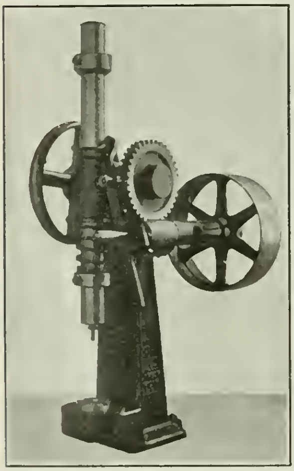
Power presses equipped with Marquette Pneumatic Die Cushions are more efficient because they turn out stampings free from wrinkles and cracks.

Submit your stamping problems to our engineering department, and let us help you solve them.

MARQUETTE TOOL & MFG. COMPANY

321 W. OHIO STREET CHICAGO, ILL., U. S. A.

AMERICAN
Power Bench Broach Press
Pays Its Way Into Your Employ



In all parts of the country, in machine shops, garages, service stations, the famous American Power Bench Broach Press and Assembling Press is earning its way into the good opinions and regard of its users.

$120.00 and up
F. O. B. Ann Arbor, Mich

That's the American's price—in some shops it has paid its cost back in a comparatively short time, making all later earnings "velvet." There is no overhead. It takes work 6" diameter, height from table to end of ram 13" maximum, capacity 1½ tons, ram 2" diameter, drive belt 2½", automatic stops on cutting stroke and return, speedy in operation, well made, absolutely reliable.

American Broach & Machine Company

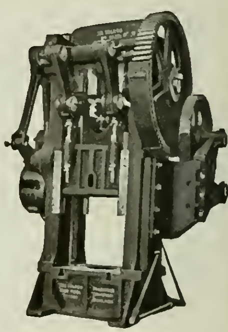
Builders of all types of Brooching Machines and Brooching Tools.

Ann Arbor Michigan

Detroit Office, 305 Scherer Bldg.

THE "TOLEDO"

Patented Single and Double Crank Toggle Drawing and Deep Stamping Presses



Just one of a line which includes machines of all sizes for every conceivable metal stamping and forming purpose.

"Toledo" Patented Toggle Drawing Presses have an especially designed blank holder control mechanism that insures the correct dwell of the blank holder during the entire operation—one of the features that make these carefully balanced, powerful machines such satisfactory producers.

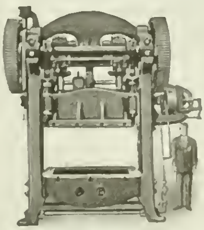
Find out more about "Toledo" Presses
"Presses for Every Purpose"

The Toledo Machine & Tool Company
TOLEDO, OHIO

Chicago Office: Room No. 611 Machinery Hall
549 West Washington Boulevard

FERRACUTE PRESSES

FOR CUTTING AND FORMING METALS

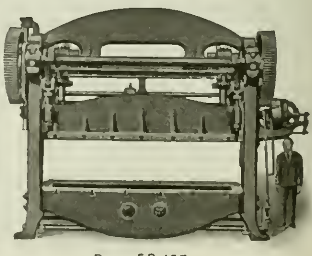


Press SD 154

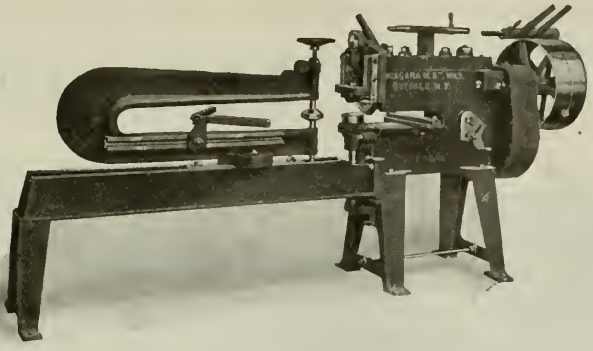
The machine at the left is a Double-action Toggle Drawing Press exerting 150 tons pressure and having a width between columns, right to left, of 76 inches. Weight about 64,000 lbs.
The machine at the right is a similar press but 148 inches wide between columns and weighing about 92,000 lbs. Presses are built having same tonnage but with one pitman and less width. Also for pressures up to 2000 tons.

PRESSES FOR EVERY PURPOSE

FERRACUTE MACHINE COMPANY, Bridgeton, New Jersey



Press SD 157



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Circle Shears With Flanging Attachments

will cut and turn flanges of exceptional height and neatness.

We manufacture a complete line of Presses, Punches, Squaring Shears, Ring and Circle Shears, Tinners' Tools and Machines, as well as equipments for special operations on Sheet Metal.

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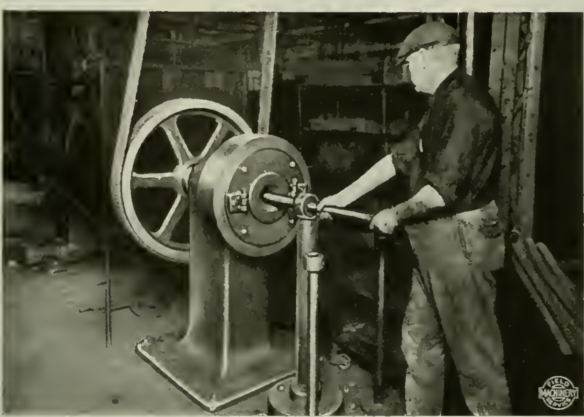
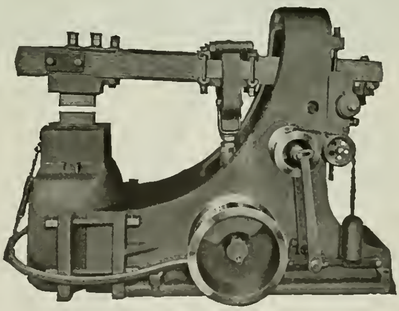
NIAGARA





One type of the Rochester Helve Hammer.

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It will hold your interest from cover to cover. It outlines in an understandable way the improvements in cutter design during the past 15 years; describes the unique advantages of "Union" High Power Undercut Tooth Cutters; explains why and how these cutters will help *your* production — improve quality, increase quantity and lower costs.

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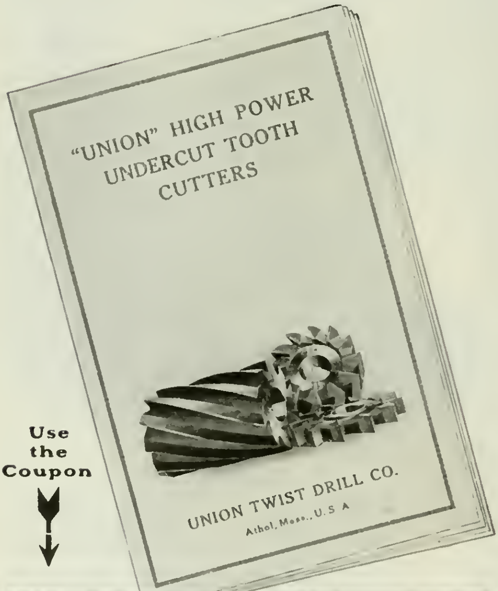

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UNION TWIST DRILL COMPANY

ATHOL, MASS., U. S. A.

Please send me a copy of your Pamphlet on UNION High Power Undercut Tooth Cutters.

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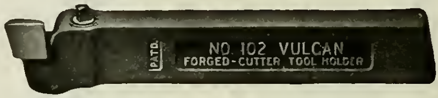
COMPANY ....

ADDRESS ....

M S 22



FOR continuous, heavy cuts at high speeds, on lathe, planer, shaper, etc., WILLIAMS' "VULCAN" FORGED-CUTTER TOOL HOLDERS provide all the advantages of the solid bar without its expense.

Change the cutter, not the tool, and save

1. **All blacksmith work.**
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Six sizes of Holders with Forged-Cutters of high speed steel for all regular machining operations.

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Milling Cutters *for* Every Requirement

Quality Ⓒ *First*

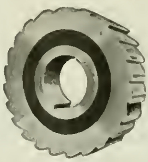
COWLES TOOL COMPANY

Cutter Manufacturers

CLEVELAND OHIO, U. S. A.

Old Cutters Made New

Send us your worn-out Milling Cutters, Slitting and Cold Saws, End Mills, Reamers or other HSS Tools. We will make them **as good as new** at less than one-half the cost of new equipment. Tag slot or gang cutters and reamers the size you wish them finished.



Worn-out Cutter

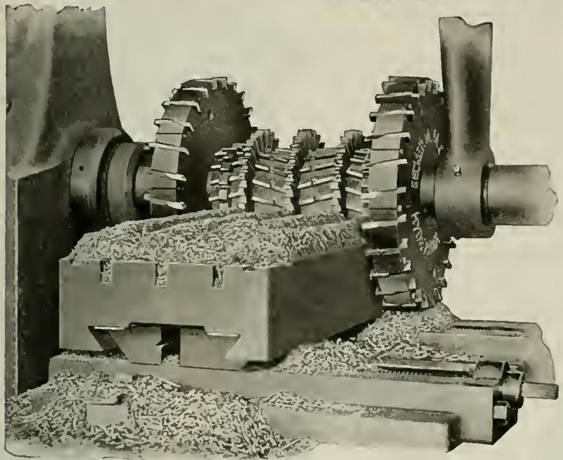
We Don't Anneal

This is a distinct advantage. Standard Oil, Disston Saw Co., Otis Elevator, Mack Truck and hundreds of others use our service regularly. You can not afford to pass this money saving proposition by. Write today.

"Eastern" Salvaged

EASTERN CUTTER SALVAGE CORP., 313 Kirk Place, Newark, N. J.

BECKER MILLING CUTTERS



Standard cutters in stock at all branch offices and agents; form cutters of any design can be supplied at short notice.

If you judge tools by performance you will appreciate the value of the service given by these high grade tools.

Send for a stock list. Let us give estimates on the special tools you need.

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SALES OFFICES: Indianapolis, Detroit, New York

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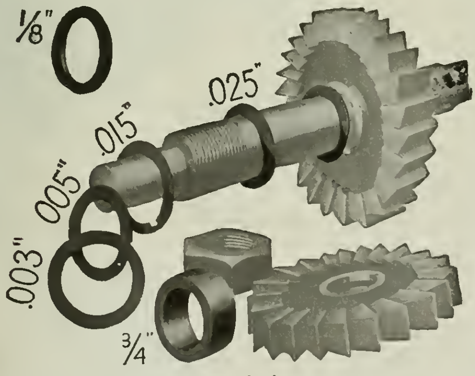

A trial order will show you.
Quotations on request.

Spacing Washers *cannot be manufactured to advantage in small lots.* Ask any one who has tried it; and ask the man who sets up your milling machines which kind give him the least trouble. Most every one you'll ask, will recommend Detroit Spacing Washers.

We carry a large stock—with or without standard keyways—for arbors of the following diameters:

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Stock Thicknesses: .003, .005, .015 and .025 inches.
To Order: .0015 to 3.000 inches.

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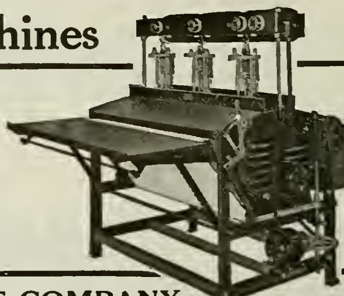
Your name on a post card brings it.



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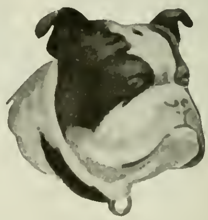

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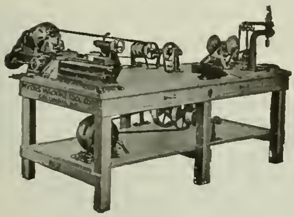
MYERS TOOLS



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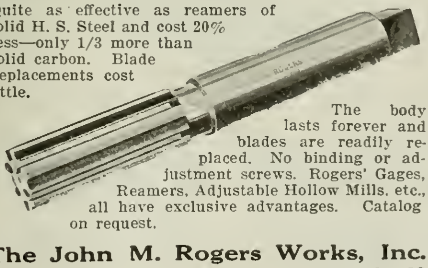
Quite as effective as reamers of solid H. S. Steel and cost 20% less—only 1/3 more than solid carbon. Blade replacements cost little.



The body lasts forever and blades are readily replaced. No binding or adjustment screws. Rogers' Gages, Reamers, Adjustable Hollow Mills, etc., all have exclusive advantages. Catalog on request.

The John M. Rogers Works, Inc.

Gloucester City, N. J., U. S. A. 1865-1922

The largest selling quality pencil in the world

TWO crowning achievements; the far-famed Venus of Milo, and the superb VENUS Pencil.

VENUS—the Peer of Pencils—meets perfectly the exacting needs of the engineer and the draftsman.

VENUS PENCILS

17 black degrees, 3 copying

For bold, heavy lines	6B-5B-4B-3B
For Writing, sketching	2B-B-HB-F-H
For clean, fine lines	2H-3H-4H-5H-6H
For delicate, thin lines	7H-8H-9H
Plain Ends, per doz.	$1.00
Rubber Ends, per doz.	1.20

Three copying Degrees for Indelible Uses

At Stationers and Stores throughout the World

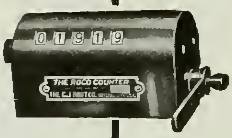
American Lead Pencil Co.

237 Fifth Avenue, New York

and London, Eng.

ROOT COUNTERS

"Census Takers of Industry"



Stop using haphazard production records—they are misleading.

Start using Root Counters. They give an accurate dependable production count that enables you to figure correct costs—eliminating all argument and misunderstanding.

It's the only safe way.

Shall we send you facts?

Write.

Catalog "G" is yours for the asking

ROOT
BRISTOL, CONN.

Reg. U. S. Patent Office

"Master Marker" Imprints are Earmarks of Quality

The impress of a *PANNIER* "Master Marker" Steel Stamp on your product is the prospective buyer's identification mark—the earmark of quality. Mark what you make with *PANNIER* "Master Markers" and you multiply sales values.

PANNIER stamps meet every marking need. They give you clean-cut markings. They give service. Use them for their long life.

MASTER PANNIER MARKERS

LETTERS AND FIGURES—NAME STAMPS—SYMBOL STAMPS—STAMPING DIES

PANNIER BROTHERS STAMP COMPANY

PITTSBURGH PENNA., U. S. A.

Piecework Lags too without Counters

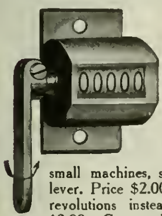
At machines where the worker is paid by piecework, "going slow" is almost as prevalent as in day work. Unless—

You measure or count the output with a Veeder Counter—which indicates not only the amount actually done but the amount which **ought** to be done.

Piecework or day work are equally subject to improvement, when

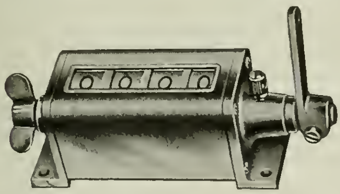
Veeder COUNTERS

show the *should-be* production and how well the worker maintains it, hour by hour.



This small **Rotary Ratchet Counter** (No. 6) counts reciprocating movements of the lever, as required in recording the product of many small machines. When the lever is moved through an angle of 40 to 60 degrees, the counter registers one. A complete revolution of the lever registers ten. This counter is adaptable to no end of small machines, simply by regulating the throw of the lever. Price $2.00. Small *Revolution* Counter, to record revolutions instead of reciprocating movements, also $2.00. *Cut nearly full size.*

The **Revolution Set-Back Counter** below is designed for the larger machines where a shaft-revolution indicates an operation.



Registers one for each revolution of shaft, and sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheels, as required. Price, with four figures, as illustrated, $10.00—subject to discount. (Cut ½ size). Set-Back Rotary Ratchet Counter, to record production of punch presses, etc., price $11.50 —subject to liberal quantity discount.

Write for booklet showing Veeder developments in counters; all kinds for your requirements are there.

The Veeder Mfg. Co.

39 Sargeant Street, Hartford, Conn.

Middle West Distributor:
F. A. Bringolf
549 Washington Blvd.
Chicago, Ill

Pacific Coast Distributor:
F. Somers Peterson Co.,
57 California St.
San Francisco, Cal.

CHAMPION

Your product is as reliable as the parts of which it is made. If a vital part fails it stops. Ceasing to produce, it earns nothing. It becomes an expense to your customer. His men are idle and costs rise.

Drop forged load bearing and strain resisting parts are vital. Machine productiveness depends upon it. By the use of Champion Drop Forgings you may achieve:

The tough, sturdy, give and take strength of steel where stamina is vital.

Lighter weight and less bulk.

One-third reduction in machining and finishing time.

Elimination of loss from breakage of tools and parts in handling resulting in economies which more than repay you the slightly higher first cost of forgings.

Hundreds of different parts can be forged by Champion. You want business then you will appreciate the cooperation of a Champion Engineer—a practical business man and productive executive who will study your problem intimately with your engineers. His services are available on request. Name the time he may prove to you the soundness of these claims.

The Champion Machine & Forging Co.

Engineering Dept.

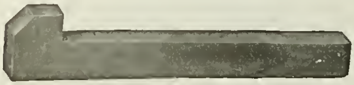
3693 East 78th St., Cleveland, Ohio

New York Office: 30 Church St.
Philadelphia Office: Bourse Bldg.
Detroit Office: 705 Ford Bldg.

DROP FORGINGS

MOLTRUP FINISHED MACHINE KEYS

The "Pass-Keys" to Real Service



Made in Standard and Special Sizes

Moltrup Finished Machine Keys are quality products; well finished, accurate, dependable; made from cold drawn steel expressly prepared for the purpose. They render real and lasting service—a service that pleases sufficiently to persuade you to come back to us again. In addition to carrying every size and style in general use, we assure you quick delivery on any *special* keys you may require. Write for particulars.

MOLTRUP STEEL PRODUCTS CO., Beaver Falls, Penna., U.S.A.

DISTRICT OFFICES: New York, Woolworth Bldg.; Boston, 201 Devonshire St.; Atlanta, Ga., 1118 Healey Bldg. SALES AGENCIES: Central Steel & Wire Co., Chicago and Detroit; H. D. Cushman Company, Cleveland, O.; Iroquois Steel Co., Buffalo, N. Y.; R. E. Murray & Co., 308 McKevitt Bldg., Norfolk, Va.; Union Iron & Steel Co., Cincinnati, Ohio.

SAVING A FEW CENTS PER POUND

Saving a few cents per Pound by buying babbitt which lasts only half as long as Ajax Bull Bearing Alloy, is not economy. It's sheer waste.

The babbitt itself is a minor item in the expense of rebabbitting. It's the time and production you lose while the machine is shut down. Labor costs don't stop, overhead keeps on piling up. Nothing goes down but the net profits.

AJAX BULL BEARING ALLOY

wears longer than any babbitt metal because it's made of virgin metals by the Ajax Alloying Process.

It's all in the Ajax Alloying Process.

The Ajax Metal Company

Main Office and Works: PHILADELPHIA, PA.

New York Boston Cleveland Louisville Birmingham Chicago

FERRO-URANIUM
FERRO-VANADIUM

of the Highest Quality

STANDARD ALLOYS COMPANY

Pittsburgh, Pennsylvania

HOYT

HIGH GRADE

SOLDERS

The HOYT name on solder is your assurance of quality—always order by name:

HOYT Warranted—the best
HOYT Strictly—high grade at moderate cost.

If your jobber can't supply you—write for our proposition.

HOYT METAL COMPANY

St. Louis Chicago Detroit New York

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It usually pays. Certainly it has helped Acklin customers get the best results in the production of stamped parts in all metals.

Acklin Stamping experts plan the methods, direct the work, approve the results. That is why Acklin Stampings are invariably satisfactory and economical.

Get expert advice on your stamping problems

THE ACKLIN STAMPING COMPANY

1657 Dorr Street Toledo, Ohio

THE MOHEGAN TUBE COMPANY

Hot and Cold Rolled
STEEL TUBING

Seamless Welded Butted
Open Seam Lock Joint

Ready for Immediate Use

We carry a large stock of round, square, rectangular and other standard shapes; and are prepared to supply specials to specifications.

Our Cold Drawn Tubes have a high lustre, well liked for fine surface finishes.

Try non-corrosive tubing of Pure Nickel and Monel Metal; and Tinned and Galvanized Tubes for all mechanical purposes. They cut out frequent replacements and improve the product.

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SuperCast Quality
The Best there is in Die Casting

Dependable SUPER CAST Die Castings

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Prompt delivery guaranteed. Send samples, blueprints or sketches for estimates.
MT. VERNON DIE CASTING CORPORATION
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ELECTRIC STEEL CASTINGS
Farrell-Cheek Steel Foundry Co.
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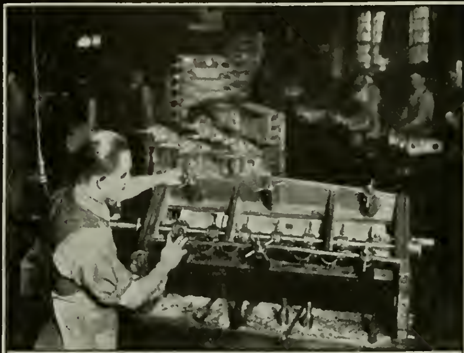


FRANKLIN DIE-CASTINGS

Best for Bearings

Not only in automobiles, but also in stationary engines, compressors, automatic pumps, etc., Franklin Die-Cast bearings represent a big advance over the old method of babbitting the shaft.

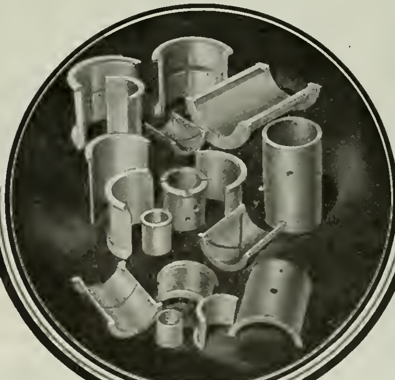
They give better service than machined bearings, being equally accurate, more uniform, quicker to interchange (no metal to pour) and harder (chilled under pressure).

They lower costs in assembly, upkeep and replacement. They require no machine operations save those customary in assembling even the most fully machined bearings—line-reaming, scraping, burnishing, etc.

The babbitts used include the S. A. E. standard formulas, together with others proved by Franklin's 30 years of experience.

Let us solve your problems. We quote from samples or blueprints. Send for booklet: "Franklin Die-Castings in Modern Inventions."

FRANKLIN DIE-CASTING CORPORATION
Gifford and Magnolia Streets Syracuse, N. Y.



"THE HOUSE OF HAWKRIDGE"

The use of Hawkridge Steel for all purposes for which high grade steels are essential has become so general in this part of the country during the past 38 years that it is fast assuming the dignity of a habit among New England steel users. "Cooperation" is our motto; and watchmakers, spring makers, small tool makers, hospitals, electrical supply houses, machine tool builders, quarries, mines, cutlery companies and many others have benefited at one time or another by our far-sighted selling policy, which gives the salesman as much credit for advancing the interests of a customer as for selling a car load of Hawkridge Steel.

Our line is complete and includes the Best High Speed Steel made, the freest cutting Machinery Steel, Crucible Tool Steel (including the "Hawk" Brand). Oil-hardening or Water-hardening, Hot-rolled or Cold-drawn, High Carbon or Low Carbon, Rough-turned or Drill Rod finish, Heat-treated or Annealed, Alloyed or just plain Steel—in Rounds, Squares, Hexagons, Octagons, Quarter Octagons and Special Shapes.

HAWKRIDGE BROS. CO., 303 Congress St., Boston 9, Mass.

UNION DRAWN SERVICE

Bright Finished Steel

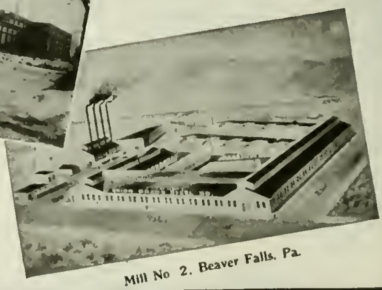
Quality, Variety, and Delivery Unexcelled

Main Mill. Beaver Falls, Pa.

Mill, Gary, Indiana

WE specialize in Cold Drawn, Turned and Polished Shafting and Elevator Guides, Free Cutting Screw Stock, Squares, Flats, Hexagons and Special Cold Drawn Shapes—Best Bright Bessemer, O. H. Alloy and Electric Steels.

Write for Quotations.

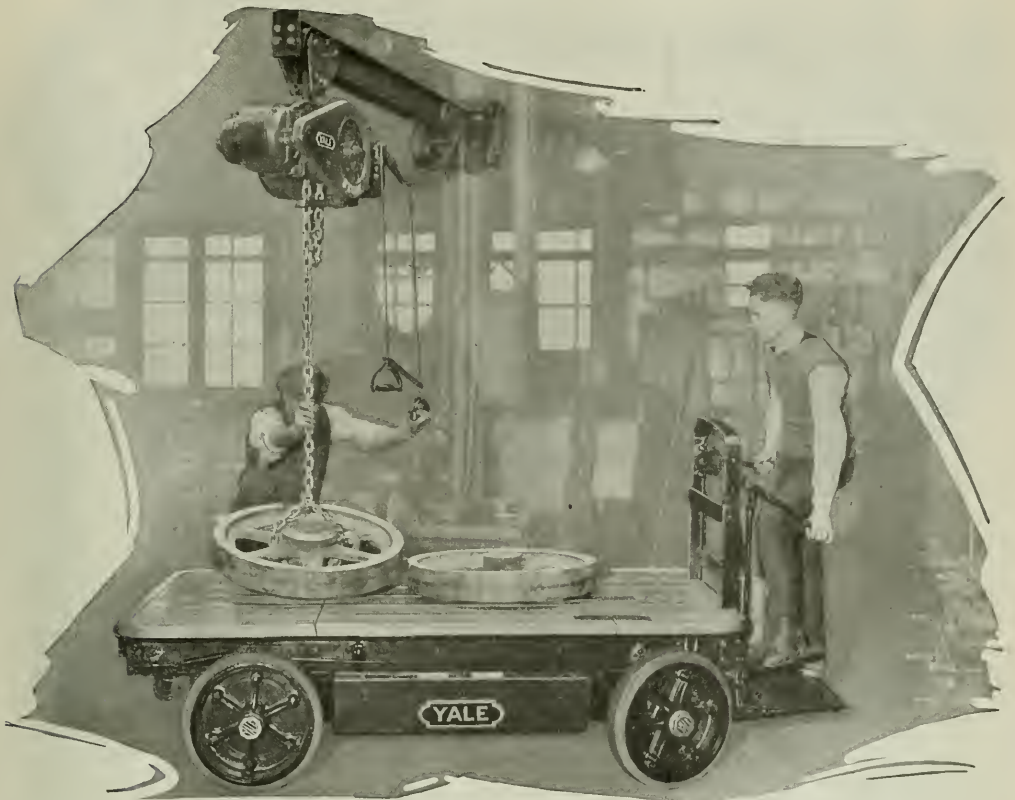


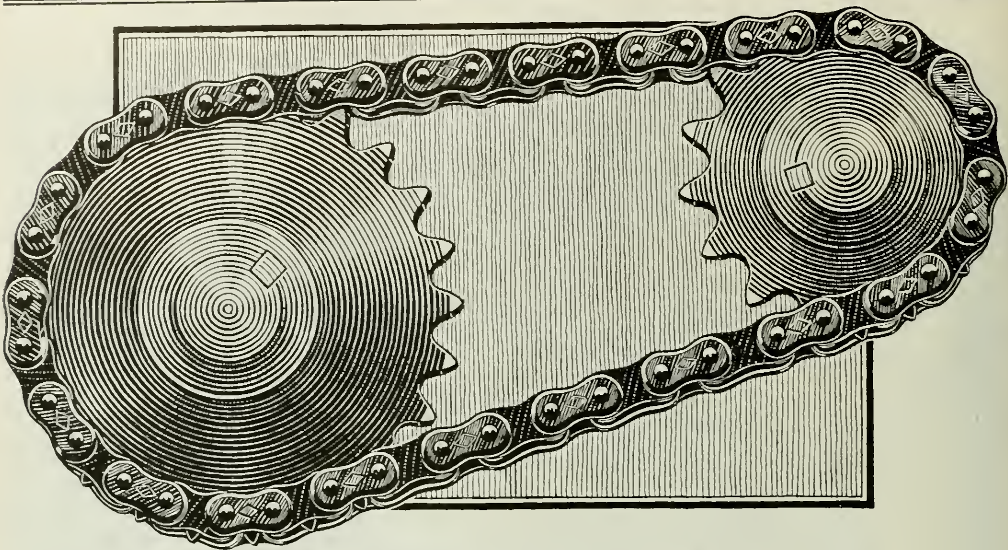
Mill No 2. Beaver Falls, Pa.

Union Drawn Steel Co. Main Office: **Beaver Falls, Pa.**

WORKS: Beaver Falls, Pa. and Gary, Ind.

Other Offices and Warehouses—New York, 460-466 Washington St. Philadelphia, Ninth and Willow Sts. Cincinnati, 2225-47 Bogen St. Chicago, 570 West Adams St. Detroit, 237 Jos. Campau Ave. Sales Offices—Boston, 45 Bromfield St.; Buffalo, White Building; Cleveland, Kirby Building.


YALE
YALE



Drive It With DIAMOND Chains and Sprockets

For practically every place where power is transmitted—whether on a light, high speed electrical device, or on a heavy, slow speed machine tool — DIAMOND Chains and Sprockets provide dependable power-drives that meet every demand of efficiency and economy. They save power, and speed up machinery, because slippage is eliminated and friction reduced. They avoid shutdowns and save repair bills by giving constant, durable service.

They are extensively used by mills, mines, factories, power plants, railroads, etc.—daily demonstrating their ability to reduce costs of power and maintenance, and increase the output of machines they serve.

In the DIAMOND Line are more than fifty standard chain models—ranging from $\frac{3}{8}$ to 2 inches in pitch, and from $\frac{1}{8}$ to $1\frac{1}{4}$ inches in width. This offers you correct chains for all transmission requirements, no matter how high the speed or how heavy the load.

And whatever size or type of sprockets you require, the DIAMOND Sprocket department is well equipped to serve you. Where special chains are required, we can produce standard roller or block chains with special features to meet your needs.

To aid you in selecting the chain and sprockets best suited to your drives, we offer the services of our engineers, who have had years of specialized experience in solving transmission problems.

We have a handy-size, loose-leaf book "Useful Data on DIAMOND Chain Drives." You'll find it of real help in ordering DIAMOND Chains and Sprockets. Write for it.

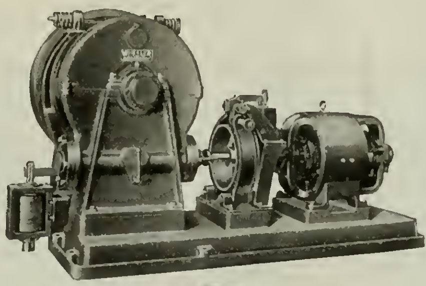
DIAMOND CHAIN & MFG. COMPANY, Indianapolis, U. S. A.

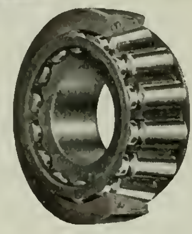
Makers of High Grade Chains and Sprockets Since 1890

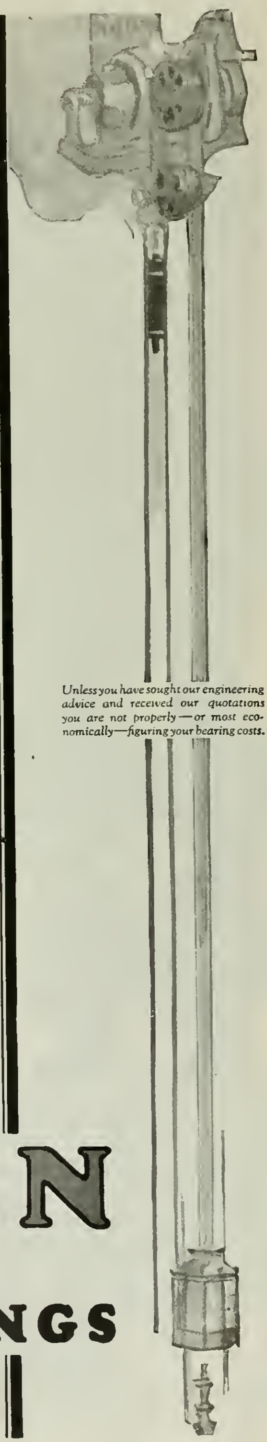
DIAMOND

CHAINS ◇ SPROCKETS

TRADE MARK

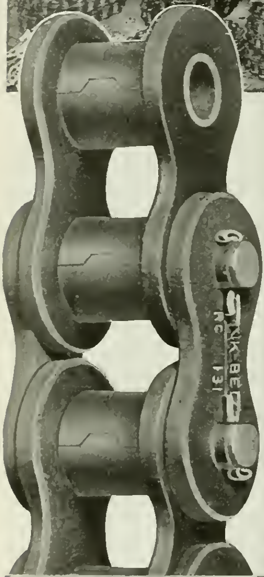






Unless you have sought our engineering advice and received our quotations you are not properly—or most economically—figuring your bearing costs.

LINK-BELT "PROOF TESTED" ROLLER CHAIN



THE Transmission of Power through roller chain drives is gaining in popularity as an effective, yet economical, method of driving machinery.

Link-Belt Roller Chain represents the highest development of chains of this type. Every foot is proved for physical strength and wearing value.

Link-Belt Roller Chain is made to the high standard maintained for the entire Link-Belt Line. Every link bears our trade mark >——< and is fully guaranteed.

Send for Data Book No. 257.

719

LINK-BELT COMPANY

World's Largest Manufacturers of Conveying and Power Transmission Chains

PHILADELPHIA CHICAGO INDIANAPOLIS

New York	Woolworth Bldg.	Seattle	820 First Ave., S.
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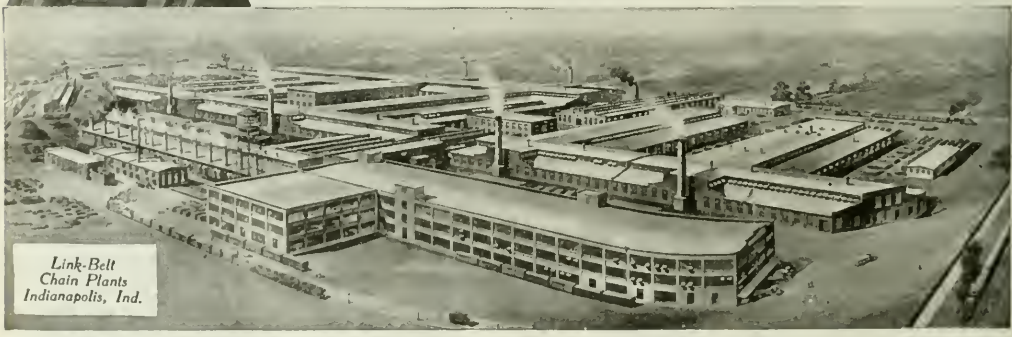
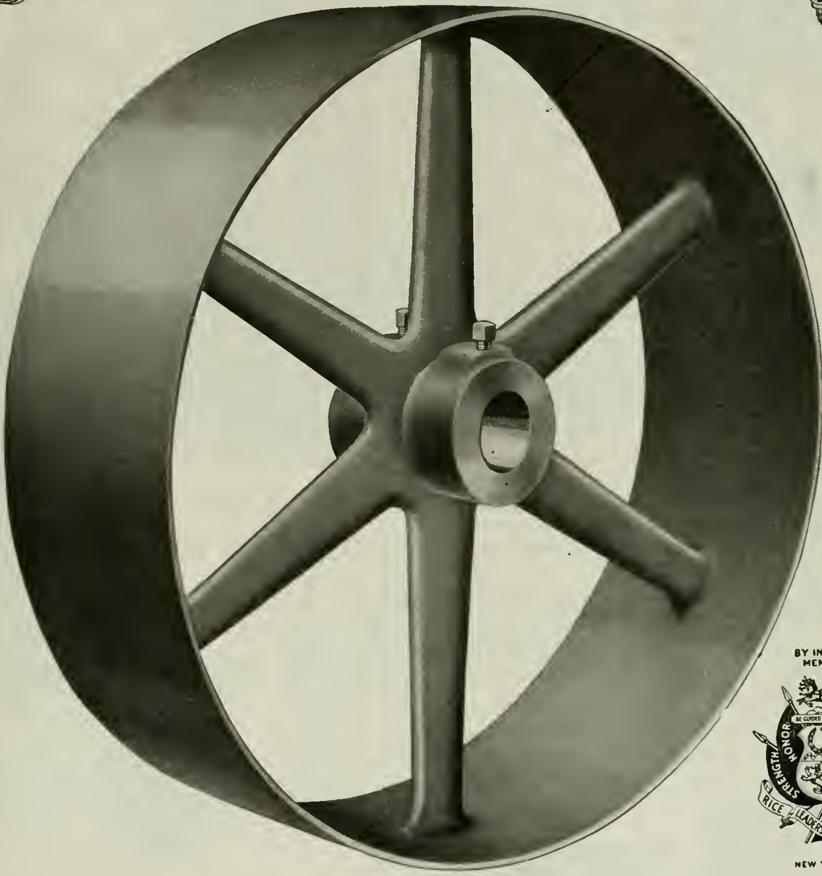
Pittsburgh	1501 Park Bldg.	San Francisco	168 Second St.
St. Louis	Central National Bank Bldg.	Los Angeles	163 N. Los Angeles St.
Buffalo	547 Ellicott Square	Denver	Lindrooth, Shubart & Co., Boston Bldg.
Wilkes-Barre	2nd National Bank Bldg.	Louisville, Ky.	Frederick Wehle, Starks Bldg.
Huntington, W. Va.	Robson-Prichard Bldg.	New Orleans	C. O. Hinz, 504 Carondelet Bldg.
Cleveland	429 Kirby Bldg.	Birmingham, Ala.	S. L. Morrow, 720 Brown-Marx Bldg.
Detroit	4210 Woodward Ave.	Charlotte, N. C.	J. S. Cothran, Com'l Bank Bldg.
Kansas City, Mo.	306 Elmhurst Bldg.	Canadian Link-Belt Co., Ltd.,	Toronto and Montreal

H. W. CALDWELL & SON CO., CHICAGO NEW YORK, Woolworth Bldg. DALLAS, TEXAS, 709 Main St.



Link-Belt Chain Plants Indianapolis, Ind.



BY INVITATION MEMBER OF
RICE LEADERS OF THE WORLD ASSOCIATION
NEW YORK, U.S.A.

In the Final Analysis——Cast-Iron Pulleys

Have you ever thought of the pulley troubles you have had and how invariably the drive was made satisfactory by installing Cast-Iron pulleys—either supplanting pulleys of some other type or by changing to cast-iron pulleys of suitable construction?

BUT IT WAS A CAST-IRON PULLEY THAT FINALLY STOOD UP UNDER THE SERVICE

Almost every user of power has had this experience and always the solution of continuously satisfactory transmission service has been the installation of cast-iron pulleys.

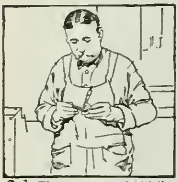
The use of cast-iron pulleys in the initial installation will prevent trouble.

T. B. WOOD'S SONS CO., Chambersburg, Penna.

POWER TRANSMITTING MACHINERY

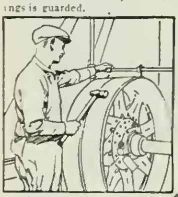
AMERICAN STEEL SPLIT PULLEYS

1st Careful laboratory work watches the fitness of the steel itself.



2d The micrometer faithfully guards the uniform correctness of jigs, dies and tools.

3d This test picture shows how the accuracy of bushings is guarded.



4th Guarding circumferential accuracy. Lasting trueness is assured by a series of such tests.

Uniformity of Service

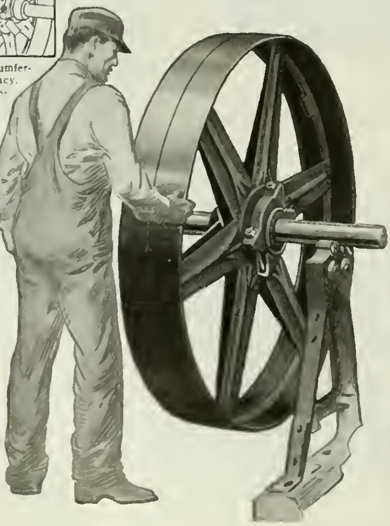
THIS essential condition of pulley efficiency is safeguarded by a long series of scientific and practical tests in the manufacturing process of "American" Pulleys. These tests make certain that each "American" Pulley is as true and perfect as every other "American."

And, in turn, this assured uniformity must be one of the major reasons why nearly six million "American" Pulleys are now in operation, both here and abroad.

A book entitled "Getting Maximum Pulley Efficiency" will be mailed you on request, at once.

The American Pulley Co.
Philadelphia, Pa.

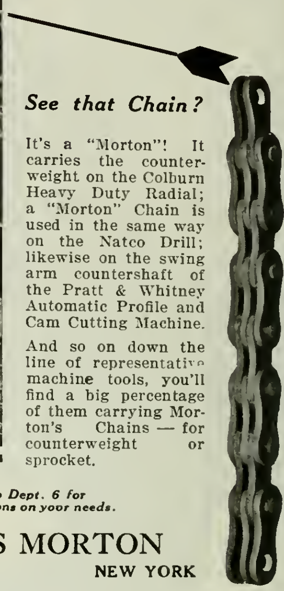
Manufacturers of Steel Split Transmission Pulleys, Steel Sash Pulleys and Pressed Steel Shapes



For complete list of distributors see MacRae's Blue Book

MORTON'S CHAINS

for
Machine Equipment



See that Chain?

It's a "Morton"! It carries the counterweight on the Colburn Heavy Duty Radial; a "Morton" Chain is used in the same way on the Natco Drill; likewise on the swing arm countershaft of the Pratt & Whitney Automatic Profile and Cam Cutting Machine.

And so on down the line of representative machine tools, you'll find a big percentage of them carrying Morton's Chains — for counterweight or sprocket.

Write to Dept. 6 for quotations on your needs.

THOMAS MORTON
245 Centre St. NEW YORK

STEEL BEARING BALLS

BRASS AND BRONZE BALLS

STEEL BURNISHING BALLS

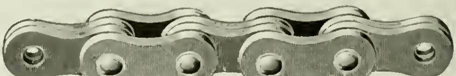
ASK FOR PRICE LIST 104

THE ABBOTT BALL CO.
ELMWOOD HARTFORD, CONN.

CABLE CHAINS

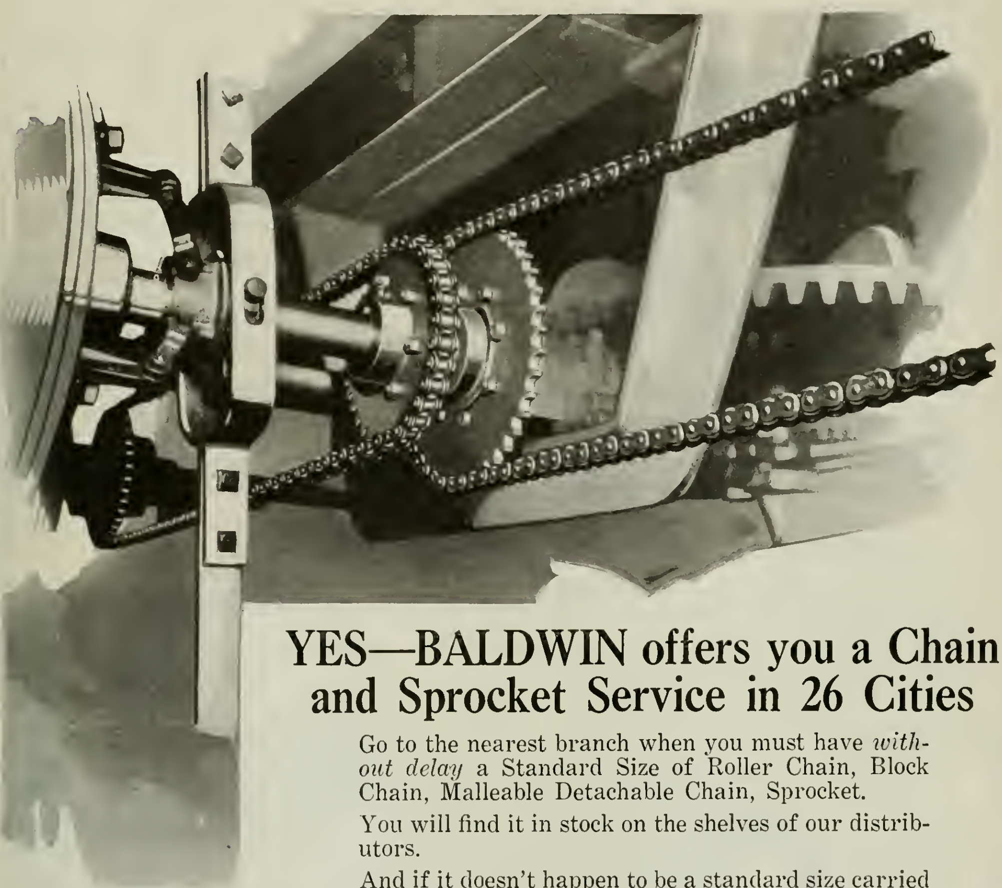
MADE IN EIGHT DIFFERENT SIZES.

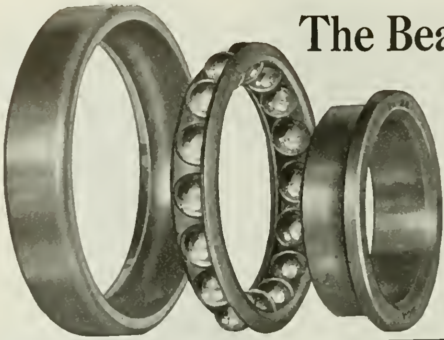
No. 30 CABLE CHAIN



NO. 50 CABLE CHAIN

THE SMITH & EGGE MFG. CO.
BRIDGEPORT, CONN.





The Bearings Company of America

LANCASTER, PENNA.

Manufacturers of Thrust Ball Bearings of all types, also

Angular Contact Thrust Bearings
Angular Contact Radial Bearings

Let our Engineers help to solve your Bearing problems.

Detroit, Michigan Office, 1012 Ford Building

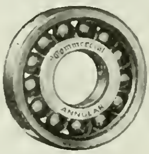
THE "Commercial" ANNULAR BALL BEARING

Eccentric Bores

Schatz "Commercial" Annular Ball Bearings can be supplied for special machines and special requirements. We have unusual facilities for producing eccentric bores, inner rings to clamp shaft, two diameter outer rings, at a reasonable cost.

Inexpensive. For moderate radial and radial thrust loads at 3,000 r.p.m. or less.

Catalog, discount sheet and samples



The Schatz Manufacturing Co.

Poughkeepsie, N. Y.

Pacific Coast Representatives:
F. M. Cobbledick Co., 1031 Polk St., San Francisco, Cal.

Those who have experienced the "just as good" kind now demand Hoover.

The World's Largest Plant Manufacturing Steel, Brass, Bronze, Monel, Aluminum and Hollow Balls

HOOVER STEEL BALL CO.

ANN ARBOR MICH.

Chicago .... 180 North Market Street
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Chattanooga .... Sanford Brothers

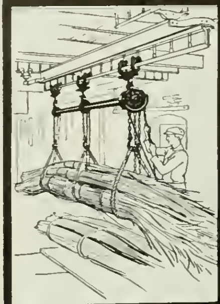
Cullman Sprockets

in stock and to order

For Block, Roller and High Speed Silent Chains. New Catalogue

CULLMAN WHEEL CO., 1339 Altgeld St., Chicago

WRIGHT HOIST



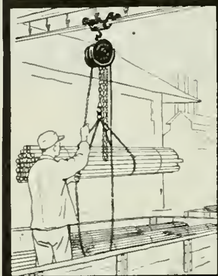
ARE you conserving Time, Energy, and Costs in your Hoisting Operations?

Wright Hoists are built to accomplish these results.

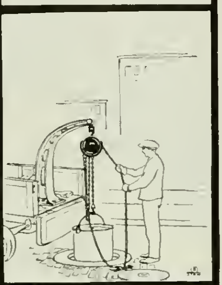
May we tell you how ruggedly they are built?

What's your name and address?

WRIGHT MANUFACTURING COMPANY
Lisbon, Ohio, U. S. A.

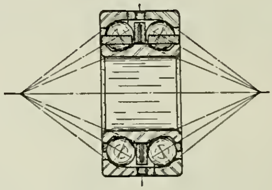


Loading Gondola



Cleaning Manhole, Hoist Suspended from Hook

Langhaar Self-Adjusting (L-S-A) Ball Bearings



COMPLETE

Because of SELF-ADJUSTMENT

Precision grinders are obtainable equipped with these bearings; giving greater production, no spindle play, and no spindle adjustments.

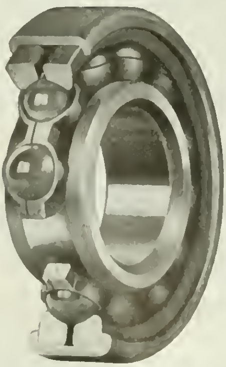
Specify L-S-A Bearings.

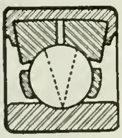
The Langhaar Ball Bearing Co.
Second Street Aurora, Indiana

Schatz "UNIVERSAL" Annular BALL BEARING

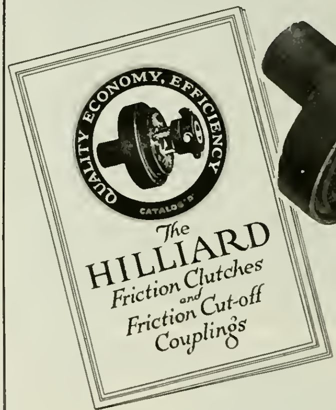
Registered U S Pat Off

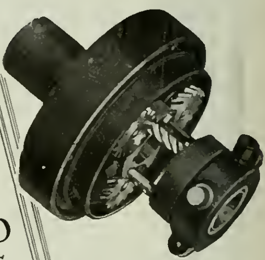
A large number of large balls operates in races scientifically formed to support them and maintain perfect alignment. 50% thrust capacity in either direction.





The Federal Bearings Co., Inc.
Poughkeepsie, N. Y.





No Levers; No Toggle Joints

The New Issue of the

HILLIARD BOOKLET

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The Hilliard Clutch & Machinery Co.
ELMIRA, N. Y., U. S. A.

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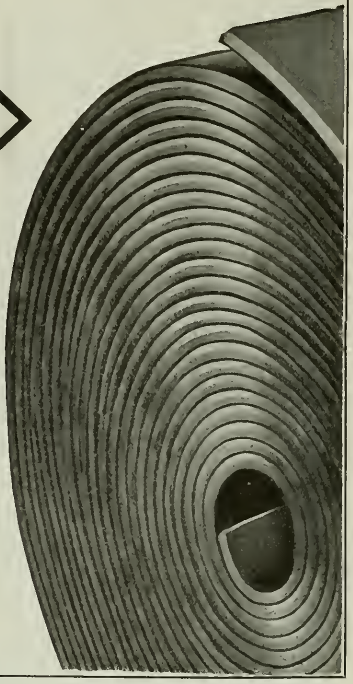

Cut from backbone center stock of carefully curried oak-tanned leather—"live" leather that retains its resiliency for years.

Seventy-three years' experience in belt manufacturing enables us to guarantee uniform quality, complete satisfaction.

Try Cocheco Belting where the drive is *hard on the belt.* Send for the Cocheco Belting Booklet; it tells why good leather belting is a profitable investment.

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Dover, New Hampshire, U. S. A.

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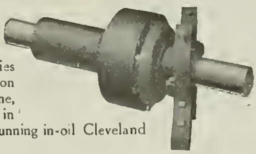
The above cut represents our No. 190 ½" Pitch Roller Chain, designed particularly for all kinds of Wrapping, Folding, Labelling and Cutting Machines. We have many other models, each especially fitted for some individual task. Our prices are low enough to be attractive and all our Chains are of flawless quality. We shall be glad to send our catalog and offer estimates.

DUCKWORTH CHAIN & MFG. CO.
Established 1871 SPRINGFIELD, MASS.

protects itself from all dirt



DIRT and dust, enemies of smooth operation and long life in any machine, are never given a chance in the entirely enclosed, running in-oil Cleveland Clutch.

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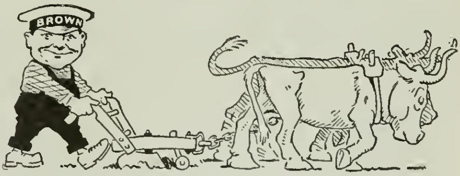
THE RELIANCE GAUGE COLUMN CO.
6008 Carnegie Ave. Cleveland, Ohio



Good for Hard Pulling

Kanti - Lever Spring Couplings enable your motors to pull hard loads with ease. By correcting misalignment they cut down bearing pressure and reduce friction. Through their spring-spoke driving system they prevent shocks and jars from reaching your motors, thus smoothing out the load curve and cutting down the cost of motor maintenance.

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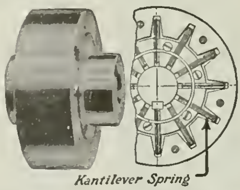
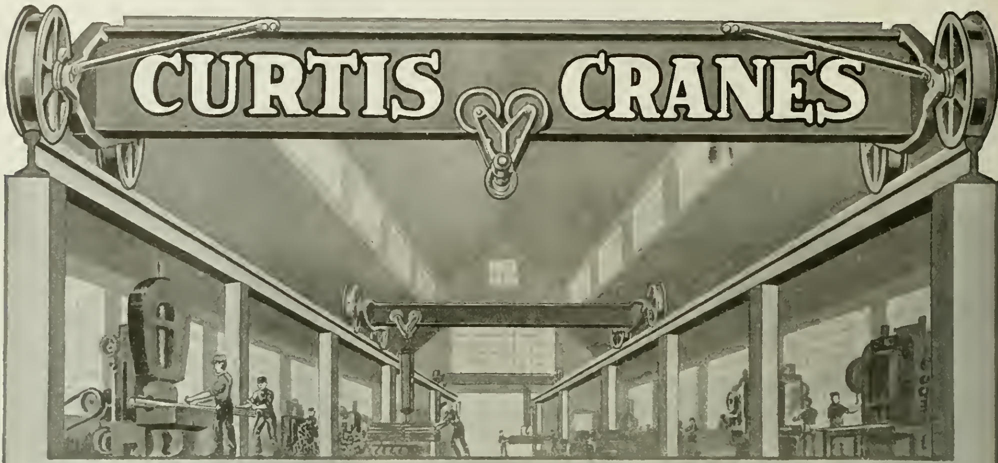
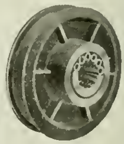
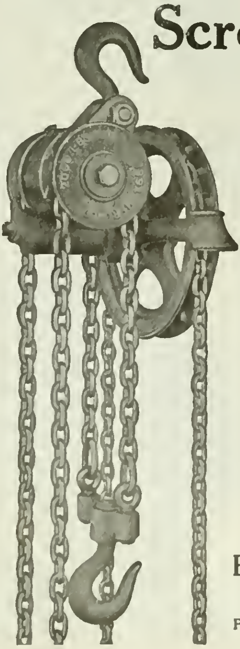


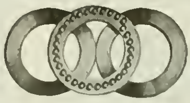
Brown
KANTI-LEVER SPRING COUPLINGS





Showing Flexible Roller Bearings





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In machines, and in parts going to make up the complete machine, the factors which will determine the difference between satisfactory service and dissatisfaction seldom reveal themselves to superficial examination. That difference lies in the intangible elements broadly comprehended in the word "quality."

All good ball bearings look very much alike. The vital differences determining values become apparent only under the tests of service. The performance records of "NORMA" Precision Bearings in high-speed, high-duty, high-service machines reveal the quality which recommends these bearings preeminently for this exacting class of work.

Our engineers will welcome an opportunity to work with yours

THE NORMA COMPANY OF AMERICA
Anable Avenue
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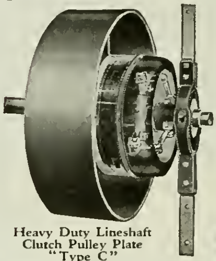
BALL, ROLLER AND THRUST BEARINGS

When Your Power Bill Is Too High

Edgemont Friction Clutches

It's surprising how much you can reduce overhead costs by an efficient unit system of power control. Whole departments, groups or single machines can be operated or shut down without reference to the rest of the plant by installing suitable Edgemont Friction Clutches at every branch of control—to apply power where, when and how it is required.



Heavy Duty Lineshaft Clutch Pulley Plate "Type C" Equipped with Oil Sleeve

Lineshafts
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Clutch and Specials
for Every Purpose

Details in Catalog "G"

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Your copy, the first installment of the DUXBAK Handbook of "Practical Facts About Belting" is awaiting your name and address.

The belting handbook will be published in 12 installments, each installment to be released the first week of each month.

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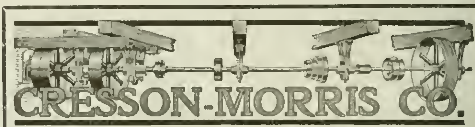

Power Transmitting Machinery

We make a specialty of equipping plants completely with power transmission machinery; including shafting, rope-transmission, machine cut and molded iron and steel gears for heavy service.

Over sixty years' experience and competent engineering advice are at your disposal.

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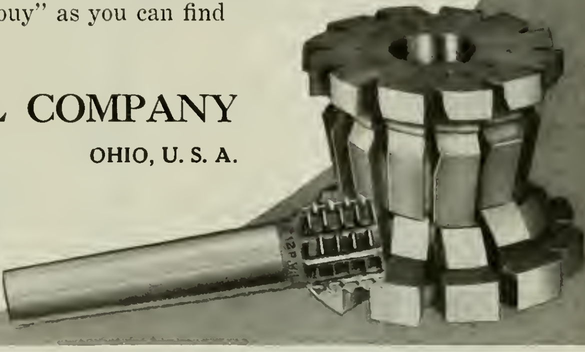
Large stocks—wide assortment of standard cutters always ready for delivery.

Efficient manufacturing methods and an exceptionally well planned distributing service make National Cutting Tools as profitable a "buy" as you can find in the cutting tool market.



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Thrust Bearing Specialists

Bearings Made To Your Requirements

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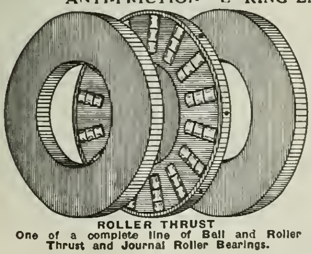

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We are rendering a special service in the design and manufacture of Ball and Roller Thrust and Journal Roller Bearings. In many places where anti-friction bearings should be used they are not used because the requirement is a special one. The Hamilton Engineers have spent a lifetime on such problems. They are prepared to design and make anti-friction bearings of all types. What is your problem?

One of a complete line of Ball and Roller Thrust and Journal Roller Bearings.

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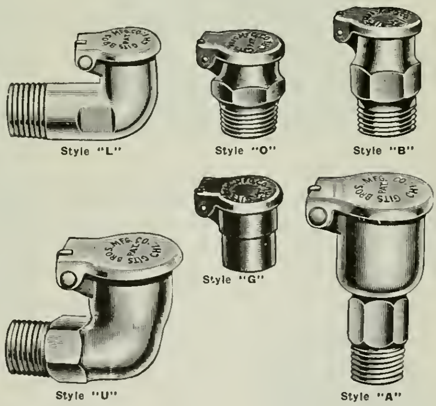
HAMILTON BEARING & MANUFACTURING CO.
Philadelphia, Penna.



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Give perfect satisfaction where others fail. State style and size in which you are interested, and we will send free samples and catalog.

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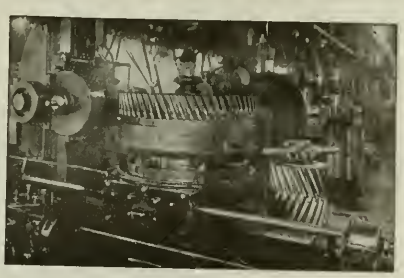

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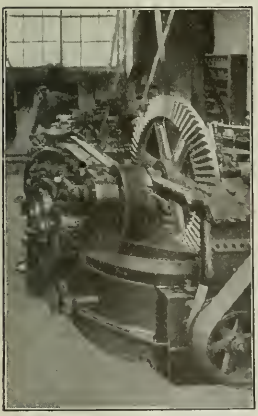
Take a look at the bird's-eye views of Phillie Gear's whole plant, and remember that the business was started only 30 years ago—the first exclusive gear making plant in the country—and has attained its present proportions solely on the merits of the service it provides.

Doesn't it indicate that this service is truly essential? And well appreciated? Doesn't it suggest that it would be a good thing for *you* also to send your gear orders to Phillie Gear?

**Bevel, Spur,
Mitre, Helical,
Spiral, Herringbone,
Worms, Wheels,
Racks, Etc.
Pinions to
Mill Gears—
any size and
in any quantity.**



Phillie Gear's Catalog is a Regular Treatise on Gears—Yours for the asking.

"Speed" is Phillie Gear's middle name; but he doesn't use it in business, for fear of misleading people who do not know that "accuracy" heads the list of "musts" in his shop.

His fondness for speed shows itself in the absence of red tape, in the accessible arrangement of his enormous stock of "ready to ship" gears and in the care with which he schedules the work so that every man and machine make "every second count."

Philadelphia GEAR Works 1120-1128 Vine St. Philadelphia

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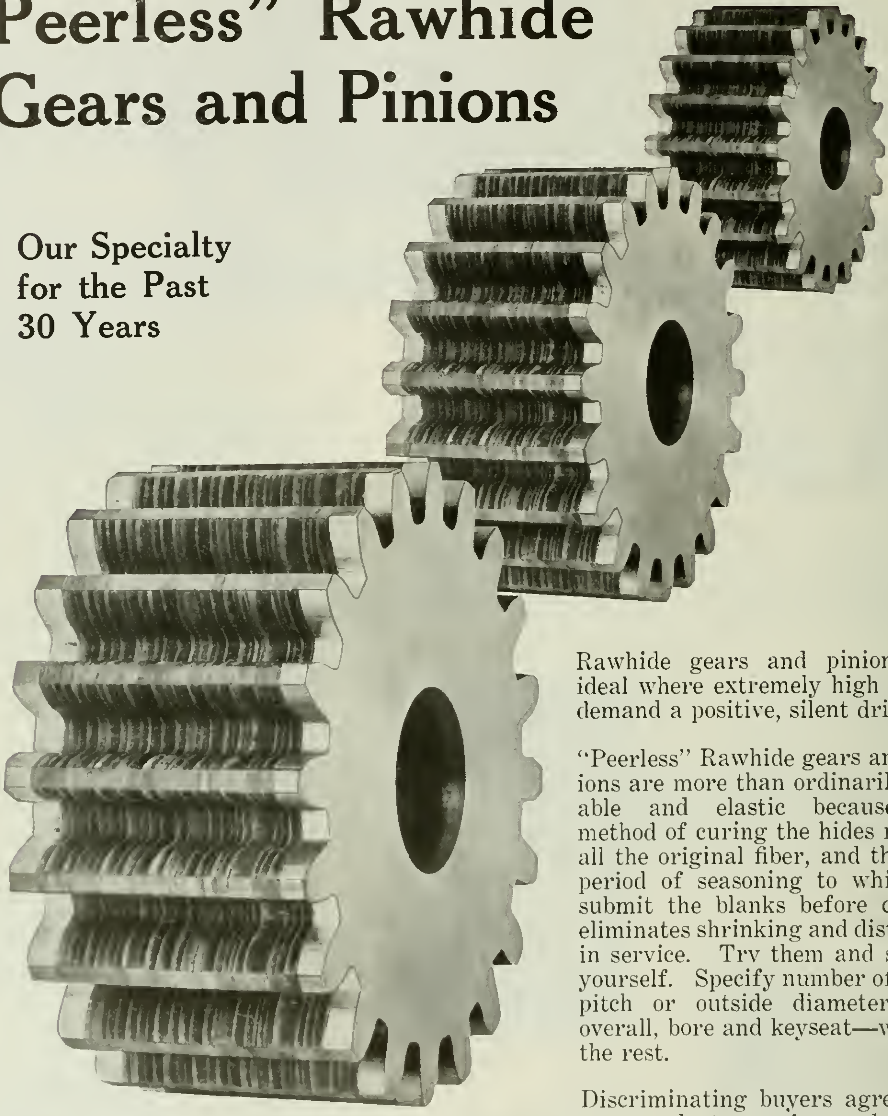
Our Specialty
for the Past
30 Years



Rawhide gears and pinions are ideal where extremely high speeds demand a positive, silent drive.

"Peerless" Rawhide gears and pinions are more than ordinarily durable and elastic because our method of curing the hides retains all the original fiber, and the long period of seasoning to which we submit the blanks before cutting eliminates shrinking and distortion in service. Try them and see for yourself. Specify number of teeth, pitch or outside diameter, face overall, bore and keyseat—we'll do the rest.

Discriminating buyers agree that our product, service and prices are right.

We also manufacture metal gears ¾ inch to 12 feet.

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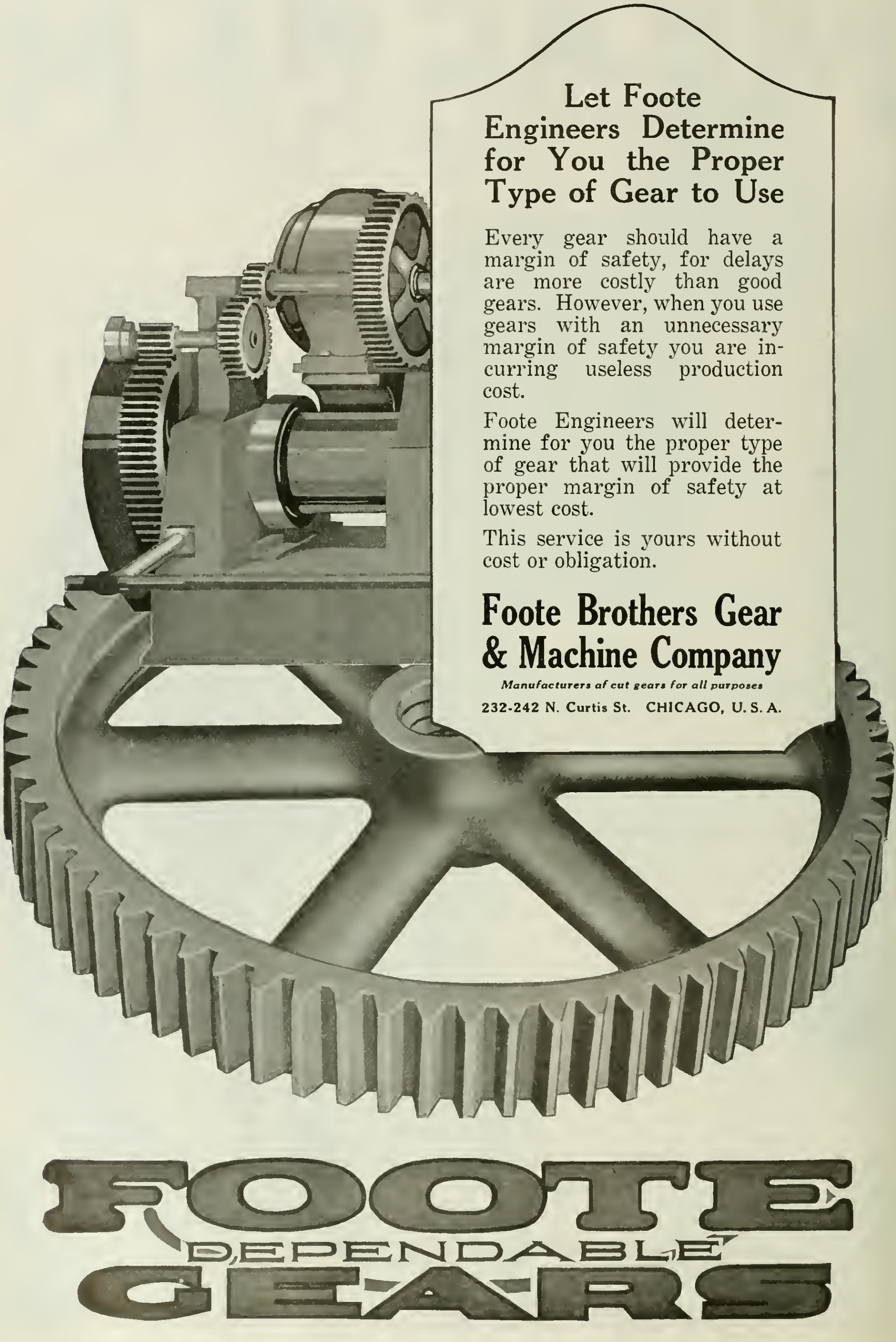
MEACHEM


Let Foote Engineers Determine for You the Proper Type of Gear to Use
Every gear should have a margin of safety, for delays are more costly than good gears. However, when you use gears with an unnecessary margin of safety you are incurring useless production cost.
Foote Engineers will determine for you the proper type of gear that will provide the proper margin of safety at lowest cost.
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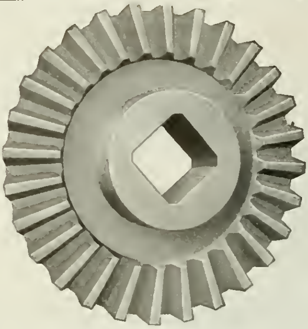
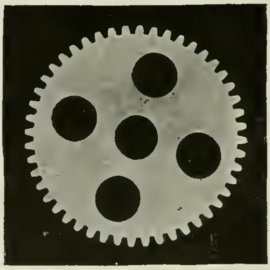
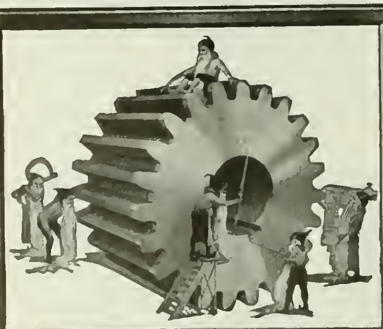
Foote Brothers Gear & Machine Company
Manufacturers of cut gears for all purposes
232-242 N. Curtis St. CHICAGO, U. S. A.
FOOTE
DEPENDABLE
GEARS







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Greater Accuracy
" Production
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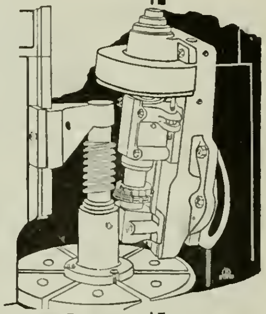
is attained by employing the G & E Worm Hobbing Method, (*Patents applied for.*) than is possible by any other process.

Progressive manufacturers find it the most economical and speediest method available to keep apace with large production schedules.

Shall we submit facts? Send us blueprints of the worms you use.



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AUTOMATIC GEAR AND RACK CUTTING MACHINERY

ESTABLISHED 1833 NEWARK, N.J. U.S.A. CHANCELLOR AVE.

CONNECTICUT GEARS

5 P or finer spur or worm gears 36" or smaller

10 P or finer helical, spiral, herringbone 8" or smaller

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May we quote? *Formica?*

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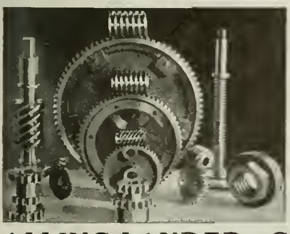

Put Alling-Lander Gears in your machines and insure silent, smooth, easy operation. Silent operation is a talking point that wins new buyers of any mechanical product.

Alling-Lander gears are high in quality of finish and accuracy. Prices are fair. Deliveries according to promise. Send your prints and specifications for quotation.

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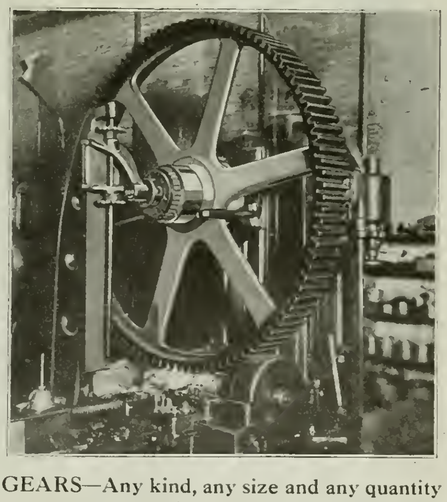

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Satisfaction Assured

D. O. JAMES MFG. COMPANY
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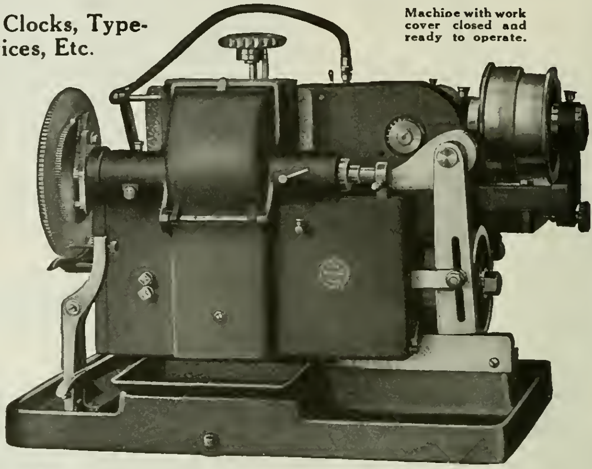
4" SPUR GEAR CUTTING MACHINES OF PRACTICAL DESIGN AND CAREFUL WORKMANSHIP

Of interest to Manufacturers of Clocks, Typewriters, Watches, Recording Devices, Etc.



Machine with work cover closed and ready to operate.

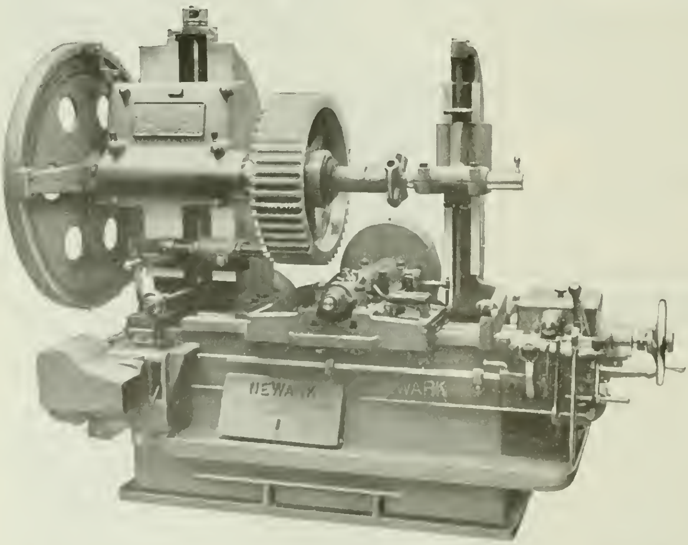
Machines so nearly automatic that they can be operated to good advantage in battery; that occupy only 18" by 28" of bench room, and provide four cutting speeds—300 and 375 R.P.M. for steel work, 1200 and 1500 R.P.M. for brass—and a standard 10" index with 120 divisions—8 to 120.

Though these machines are designed for production, they are so easily set up that they are equally profitable for jobbing; and individual geared pump, silent chain drive, plenty of ball bearings and other "quality" features insure uninterrupted satisfaction and low maintenance costs. Catalog on request.

Small Thread Millers, Gear Cutters and other small Automatic Machines

WALTHAM MACHINE WORKS, Newton St., Waltham, Mass.

Newark Spur Gear Cutting Machine



Newark Spur Gear Cutting Machines, for steady everyday run of gears.

Highest production per day. Lowest upkeep.

Nothing complicated to confuse the operator or to get out of order.

NEWARK GEAR CUTTING MACHINE CO.

NEWARK HENRY E. EBERHARDT, President NEW JERSEY

900 Oil Pumps, Air Pumps and Brass-Fitted Water Pumps

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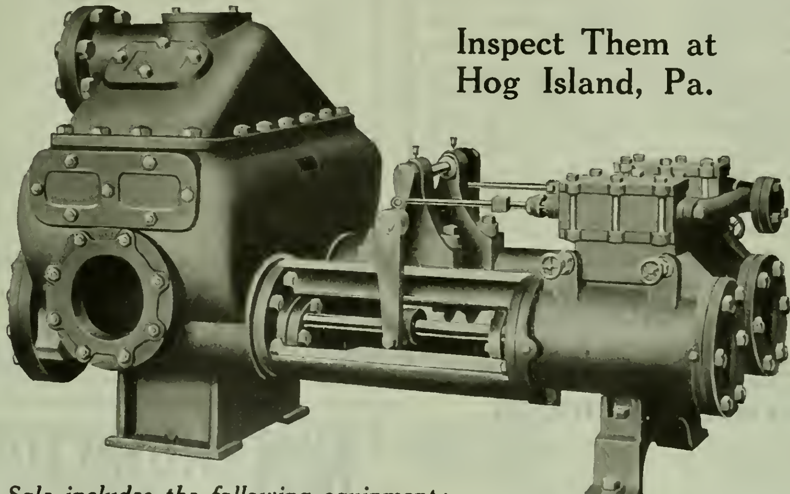
BY THE UNITED STATES SHIPPING BOARD

Through the United States Shipping Board Emergency Fleet Corporation



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Hog Island, Pa.

This Sale includes the following equipment:

110 Air, rotex and condensate
22 Centrifugal, steam driven
136 Duplex and simplex horizontal steam pumps
296 Duplex and simplex vertical steam pumps
6 Centrifugal, gas driven
139 Diaphragm, gas driven
5 Centrifugal, for motor or belt drive
167 Hand diaphragm and force pumps
8 Piston type, gas driven

BUILT BY ESTABLISHED PUMP MANUFACTURERS

CONTRACTORS, MANUFACTURERS, ENGINEERS AND SHIPBUILDERS are urged to visit Hog Island, where every facility will be extended to them for the inspection of this stock, which contains pumps in a large variety of sizes and capacities.

Any or all of these pumps will be sold "as is, where is," and without warranty as to condition, quality or capacity. The United States Shipping Board Emergency Fleet Corporation will load on cars at its expense at above location. Pumps are offered subject to prior sale or other disposition.

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J. T. EASON, Sales Manager, Material Sales Division

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2" Cleveland Model "A" Automatic
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1-M Potter & Johnston Automatic Horizontal
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No. 612 Fellows Gear Shaper, GOOD AS NEW
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400-ton Hydraulic Forcing Press
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Boring Machine, 6 sp. Foote-Burt
Boring Machine, 52" Bertram
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Drills, 14" 4 sp. Allen B. B. (7)
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Punches and Shears, Cleveland Style E. F., single end, 36" and 48" throats. (2)
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Screw Machines, 2", 2¼", 2½", model "A" Cleveland automatic
Shaper, 24" Steptoe B. Gd.
Shears, 52" Loy & Nawrath Power Square, actual stroke 4"

Lots More In Our Store

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551-557 Washington Blvd. Chicago

Priced Right for Present Conditions

1—Bradford 18 x 8' Standard Engine Lathe, S.B.G. C. R.
1—⅞" Cleveland Automatic Screw Machine
1—2" Cleveland Automatic Screw Machine
1—Wells Cutter Grinder, plain
1—Hurlbut Rogers 4" Double Cut-off Machine
1—Hurlbut-Rogers 5" Double Cut-off Machine
1—Niles Horizontal Boring Machine, 3 3/16" bar
1—No 1½ Brown & Sharpe Plain Milling Machine, cone drive
1—Bridgeford 36" x 24' Extra Heavy Geared Head Engine Lathe, motor driven
1—Lodge & Shipley 36" x 22' Geared Head Quick Change Lathe
1—No. 2 Brown & Sharpe Plain Milling Machine
1—King 40" Vertical Boring Mill, two heads
1—LeBlond No. 4 Plain Milling Machine, D.F.B.G. Table 16¼ x60"
1—Porter-Cable 9" x 20" Production Lathe
1—American Tool & Machine Co.'s No. 1 Square Arbor Brass Worker's Lathe
1—LeBlond 25" x 24' UC Engine Lathe, taper attachment, 20" 4 jaw chuck
1—No. 2 Brown & Sharpe Vertical Milling Machine
1—2 spindle Garvin Profiler
1—Cincinnati Electric Grinder, 120 volt D. C.
1—Brown & Sharpe No. 29 Plain Cylindrical Grinder, capacity 18" x 10' between centers
1—Landis 16" x 72" Plain Cylindrical Grinder
1—Brown & Sharpe No. 2 Surface Grinder
1—6" Oster Pipe Machine and equipment
1—36 x 36 x 12' Gray Planer, four heads

The E. A. Kinsey Co., Cincinnati, O. Indianapolis, Ind. Hamilton Ohio

Milling Machines Plain and Universal

NEW

3—No. 1½ Rockford Univ. Cone type, cap. 25x7½x8.
2—No. 2½ Rockford Univ. Cone type, cap. 34x9x18.
1—No. 2½ Rockford Univ. High Power Geared Single Pulley Drive, cap. 34x9x18.
1—No. 1½ American Univ. Cone type, cap. 25x9x18.
1—No. 1½ American Plain Cone type, cap. 25x9x19.
1—No. 0 Bickett Vert. Miller and Profiler.
6—P. & W. 12" Auto Mills.

USED

1—No. 1 Cincinnati Plain—arranged for motor drive.
1—No. 1½ American Plain—Cone type.
1—No. 2 Becker Plain—arranged for motor drive.
3—No. 3½ Fox Power and Hand Millers—size table 7x27½.
1—No. 4 Cincinnati Univ.—arranged for motor drive.
6—No. 32 Kempsmith Lincoln Type—Cone drive; longitudinal feed 36"; size table 36x12.
1—Ingersoll Slab—20"x20"x8'.
1—No. 1 Newton Keyseat Miller—arr. motor drive.
1—No. 2 Newton Keyseat Miller—arr. motor drive.

A FEW MISCELLANEOUS SELECTIONS

3—16" x 8' Sidney Lathes—Q.C. D.B.G.
1—37" Niles Boring Mill—2 heads.
1—50" Sellers Car Wheel Borer.
1—52" Bertsch Multiple Punch.
3—Quickwork Rotary Shears—cap. up to 1".
2—Hendey Shapers—15" and 20".
1—No. 3 Sidney Inclinable Press—weighs 2600 lbs.
1—Landis Plain Grinder—10 x 24".
2—Thompson Univ. Grinders, 10" x 36".
12—Gisholts—21" and 24" Turret Lathes
4—Multiple Drills—10 to 24 spindles.
14—Screw Machines ½" to 3¼" cap.
4—Radial Drills—3½' to 4' and 5' Plain and Univ.
1—No. 2 Oakley Univ. Cutter & Tool Grinder, 10 x 20.
1—No. 20 Lea Simplex Metal Saw.

We have over 1000 machines in stock. Carry a full line.

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Ft. Wayne, Ind.

LOUISVILLE, KY. DAYTON, OHIO

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Latest Models—Bargain Prices.

Our Green List Describes Them—Our Picture Book Illustrates Them. Write for Both.

WE WANT TO BUY FOR CASH

2000 Late Model Machines in good condition.

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2—sp. Avey, ball bearing
2—sp. Henry & Wright ball bearing
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4—sp. Francis Reed, plain bearing
20-in. Prentice Bros. sl. hd. BG., PF.
25-in. Snyder sl. hd., BG., PF., tapping att.
32-in. Cinti. Bick. H.S. shaft drive, speed box, tapping att.
37-in. Gould & Eberhardt sl. hd. BG. PF., compound table, tapping att.
42-in. Cinti. Bick. sl. hd. BG. PF., tap att., compound table
No. 11 Natco multiple spindle
No. 30 Bausch multiple sp. tapping att.
4-ft. Cinti. Bick. pl. radial, tapping att.
5-ft. Cinti. Bick. pl. radial, tapping att.
Colburn Manufacturing Type Drills

Lathes

7-in. x 32-in. Stark Precision slide rest
10-in. x 5 ft. Pratt & Whitney tool-room
14-in. x 6-ft. Lodge & Shipley, CR., PCF., taper att.
14-in. x 6 ft. Hendey, CR., PCF. Arranged for taper att.
14-in. x 6-ft. Mulliner CR., PCF., relieving att.
14-in. x 6-ft. Prentice Br. CR., PCF., QCG.
16-in. x 8-ft. Lodge & Shipley geared head. CR., PCF., taper att.
17-in. x 8-ft. LeBlond CR., PCF., QCG.
17-in. x 8-ft. Flather, CR., PCF., QCG.
18-in. x 8-ft. Rahn Larmon, CR., PCF.
20-in. x 8-ft. American, CR., PCF.
26-in. x 12-ft. Putnam, CR., PCF.
32-in. x 14-ft. Hamilton, CR., PCF., triple geared
38-in. x 20-ft. New Haven, CR., PCF.

Boring Bars

No. 2 Beaman & Smith hor. floor type, arr. for M. D.
34-in. Colburn turret head, vertical
38-in. Niles, 2 reg. heads, vertical
51-in. Niles, 2 reg. heads, vertical
110-in. Betts, 2 reg. hds., vertical

Screw Machines and Turret Lathes

½" capacity Cleveland plain automatic Model B screw machine
1" capacity Cincinnati-Acme wire feed screw machine
1¼" capacity Cincinnati-Acme wire feed screw machine
1½" capacity Cincinnati Acme wire feed screw machine
16" and 18" Cincinnati-Acme univ. Fox type turret lathe
3½" capacity No. 3 Cincinnati-Acme univ. flat turret lathe
2¼" x 24" Jones & Lamson bar or chucking equipment
3¼" x 36" Jones & Lamson bar or chucking equipment
No. 1-B Foster geared head turret lathe

Millers

Nos. 2, 3 and 4 Cincinnati, plain
Nos. 2-A and 5, and 9 Kempsmith, plain
Nos. 3 and 4 Cincinnati, vertical
Nos. 2-A, C-2, 4-B and 5 Becker Vertical
No. 2 Brown & Sharpe, universal
36-in. x 10-ft. Newton Face Slab Miller.
4½ x 12 Pratt & Whitney thread milling machine
A.C.S. Becker continuous miller

Grinders

3-in. x 18-in. Norton plain
6-in. x 32-in. Norton plain
10-in. x 36-in. Norton plain
14-in. x 72-in. Norton plain, arr. M.D.
18-in. x 96-in. Norton plain, arr. M.D.
10-in. x 30-in. Landis, plain
12-in. x 120-in. Landis, plain
12-in x 36-in. and 48-in. Cincinnati, plain
No. 2 Cincinnati, 12 in. x 36 in., universal
No. 1 Cincinnati Cutter and Reamer Grinder
No. 70 and No. 75 Heald Internal Grinders
No. 6 Rivett Internal
No. 11 Rivett, ball race
Saxon Face Grinder
10-in. Garrigus Rotary, with magnetic chuck
No. 2 Brown & Sharpe Surface Grinder
No. 16 Blanchard Grinder, direct M. D. type
18-in. and 20-in. Disc Grinders
No. 6 A Heald Cylinder Grinder

Shapers and Planers

14-in. Springfield Crank Shaper
20-in. Davis back geared crank shaper
20-in. Whipp Crank, back geared shaper
24" Stockbridge crank, back geared shaper
15" and 24" Hendey friction shapers
24" x 24" x 6' Flather planer, with 1 head
24" x 24" x 8' Cincinnati planer, 1 head
36" x 36" x 12' Pond planer, 2 heads
36" x 30" x 14' Cincinnati, planer, 3 heads
36" x 36" x 12' Cincinnati planer, 4 heads
48" x 48" x 15' Sellers planer, 3 heads
50" x 40" x 14' Pond planer, 2 heads
50" x 40" x 10' Pond planer, 2 heads
50" x 40" x 12' Pond planer, 2 heads
66" x 60" x 30' Bement planer, 3 heads

Miscellaneous

No. 00 S. & S. Hobbing Gear Cutter
No. 000 S. & S. Hobbing Gear Cutter
36-in. Brown & Sharpe Gear Cutter
No. 3 Lapointe Broaching Machine
3-in. Pratt & Whitney Centering Machine
No. 72 Ferracute Press
½-in. and 1-in. Acme Nut Tapper
Nos. 12 and 18 Pratt & Whitney Profilers
¾-in. x ¾-in. Single-end Punch and Shear
2-in. to 6-in. Merrill hand pipe machine
Newton, Burr, and Racine Saws
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1—16 x 6 American High Duty Lathe Friction Double Back Geared Head complete with quick change mechanism, complete with lead screw compound rest and countershaft, latest type $800.00
1—20 x 8 Oakley Lathe, built from American Tool Works Co. patterns, plain turning lathe without gear box or lead screw, complete with double back geared head, compound rest, tail stock and countershaft... $325.00
1—20 x 5, same as above, with turret on carriage, without tail stock $350.00
1—No. 2 Plain Cleveland Milling Machine, like new.............. $1100.00
1—32 x 32 x 12 Double Head Right Angle Worm Drive Niles Planer $1500.00
1—No. 1 Cleveland Horizontal Boring Mill, single pulley drive..... $2400.00
1—No. 2B Cochrane & Bly Cold Saw $225.00

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No. 2 Farrel Foundry 2-cycle Header

Double stroke, solid die, excellent condition. Price, **$750**

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Three 00 G. Brown & Sharpe with screw slotting attachments and two 00 turret forming machines. On hand, crated for immediate shipment. Never used. Sell market price. Box 555, care of MACHINERY, 148 Lafayette St., New York City.

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COLUMBUS OHIO

Bending Rolls, 7' for ⅜ plate
Boring Mill, vertical 12', 2 heads
Compressors, 6 x 6, 9 x 8 and 12 x 10
Drills, Sensitive 1, 2, 3, 4 and 6 spindles
Drills, Sliding Head 24, 26, 28 and 32"
Gear Cutter, 36" Whiton, spur and worm
Gear Millers, Automatic, Bilton No. 1 (5)
Grinder, Plain 10 x 24 Norton and 12 x 42 Landis
Grinders, Surface 1, 3, 78 Wilmarth & Morman
Grinders, Universal 10 x 30 Webster & Perks
Hammer, 40 lb. Bradley Cushioned Helve
Lathes, 10" x 5' Summit (4)
Lathe, 13" x 5' LeBlond with collet attachment
Lathes, 14" x 6' and 18" x 8' Monarch
Lathe, 18" x 8' Monarch, quick change
Lathe, 25" x 14', Schummacher-Boye
Milling Machine, No. 1 Kempsmith Universal
Milling Machine, No. 1½ B. & S. Plain
Milling Machine No. 2, heavy Brown & Sharpe Pl.
Milling Mch., No. 32 Kempsmith, Lincoln Type, (3)
Milling and Drilling Machine, No. 1 Knight
Oil Groover, Garvin, nearly new
Planer, 24" x 24" x 6'—1 Gray and 1 Pease
Planer, 36" x 36" x 12' Niles, parallel drive
Planer, 48" x 48" x 16' Bement-Miles, 2 head
Planer, 60" x 60" x 17' Betts
Planer, 84" x 84" x 32' Putnam, 4 head
Presses, No. 3-A, 4-A and 5-A Willard O.B.I.
Press, No. 18 Bliss open back inclinable
Press, Rockford No. 6, straight side
Punch and Shear, ½ x ½—10" throat
Radials, 3' and 4½' Morris, plain gear box
Screw Machines, National Acme, Nos. 52 and 56
Shaper, 14" Niles, traveling head
Shapers, 14", 16" and 21" Smith & Mills
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Shear, 5' Robinson, 10 gauge
Shear, 52" Niagara, 18 gauge
Turret Lathe, 1" and 1⅝" Millholland
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Motors, ½ to 50 H. P., 3 phase G. E., new

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Power Plant 200 HP Complete

Have installed Central Station Power. 200 HP. Vertical Tudor Boiler. 16 x 36 Corliss Engine. 12' diam. 21" face fly wheel. 5¼ x 3½ x 5 Worthington Duplex Feed Pump. 6-PP Wainwright Feed Water Heater. All necessary piping, gauges, valves, stack, lubricator, etc. Complete Plant. Bargain Price.

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—256 Horse Power.

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120" Niles, two swivel heads
80" Niles-Bement-Pond, 2 swivel heads
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64" Poole, 2 swivel heads, thread cutting
44" Niles, 1 swivel head, 1 turret head
42" Putnam carwheel, hub facing attachment.
32" Rogers, swivel turret head, universal jaws

MISCELLANEOUS

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11' D. H., Stoll Squaring Shear, 16 gauge
10' D. H. Stoll Squaring Shear, 16 gauge
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No. 5 Long & Allstatter, Double End Punch and Shear, 12" throat, ⅝" capacity
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21" swing Pit Lathe, triple geared, internal face plate drive
96" x 96" x 37' Hewes & Phillips Planer, 4 heads and 1 auxiliary head

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Brown & Sharpe Grinders & Millers
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10" to 48" Engine Lathes
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28" Smith & Mills B.G. Crank Shaper
Nos. 2 and 3 Plain & Univ. Millers
30" x 30" x 9' Ingersoll Slab Miller
2", 4", 6", 12" Pipe Machines
1¼," 1½", 2", 3" Bolt Cutters
3, 4, 5, 6' Radial Drills
36", 72", 90" Niles Boring Mills
54" Bullard Boring Mill, M. D., 220 V., 3 Phase, 60 Cycle
7—10' Betts Boring Mill, 2 swivel hds.
36-P Toledo Punch Press, geared 2" str.
No. 2 Toledo and No. 20 Bliss Presses.
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16" x 6' Lodge & Shipley motor driven lathe, 2 horse power, 220 volt, 3 phase, 60 cycle motor, draw-in collets, compound, taper chuck.
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No. 2 Garvin old style milling machine.
2—18 x 8 Cisco quick change lathes, draw in on 1.
16 x 6 Cisco quick change lathe.
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2 double burnishing barrels (Baird).
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2 Farrel foundry presses.
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14 x 6 Hendey, not yoke head, quick change, taper attachment.
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16" Gould & Eberhardt shaper.
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No. 3 Greenard Arbor Press.
Waterbury Farrel Foundry Screw Press.
B4 Dalton lathe with taper attachment, compound rest, collets, chuck and rests.
No. 3 Burke bench millers with draw-in attachment, dividing heads, vise, practically new.
4 small Waterbury Farrel foundry presses.
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1—Worthington Underwriters steam driven 1000 gallons fire pump.
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All in good condition and bargains.
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A most interesting general review of "The Machine Tool Trade in Japan" will be found on page 983 this number of MACHINERY. The information, which was furnished by Yamatake & Co., of Tokyo, Japan, will be of great value to the American manufacturer who is desirous of securing and holding Japanese trade. The company also offers some practical suggestions in the matter of handling and shipping, which, if followed, will go far towards avoiding the troubles that commonly beset the exporter.

FOR LOCATION OF ADVERTISEMENTS OF MANUFACTURERS LISTED IN THIS INDEX SEE ALPHABETICAL INDEX, PAGES 275-276

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'arborundum Co., Niagara Falls, N. Y.

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'hambersburg Engineering Co., Chambersburg, Pa.
:lmes Eng. Works, Charles F., 222 North Morgan St., Chicago.
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AIR HOISTS
See Hoists, Air.

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See Presses, Arbor.

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See Boring Bars.

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Ajax Mfg. Co., Cleveland, O.

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Brown Engineering Co., 133 No. 3rd St., Reading, Pa.
Bunting Brass & Bronze Co., 748 Spencer St., Toledo, O.
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Dietzgen Co., Eugene, 166 W. Monroe St., Chicago.
Economy Drawing Table & Mfg. Co., Adrian, Mich.
Keuffel & Esser Co., Hoboken, N. J.
Paragon Machine Co., Rochester, N. Y.

CABINETS, TOOL

Armstrong Bros. Tool Co., 313 North Francisco Ave., Chicago, Ill.
Gerstner & Sons, H., Dayton, O.
Lupton's Sons Co., David, Philadelphia, Pa.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Whitman & Barnes Mfg. Co., Akron, Ohio.

CALCIUM CARBIDE

Air Reduction Sales Co., Inc., 342 Madison Ave., N. Y.

CALIPER GAGES

Williams & Co., J. H., 61 Richards St., Brooklyn, N. Y.

CALIPERS, BOW

Brown & Sharpe Mfg. Co., Providence, R. I.
Goodell-Pratt Co., Greenfield, Mass.
Starrett Co., L. S., Athol, Mass.

CALIPERS, MICROMETER

Almond Mfg. Co., T. R., Ashburnham, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Goodell-Pratt Co., Greenfield, Mass.
Slocomb Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

CAMS

American Machine & Foundry Co., 5520 Second Ave., Brooklyn, N. Y.
Garvin Machine Co., Spring and Varick Sts., New York.
Rowbottom Mch. Co., Waterbury, Ct.

CASE-HARDENING

Meisel Press Mfg. Co., 948 Dorchester Ave., Boston 25, Mass.
Pittsburgh Gear & Mch. Co., 2700 Smallman St., Pittsburgh.
Williams & Co., J. H., 61 Richards St., Brooklyn, N. Y.

CASE-HARDENING COMPOUND

Kasenit Co., 30 South William St., New York.

CASE-HARDENING FURNACES

See Furnaces, Case-Hardening.

CASTINGS, BRASS, BRONZE AND ALUMINUM

Ajax Metal Co., Philadelphia.
Machinery Co. of America, Big Rapids, Mich.

CASTINGS, DIE OR DIE MOLDED

Doehler Die-Casting Co., Brooklyn, N. Y.
Franklin Die Casting Corp., Syracuse, N. Y.
Mt. Vernon Die-Casting Corp., Mt. Vernon, N. Y.
Republic Die Casting Co., 138 Mott St., New York.
Superior Die-Casting Co., Cleveland.
Veeder Mfg. Co., 39 Sargeant St., Hartford, Conn.

CASTINGS, DIE OR DIE MOLDED ALUMINUM

Doehler Die-Casting Co., Brooklyn, N. Y.
Franklin Die-Casting Corp., Syracuse, N. Y.
Mt. Vernon Die-Casting Corp., Mt. Vernon, N. Y.
Republic Die Casting Co., 138 Mott St., New York.
Superior Die-Casting Co., Cleveland.

CASTINGS, GRAY IRON

Brown & Sharpe Mfg. Co., Providence, R. I.
Cresson-Morris Co., Philadelphia.
Machinery Co. of America, Big Rapids, Mich.
Sinclair Engine & Fdry. Co., Inc., New Orleans, La.
Sweet & Doyle Foundry & Machine Co., Troy, N. Y.
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.

CASTINGS, MALLEABLE

Link-Belt Company, Chicago.

CASTINGS, STEEL

Cresson-Morris Co., Philadelphia.
Farrell-Cheek Steel Foundry Co., Sandusky, O.

CEMENT, DISC GRINDING WHEEL

Badger Tool Co., Beloit, Wis.
Gardner Machine Co., Beloit, Wis.

CENTERING MACHINES

Hanson-Whitney Machine Co., Hartford, Conn.
Hendey Mch. Co., Torrington, Conn.
Newton Mch. Tool Works, Inc., Philadelphia, Pa.
Niles-Bement-Pond Co., 111 Broadway New York.
Porter Cable Machine Co., Syracuse, N. Y.
Pratt & Whitney Co., Hartford, Conn.
Standard Engineering Works, Pawtucket, R. I.
Whiton Mch. Co., D. E., New London, Conn.

CENTERS, PLANER AND MILLER

Cincinnati Planer Co., Cincinnati.
Morse Twist Drill & Mch. Co., New Bedford, Mass.

CHAIN BLOCKS

See Hoists, Chains, etc.

CHAIN, CABLE FOR COUNTERWEIGHTS, ETC.

Morton, Thomas, 245 Centre St., New York.
Smith & Egge Mfg. Co., Bridgeport, Conn.

CHAINS, POWER TRANSMISSION

Baldwin Chain & Mfg. Co., Worcester, Mass.
Boston Gear Works, Norfolk Downs, Mass.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Duckworth Chain & Mfg. Co., Springfield, Mass.
Link-Belt Company, Chicago.
Morse Chain Co., Ithaca, N. Y.
Morton, Thomas, 245 Centre St., New York.
Whitney Mfg. Co., Hartford, Conn.

CHECKS, TIME, TOOL AND PAY

Matthews & Co., Jas. H., Pittsburgh.
Noble & Westbrook Mfg. Co., Hartford, Conn.
Pannier Bros. Stamp Co., Pittsburgh.
Schwerdtle Stamp Co., Bridgeport, Ct.

CHISEL BLANKS

Hunter Saw & Mch. Co., Pittsburgh.

CHUCKING MACHINES, AUTOMATIC

Gisholt Machine Co., 9 South Baldwin St., Madison, Wis.
Jones & Lamson Mch. Co., Springfield, Vt.
McDonough Mfg. Co., Eau Claire, Wis.
Potter & Johnston Machine Co., Pawtucket, R. I.

CHUCKING MACHINES, MULTIPLE SPINDLE, AUTOMATIC

McDonough Mfg. Co., Eau Claire, Wis.

CHUCKING MACHINES, SEMI-AUTOMATIC

Brown & Sharpe Mfg. Co., Providence, R. I.
Gisholt Machine Co., 9 South Baldwin St., Madison, Wis.
Jones & Lamson Mch. Co., Springfield, Vt.
National Acme Co., Cleveland.

CHUCKS, AIR-OPERATED

Bardons & Oliver, Cleveland.
Frontier Chuck & Tool Co., Buffalo, N. Y.
Garvin Machine Co., Spring and Varick Sts., New York.
Hannifin Mfg. Co., Kolmar Ave. and Lexington St., Chicago.
Nelson-Blanck Mfg. Co., Detroit, Mich.
S-P Mfg. Co., Cleveland.

CHUCKS, COLLET OR SPLIT

Ames Co., B. C., Waltham, Mass.
Hardinge Bros., Inc., Bertean and Ravenswood Aves., Chicago.
Ney Co., J. M., Hartford, Conn.
Rivett Lathe & Grinder Co., Brighton, Boston.
Standard Engineering Works, Pawtucket, R. I.
Stark Tool Co., Waltham, Mass.

CHUCKS, DRILL

Almond Mfg. Co., T. R., Ashburnham, Mass.
Beaman & Smith Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland.
Cushman Chuck Co., Hartford, Conn.
Detroit Twist Drill Co., Detroit.
Eastern Tube & Tool Co., Inc., Brooklyn, N. Y.
Goodell-Pratt Co., Greenfield, Mass.
Horton & Son Co., E., Windsor Locks, Conn.
Jacobs Mfg. Co., Hartford, Conn.
Johansson, Inc., C. E., Poughkeepsie, N. Y.
Marvin & Casler Co., Canastota, N. Y.
McCrosky Tool Corp., Meadville, Pa.
Modern Tool Co., 2nd and State Sts., Erie, Pa.

Morse Twist Drill & Mch. Co., New Bedford, Mass.
Narragansett Machine Co., Providence, R. I.
National Twist Drill & Tool Co., Detroit.
Scully-Jones & Co., 2013 W. 13th St., Chicago.
Skinner Chuck Co., New Britain, Ct.
Titan Tool Co., Erie, Pa.
Trump Bros. Machine Co., Wilmington, Del.
Union Mfg. Co., New Britain, Conn.
Westcott Chuck Co., Oneida, N. Y.
Watts Bros. Tool Works, Turtle Creek, Pa.
Whiton Machine Co., D. E., New London, Conn.

CHUCKS, ECCENTRIC BORING

Marvin & Casler Co., Canastota, N. Y.

CHUCKS, FULL FLOATING

Watts Bros. Tool Works, Turtle Creek, Pa.

CHUCKS, LATHE, ETC.

Almond Mfg. Co., T. R., Ashburnham, Mass.
Cushman Chuck Co., Hartford, Conn.
Foster Machine Co., Elkhart, Ind.
Gisholt Machine Co., 9 South Baldwin St., Madison, Wis.
Hardinge Bros., Inc., Berteau and Ravenswood Aves., Chicago.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Horton & Son Co., E., Windsor Locks, Conn.
McCrosky Tool Corp., Meadville, Pa.
Rivett Lathe & Grinder Co., Brighton District, Boston.
Ryerson & Son, Joseph T., 2558 West 16th St., Chicago.
Sinclair Engine & Fdry. Co., Inc., New Orleans, La.
Skinner Chuck Co., New Britain, Ct.
Union Mfg. Co., New Britain, Conn.
Westcott Chuck Co., Oneida, N. Y.
Whiton Mch. Co., D. E., New London, Conn.

CHUCKS, MAGNETIC

Heald Mch. Co., 16 New Bond St., Worcester, Mass.
Walker Co., Inc., O. S., Worcester, Mass.

CHUCKS, PLANER

Cincinnati Planer Co., Cincinnati, O.
Cushman Chuck Co., Hartford, Conn.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Horton & Son Co., E., Windsor Locks, Conn.
Skinner Chuck Co., New Britain, Ct.
Union Mfg. Co., New Britain, Conn.

CHUCKS, TAPPING

Beaman & Smith Co., Providence, R. I.
Errington Mechanical Laboratory, Broadway and John St., New York.
McCrosky Tool Corp., Meadville, Pa.
Procunier, Wm. L., 18 South Clinton St., Chicago.
Scully-Jones & Co., 2013 West 13th St., Chicago.
Watts Bros. Tool Works, Turtle Creek, Pa.

CIRCUIT BREAKERS

General Electric Co., Schenectady, N. Y.
Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.

CLAMPS

Armstrong Bros. Tool Co., 313 No. Francisco Ave., Chicago.
Besly & Co., Charles H., 120-B No. Clinton St., Chicago.
Brown & Sharpe Mfg. Co., Providence, R. I.
Starrett Co., L. S., Athol, Mass.
Western Tool & Mfg. Co., Springfield, Ohio.
Williams & Co., J. H., 61 Richards St., Brooklyn, N. Y.

CLEANSERS, CHEMICAL FOR WASTE AND METAL

Cleveland Flue Cleaner Mfg. Co., Cleveland.
Oakley Chemical Co., 26 Thames St., New York.

CLEANING COMPOUND

See Compound, Cleaning.

CLOCKS, WATCHMEN'S

Hardinge Bros., Inc., Berteau and Ravenswood Aves., Chicago.

CLUTCHES, FRICTION, ETC.

Brown Co., A. & F., 79 Barclay St., New York.
Brown Engineering Co., 133 No. 3rd St., Reading, Pa.
Caldwell & Son Co., H. W., 17th St. and Western Ave., Chicago.
Cresson-Morris Co., Philadelphia.
Edgemont Machine Co., Dayton, O.
Hilliard Chuck & Mchy. Co., Elmira, N. Y.
Johnson Machine Co., Carlyle, Manchester, Conn.
Jones Foundry & Machine Co., W. A., 4409 W. Roosevelt Rd., Chicago.
Link-Belt Company, Chicago.
Moore & White Co., 2707-2737 No. 15th St., Philadelphia.

Production Machine Co., Greenfield, Mass.
Reliance Gauge Column Co., 6008 Carnegie Ave., Chicago.
Skayef Ball Bearing Co., 165 Broadway, New York.
S K F Industries, Inc., 165 Broadway, New York
Wood's Sons Co., T. B., Chambersburg, Pa.

COLLARS, SAFETY
Bridgeport Safety Emery Wheel Co., Inc., Bridgeport, Conn.
Brown Co., A. & F., 79 Barclay St., New York.
Link-Belt Company, Chicago.
Royersford Foundry & Machine Co., 54 North 5th St., Philadelphia.
Standard Pressed Steel Co., Jenkintown, Pa.
Wood's Sons Co., T. B., Chambersburg, Pa.

COLLARS, SPACING, ETC.
Detroit Stamping Co., Detroit, Mich.
Scully-Jones Co., 2013 West 13th St., Chicago.

COLLETS
Cleveland Twist Drill Co., Cleveland.
Pratt & Whitney Co., Hartford, Conn.
Union Twist Drill Co., Athol, Mass.

COLLETS, SPRING
Ames Co., B. C., Waltham, Mass.
Hardinge Bros., Inc., Berteau and Ravenswood Aves., Chicago.
Ney Co., J. M., Hartford, Conn.
Rivett Lathe & Grinder Co., Brighton, Boston.
Standard Engineering Works, Pawtucket, R. I.
Stark Tool Co., Waltham, Mass.

COMMUTATORS
General Electric Co., Schenectady, N. Y.
Westinghouse Electric & Mfg. Co., E. E. Pittsburgh, Pa.

COMPARATOR, SCREW THREAD
Coats Machine Tool Co., Inc., 112 W. 40th St., New York.
Jones & Lamson Mch. Co., Springfield, Vt.

COMPOUND, CLEANING
Cleveland Flue Cleaner Mfg. Co., Cleveland.
Oakley Chemical Co., 26 Thames St., New York.

COMPOUND, CUTTING, GRINDING, ETC.
Oakley Chemical Co., 26 Thames St., New York.
Sun Company, Philadelphia.
Texas Company 17 Battery Place, New York.
White & Bagley Co., Worcester, Mass.

COMPRESSING PLANTS, ACETYLENE
Air Reduction Sales Co., 342 Madison Ave., New York.

COMPRESSORS, AIR AND GAS
Curtis Pneumatic Machinery Co., 1568 Kienlen Ave., St. Louis, Mo.
General Electric Co., Schenectady, N. Y.
Ingersoll-Rand Company, 11 Broadway, New York.

CONDUITS
Eastern Tube & Tool Co., Inc., Brooklyn, N. Y.

CONNECTORS, FRANKEL SOLDERLESS
Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.

CONTRACT WORK
American Machine & Foundry Co., 5520 2nd Ave., Brooklyn, N. Y.
American Tool & Mfg. Co., Urbana, O
Bliss Co., E. W., Brooklyn, N. Y.
Brock Tool & Mfg. Works, Arthur, Jr., Philadelphia.
Brown & Sharpe Mfg. Co., Providence, R. I.
Diefendorf Gear Corp., Syracuse, N. Y.
Du Pont Engineering Co., Wilmington, Del.
Gisholt Machine Co., 9 South Baldwin St., Madison, Wis.
Globe Machine & Stamping Co., Cleveland.
Hanna Engineering Works, 1763 Elston Ave Chicago.
Kent-Owens Mch. Co., Toledo, O
Langelier Mfg Co., Arlington, Cranston, R. I.
Marvin & Casler Co., Canastota, N. Y.
Marvin Mfg. Co., W. B., Urbana, O.
Mehl Mch. Tool & Die Co., Roselle, N. J.
Meisel Press Mfg. Co. 948 Dorchester Ave., Boston 25.
McIrvin-Gabrielson Corp., Syracuse, N. Y.
Minster Machine Co , Minster, O
Modern Tool, Die & Machine Co., Columbus, O.

Mummert-Dixon Co., Hanover, Pa.
Nicholson & Co., W. H., 112 Oregon St., Wilkes-Barre, Pa.
Production Mch Tool Co., Cincinnati.
Reliance Die & Stamping Co., 515 No. LaSalle St. Chicago.
S P Mfg. Co., Cleveland.
Standard Gauge Steel Co., Beaver Falls, Pa.
Steel Products Engineering Co., Springfield, O.
Taylor & Fenn Co., Hartford, Conn.
U. S. Tool Co., Inc., Newark, N. J.
V & O Press Co., Glendale, Long Island, N. Y.
Woods Engineering Co., Alliance, O.

CONTROLLERS
General Electric Co., Schenectady, N. Y.
Monitor Controller Co., Baltimore, Md.
Reliance Electric & Eng. Co., 1056 Ivanhoe Road, Cleveland.
Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.

CONVEYERS, BELT
Link-Belt Company, Chicago.

CONVEYERS, GRAVITY
Caldwell & Son Co., H. W., 17th St. and Western Ave., Chicago.
Link-Belt Company, Chicago.

COTTER PINS
Williams & Co., J. H., 61 Richards St., Brooklyn, N. Y.

COUNTERBORES
Alvord Reamer & Tool Co., Millersburg Pa.
Brown & Sharpe Mfg. Co., Providence, R. I.
Chapin-Skelton Corp , Syracuse, N. Y.
Cleveland Twist Drill Co., Cleveland.
Detroit Twist Drill Co., Detroit.
Morse Twist Drill & Mch. Co., New Bedford, Mass,
National Tool Co., Cleveland.
National Twist Drill & Tool Co., Detroit, Mich.
Pratt & Whitney Co., Hartford, Conn.
Starrett Co., L. S., Athol, Mass.
Union Twist Drill Co., Athol, Mass.
Whitman & Barnes Mfg. Co., Akron, Ohio.

COUNTERSHAFTS, FRICTION, ETC.
Bardons & Oliver, Cleveland.
Brown Co., A. & F., 79 Barclay St., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders Iron Fdry. Providence, R. I.
Diamond Mch. Co., Providence, R. I.
Edgemont Mch. Co., Dayton, O.
Garvin Machine Co., Spring and Varick Sts., New York.
Gisholt Mch. Co., 9 So. Baldwin St., Madison, Wis.
Hannifin Mfg. Co., Kolmar Ave. and Lexington St., Chicago.
Hilliard Clutch & Machinery Co., Elmira, N. Y.
Jones Foundry & Mch. Co., W. A., 4409 W. Roosevelt Rd., Chicago.
LeBlond Mch. Tool Co., R. K., Cincinnati, O.
Wood's Sons Co., T. B., Chamersburg, Pa.

COUNTERSINKS
Alvord Reamer & Tool Co., Millersburg, Pa.
Cogsdill Mfg Co., Detroit, Mich.
Greenfield Tap & Die Corp., Greenfield, Mass
Whitman & Barnes Mfg. Co., Akron, Ohio.

COUNTERS, REVOLUTION
Bristol Co., Waterbury, Conn.
Brown Instrument Co , Philadelphia.
Goodell-Pratt Co., Greenfield, Mass.
Grant Mfg. & Machine Co., N. W. Station, Bridgeport, Conn.
Root Co., Bristol, Conn.
Starrett Co , L. S , Athol, Mass.
Veeder Mfg Co., 39 Sargeant St., Hartford, Conn.

COUPLERS, HOSE
Greene Tweed & Co., 109 Duane St., New York.
Ingersoll-Rand Company, 11 Broadway, New York.

COUPLINOS, CUT-OFF, FRICTION
Edgemont Machine Co., Dayton, O.
Johnson Machine Co., Carlyle, Manchester, Conn.
Wood's Sons Co., T. B., Chambersburg, Pa.

COUPLINGS, FLEXIBLE SHAFT
Boston Gear Works, Norfolk Downs, Mass.
Brown Engineering Co., 133 No. 3rd St., Reading, Pa.
Caldwell & Son Co., H. W., 17th St. and Western Ave., Chicago.
Cresson-Morris Co., Philadelphia.
Nicholson & Co., W. H , 112 Oregon St , Wilkes-Barre, Pa.
Nuttall Co., R D , Pittsburgh.
Smith & Serrell, Newark, N. J.
Wood's Sons Co., T. B., Chambersburg, Pa.

COUPLINGS, PIPE
Dart Mfg. Co., E. M., Providence, R. I.

COUPLINGS, SHAFT
Brown Co., A. & F., 79 Barclay St., New York.
Brown Engineering Co., 133 N. Third St., Reading, Pa.
Caldwell & Son Co., H. W., 17th St. and Western Ave., Chicago.
Cresson-Morris Co., Philadelphia.
Hilliard Clutch & Mchy. Co., Elmira, N. Y.
Moore & White Co., 2707-2737 No. 15th St., Philadelphia.
Nicholson & Co., W. H., 112 Oregon St., Wilkes-Barre, Pa.
Royersford Foundry & Mch. Co., 54 No. 5th St., Philadelphia.
Sellers & Co., Inc., Wm., Philadelphia.
Smith & Serrell, Newark, N. J.
Wood's Sons Co., T. B., Chambersburg, Pa.

CRANES
Curtis Pneumatic Machinery Co., 1568 Kienlen Ave., St. Louis, Mo.
Hanna Engineering Works, 1763 Elston Ave., Chicago.
Harrington, Son & Co., Inc., Edwin, Philadelphia.
Link-Belt Company, Chicago.
Milwaukee Elec. Crane & Mfg. Co., Milwaukee, Wis.
Niles-Bement-Pond Co., 111 Broadway, New York.
Northern Engineering Works, Detroit.
Vandyck Churchill Co., 149 Broadway, New York.
Wright Mfg. Co., Lisbon, O.

CRANES, ELECTRIC TRAVELING
Link-Belt Company, Chicago.
Milwaukee Elec. Crane & Mfg. Co., Milwaukee, Wis.
Niles-Bement-Pond Co., 111 Broadway, New York.
Northern Engineering Works, Detroit.
Roeper Crane & Hoist Works, Reading, Pa.

CRANES, HAND TRAVELING
Hanna Engineering Works, 1763 Elston Ave., Chicago.
Milwaukee Elec. Crane & Mfg. Co., Milwaukee, Wis.
Roeper Crane & Hoist Works, Reading, Pa.

CRANES, LOCOMOTIVE
Hanna Engineering Works, 1763 Elston Ave., Chicago.
Link-Belt Company, Chicago.

CRANES, PORTABLE
Canton Fdry. & Mch. Co., Canton, O.

CRANK PIN TURNING MACHINES
American Tool Works Co., Cincinnati.
LeBlond Mch. Tool Co., R. K., Cincinnati.
Lodge & Shipley Machine Tool Co. Cincinnati.
Niles-Bement-Pond Co., 111 Broadway New York.
Pedrick Tool & Machine Co., 3639 N. Lawrence St., Philadelphia.
Underwood Corp., H. B., Philadelphia.

CRUCIBLES
Dixon Crucible Co., Joseph, Jersey City, N. J.

CUTTER COMPOUND
See Compound, Cutting, Grinding. etc.

CUTTER SALVAGE
Eastern Cutter Salvage Corp., Newark, N. J.

CUTTERS, BALL BEARING LATHE
Snellex Mfg. Co., Rochester, N. Y.

CUTTERS, MILLING
Alvord Reamer & Tool Co., Millersburg, Pa.
Barber-Colman Co., Rockford, Ill.
Becker Milling Machine Co., Worcester, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland.
Cowles Tool Co., Cleveland.
Detroit Twist Drill Co., Detroit.
Eastern Cutter Salvage Corp., Newark, N. J.
Gould & Eberhardt, Newark, N. J.
Greenfield Tap & Die Corp., Greenfield, Mass.
Ingersoll Milling Machine Co., Rockford, Ill.
Kearney & Trecker Corp., Milwaukee, Wis.
Lovejoy Tool Co., Inc., Springfield, Vt.
Morse Twist Drill & Mch. Co., New Bedford Mass.
National Tool Co., Cleveland.
National Twist Drill & Tool Co., Detroit.
Newark Gear Cutting Machine Co., Newark, N. J.
O. K. Tool-Holder Co., Shelton, Conn.
Pratt & Whitney Co , Hartford, Conn.
Union Twist Drill Co., Athol, Mass.
Weldon Tool Co., Cleveland.
Whitney Mfg. Co., Hartford, Conn.

CUTTING-OFF MACHINES, ABRASIVE WHEEL
Armstrong Bros. Tool Co., 313 North Francisco Ave., Chicago.
Greenfield Tap & Die Corp., Greenfield, Mass.

CUTTING-OFF MACHINES, COLD SAW
See Sawing Machines, Circular.

CUTTING-OFF MACHINES, ROTARY
Brown & Sharpe Mfg. Co., Providence, R. I.
Curtis & Curtis Co., 324 Garden St., Bridgeport, Conn.
Etna Machine Co., Toledo, O.
Fawcus Machine Co., Pittsburgh, Pa.
Hurlbut, Rogers Mchy. Co., South Sudbury, Mass.

CUTTING-OFF TOOLS
Armstrong Bros. Tool Co., 313 North Francisco Ave., Chicago.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.
Western Tool & Mfg. Co., Springfield, Ohio.
Williams & Co., J. H., 61 Richards St., Brooklyn, N. Y.

CYCLOMETERS
Veeder Mfg. Co., 39 Sargeant St., Hartford, Conn.

CYLINDER BORERS
Baker Bros., Toledo, O.
Beaman & Smith Co., Providence, R. I.
Newton Machine Tool Works, Inc., Philadelphia.
Niles-Bement-Pond Co., 111 Broadway, New York.

CYLINDER BORING MACHINES, PORTABLE
Pedrick Tool & Machine Co., 3639 N. Lawrence St., Philadelphia.
Underwood Corp., H. E., Philadelphia.

DEALERS, MACHINERY
Allen, H. F., 30 Church St., New York.
Bath & Co., Cyril J., Cleveland.
Besly & Co., Charles H., 120-B North Clinton St., Chicago.
Brownell Mchy. Co., Providence, R. I.
Cadillac Machinery Co., Detroit.
Earle Gear & Machine Co., 4707 Stenton Ave., Philadelphia.
Essley Machinery Co., E. L. 555 Washington Blvd., Chicago.
Garvin Machine Co., Spring and Varick Sts., New York.
Hill, Clarke & Co. of Chicago, 649 Washington Blvd., Chicago.
Kinsey Co., E. A., Cincinnati.
Lucas & Son, Inc., J. L., Bridgeport, Conn.
Niles-Bement-Pond Co., 111 Broadway, New York.
Osgood Tool Co., J. L., Buffalo, N. Y.
Oviatt & Co., D. C., Cleveland.
Prentiss & Co., Inc., Henry, 149 Broadway, New York.
Ryerson & Son, Joseph T., 2558 West 16th St., Chicago.
Vandyck Churchill Co., 149 Broadway, New York.

DEMAGNETIZERS
Heald Machine Co., 16 New Bond St., Worcester, Mass.
Luma Electric Equipment Co., Toledo, O.
Walker Co., Inc., O. S., Worcester, Mass.

DESIGNERS, MACHINE AND TOOL
Manufacturing Consulting Engineers, Syracuse, N. Y.

DESKS, STEEL FACTORY
Lupton's Sons Co., David, Philadelphia, Pa.

DIAMONDS, BORTZ AND CARBON
Desmond-Stephan Mfg. Co., Urbana, O.
Francis & Co., Hartford, Conn.

DIAMOND TOOLS
Desmond-Stephan Mfg. Co., Urbana, O.
Francis & Co., Hartford, Conn.

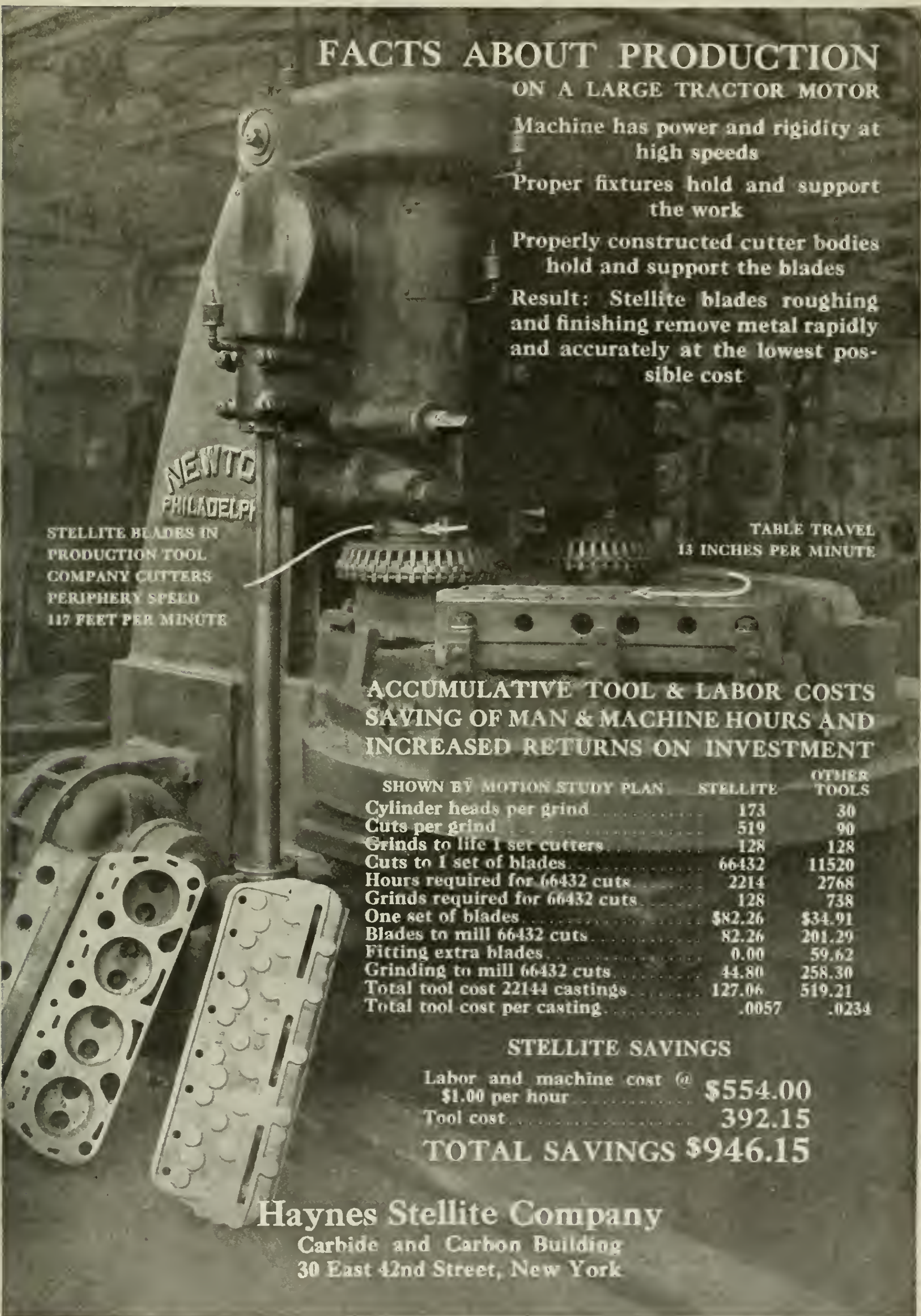
DIE BLOCKS
Dyson & Sons, Joseph, Cleveland.

DIE CASTINGS
See Castings, Die or Die Molded.

DIE CUSHIONS, PNEUMATIC
Marquette Tool & Mfg. Co., 331 West Ohio St., Chicago.

DIE FORMING MACHINES
Anderson Die Machine Co., Bridgeport, Conn.

DIE SINKERS, AUTOMATIC
Keller Mechanical Engraving Co., 74 Washington St., Brooklyn, N. Y.


FACTS ABOUT PRODUCTION
ON A LARGE TRACTOR MOTOR
Machine has power and rigidity at high speeds
Proper fixtures hold and support the work
Properly constructed cutter bodies hold and support the blades
Result: Stellite blades roughing and finishing remove metal rapidly and accurately at the lowest possible cost
STELLITE BLADES IN PRODUCTION TOOL COMPANY CUTTERS PERIPHERY SPEED 117 FEET PER MINUTE
TABLE TRAVEL 13 INCHES PER MINUTE
ACCUMULATIVE TOOL & LABOR COSTS SAVING OF MAN & MACHINE HOURS AND INCREASED RETURNS ON INVESTMENT
SHOWN BY MOTION STUDY PLAN STELLITE OTHER TOOLS
Cylinder heads per grind 173 30
Cuts per grind 519 90
Grinds to life 1 set cutters 128 128
Cuts to 1 set of blades 66432 11520
Hours required for 66432 cuts 2214 2768
Grinds required for 66432 cuts 128 738
One set of blades $82.26 $34.91
Blades to mill 66432 cuts 82.26 201.29
Fitting extra blades 0.00 59.62
Grinding to mill 66432 cuts 44.80 258.30
Total tool cost 22144 castings 127.06 519.21
Total tool cost per casting .0057 .0234
STELLITE SAVINGS
Labor and machine cost @ $1.00 per hour $554.00
Tool cost 392.15
TOTAL SAVINGS $946.15
Haynes Stellite Company
Carbide and Carbon Building
30 East 42nd Street, New York

DIE SINKING MACHINES
Pratt & Whitney Co., Hartford, Conn.

DIE STOCKS
See Stocks, Dies and Taps and Dies.

DIES, DRAWING, PRESSURE ATTACHMENTS
King, R. D., 1620 Monadnock Block, Chicago.
Marquette Tool & Mfg. Co., 331 West Ohio St., Chicago.

DIES, DROP FORGING
Keller Mechanical Engraving Co., 74 Washington St., Brooklyn, N. Y.

DIES, LETTERING AND EMBOSSING
Matthews & Co., James H., Pittsburgh, Pa.
Noble & Westbrook Mfg. Co., Hartford, Conn.

DIES, SHEET METAL, ETC.
Acklin Stamping Co., 1657 Dorr St., Toledo, O.
Adriance Machine Works, Inc., 78 Richards St., Brooklyn, N. Y.
American Tool & Mfg. Co., Urbana, O.
Bliss Co., E. W., Brooklyn, N. Y.
Diamant Tool & Mfg. Co., Inc., Newark, N. J.
Ferracute Mch. Co., Bridgeton, N. J.
Globe Mch. & Stamping Co., Cleveland, O.
Keller Mechanical Engraving Co., 74 Washington St., Brooklyn, N. Y.
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Marvin Mfg. Co., W. B., Urbana, O.
Mehl Mch. Tool & Die Co., Roselle, N. J.
Meldrum-Gabrielson Corp., Syracuse, N. Y.
Modern Tool, Die & Mch. Co., Columbus, O.
Pannier Bros. Stamp Co., Pittsburgh.
Reliance Die & Stamping Co., 515 N. LaSalle St., Chicago.
Toledo Mch. & Tool Co., Toledo, O.
U. S. Tool Co., Newark, N. J.
V & O Press Co., Glendale, Long Island, N. Y.
Waltham Machine Works, Waltham, Mass.

DIES, THREADING
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American Tap & Die Co., Greenfield, Mass.
Brubaker & Bros., W. L., 50 Church St., New York.
Butterfield & Co., Div. Union Twist Drill Co., Derby Line, Vt.
Card Mfg. Co., S. W. Div. Union Twist Drill Co., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Geometric Tool Co., New Haven, Ct.
Greenfield Tap & Die Corp., Greenfield, Mass.
Hardinge Bros., Inc., Berteau and Ravenswood Aves., Chicago.
Hart Mfg. Co., E. 20th St. and Marion Ave., Cleveland.
Jones & Lamson Mch. Co., Springfield, Vt.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Acme Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Reed Mfg. Co., Erie, Pa.
Rogers Works, Inc., J. M., Gloucester City, N. J.
Saunders' Sons, Inc., D., Yonkers, N. Y.

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Eastern Machine Screw Corp., New Haven, Conn.
Errington Mechanical Laboratory, Broadway and John St., New York.
Geometric Tool Co., New Haven, Ct.
Greenfield Tap & Die Corp., Greenfield, Mass.
H & G Works, Eastern Mch. Screw Corp., New Haven, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Landis Machine Co., Inc., Waynesboro, Pa.
Modern Tool Co., Second and State Sts., Erie, Pa.
Murchey Mch. & Tool Co., 34 Porter St., Detroit.
National Acme Co., Cleveland.
Rickert-Shafer Co., Erie, Pa.
Victor Tool Co., Madison & W. M. R. R., Waynesboro, Pa.

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Badger Tool Co., Beloit, Wis.
Besly & Co., Charles H., 120-B North Clinton St., Chicago.
Gardner Machine Co., Beloit, Wis.

DIVIDING HEADS
Knight Mchy. Co., W. B., St Louis.
Production Mch. Tool Co., Cincinnati.
See also Milling Machines, Horizontal, Universal.

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Dietzgen Co., Eugene, 166 W. Monroe St., Chicago.
Keuffel & Esser Co., Hoboken, N. J.
Paragon Mch. Co., Rochester, N. Y.

DRAFTING MACHINES
Dietzgen Co., Eugene, 166 W. Monroe St., Chicago.
Keuffel & Esser Co., Hoboken, N. J.
Universal Drawing Mch. Co., Cleveland, O.

DRAWING BOARDS AND TABLES
Dietzgen Co., Eugene, 166 W. Monroe St., Chicago.
Economy Drawing Table & Mfg. Co., Adrian, Mich.
Keuffel & Esser Co., Hoboken, N. J.
Paragon Mch. Co., Rochester, N. Y.
Universal Drawing Mch. Co., Cleveland, O.

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Dietzgen Co., Eugene, 166 W. Monroe St., Chicago.
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Calder Co., George H., Lancaster, Pa.
Cleveland Flue Cleaner Mfg. Co., Cleveland.
Desmond-Stephan Mfg. Co., Urbana, Ohio.
Francis & Co., Hartford, Conn.
Machinery Co. of America, Big Rapids, Mich.
Norton Co., Worcester, Mass.
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Vitrified Wheel Co., Westfield, Mass.
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Nelson-Blanck Mfg. Co., Detroit, Mich.
Rockford Drilling Machine Co., Rockford, Ill.

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Detroit Twist Drill Co., Detroit.
Greenfield Tap & Die Corp., Greenfield, Mass.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Twist Drill & Tool Co., Detroit, Mich.
Scully-Jones & Co., 2013 West 13th St., Chicago.
Union Twist Drill Co., Athol, Mass.
Whitman & Barnes Mfg. Co., Akron, Ohio.

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DRILL STANDS
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Whitman & Barnes Mfg. Co., Akron, Ohio.

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Moline Tool Co., Moline, Ill.
Taylor & Fenn Co., Hartford, Conn.

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Barnes Drill Co., Inc., 814 Chestnut St., Rockford, Ill.
Kingsbury Mfg. Co., Keene, N. H.

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Barnes Co., W. F. & John, 231 Ruby St., Rockford, Ill.
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Burke Machine Tool Co., 516 Sandusky St., Conneaut, O.
High Speed Hammer Co., Inc., Rochester, N. Y.
Kingsbury Mfg. Co., Keene, N. H.
Langelier Mfg. Co., Arlington, Cranston, R. I.
Leland-Gifford Co., Worcester, Mass.
National Automatic Tool Co., Richmond, Ind.
Reed Co., Francis, 43 Hammond St., Worcester, Mass.
Rockford Drilling Machine Co., Rockford, Ill.
United States Electrical Tool Co., 6th Ave. and Mt. Hope St., Cincinnati.

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Cincinnati-Bickford Tool Co., Oakley, Cincinnati.
Foote-Burt Co., Cleveland.
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Niles-Bement-Pond Co., 111 Broadway, New York.
Sellers & Co., Inc., Wm., Philadelphia.

DRILLING MACHINES, GANG
Baker Bros., Toledo, O.
Barnes Co., W. F. & John, 231 Ruby St., Rockford, Ill.
Barnes Drill Co., Inc., 814 Chestnut St., Rockford, Ill.
Cincinnati-Bickford Tool Co., Oakley, Cincinnati.
Colburn Machine Tool Co., Cleveland.
Foote-Burt Co., Cleveland.
Fosdick Mch. Tool Co., Cincinnati.
Garvin Machine Co., Spring and Varick Sts., New York.
Hoefer Mfg. Co., Freeport, Ill.
Langelier Mfg. Co., Arlington, Cranston, R. I.
Leland-Gifford Co., Worcester, Mass.
Moline Tool Co., Moline, Ill.
Niles-Bement-Pond Co., 111 Broadway, New York.
Rockford Drilling Mch. Co., Rockford, Ill.
Taylor & Fenn Co., Hartford, Conn.

DRILLING MACHINES, HEAVY DUTY
Baker Bros., Toledo, O.
Barnes Drill Co., Inc., 814 Chestnut St., Rockford, Ill.
Colburn Machine Tool Co., Cleveland.
Foote-Burt Co., Cleveland.
Minster Machine Co., Minster, O.

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Garvin Machine Co., Spring and Varick Sts., New York.
Langelier Mfg. Co., Arlington, Cranston, R. I.

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Baush Machine Tool Co., Springfield, Mass.
Foote-Burt Co., Cleveland.
Harrington, Son & Co., Inc., Edwin, Philadelphia.
Langelier Mfg. Co., Arlington, Cranston, R. I.
Moline Tool Co., Moline, Ill.
National Automatic Tool Co., Richmond, Ind.
Nelson-Blanck Mfg. Co., Detroit, Mich.
Pratt & Whitney Co., Hartford, Conn.
Taylor & Fenn Co., Hartford, Conn.

DRILLING MACHINES, MULTIPLE SPINDLE, HORIZONTAL
Baush Machine Tool Co., Springfield, Mass.
Harrington, Son & Co., Inc., Edwin, Philadelphia.
Langelier Mfg. Co., Arlington, Cranston, R. I.
Moline Tool Co., Moline, Ill.
National Acme Co., Cleveland.
National Automatic Tool Co., Richmond, Ind.
Nelson-Blanck Mfg. Co., Detroit, Mich.

DRILLING MACHINES, MULTIPLE SPINDLE, TURRET
Langelier Mfg. Co., Arlington, Cranston, R. I.

DRILLING MACHINES, MULTIPLE SPINDLE, VERTICAL
Avey Drilling Mch. Co., Cincinnati.
Baker Bros., Toledo, O.
Barnes Co., W. F. & John, 231 Ruby St., Rockford, Ill.
Barnes Drill Co., Inc., 814 Chestnut St., Rockford, Ill.
Baush Machine Tool Co., Springfield, Mass.
Cincinnati-Bickford Tool Co., Oakley, Cincinnati.
Clark Electric Co., Inc., James, Jr., Louisville, Ky.
Colburn Machine Tool Co., Cleveland, Ohio.
Foote-Burt Co., Cleveland.
Harrington, Son & Co., Inc., Edwin, Philadelphia.
Hoefer Mfg. Co., Freeport, Ill.
Langelier Mfg. Co., Arlington, Cranston, R. I.
Leland-Gifford Co., Worcester, Mass.
Moline Tool Co., Moline, Ill.
National Automatic Tool Co., Richmond, Ind.
Nelson-Blanck Mfg. Co., Detroit, Mich.
Niles-Bement-Pond Co., 111 Broadway, New York.
Pratt & Whitney Co., Hartford, Conn.
Reed Co., Francis, 43 Hammond St., Worcester, Mass.
Rockford Drilling Mch. Co., Rockford, Ill.
Rockford Machine Tool Co., Rockford, Ill.
Sellers & Co., Inc., Wm., Philadelphia.
Sipp Machine Co., Paterson, N. J.

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Ingersoll-Rand Company, 11 Broadway, New York.

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Cincinnati Electrical Tool Co., Cincinnati.
Clark Electric Co., Inc., James, Jr., Louisville, Ky.
Errington Mechanical Laboratory, Broadway and John St., New York.
Haskins Co., R. G., 27 So. Desplaines St., Chicago.
Louisville Elec. Mfg. Co., Louisville, Ky.
Neil & Smith Electric Tool Co., Cincinnati.
Stow Mfg. Co., Binghamton, N. Y.
United States Electrical Tool Co., 6th Ave. and Mt. Hope St., Cincinnati.

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American Tool Works Co., Cincinnati.
Barnes Co., W. F. & John, 231 Ruby St., Rockford, Ill.
Busch Co., J. C., 1763 Elston Ave., Chicago.
Canedy-Otto Mfg. Co., Chicago Heights, Ill.
Cincinnati-Bickford Tool Co., Oakley, Cincinnati.
Dreses Machine Tool Co., Cincinnati.
Fosdick Machine Tool Co., Cincinnati.
Morris Machine Tool Co., Cincinnati.
Mueller Machine Tool Co., Cincinnati.
Niles-Bement-Pond Co., 111 Broadway, New York.
Reed-Prentice Co., Worcester, Mass.
Ryerson & Son, Joseph T., 2558 West 16th St., Chicago.
Sellers & Co., Inc., Wm., Philadelphia.

DRILLING MACHINES, RAIL
Baker Bros., Toledo, O.
Colburn Machine Tool Co., Cleveland.
Foote-Burt Co., Cleveland.
General Electric Co., Schenectady, N. Y.
Harrington, Son & Co., Inc., Edwin, Philadelphia.
Moline Tool Co., Moline, Ill.
Newton Machine Tool Works, Inc., Philadelphia.
Niles-Bement-Pond Co., 111 Broadway, New York.
Sellers & Co., Inc., Wm., Philadelphia.

DRILLING MACHINES, SENSITIVE
Avey Drilling Mch. Co., Cincinnati.
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Burke Machine Tool Co., 516 Sandusky St., Conneaut, O.
Canedy-Otto Mfg. Co., Chicago Heights, Ill.
Edlund Machinery Co., Inc., Cortland, N. Y.
Fosdick Mch. Tool Co., Cincinnati.
Henry & Wright Mfg. Co., Hartford, Conn.
High Speed Hammer Co., Inc., Rochester, N. Y.
Kingsbury Mfg. Co., Keene, N. H.
Langelier Mfg. Co., Arlington, Cranston, R. I.
Leland-Gifford Co., Worcester, Mass.
Manufacturers Consulting Engineers, Syracuse, N. Y.
Myers Machine Tool Corp., Columbia, Pa.
Pratt & Whitney Co., Hartford, Conn.
Reed Co., Francis, 43 Hammond St., Worcester, Mass.
Rockford Machine Tool Co., Rockford, Ill.
Royersford Foundry & Machine Co., 54 North 5th St., Philadelphia.
Sibley Mch. Co., 8 Tutt St., South Bend, Ind.
Sipp Machine Co., Paterson, N. J.

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Baker Bros., Toledo, O.
Barnes Co., W. F. & John, 231 Ruby St., Rockford, Ill.
Barnes Drill Co., Inc., 814 Chestnut St., Rockford, Ill.
Beaman & Smith Co., Providence, R. I.
Buffalo Forge Co., Buffalo, N. Y.
Canedy-Otto Mfg. Co., Chicago Heights, Ill.
Cincinnati-Bickford Tool Co., Oakley, Cincinnati.
Colburn Machine Tool Co., Cleveland.
Foote-Burt Co., Cleveland.
Fosdick Machine Tool Co., Cincinnati.
Garvin Machine Tool Co., Spring and Varick Sts., New York.
Harrington, Son & Co., Inc., Edwin, Philadelphia.
Hoefer Mfg. Co., Freeport, Ill.
Knight Machinery Co., W. B., St. Louis, Mo.
Langelier Mfg. Co., Arlington, Cranston, R. I.
Leland-Gifford Co., Worcester, Mass.
Mechanics Tool Co., Rockford, Ill.
Minster Machine Co., Minster, O.
Moline Tool Co., Moline, Ill.
Niles-Bement-Pond Co., 111 Broadway, New York.
Pratt & Whitney Co., Hartford, Conn.
Production Mch. Tool Co., Cincinnati.
Reed Co., Francis, 43 Hammond St., Worcester, Mass.
Rockford Drilling Machine Co., Rockford, Ill.
Sellers & Co., Inc., Wm., Philadelphia.
Sibley Machine Co., 8 Tutt St., South Bend, Ind.
Sipp Machine Co., Paterson, N. J.
Snyder & Son, J. E., Worcester, Mass.

DRILLING MACHINES, WALL RADIAL
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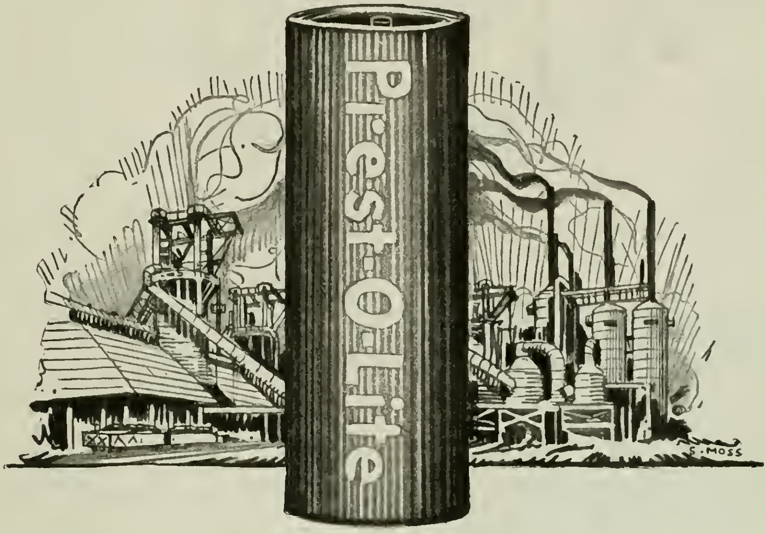
Prest-O-Lite
S. MOSS

DRILLS, CENTER
Cleveland Twist Drill Co., Cleveland.
Cogsdill Mfg. Co., Detroit.
Detroit Twist Drill Co., Detroit.
Greenfield Tap & Die Corp., Greenfield, Mass.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Twist Drill & Tool Co., Detroit.
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Providence, R. I.
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National Twist Drill & Tool Co., Detroit.
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Cleveland Twist Drill Co., Cleveland.
Colton Co., Arthur, 2618 Jefferson Ave., E., Detroit, Mich.
Detroit Twist Drill Co., Detroit.
Greenfield Tap & Die Corp., Greenfield, Mass.
Latrobe Tool Co., Latrobe, Pa.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Twist Drill & Tool Co., Detroit.
Pratt & Whitney Co., Hartford, Conn.
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Link-Belt Company, Chicago.

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See Grinding Wheels.

EMERY WHEEL DRESSERS
See Dressers, Grinding Wheels.

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Oliver Instrument Co., Adrian, Mich.

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Ajax Mfg. Co., Cleveland.
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Williams & Co., J. H., 61 Richards St., Brooklyn, N. Y.

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General Electric Co., Schenectady, N. Y.
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Yost Mfg. Co., Meadville, Pa.

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Chicago Flexible Shaft Co., 1154 So. Central Ave., Chicago.
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Surface Combustion Co., 362 Gerard Ave., New York.

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Chicago Flexible Shaft Co., 1154 So. Central Ave., Chicago.
Clements Mfg. Co., 606 Fulton St., Chicago.
General Electric Co., Schenectady, N. Y.
Surface Combustion Co., 362 Gerard Ave., New York.

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Dietzgen Co., Eugene, 166 W. Monroe St., Chicago.
Economy Drawing Table & Mfg. Co., Adrian, Mich.

FURNITURE, SHOP
Lupton's Sons Co., David, Philadelphia.
Myers Mch. Tool Corp., Columbia, Pa.
Western Tool & Mfg. Co., Springfield, O.

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Slocomb Co., J. T., Providence, R. I.
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Starrett Co., L. S., Athol, Mass.

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Rogers Works, Inc., J. M., Gloucester City, N. J.
Starrett Co., L. S., Athol, Mass.
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GAGES, HEIGHTH
Brown & Sharpe Mfg. Co., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

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Brown & Sharpe Mfg. Co., Providence, R. I.
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Meldrum-Gabrielson Corp., Syracuse, N. Y.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Reliance Gauge Column Co., 6008 Carnegie Ave., Cleveland.

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Brown Instrument Co., Philadelphia.
Reliance Gauge Column Co., 6008 Carnegie Ave., Chicago.
Taylor Instrument Companies, Rochester, N. Y.

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Greenfield Tap & Die Corp., Greenfield, Mass.
Johansson, Inc., C. E., Poughkeepsie, N. Y.
Marvin Mfg. Co., W. B., Urbana, O.
Meldrum-Gabrielson Corp., Syracuse, N. Y.
Pratt & Whitney Co., Hartford, Conn.
Reliance Die & Stamping Co., 515 No. LaSalle St., Chicago.
Rogers Works, Inc., J. M., Gloucester City, N. J.
S P Mfg. Co., Cleveland.
Starrett Co., L. S., Athol, Mass.
Williams & Co., J. H., 61 Richards St., Brooklyn, N. Y.

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Pratt & Whitney Co., Hartford, Conn.
S P Mfg. Co., Cleveland.
Starrett Co., L. S., Athol, Mass.

GAGES, TAPER
Pratt & Whitney Co., Hartford, Conn.
Starrett Co., L. S., Athol, Mass.

GAGES, THREAD
Brown & Sharpe Mfg. Co., Providence, R. I.
Goodell-Pratt Co., Greenfield, Mass.
Greenfield Tap & Die Corp., Greenfield, Mass.
Hartford Tap & Gauge Co., Hartford, Conn.
Johansson, Inc., C. E., Poughkeepsie, N. Y.
Jones & Lamson Mch. Co., Springfield, Vt.
Pratt & Whitney Co., Hartford, Conn.
Reliance Die & Stamping Co., 515 No. LaSalle St., Chicago.
Rogers Works, Inc., J. M., Gloucester City, N. J.
Starrett Co., L. S., Athol, Mass.

GASKETS
Greene, Tweed & Co., 109 Duane St., New York.
Wilmington Fibre Specialty Co., Wilmington, Del.

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Bunting Brass & Bronze Co., 748 Spencer St., Toledo, O.
Williams & Co., J. H., 61 Richards St., Brooklyn, N. Y.

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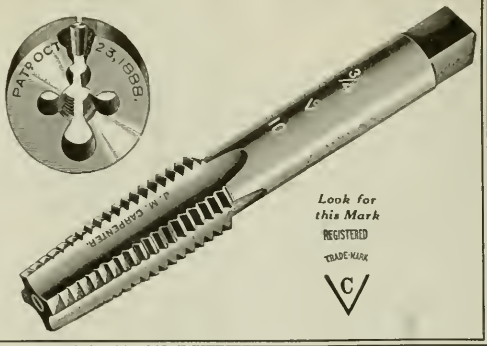

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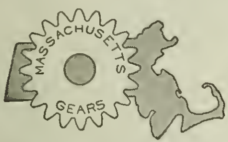

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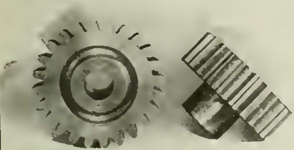

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Union Twist Drill Co., Athol, Mass.

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Abrasive Mch. Tool Co., East Providence, R. I.
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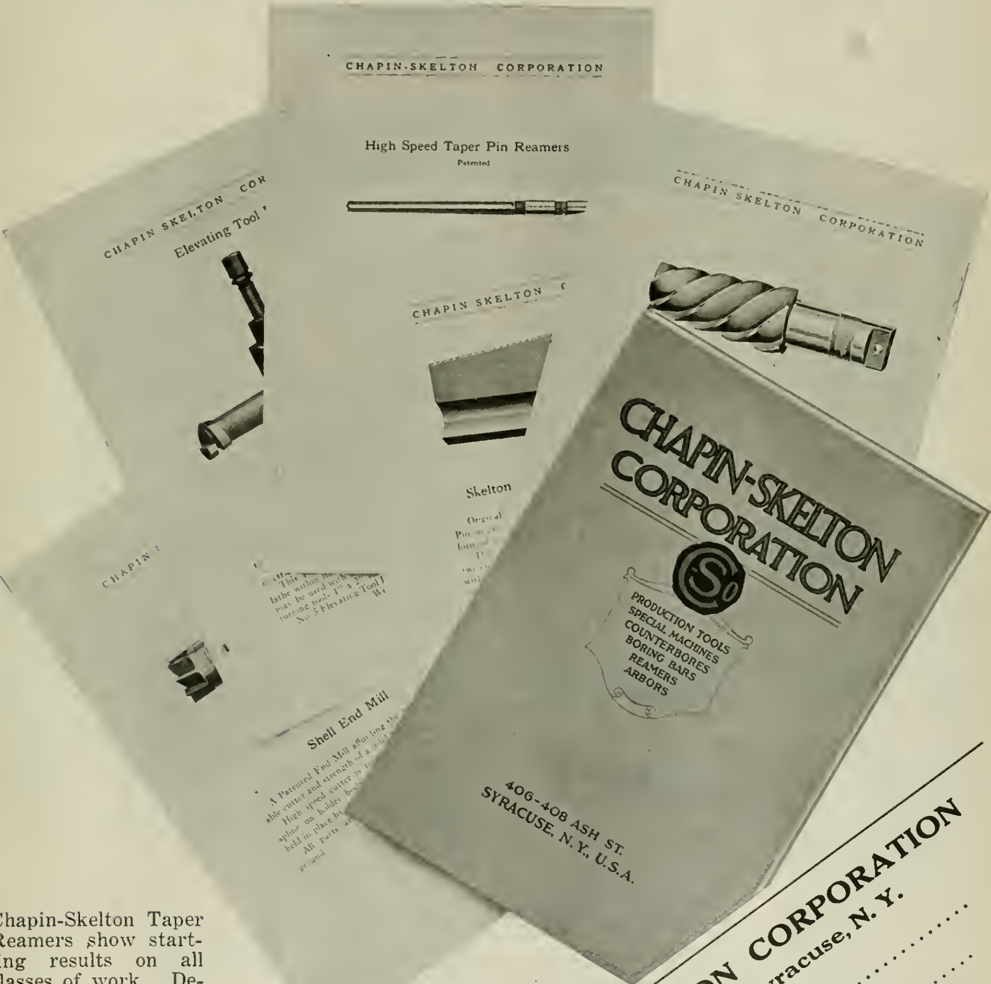

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Saunders' Sons, Inc., D., Yonkers, N. Y.

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NUT TAPPERS

See Bolt and Nut Machinery

ODOMETERS

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OILERS

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General Electric Co., Schenectady, N. Y.

OXY-ACETYLENE APPARATUS

See Welding and cutting, Oxy-Acetylene Equipment.

OXYGEN

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PHOSPHOR BRONZE

See Bronze.

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See Hammers, Drop

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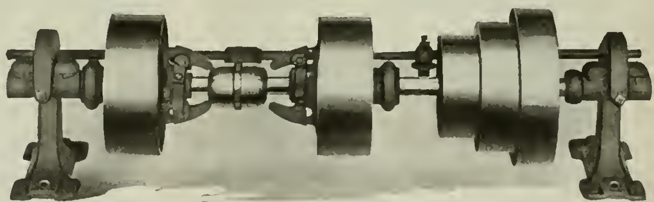

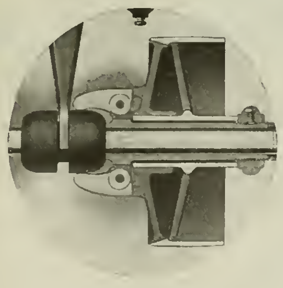

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Goodell-Pratt Co., Greenfield, Mass.
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Goodell-Pratt Co., Greenfield, Mass.
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Simonds Mfg. Co., Fitchburg, Mass.
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Machinery Co. of America, Big Rapids, Mich.

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Burr & Son, John T., Brooklyn, N. Y.
Earle Gear & Machine Co., 4707 Stenton Ave., Philadelphia.
Espen-Lucas Machine Works, Philadelphia, Pa.
Greenfield Tap & Die Corp., Greenfield, Mass.
Hanna Engineering Works, 1763 Elston Ave., Chicago.
Harrington, Son & Co., Inc., Edwin, Philadelphia.
Newton Machine Tool Works, Inc., Philadelphia.
Vandyck Churchill Co., 149 Broadway, New York.

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Myers Mch. Tool Corp., Columbia, Pa.
Napier Saw Works, Inc., Middletown, N. Y.
Peerless Mch. Co., Racine, Wis.
Racine Tool & Mch. Co., Racine, Wis.
Thompson & Son Co., Henry G., New Haven, Conn.
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Machinery Co. of America, Big Rapids, Mich.
Scherr, George, 126 Liberty St., New York.
Wardwell Mfg. Co., Cleveland.

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Cone Automatic Mch. Co., Inc., Windsor, Vt.
National Acme Co., Cleveland.
Pratt & Whitney Co., Hartford, Conn.

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Acme Machine Tool Co., Cincinnati.
Bardons & Oliver, Cleveland.
Brown & Sharpe Mfg. Co., Providence, R. I.
Dreses Machine Tool Co., Cincinnati.
Foster Machine Co., Elkhart, Ind.
Garvin Machine Co., Spring and Varick Sts., New York.
Greenfield Tap & Die Corp., Greenfield, Mass.
Jones & Lamson Machine Co., Springfield, Vt.
Kent-Owens Mch. Co., Toledo, O.
Millholland Machine Co., Indianapolis, Ind.
Potter & Johnston Machine Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Rivett Lathe & Grinder Co., Brighton, Boston.
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Warner & Swasey Co., Cleveland.

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Cone Automatic Machine Co., Inc., Windsor, Vt.
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Jones & Lamson Machine Co., Springfield, Vt.
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Potter & Johnston Machine Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
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Warner & Swasey Co., Cleveland.

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Meisel Press Mfg. Co., 948 Dorchester Ave., Boston, 25, Mass.
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Reliance Die & Stamping Co., 515 No. LaSalle St., Chicago.
Standard Pressed Steel Co., Jenkintown, Pa.

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Brubaker & Bros. Co., W. L., 50 Church St., New York.
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Card Mfg. Co., S. W. Div. of Union Twist Drill Co., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Greenfield Tap & Die Corp., Greenfield, Mass.
Hart Mfg. Co., E. 20th St. and Marion Ave., Cleveland.
Hjorth Lathe & Tool Co., Boston.
Morse Twist Drill & Mch. Co., New Bedford, Mass.

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National Acme Co., Cleveland.

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Allen Mfg. Co., Hartford, Conn.
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Cincinnati Planer Co., Cincinnati.
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Hill, Clarke & Co. of Chicago, 649 Washington Blvd., Chicago.
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Lucas & Son, Inc., J. L., Bridgeport, Conn.
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Springfield Machine Tool Co., 631 Southern Ave., Springfield, O.
Steel Products Engineering Co., Springfield, O.
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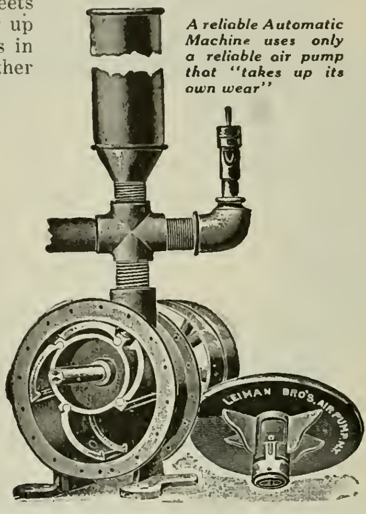

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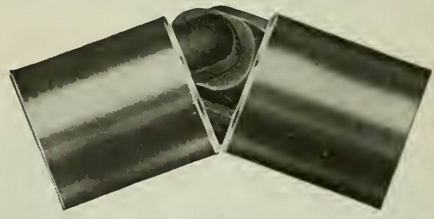

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Morton, Thomas, 245 Centre St., New York.
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Torrington Co., Torrington, Conn.

SWITCHBOARDS
General Electric Co., Schenectady, N. Y.
Westinghouse Electric & Mfg. Co., 160 Seventh Ave., Brooklyn, N. Y.

SWITCHES
Bristol Co., Waterbury, Conn.
General Electric Co., Schenectady, N. Y.
Monitor Controller Co., Baltimore, Md.
Westinghouse Electric & Mfg. Co., 160 Seventh Ave., Brooklyn, N. Y.

TACHOMETERS
Bristol Co., Waterbury, Conn.
Brown Instrument Co., Philadelphia.
Coats Mch. Tool Co., Inc., 112 West 40th St., New York.
Veeder Mfg. Co., 39 Sargeant St., Hartford, Conn.

TAPES, MEASURING
Dietzgen Co., Eugene, 166 W. Monroe St., Chicago.
Keuffel & Esser Co., Hoboken, N. J.
Starrett Co., L. S., Athol, Mass.

TAP EXTENSIONS
Allen Mfg. Co., Hartford, Conn.

TAP EXTRACTORS
Walton Co., Hartford, Conn.

TAP HOLDERS
National Automatic Tool Co., Richmond, Ind.

TAPPING ATTACHMENTS AND DEVICES
American Tool Works Co., Cincinnati.
Baker Bros., Toledo, O.
Barnes Co., W. F. & John, 231 Ruby St., Rockford, Ill.
Beaman & Smith Co., Providence, R. I.
Cincinnati Bickford Tool Co., Oakley, Cincinnati.
Eastern Tube & Tool Co., Inc., Brooklyn, N. Y.
Errington Mechanical Laboratory, Broadway and John St., New York.
Geometric Tool Co., New Haven, Conn.
Leland-Gifford Co., Worcester, Mass.
Modern Tool Co., 2nd and State Sts., Erie, Pa.
Mueller Machine Tool Co., Cincinnati.
National Automatic Tool Co., Richmond, Ind.
Procunier, Wm. L., 18 So. Clinton St., Chicago.
Whitney Mfg. Co., Hartford, Conn.

TAPPING MACHINES
Acme Machinery Co., Cleveland.
Baker Bros., Toledo, O.
Burke Machine Tool Co., 516 Sandusky St., Conneaut, O.
Eastern Tube & Tool Co., Inc., Brooklyn, N. Y.
Garvin Machine Co., Spring and Varick Sts., New York.
Geometric Tool Co., New Haven, Ct.
Harrington, Son & Co., Inc., Edwin, Philadelphia.
Langelier Mfg Co., Arlington, Cranston, R. I.
Moline Tool Co., Moline, Ill.
National Automatic Tool Co., Richmond, Ind.
National Machinery Co., Tiffin, O.
Procunier, Wm. L., 18 S. Clinton St., Chicago.
Rickert-Shafer Co., Erie, Pa.
Rockford Drilling Mch. Co., Rockford, Ill.
Saunders' Sons, Inc., D., Yonkers, N. Y.

TAPPING MACHINES, SENSITIVE, VERTICAL
Anderson Die Machine Co., Bridgeport, Conn.

TAPS
Alvord Reamer & Tool Co., Millersburg, Pa.
American Tap & Die Co., Greenfield, Mass.
Besly & Co., Charles H, 120-B No. Clinton St., Chicago.
Brubaker & Bros. Co., W. L., 50 Church St., New York.
Butterfield & Co., Div. Union Twist Drill Co., Derby Line, Vt.
Card Mfg. Co., S. W. Div. of Union Twist Drill Co., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Geometric Tool Co., New Haven, Ct.
Greenfield Tap & Die Corp., Greenfield, Mass.
Hardinge Bros., Inc., Berteau and Ravenswood Aves., Chicago.
Hartford Tap & Gauge Co., Hartford, Conn.
Landis Machine Co., Inc., Waynesboro, Pa.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Acme Co., Cleveland.
Pratt & Whitney Co., Hartford, Conn.
Reiff & Nestor Co., Lykens, Pa.
Saunders' Sons, Inc., D., Yonkers, N. Y.

TAPS, COLLAPSING
Errington Mechanical Laboratory, Broadway and John St., New York.
Geometric Tool Co., New Haven, Ct.
Modern Tool Co., 2nd and State Sts., Erie, Pa.
Murchey Mch. & Tool Co., 34 Porter St., Detroit, Mich.
National Acme Co., Cleveland.
Rickert Shafer Co., Erie, Pa.
Victor Tool Co., Madison & W. M. R. R., Waynesboro, Pa.

THERMOMETERS
Bristol Co., Waterbury, Conn.
Brown Instrument Co., Philadelphia.
Taylor Instrument Companies, Rochester, N. Y.

THERMOMETERS, INDICATING AND RECORDING
Brown Instrument Co., Philadelphia.
Taylor Instrument Companies, Rochester, N. Y.
Wilson-Maeulen Co., 763 East 143rd St., New York.

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Automatic Mch. Co., Bridgeport, Ct.
Eastern Machine Screw Corp., New Haven, Conn.
Geometric Tool Co., New Haven, Conn.
H & G Works, Eastern Machine Screw Corp., New Haven, Conn.
Landis Machine Co., Inc., Waynesboro, Pa.
National Acme Co., Cleveland.
National Machinery Co., Tiffin, O.
Pratt & Whitney Co., Hartford, Conn.
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