LYDDITE AND SHRAPNEL NUMBER

CANADIAN MACHINERY AND MANUFACTURING NEWS

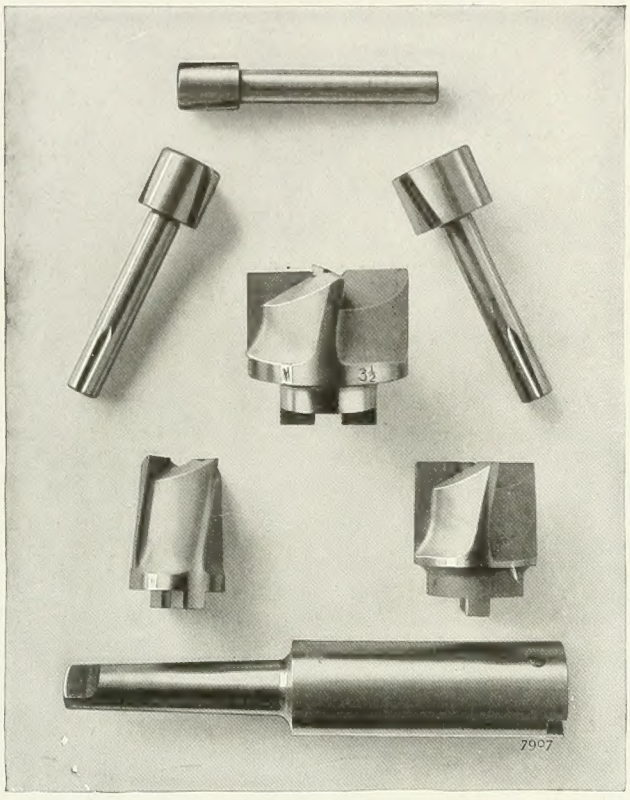
A Weekly Newspaper Devoted to the Mechanical, Power, Foundry and Allied Fields.

Vol. XIV. PUBLICATION OFFICE, TORONTO, SEPT. 2, 1915 No. 10

The MacLean Publishing Company, Limited

MONTREAL, WINNIPEG, NEW YORK, TORONTO, CHICAGO, BOSTON, LONDON, ENG.

Make Your Own Combination



For every counterboring job you can make immediately the right combination of holder, cutter and guide if your tool room is equipped with

P. & W. Interchangeable Cutter Counterbores

Holders, Cutters and Guides furnished in wide range of sizes.

Holders

End of holder is milled to receive the driving lug of the cutter and there is also a hole and set screw to accommodate the shank of the guides.

Guides

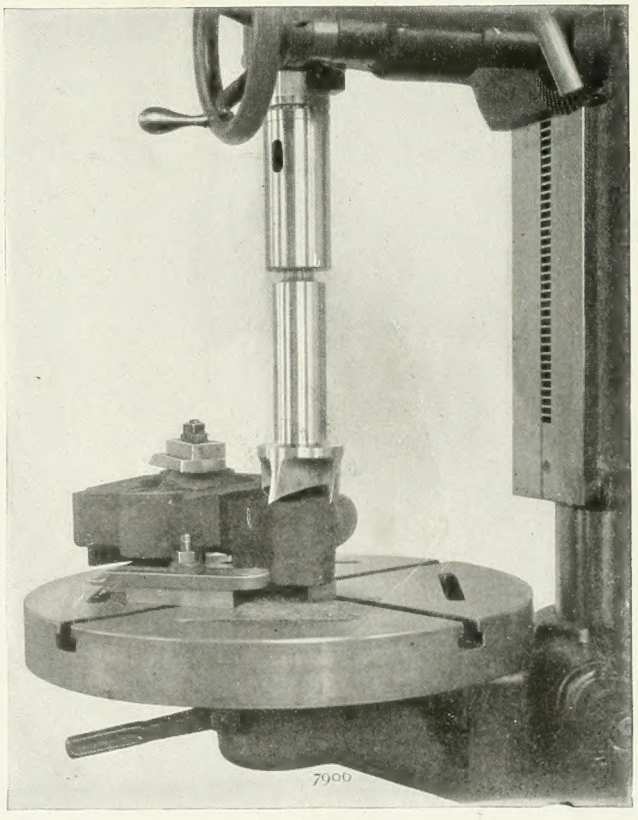
Are of hardened tool steel. They are held in place by means of a set screw in the holder engaging a V-slot in the shank of the guide.

Cutters

Can be furnished of either carbon or high speed steel.

The shank of the guide passes through the hole in the cutter and the shoulder between the guide and its shank keeps the cutter in place. Cutters can be sharpened on the face and the guide is simply pushed further in the hole after grinding.

Write for catalog "Small Tools" showing our complete line.



Spot Facing
with a P. & W. Interchangeable Cutter Counterbore

Place a trial order with our nearest store.

Pratt & Whitney Company of Canada, Limited

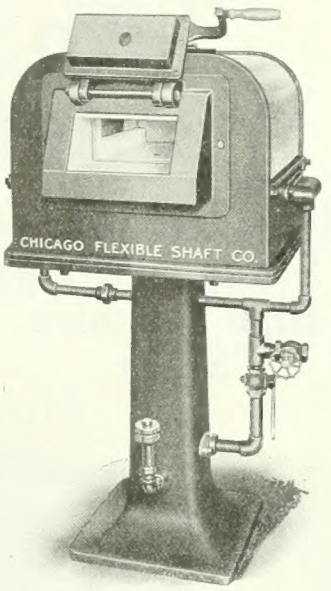
DUNDAS	MONTREAL	WINNIPEG	VANCOUVER
Ontario	723 Drummond Bldg.	Bank of Hamilton Bldg.	B.C. Equipment Co.

Stewart Gas and Oil Furnaces

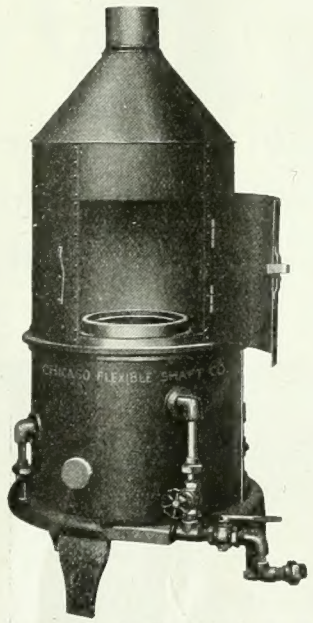
FOR THE TOOL ROOM, ETC.

To keep a plant up to its highest efficiency provision must be made for the proper hardening of its tools (high speed or carbon steel).

The Stewart No. 1 Oven has proven by most severe tests that it is equal to every occasion. The walls are 4″ thick and made of a special mixture of fire clay and silica to withstand the high heats. By a Simple Central, heats may be varied from those for carbon steel to high-speed steel. The opening is 5″ high by 9″ wide by 13½″ deep. The average gas consumption 100 cubic feet per hour. **Price with blower $100.00. Price without blower $75.00. Twenty-seven other sizes of ovens in stock.**



STEWART NO. 1 OVEN



Stewart No. 10 Cyanide Furnace

The Stewart No. 10 Cyanide Furnace may be used for any sort of a bath requiring a heat under 1800° Fahr. It is fitted with a hood to carry the poisonous or offensive fumes to a flue. The pot is of pressed steel and is 8″ in diameter and 10″ deep, ¼″ thick, allowing a quick heat. By having a number of extra pots ($4.00 each), as many different baths as desired may be used. Lead or cyanide hardening—salts bath—oil tempering, etc.

Price with blower $115.00
Price without blower 75.00

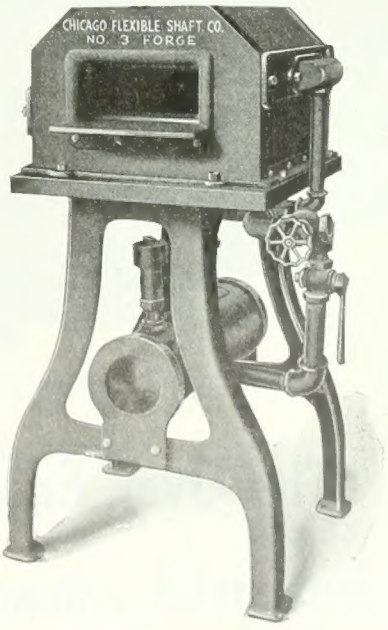
We have 24 other stock sizes in this type.

This Stewart No. 3 Forge is most convenient in the tool room for tool dressing, forming, shaping or bending. The front opening is 3½″ x 8″ and gives a heat 10″ long. Rear opening 3¼″ diameter (same size as front if specified.)

High heats (direct) may be obtained much more quickly than in an oven and may be held indefinitely. Occupies little floor space (23″ x 26″) and consumes about 90 cubic feet of gas per hour. This, like all other furnaces, must operate on a positive air pressure of 1½ lbs. to the square inch, which is best supplied by a positive pressure blower.

Price with blower $65.00
Price without blower 40.00

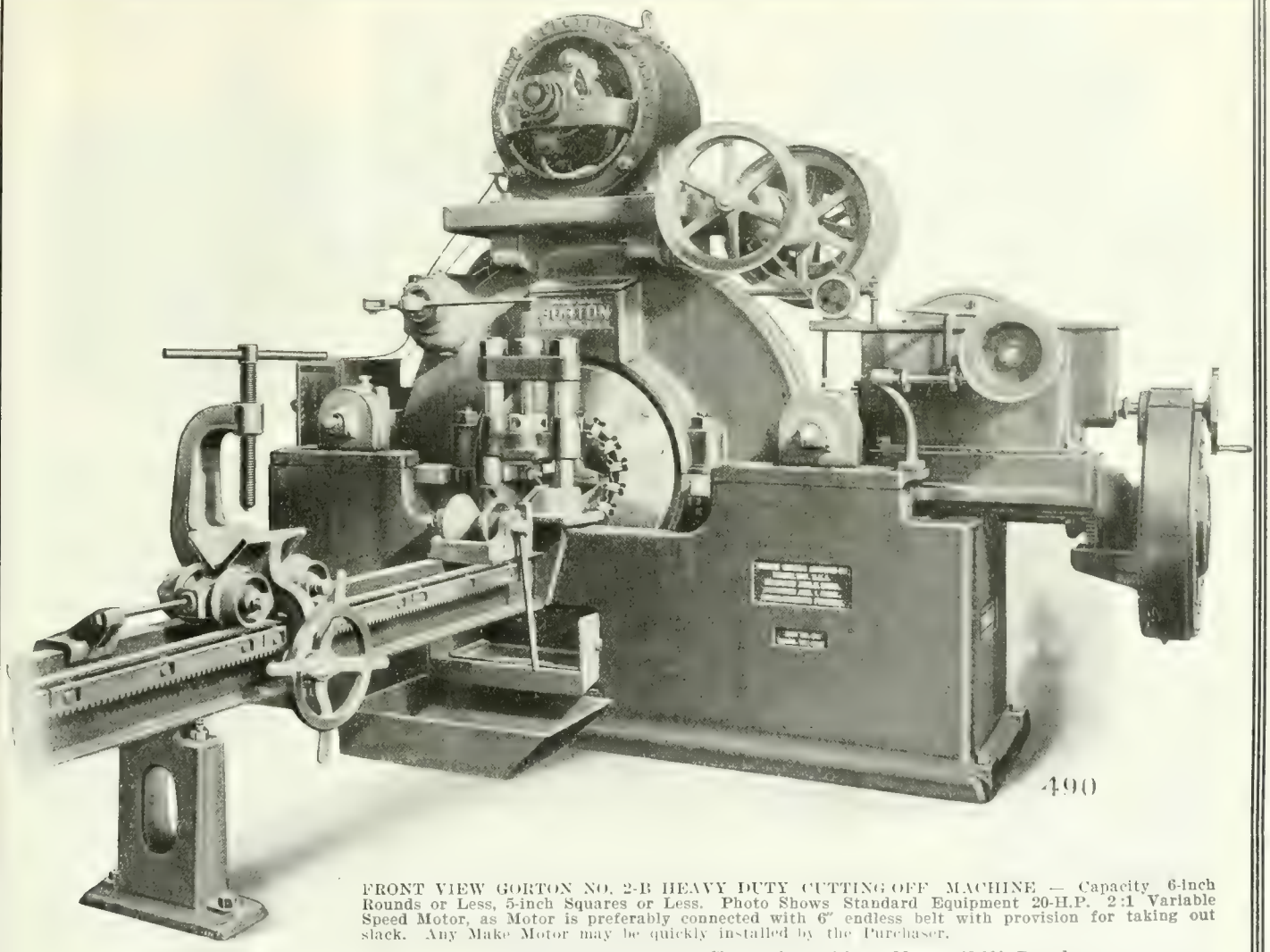
Send for our catalogue No. 56. Tell us your requirements and we will make recommendations.



NO. 3 FORGE

Chicago Flexible Shaft Co.

210 to 230 Ontario St., CHICAGO



FRONT VIEW GORTON NO. 2-B HEAVY DUTY CUTTING OFF MACHINE — Capacity 6-inch Rounds or Less, 5-inch Squares or Less. Photo Shows Standard Equipment 20-H.P. 2:1 Variable Speed Motor, as Motor is preferably connected with 6" endless belt with provision for taking out slack. Any Make Motor may be quickly installed by the Purchaser.

Net Weight Complete as Shown, but without Motor, 18,000 Pounds.

Code Word, Complete as Shown But Without Motor Kroudslager. (Special Catalog on request.)

Can make prompt delivery of 6" machine, as above. This is a type of machine which originated with this company, and has been very carefully developed for ten years past, and is used by all of the large steel works and by other manufacturers in the United States.

This is the only machine for shrapnel work. We are furnishing twelve to one large firm and several to each of a number of other firms.

3½" Round Shrapnel stock, when cutting bars singly, may be severed at the rate of 600 cuts per 12 hours. Arranged with special jaws to cut two bars at a time 800 to 1100 cuts can be made per 12 hours.

3¼" Square Shrapnel stock may be necked down to 1" diameter by using our rotary attachment, at the rate of 600 cuts per ten hours.

6" ordinary round steel may be cut at the rate of over 300 cuts per ten hours.

We have a 13" machine, net weight without motor, 53,000 lbs. Code word KRAAGMAN. It severs 12½" Round, Nickel Steel Armor Piercing stock at the rate of 60 cuts per ten hours, being about five times faster than any other machine obtainable. Catalog on request.

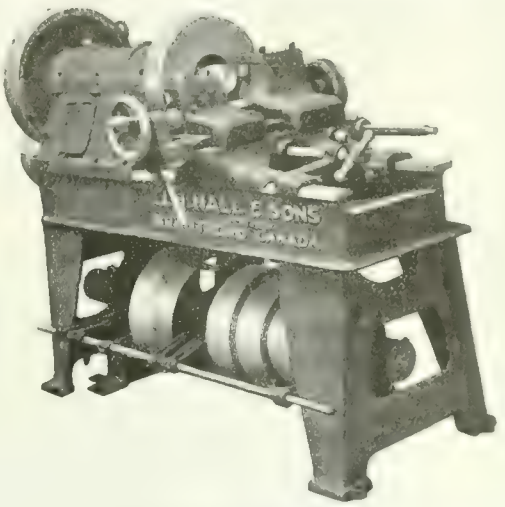
GEORGE GORTON MACHINE COMPANY

Manufacturers of Engraving Machines and Heavy Duty Cutting-off Machines

RACINE, WIS., U.S.A.

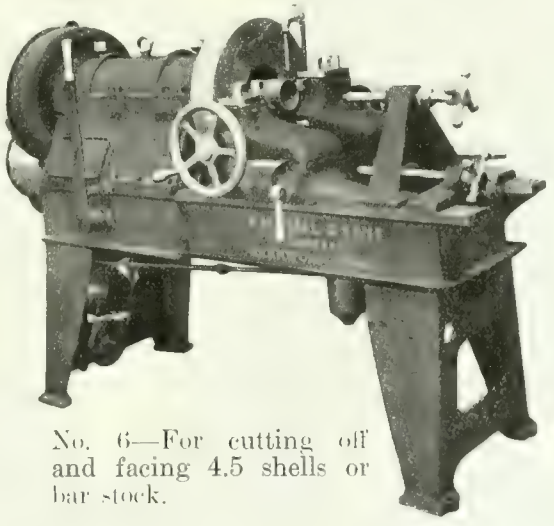
CABLE ADDRESS, "GORTON, RACINE." Use A. B. C. Code (4th edition) or Western Union Code (Universal Edition)

HALL
Shell Cutting-off and Facing Machines
FOR SHELLS, BAR STOCK, INGOTS
HIGH SPEED, HEAVY DUTY



No. 4—For cutting off and facing shrapnel or for bar stock.

The new conditions imposed in the manufacture of Shells necessitated a new type of machine. This was successfully developed and we are now fulfilling all the important requirements of manufacturers in *cutting Shrapnel Stock, Bar Stock, Ingots, finishing the base of Shells and facing-off the plugs*. Satisfaction is the proof of good usage. This is the evidence we have from manufacturers all over the Dominion.

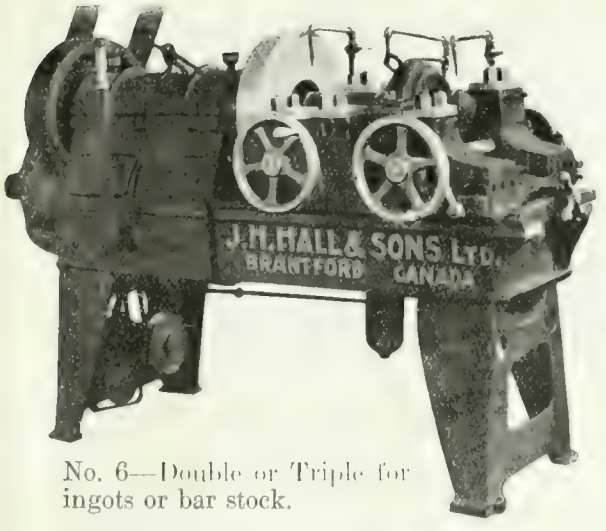


No. 6—For cutting off and facing 4.5 shells or bar stock.

After the shells are forged you need a "Hall" machine to get the required lengths.

After the Shells are bored and tested for wall thickness, etc., you need a "Hall" for finishing the base.

The projecting ends of the plugs must be faced off and "Hall" Machines are wonderfully adapted for this work also.



No. 6—Double or Triple for ingots or bar stock.

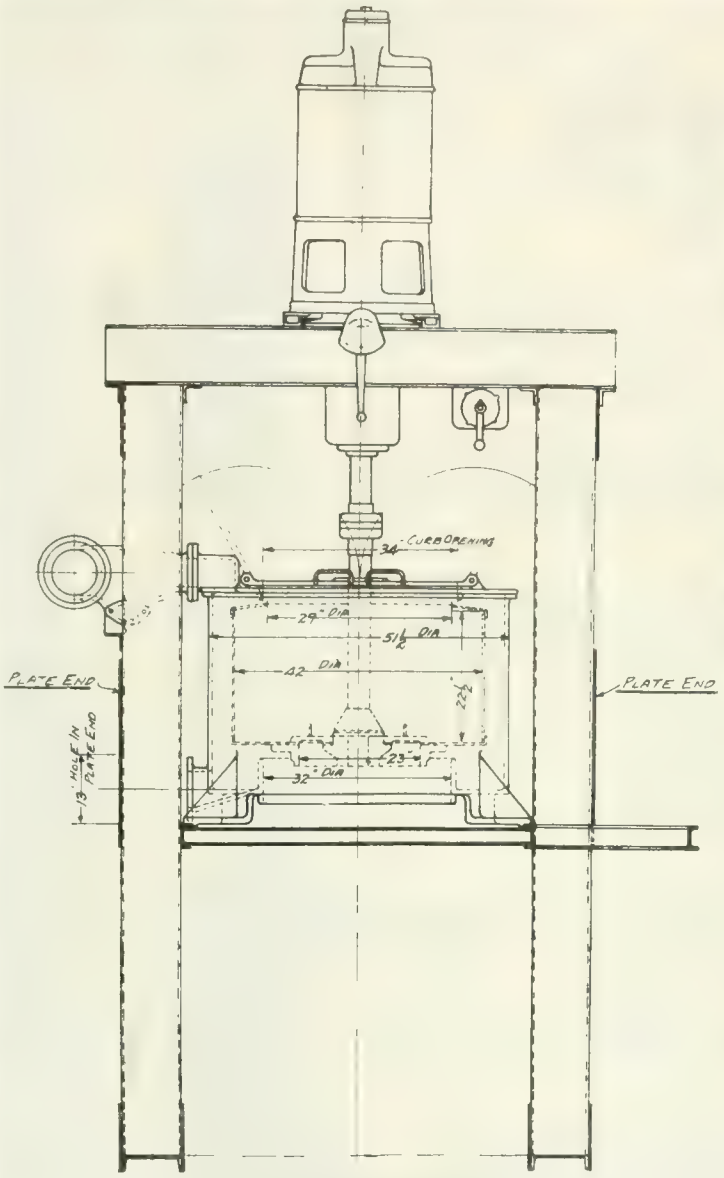
If you will write us for prices and further particulars we can go more closely into details and tell you the nearest point at which you can see one of these machines in operation.

John H. Hall & Son, Limited

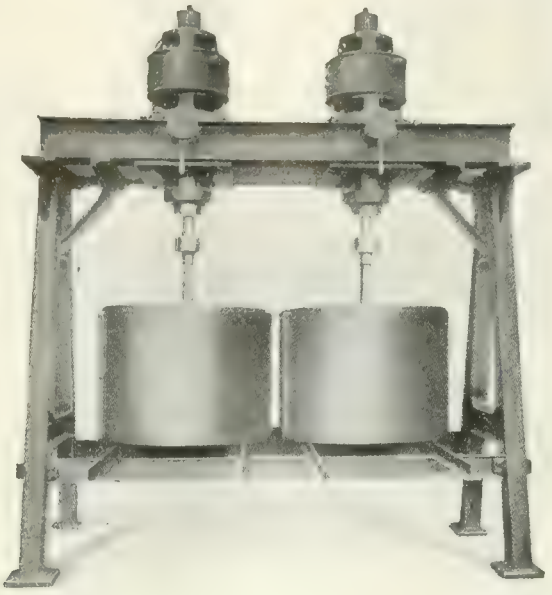
Brantford, Canada

The advertiser would like to know where you saw his advertisement—tell him.

The advertiser would like to know where you saw his advertisement—tell him.



NITRATING CENTRIFUGAL
D'Olier-Weston type
42" Direct Electric driven.
Unit steel framing construction



All of the features recognized as essential to this ideal Centrifugal resulting in greatest output at lowest maintenance will be found incorporated in

D'Olier
"Weston" Centrifugals

For sugar, chemicals, sewage, oil and waste reclaiming, clarifying and filtering and textile work.

Nitrating Centrifugals

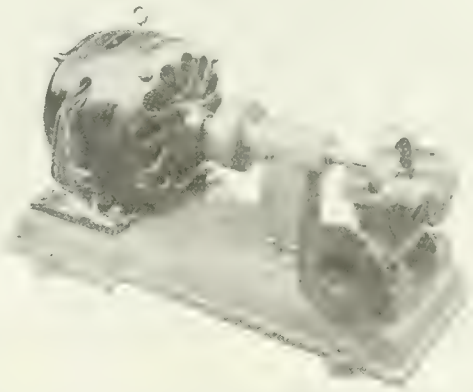
D'Olier, patent, single spindle, ball bearing type. Strictly high-grade machines, of rugged construction and high efficiency.

Write for particulars of this improved type centrifugal, now being furnished for use in United States Government smokeless powder factories.

Bulletins on request.

D'Olier Volute and Turbine Pumps

for all pumping purposes in Sugar Refineries, Paper Mills, Mine Service, Metallurgical and Chemical Industries, General Water Supply, Fire Service. Write for Bulletin.



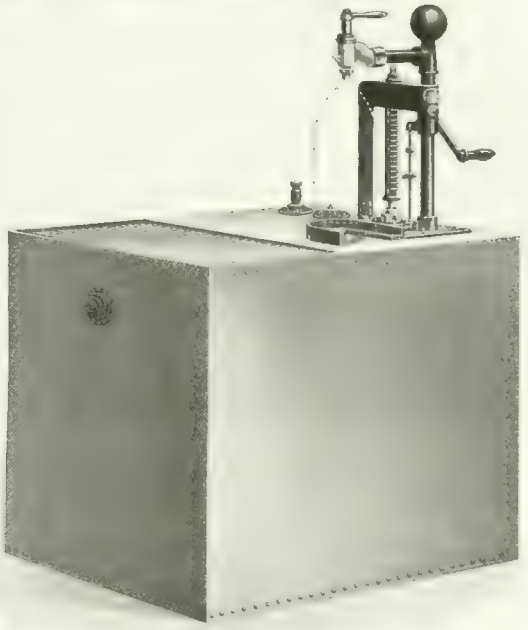
4" D'Olier pump for pumping nitrated cotton: efficiency and accessibility are features of this design.

D'OLIER
CENTRIFUGAL PUMP and MACHINE CO.
Philadelphia, Pa., U.S.A.

The advertiser would like to know where you saw his advertisement—tell him.

Save Time and Material In Varnishing Shells

The only absolutely sure method of varnishing shells is to completely fill them with varnish thereby insuring that the entire interior is covered.



Cut No. 401—Shell Varnishing Outfit

BOWSER
ESTABLISHED 1885
(STANDARD THE WORLD OVER)

Shell Varnishing Equipment

will enable you to varnish Lyddite Shells much faster than is possible with any other method.

Bowser Equipment is so designed that the pump can be set to exactly fill the different sizes of shells being manufactured. The shells can be filled as fast as the pump can be operated. They can then be drained and the varnish returned to storage in a clean and pure condition. Government specifications for varnishing can be fulfilled.

Think what this means to you as a manufacturer. There is no danger from spilling varnish on the outside of the shell and the shell is filled exactly full.

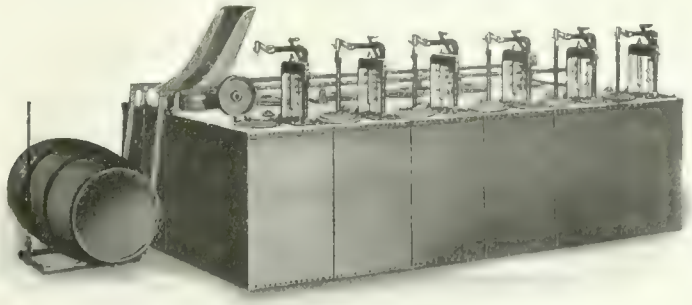
Should the Bowser Equipment at any time not be needed in manufacture of shells it is equally adapted to storage of varnish, paint and other oils wherever they are used.

We manufacture over 500 different oil handling devices, for storing and handling oils of all kinds under varying conditions. It will pay you to investigate what Bowser Equipment will mean to your works.

Write for further information on outfits suitable to your needs.

A letter or postal will bring you complete details and illustrated literature without obligating you in the least.

AWARDED HIGHEST HONORS—GRAND PRIZE AND GOLD MEDAL—AT PANAMA-PACIFIC INTERNATIONAL EXPOSITION, SAN FRANCISCO, CAL., U. S. A. A. D., 1915.



A Battery Equipment for Lubricating and Paint Oils

Made in Canadian Works by Canadian Workmen and Sold by Canadian Salesmen.

S. F. Bowser & Co., Inc.
66-68 Frazer Avenue
Toronto, Ontario, Canada

Sales Offices in all Centers and Representatives Everywhere

The PHILIPS Pressed Steel PULLEY

Cast Iron Split Pressed Steel Pulleys
6 to 11-in. diameter, 8 to 12-in. face inclusive.

Genuine Oak Leather Belting

None Better

We are supplying the largest users in Canada

Balata Belting

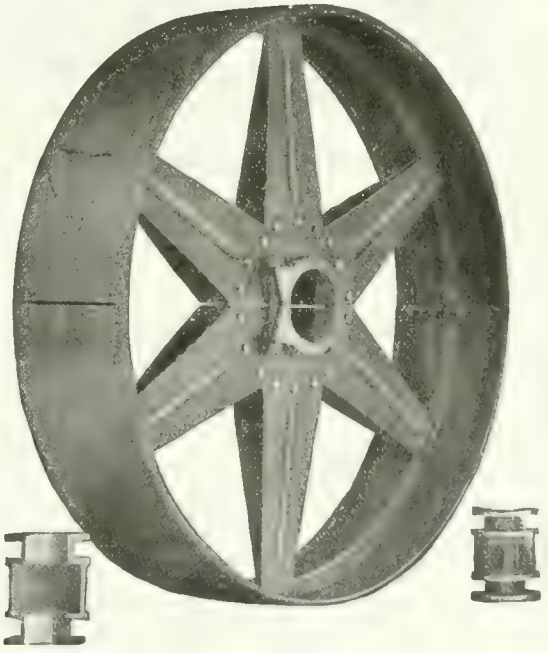
the genuine British made

D. K.

Wood Split Pulleys

We carry the largest stock of these lines in Canada

PROMPT SHIPMENT



Steel Split Pulley from 12 to 48-inch Diameter, 3 to 12 in. face.

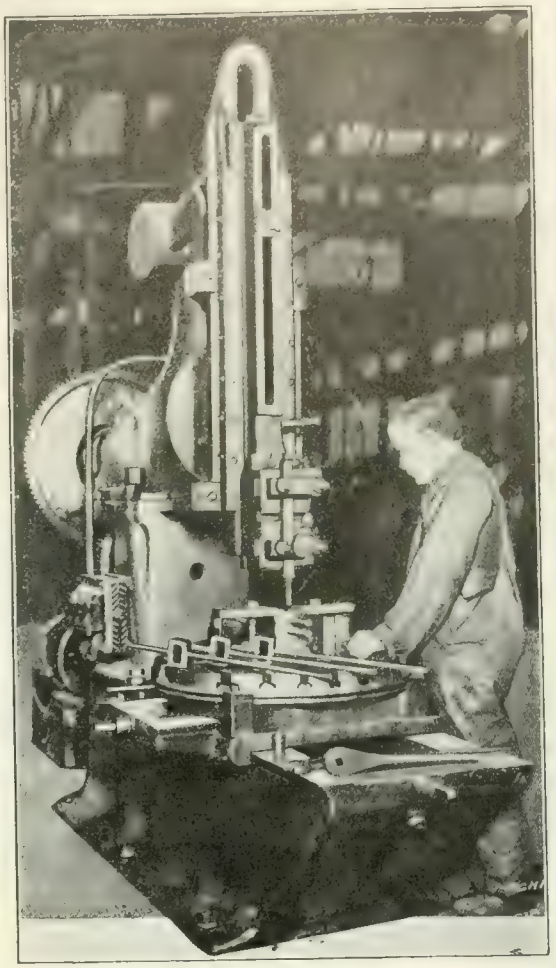
We carry a full stock of all sizes

D. K. McLaren, Limited

Head Office and Factory: **351 St. James Street, Montreal, P.Q.**

TORONTO, ONT. 200 King St. West
ST. JOHN, N.B. 64 Prince William St.
VANCOUVER, B.C. 847 Beatty St.

ENGINEERS SUPPLY COMPANY, 123 Bannatyne Ave. East, Winnipeg, Man.



The Dill Slotter

with its travelling bed is a wide range utility machine. It is said by some to be the most universal machine on the market. It will do work that is next to impossible on any other machine, with a 5-year average up-keep expense of 90 cents.

Accuracy, perfect alignment, rigidity of cut, together with many other vital features, are embodied in Dill construction.

We have a 15"-18" Dill Slotter in stock in Montreal ready for immediate shipment. Full specifications on request.

The Canadian Fairbanks-Morse
COMPANY, LIMITED

CFM

St. John Montreal
Quebec Ottawa
Toronto Hamilton
Winnipeg Saskatoon
Calgary Edmonton
Vancouver Victoria

CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS

Machine Tools for Immediate Delivery

The following Machine Tools are in stock at our Montreal or Toronto Houses:

ENGINE LATHES:
1 Seneca Falls, 12" geared head.
1 Seneca Falls, 9" x 5'.
1 Seneca Falls, 12", geared head.
3 South Bend, 16" x 6'.
2 Rockford, 16" x 6'.
1 Seneca Falls 10" x 4' speed lathe.
1 Davis 20" turret lathe, plain head (second-hand).

SHAPERS:
1 18" Stockbridge two-piece crank-shaper with single pulley drive and power feed to head.
1 20" McDougall back geared shaper.

SLOTTERS:
1—"Dill" 15"-18" belt-driven, slotter.

DRILLING MACHINES:
1 9" Hoeffer friction bench drill.
1 16" Hoeffer friction drill.
1 45" Hoeffer assembling drill, capacity up ⅜".
6—20" McDougall plain drilling machines, lever feed.
2 20" McDougall plain drilling machines, power feed.
6 20" McDougall plain drilling machines, with back gears.
2—Barnes All Geared 24" back-geared drilling machines.
1—Sibley 24" sliding head drilling machine.
1 Henry & Wright No. B 8" ball bearing drill press.

PORTABLE ELECTRIC DRILLS:
Made by the U. S. Electric Tool Company
1 Style "T," capacity to ⅜" for A.C., 110 volts.
1 Style "CU," capacity to ⅜" for A.C. or D.C., 110 volts.
1 Style "U," capacity to ½" for A.C., 110 volts.
2 Style "EU," capacity to ⅞" for A.C. or D.C., 110 volts.
1—Style "DEA," capacity to ½" for A.C., for 110 volts.
1—Style "EA," capacity to ¾" for A.C., 110 volts.
1 Style "FA," capacity to 1" for A.C., 100 volts.

PIPE-THREADING MACHINES:
1 Oster No. 201 hand machine, capacity ¼" to 2".
3—Oster No. 304A, capacity to 4", hand or power.
1—Oster No. 306A, capacity to 4", hand or power.
1—Merrell No. 5½, capacity to 4", hand or power.

BOLT CUTTERS:
1—Wiley & Russell No. 42, capacity up to 1¼".
1 Acme ½" bolt cutter.

POWER HAMMERS:
1—Fairbanks 75-lb. power hammer.
1—Fairbanks 100-lb. power hammer.

POWER HACK SAWS:
1 Robertson No. 3 High-Speed Hack Saw, capacity 8".
1 Robertson No. 5 High-Speed Hack Saw, capacity 8x15".
4—Fairbanks Power Hack Saws, capacity 5".
1—West Haven Power Hack Saw, capacity 6".

TOOL GRINDERS:
1 Walker No. 2 Universal Tool and Cutter Grinder, automatic feeds.
1—Blount 20" wet tool grinder.
1 Ford-Smith 20" wet tool grinder.

PORTABLE ELECTRIC GRINDERS:
We have various sizes in stock, made by the U.S. Electrical Tool Company for internal and external grinding.

MISCELLANEOUS:
1 Hand Lever Punch, steel construction, capacity ⅝" hole in ¾" plate.
1—Hand Lever Shear, steel construction, capacity 1¼" rounds, 3x⅝" plate.
1 Hand Lever Shear, steel construction, capacity ¼" plates, 2x½" flats and ⅝" rounds.
1—Alligator shear, capacity 1" rounds, 4x½" flats.
1—Grabo 36" x 6" Grindstone and frame with tight and loose pulleys, complete with a stone water pot and truing device.
1—Gardner Disc Grinder, size 20 x 23".
1 No. 1 Greenard arbor press.
1 No. 80 Grant riveter, pedestal type.

For full particulars apply to our nearest branch house.

The Canadian Fairbanks-Morse
COMPANY, LIMITED

CFM

St. John Montreal
Quebec Ottawa
Toronto Hamilton
Winnipeg Saskatoon
Calgary Edmonton
Vancouver Victoria

CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS

Combined Shrapnel and High Explosive Shell Manufacturing Plant

Staff Article

An installation such as here described puts the onus of successful production largely on the machine tool builder, and, as to how the latter has met the requirement as far as 3.3 shrapnel and high explosive shells are concerned, a careful study of the illustrations and text data will make the position clear. It will also evidence the ingenuity of the management.

THE plant here described is one of the most modern and up-to-the-minute mechanical engineering establishments in Canada. It is working night and day, producing both shrapnel and high explosive shells. Everything has been carefully planned, no detail having been overlooked in the placing of the multitude of machines required for the systematic handling of large numbers of shells. As these progress through the shop, the machines are so arranged that a minimum amount of effort is required in the removal of one series of shells from one operation to another.

Routine of Work.

The rough bars or billets enter the shop at one end and continue from one group of machines to another until they reach the other end; they are then transferred to the floor above and continue in the opposite direction until they again reach the entrance end. By this time they have been finally inspected and are ready for shipment.

Stock Yard.

The first view one gets upon entering the yard leading to the shell department, impresses the observer with the extent of the operations that must successively follow. Fig. 1 shows a view of the stock as it is received from the mill. The pile of billets to the left of the track is for the making of 3.3 shrapnel shell, and the piles of steel bars to the right are to be cut into lengths for the production of 3.3 high explosive lyddite shells; in the background is a view of the shell department building.

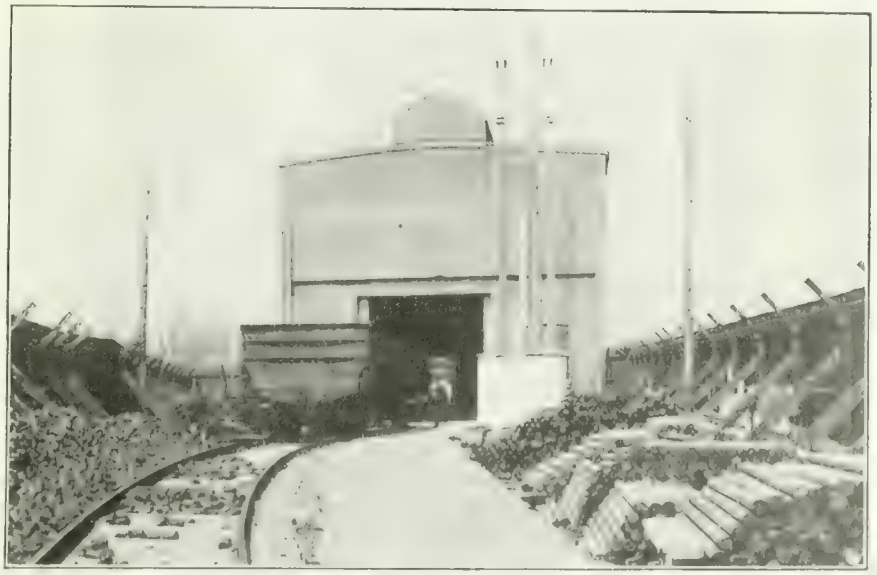


FIG. 1. VIEW OF YARD SHOWING STOCK OF SHELL BARS AND BILLETS SHELL SHOP IN BACKGROUND

Shell Shop Features.

The shell shop was especially erected for the manufacture on a large scale of both 3.3 shrapnel and high explosive shells. The building is a two-storey steel structure 400 feet long and 50 feet wide. The ground floor is of concrete and the upper floor double boarded.

Lighting.

Light is received from a row of large windows running along both sides while, in addition the top floor is lighted by a skylight the full length of the building. Directly above the large hydraulic presses is an opening which allows a considerable amount of light to penetrate to the lower floor. Artificial light is obtained from thirty-two globes at equal intervals along both sides of the shop, each globe containing a cluster of five tungsten lamps. Each individual machine is equipped with a Wallworks, Manchester England light stand, the wires from which are placed in pipes,

and run beneath the cement floor to the walls on either side.

Heating and Fire Protection.

The building is heated by steam; pipes running along the walls on both sides the full length of the shop. It is also fully equipped against fire, being furnished throughout with a sprinkler system and "Dominion" fire extinguishers, which are placed at intervals along each wall.

Grouping of Machines.

The machines are placed in a number of groups on either side of a centre aisle, each group being driven by a 30 or 35 horse-power "Vickers" motor, the belting for same being supplied by the Beardmore Belting Co., Toronto. The machines are so arranged that the shrapnel shells progress along one side, while the high explosive shells advance along the other side.

FIG. 2. "MECHANICAL ENGINEERING CO." FURNACES FOR HEATING AND REHEATING BILLETS.

Shrapnel Shell Forging.

The shrapnel shell billets after entering the shop are taken to the three Mechanical Engineering Co. oil furnaces shown in Fig. 2, where they are heated and prepared for piercing. When ready, they are placed in one of the 250-ton Boomer & Boschert hydraulic presses shown in Fig. 3, leaving same in a shape similar to Fig. 4, and constituting the first piercing operation. The pierced billets are again heated and placed in a 200-ton B. & B. press, from which they emerge as finished forgings. A view of the drawing die is shown in Fig. 5 and the punch in Fig. 6.

The sketch Fig. 6A shows the device employed for cooling the punch. This is moved up and down around the punch while a strong stream of water is forced out of the small holes in the ring.

Cutting to Length.

After the shells are forged, they are tested for the thickness of the wall. Following this inspection, they are taken to two "Hall" cutting-off machines where the rough open end is trimmed off.

Rough Turning.

They are then centered on a jig in several Foote-Burt drilling machines after which they pass to ten C.M.C. 16 inch lathes and are rough turned over the complete surface, the mandril for driving being similar to that shown in Fig. 7. Here this plant differs somewhat from others in that the shell is rough turned to the one size its full length. The rough shell is, however, somewhat longer than otherwise, due to the required subsequent nosing operations.

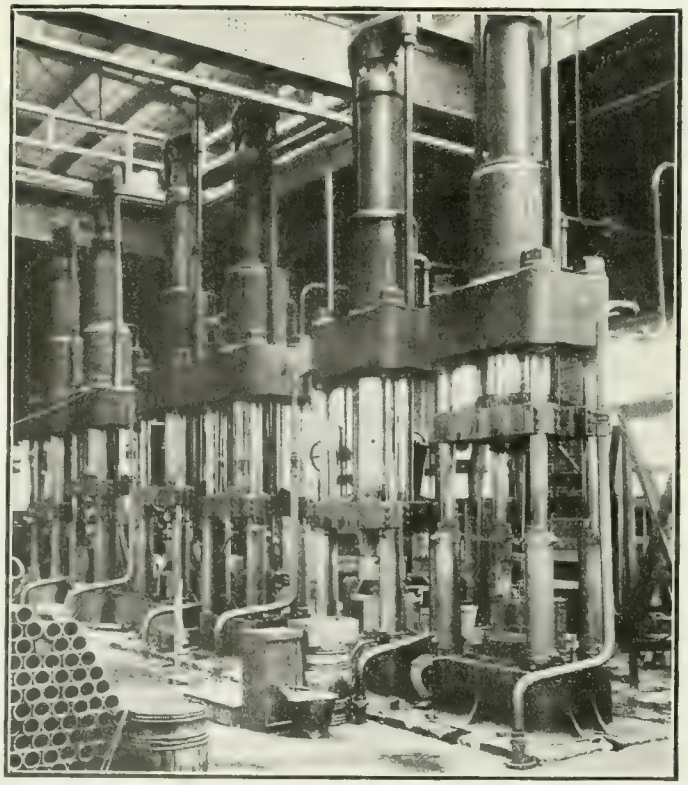


FIG. 3. THREE EACH, 250-TON "BOOMER & BOSCHERT" PIERCING AND DRAWING PRESSES.

Boring.

The shells are again tested for wall thickness and then taken to twelve 25-inch C.M.C. turret lathes where the powder recess is finished. The base is next finished on four "Hall" cutting-off machines.

Bottling.

The shells are now gathered into groups of 120 each, and are taken to the bottling presses in readiness for forming the nose. It might be stated that the hardening of the shells customary in most plants is dispensed with here as the nature of the steel as it comes to the shop and after drawing leaves the shell of the proper hardness. This is the only plant in Canada using 75 per cent. carbon steel. The latter is somewhat harder to work, but by using "Double Mushet" tool steel this disadvantage has been much minimized, an average of 45 shells being rough turned in ten hours with very little touching-up of the cutting tools.

The nosing or bottling is done in two operations, and the dies are so constructed that after the second operation the shape is almost the desired form, and requires very little machining. The dies for the two operations are shown in Figs. 8 and 9. When heating for the first operation, the open end of the shells in sets of four are placed in a vertical position in openings at the top of a "Mechanical Engineering Co." oil furnace, arrangements being made to revolve the shell while being heated. The first operation requires heating of about 2 inches or more back from the open end, and after the first process the nose is again heated in another M.E. furnace for a distance back of about ¾ of an inch, the nose being finished in the die shown in Fig. 9.

Water-Cooled Oil Furnaces.

All these oil furnaces are water-cooled, each having a water chamber be-

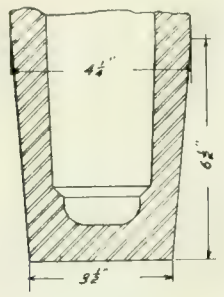


FIG. 4 SHRAPNEL BILLET AFTER FIRST DRAWING OPERATION.

tween the fire-brick and the outside casing. After the bottling operation is completed, the noses of the shells are annealed for further machining.

Finishing and Threading Nose.

The shells are next taken to eight-16 inch. "C.M.C." lathes, fitted with turret heads and carrying a special chuck similar to Fig. 10. Thirty or forty of these chucks are in continual use. After the machining is done on the nose of the shell they go to two "Lees-Bradner" machines, where the thread in the nose is milled out. A view of these machines is shown in Fig. 11.

Finish Turning.

When threaded they are then finish-turned and the contour of nose formed by means of a fixed templet at the back of the lathe which takes care of the lateral movement of the tool-post rest.

Waving and Grooving.

The shells are now taken to five 16-inch "C.M.C." lathes, where they are held in a chuck similar to Fig. 10, and have the groove roughed out. They are afterwards taken to five 16-inch "C.M.C." lathes to have the waving and undercutting performed by means of a "Bertram" waving attachment. On account of the nature of the steel the roughing and finishing are done on separate lathes to save the cutting tools.

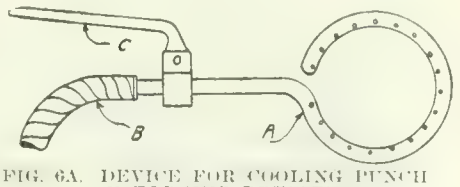
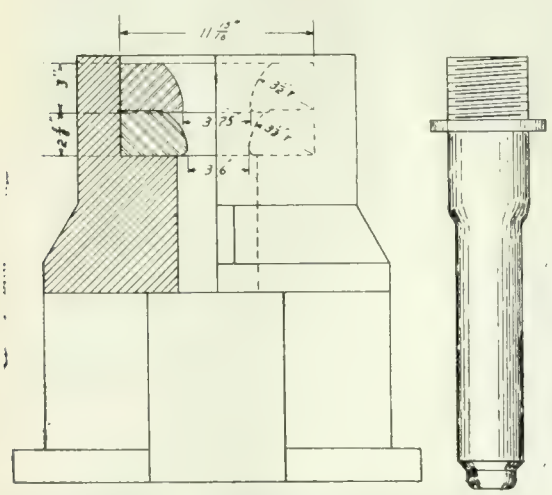


FIG. 6A. DEVICE FOR COOLING PUNCH OF FORGING PRESSES.

Final Operations.

The foregoing completes the operations as performed on the ground floor. The shells are therefore transferred by means of "Chapman" and "Cowan" elevating trucks to an "Otis-Fensom" hoist and raised to the upper floor where they are filled with shot and resin and have the final operations completed. They are finally lowered on another hoist, ready for shipment.



FIGS. 5 AND 6. DRAWING DIE AND PUNCH FOR FINISHED SHRAPNEL FORGING.

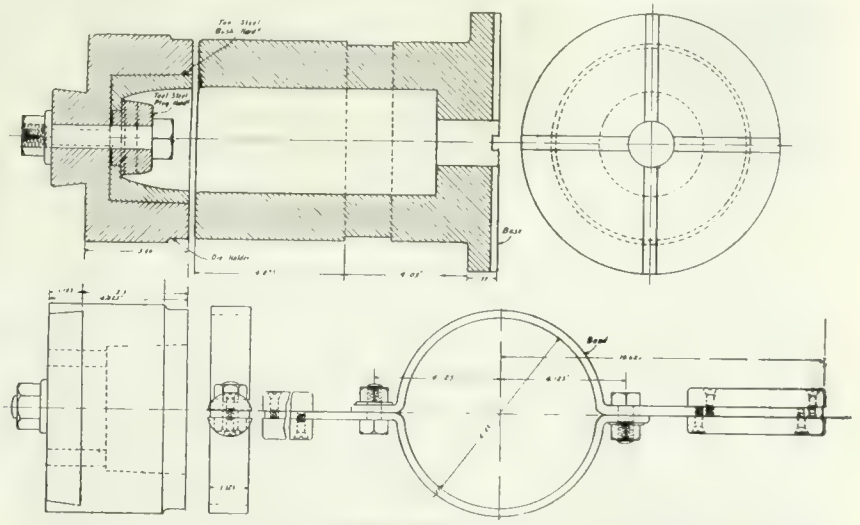


FIG. 8. DIES FOR FORMING SHRAPNEL SHELL NOSE FIRST OPERATION

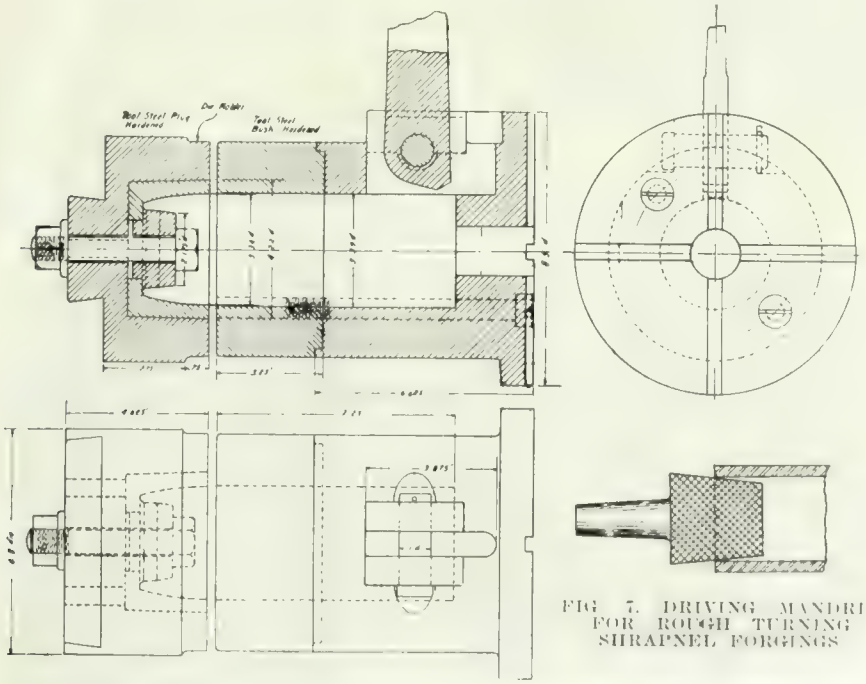


FIG. 9. DIES FOR FORMING SHRAPNEL SHELL NOSE SECOND OPERATION.

FIG. 7. DRIVING MANDRIL FOR ROUGH TURNING SHRAPNEL FORGINGS

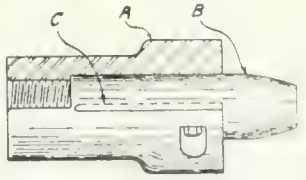


FIG. 10. SPECIAL GENERAL PURPOSE CHUCK.

A general view of shell shop with its multitude of tools is shown in Fig. 20, which is the illustration used in the title of our article.

High Explosive Shell Production.

The material for the production of 3.3 high explosive shells comes to the plant from the mill in bars as shown to the right of Fig. 1. These bars are brought into the shell shop and are first

cut into billets on an "Espen-Lucas" inserted tooth cold saw, driven by a 15 h.p. "Vickers" motor.

Rough Drilling.

The billets are placed in a jig and drilled in a battery of six "Foote-Burt" drilling machines, the drills used being furnished by the Celfor Tool Co., and the Jno. Morrow Co. After they are rough drilled they are placed on a jig similar to Fig. 13 and centered.

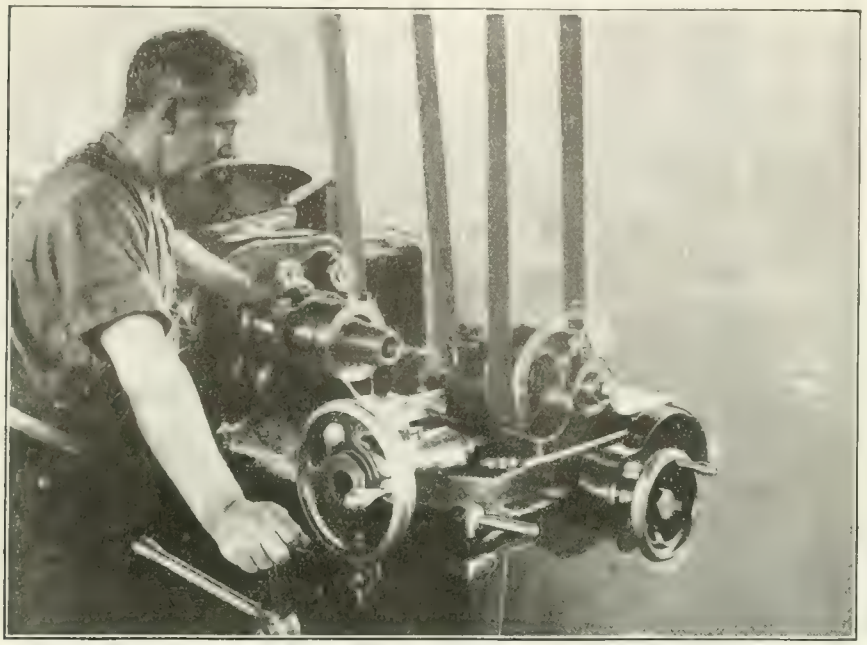


FIG. 11. THREADING NOSE OF HIGH EXPLOSIVE AND SHRAPNEL SHELLS ON A "LEES-BRADNER" THREADING MACHINE.

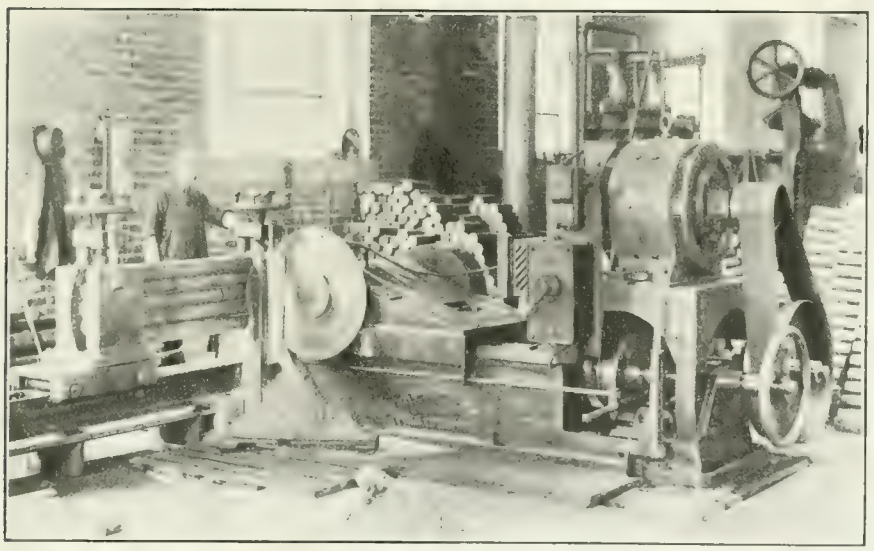


FIG. 12. "ESPEN-LUCAS" COLD SAW CUTTING-OFF BILLETS FOR 3.3 H. E. SHELLS.

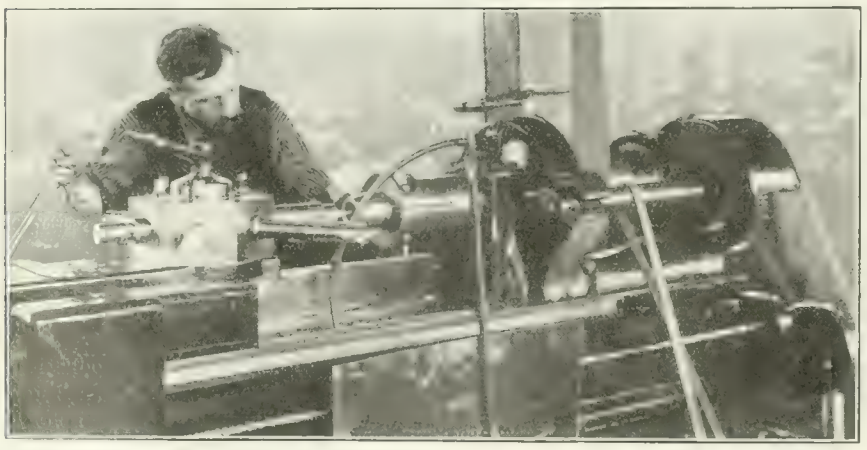


FIG. 13. TURRET OPERATIONS ON NOSE OF 3.3 HIGH EXPLOSIVE SHELLS.

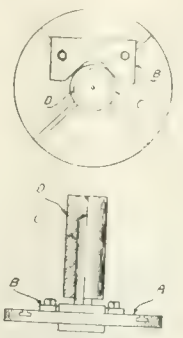


FIG. 13. CENTERING JIG

FIG. 14. NOSE FORMING TOOL

Rough Turning and Boring.

The billets are then taken to eight 16-inch "C.M.C." lathes to be rough turned and have the contour of the shell nose formed by tools shown in Fig. 14; the tool A is for roughing, and tool B for finishing, the profile of nose. The shells are next taken to six "C.M.C." lathes fitted with turrets, and on these the boring and finishing of the inside of the nose is performed as shown in Fig. 15. The cycle of operations is shown in Fig. 15 A, and consists of facing, drilling, roughing powder chamber, reaming, recessing at bottom of thread, and finishing powder chamber.

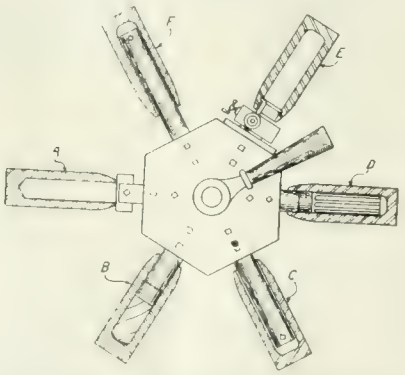


FIG. 15A. TURRET LAYOUT FOR FACING NOSE AND FINISHING INSIDE OF SHELL

Threading and Finish Turning.

The threading of the nose is done on two "Lees-Bradner threading machines as shown in Fig. 11. The shells are then finish-turned on six "C.M.C." lathes, the driving being done by means of the chuck shown in Fig. 16. Grooving and waving are performed on six

FIG. 16. DRIVING CHUCK FOR FINISH TURNING.

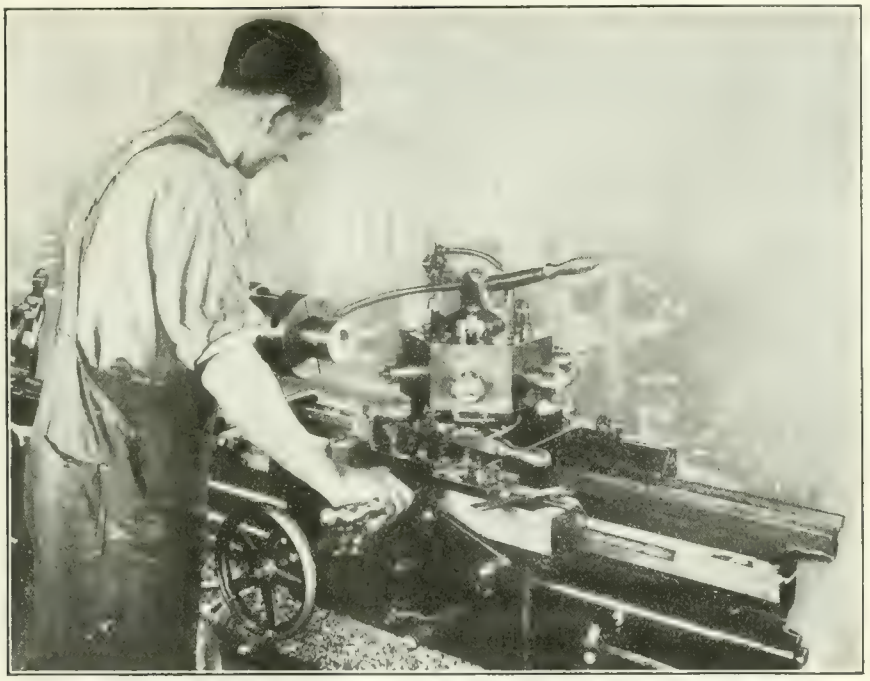


FIG. 17. FINISHING BASE OF HIGH EXPLOSIVE SHELLS ON "McDOUGALL" LATHE FITTED WITH TURRET HEAD.

"CMC" lathes fitted with a "Bertram" waving attachment.

Finishing Nose and Base.

Finishing the nose to receive the brass sockets is done on four R. McDougal Co.

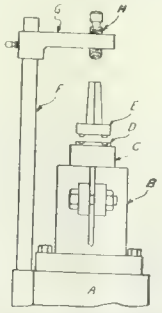


FIG. 18. JIG FOR SCREWING IN STEEL BASE PLATES.

18-in. lathes. The turret operation on the base of the shell to receive the steel disc is indicated in Fig. 17.

Drilling and Tapping Nose.

The shells are now carried on "Chapman" and "Cowan" elevating trucks to the hoist where they are removed to the second storey. The grub screw holes are drilled and tapped in the nose and a finishing tap is run into the latter to bring the thread to the required size. The copper bands are next pressed on with a pressure of 700 to 800 lbs. per sq. in.

Screwing in Base Plates.

The steel base plates are screwed tightly in by means of the jig shown in Fig. 18. Two ½ inch holes are drilled diametrically opposite, flat bottomed and about 3-32 in. deep, so that they will be completely removed when plug is turned off flush. The stand A is firmly secured to the floor and the chuck B is bolted to the base. The shell C is rigidly clamped in piece B and the plug entered in its place; the support G for the ratchet is fastened to the piece E; the piece E having a shank which fits the socket of the ratchet and also fits the holes in the disc.

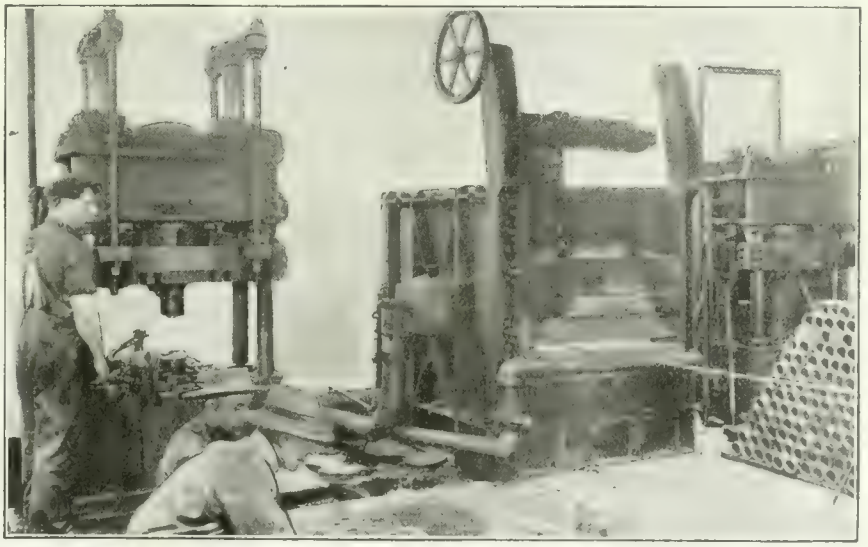


FIG. 21. "MECHANICAL ENGINEERING CO." OIL FURNACE AND "BOOMER & BOSCHERT" PRESSES FOR PRODUCING SHRAPNEL SHELL DIAPHRAGMS

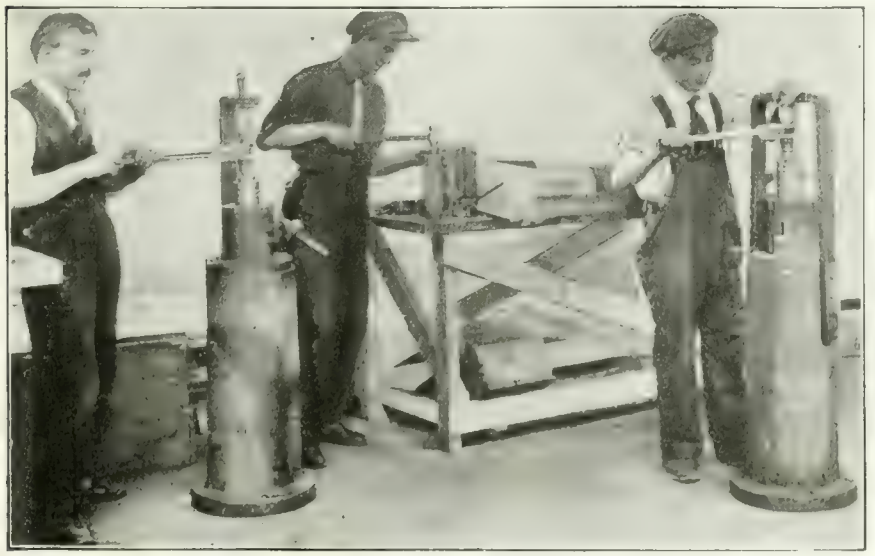


FIG. 19. SCREWING AND RIVETING REINFORCING DISCS INTO BASES OF HIGH EXPLOSIVE SHELLS.

This arrangement can be made much more rigid by bridging the support as shown in Fig. 19. After the discs are screwed home, they are riveted in as shown in the centre of Fig. 19.

Finishing Base.

The projecting ends of the plugs are afterwards faced off on fifteen "Hall" cutting-off machines, these tools being specially adapted to this particular work.

Baking and Varnishing.

After the shells have been machined and inspected, they are ready for baking and varnishing. This operation is shown in Fig. 23. In the foreground is seen the arrangement for cleaning out the interior by means of a strong blast of air. The shells are next placed upon the hot plate shown in the background,

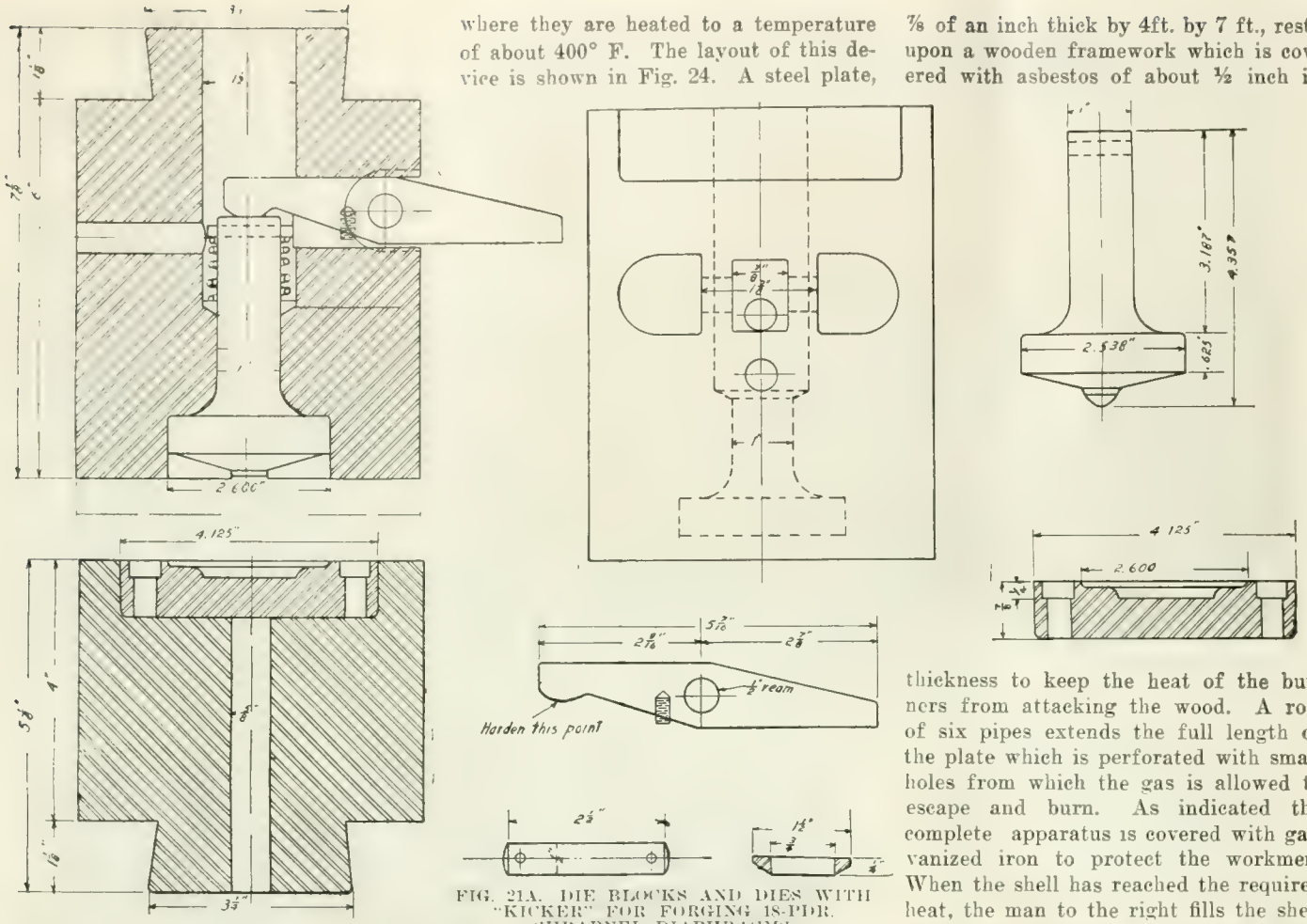


FIG. 21A. DIE BLOCKS AND DIES WITH "KICKER" FOR FORGING 18-PDR. SHRAPNEL DIAPHRAGMS.

where they are heated to a temperature of about 400° F. The layout of this device is shown in Fig. 24. A steel plate, ⅞ of an inch thick by 4ft. by 7 ft., rests upon a wooden framework which is covered with asbestos of about ½ inch in thickness to keep the heat of the burners from attacking the wood. A row of six pipes extends the full length of the plate which is perforated with small holes from which the gas is allowed to escape and burn. As indicated the complete apparatus is covered with galvanized iron to protect the workmen. When the shell has reached the required heat, the man to the right fills the shell with varnish and then empties it into

FIG. 22. GROUP OF LATHES TURNING DIAPHRAGMS FOR 3.3 SHRAPNEL SHELLS.

the next shell to be varnished, sufficient varnish adhering to the interior to leave the required coating. Heat drying immediately follows. A thin shell piece screwed into the nose serves to protect the thread from the varnish.

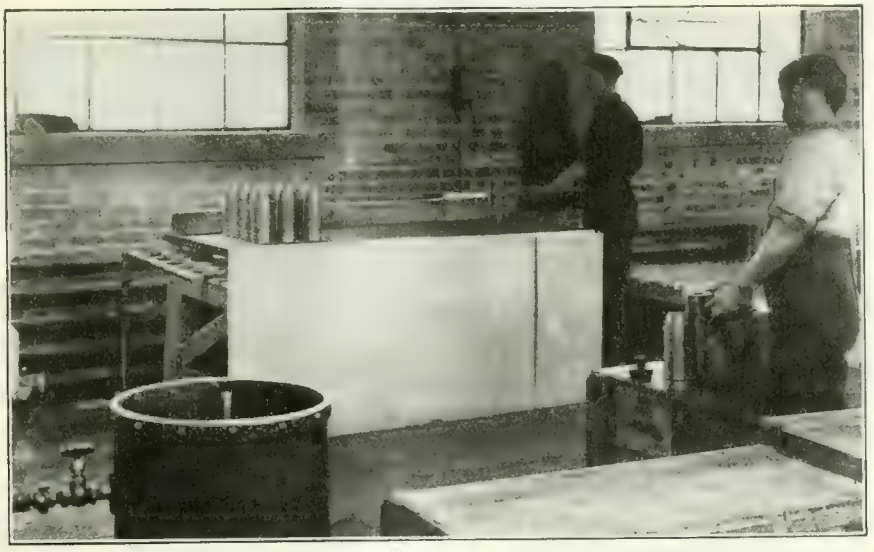


FIG. 23. AIR BLAST, BAKING AND VARNISHING.

Painting.

The painting is done as shown in Fig. 25, four shells being revolved in the one jig as the painting progresses. Fig. 26 shows the revolving arrangement. The shells C are placed on the piece B, this having a stem passing through the piece A which is secured to the bench. Attached to the bottom of each stem is the gear E which meshes with the intermediate gears F. Connected to the center shaft is an ordinary air motor which is supported in position by the cross piece of wood H. The same arrangement applies to the painting of the 3.3 shrapnel shells.

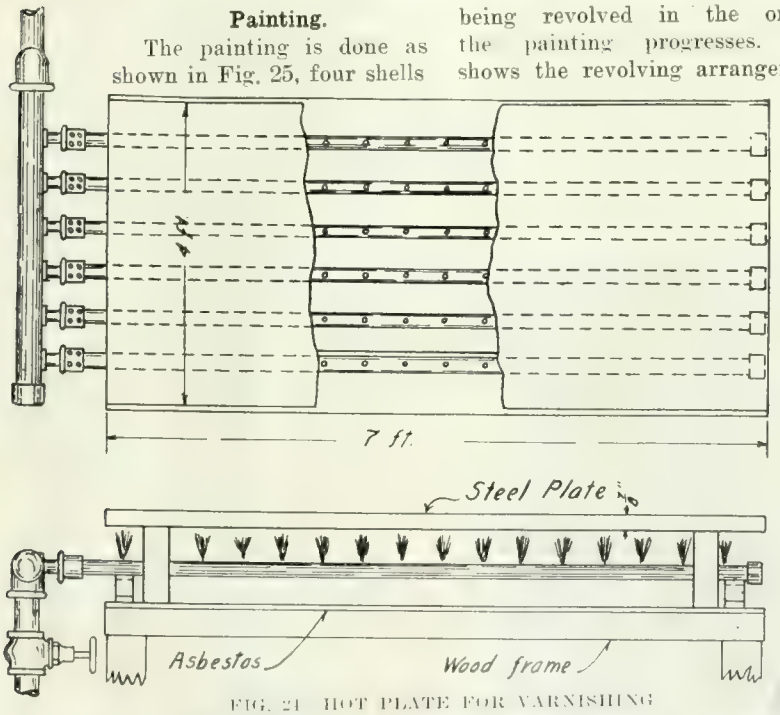


FIG. 24. HOT PLATE FOR VARNISHING

FIG. 25. PAINTING THE FINISHED SHELLS

Shrapnel Shell Diaphragms.

The production of the diaphragm discs, which are placed inside shrapnel shells before the nose is formed, is one of the interesting features in connection with the manufacture of these projectiles. Punchings of 7-16 inch steel plate are forged to the desired shape and machined to fit the recess in the finished shell.

The punchings are placed in the Mechanical Engineering Co. oil furnace, shown in Fig. 21, and are heated and forged in the two Boomer & Boschert presses shown to the right and left of the furnace. A sketch of the forging die is shown in Fig. 21A. After being forged, they are taken upstairs and finished to the desired shape in the machines shown in Fig. 22.

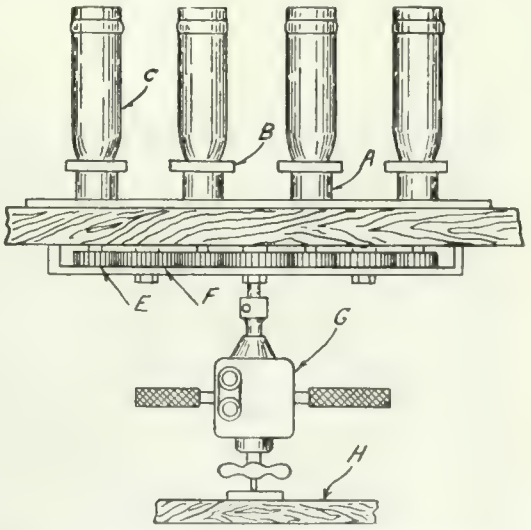


FIG. 26. PAINTING ARRANGEMENT

When this plant is fully equipped an output of 5,000 each of 3.3 shrapnel and high explosive shells per week is expected.

The conversion of shipbuilding and marine engineering shops into shell factories proceeds apace in Great Britain, and still the demand for munitions exceeds the output. It is stated in this connection that for every soldier in the field there should be a munition worker at home, and that a battery of field artillery can use in a single day the output of 300 mechanics.

CARTRIDGE CASE COOLING CONVEYORS.

THE accompanying cuts show two special conveyors of 33 feet centres furnished by the Stephens-Adamson Mfg. Co., Aurora, Illinois, to the Metal Drawing Co., St. Catharines, Ont., for carrying red hot cartridge cases for 18-pdr. shrapnel shells from the annealing ovens to the pickling tanks prior to being re-drawn. The function of these conveyors is to afford a means whereby the cartridge cases can be cooled gradually while travelling from ovens to tanks.

Fig. 1 shows a pan of cartridge cases which have just been discharged from the annealing furnaces. These are picked off the pan singly or in pairs by means of long hand pinchers or tongs, and placed in a wire basket, which holds forty cases. The pan when empty is trucked around to the receiving end of oven ready to receive another batch of cases to be annealed. The conveyor is then put in operation and moves for a distance of two feet bringing an empty basket ready to receive its load.

Fig. 2 shows the discharge end of conveyor with basket laying in horizontal position (same as receiving end) ready for cartridge cases to be removed by hand and placed in pickling tanks for treatment.

The conveyors are spaced 14 ft. centres in line with the annealing furnaces, and between the conveyors is installed an exhauster for cooling the cartridge cases while in transit, the conveyors being started and stopped at will at either end by means of a friction clutch pulley on line shaft driving the same.

The capacity of each conveyor is approximately 1,400 shells per hour, and the time consumed between receiving and discharge end is thirty minutes, the cartridge cases emerging from conveyor thoroughly cooled. Edwin J. Banfield, Toronto, is the Ontario representative of the Stephens-Adamson Co.

FIG. 1. CARTRIDGE CASES BEING PICKED OFF PAN FROM ANNEALING FURNACE AND LOADED INTO WIRE BASKET ON CONVEYOR.

FIG. 2. DISCHARGE END OF CONVEYOR SHOWING CARTRIDGE CASES IN WIRE BASKET FOR REMOVAL TO PICKLING TANKS.

FORGING PLANT FOR 6-INCH SHELL FORGINGS.

THE cost of equipment for producing shells increases very rapidly with the size of the shell. While it is possible to extemporize to a great extent in the manufacture of 18-pdr. shrapnel and high explosive shells, the requirements of 4.5 inch shells demand more perfect machines. If the forging equipment be taken into consideration, the cost rises very rapidly. With 18-pounder shells, the forging has been done in heavy power presses or bulldozers, but 6-inch shells require a plant of a different type.

Recent estimates show that to produce 6-inch shell forgings, the following equipment is necessary. The shells are 30 inches long and the output is 30,000 per month, working 100 hours per week:

Five 450-ton vertical combined piercing and drawing presses, approximate weight 40 tons each; three 200-ton vertical cylinder pointing presses, approximate weight 8½ tons each; two 550-ton type banding presses, approximate weight 8½ tons each; three 200 brake horse-power, electrically driven, 3-throw hydraulic pumps, approximate weight 2¼ tons each; one 26-inch x 20-foot hydraulic accumulator, weight 90 tons.

A method of making a submarine periscope invisible at sea at any considerable distance is to be tested on the K. 6, now in dry dock in Brooklyn Navy Yard. The periscope has been painted in parallel stripes in various colours of the spectrum and it is calculated that the colours when refracted will be converted into a white ray.

4.5 Howitzer Shell Production in a Structural Steel Plant

Staff Article

Uncertain as to the war duration, but with the desire to bear a part in furnishing our Empire with munitions of war while maintaining its normal manufacturing equipment practically intact, the institution here described has, by the investment of a moderate amount of capital and by drawing on the skill and aptitude of its staff, succeeded in achieving a highly satisfactory degree of success in the matter of shrapnel shell quality and quantity output.

IN many cases of shell manufacture the producers were formerly engaged in branches of engineering which called for a more or less complete machine shop equipment, consequently their personnel and plant were capable of adaptation to the shell businesss, promptly and effectively.

A structural steel works such as forms the subject of this article could not be expected to enter the list of producers on equal terms with machine shop establishments. Their energies had been devoted to an entirely different class of work, involving machines, material, and operations quite foreign to the average machinist. Besides being handicapped by the nature of their previous work, they had to go into the market for tools when it was a case of taking what one could get instead of getting what one wanted.

A study of the methods and machines as developed under these conditions should be of considerable assistance to firms who are not yet advanced to the "shipping" stage. Most of our readers are now familiar with shrapnel manufacture, therefore, the points of variation will be easily noticeable.

Many special attachments are now obtainable from different machine tool builders, either for use on their own product or adaptable to any standard type of machine. It is noteworthy in the plant in question that with the exception of collapsible taps all fixtures, jigs and other appliances are the product of the shop. A consideration of the operations and the tooling equipment developed shows most creditable work by the tool room staff.

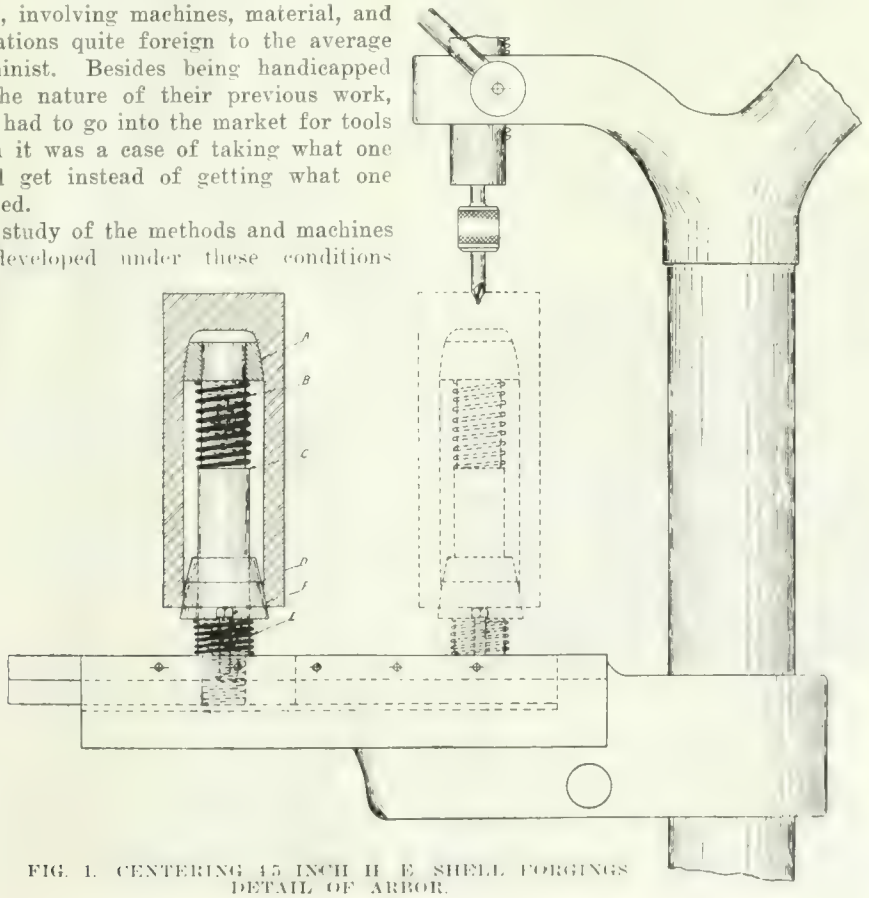


FIG. 1. CENTERING 4.5 INCH H. E. SHELL FORGINGS DETAIL OF ARBOR.

Table I. shows the sequence of operations as at present adopted.

Table I.

1—Cutting off open end only—one spur geared constant speed cutting-off machine, built by Williams Tool Co.
2—Centering—one 10-in. single-geared drill press, built by W. F. & John Barnes.
3—Rough turn outside—one 28-in. "New Haven" engine lathe and one 28 in. "Leblond" engine lathe, both fitted with special tool equipment.
4—Rough face base—one 32 in. "American" engine lathe.
5—Bore and ream—three 24-in. "Davis" turret lathes.
6—Countersinking bevel on mouth—one 36 in. "Fosdick" radial drill.
7—Nosing—one "Hanna" pneumatic riveter.
8—Bore face and tap nose—one 20 in. "Dreses" turret lathe.
9—Turn body and nose—one 22 in. "Hill, Clarke" engine lathe.
10—Finish internal profile of nose—one 20 in. "American" engine lathe.
11—Bore and tap recess—one "Acme" screw machine.
12—Insert plate and face off.
13—Groove, undercut and form waved rib—one "Whitcomb-Blaisdell" engine lathe.
14—Pressing driving bands—one three-throw "Perrin" plunger pump and banding press.
15—Turning bands—suitably equipped engine lathes.
16—Varnishing—steam heated oven.

Reviewing the operations in rotation: The cutting off does not call for special mention, beyond the fact that the choice of a constant speed machine is justified by the small amount of tool travel due to cutting off the open end only, and leaving the facing of the base for a subsequent operation. The avoidance of friction discs and other accessories of variable speed machines is desirable in heavy work. Fig. 1 shows the detail of supporting arbor for centering shells on a small drill press. The bushing A slides on the arbor and rests on a spring B, which maintains it in a position near the top of the arbor. The spring B in turn rests upon shoulder C formed by the lower part of the arbor.

Bushing A is made an approximate fit

for the rough bore of the forging near the base. Bushing D is a sliding fit for the lower part of the arbor, and is maintained in its highest position by spring E. Bushing D is made with a suitable taper so as to rest half way into the open end of the forging. The arbor itself is fastened to a block which slides

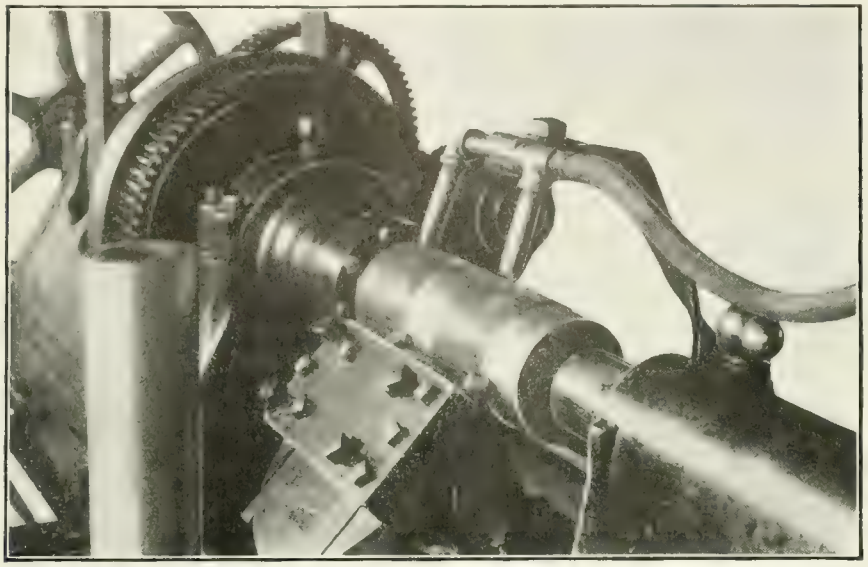


FIG. 2. ROUGH TURNING 4.5 H. E. SHELLS.

in vees formed on the table of the drill press. When the arbor is in the outer position it is well clear of the spindle and allows the forging to be placed over it. This being done, bushing A centres itself from the rough bore near the base while the mouth of the shell is centred on conical bush D. Both of these bushings now compress the springs B and E until the weight of the forging is taken

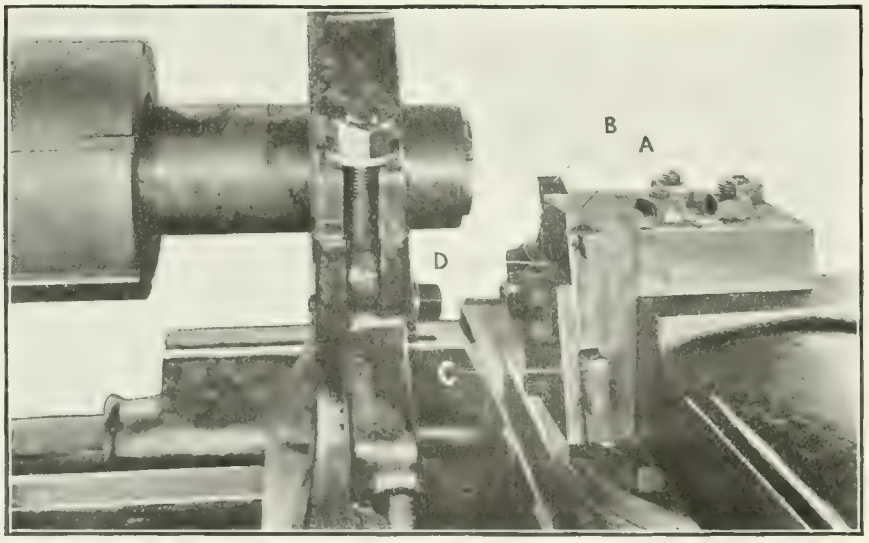


FIG. 3. OVERHUNG TOOL HOLDER FACING-OFF SHELL BASE.

by stop pins F. By sliding the arbor to the inner position where it comes against a stop the centre of the shell is brought exactly under the centre of the drill which drills the centre hole in the usual manner.

Rough Turning.

After centering, the forgings are ready for operation (3), viz., rough turning the outside. The machines on which this is done are standard engine lathes. They are fitted with special tool boxes which carry two cutting tools spaced half the length of the shell apart from each other so that the time for the operation is halved. The tool box is of very substantial design, the tools being made of square tool steel inclined nearly to a vertical position so as to have a constant angle of clearance underneath, irrespective of the amount of top rake. The forging is driven by means of a tapered arbor with longitudinal grooves forming teeth on which the shell is driven, and held by the centre in the tail stock. This machine is shown in Fig. 2. As the amount of stock to be removed from the forging is just over one-quarter of an inch on the diameter, the capacity of these machines is limited by the the ability of the tool steel to stand up under a high speed rather than by the amount of power required to remove the material. A speed of 60 feet per minute is easily maintained by the steel at present used.

The body of the rough turned shell is now of two diameters, the half of the shell next the base having just enough left on to take a final cut at a later stage, while the half next the mouth of the shell is left somewhat larger so as to have a safe margin of stock to allow for any variation in the profile of the nose after nosing-in.

The base of the shell must now be faced off to the proper thickness. Considerable variation is liable to occur in the forgings at this point, and in centering the forgings in operation (2), care must be taken to drill the center holes to a uniform depth, measured from the inside. The probability of excessive stock having to be removed at this point calls for a machine of ample capacity. The machine provided in this case is satisfactory.

An Interesting Tool Holder.

A feature of the equipment is the overhung side cutting tool holder with wedge adjustment for the cutting tool. This is clearly shown in Fig. 3. An L-shaped block is clamped on the tool box of the lathe, with one arm hanging downwards on the left side. A slot is provided in this overhanging arm to take the square tool B, which is inclined slightly from the vertical for clearance. The tool is adjusted vertically by means of the flat wedge or cotter C., the end of which can be observed in the illustration. A securely fastened side plate D holds tool and cotter in position. During this operation the shell is held in a collect chuck by the nose, while the base end revolves in the steady rest.

Boring the parallel portion of the inside, and reaming the tapering portion where the sides meet the bottom constitute the fifth operation. Heavy turret lathes are employed, having three boring bars fitted with a single cutter bar for the parallel portion of bore, and a roughing and finishing reamer for the tapered portion. The layout of the turret is shown in Fig. 4, from which it will be observed that the bars are fastened to the turret faces by flanges, into which the bars are tightly screwed and keyed. Holes on the top side of the flange communicate with a central hole which emerges at the point of the bar and allows the use of a copious supply of cutting compound at the proper point. The compound is supplied through a hose pipe with a nozzle to fit the holes in the flanges, and is changed round to each flange as its bar is brought into operation.

Impromptu Nosing Press.

A radial drill for which suitable employment had not been found was utilized for shaping the mouth of the nose preparatory to nosing. The section of the shell before and after nosing is shown in Fig. 9. The exact outline required before nosing has been the subject of considerable experiment by most makers, and the shape shown here will be useful for comparison with present and proposed outlines. The cutter is shown in Fig. 5. This is of the flat double-edged type, and is provided with a substantial pilot, which enables the full power of the drilling machine to be applied to the cutter without excessive vibration or chatter.

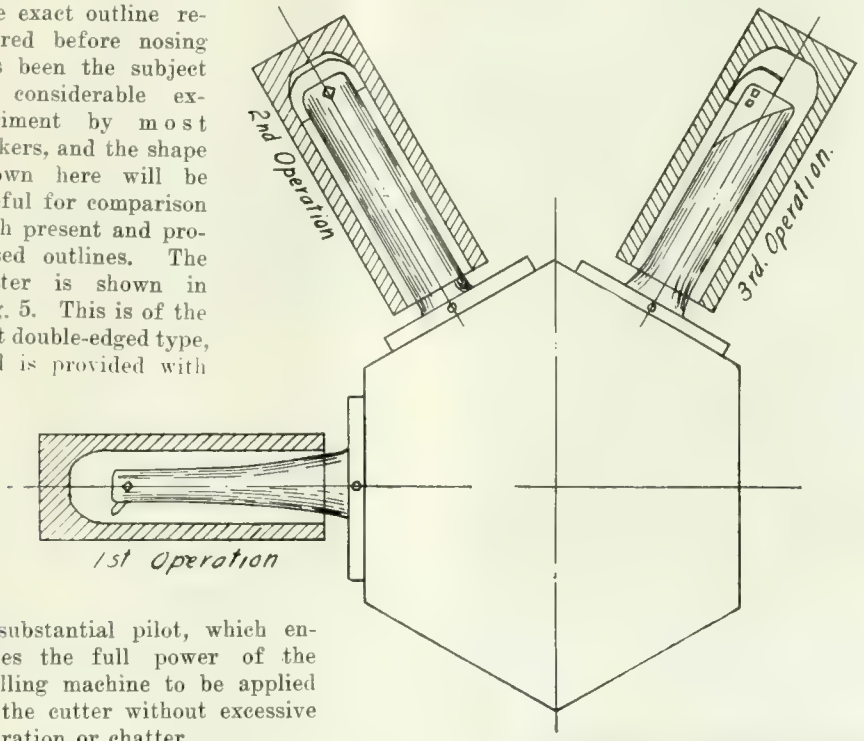


FIG. 4 LAYOUT OF TOOLS ON "DAVISS" TURRET LATHE.

While to the casual observer nosing seems one of the simplest operations, there is probably a greater variety of machines used in this than in any other operation. In utilizing an existing pnuematic riveter, this firm has shown a further example of adaptation which is interesting. The machine is of the fixed horizontal gap type, with a vertical ram actuated by a compressed air cylinder operating toggle gear on the upper part of the frame. This nosing press is shown in Fig. 6, also the home-made furnace for heating the noses.

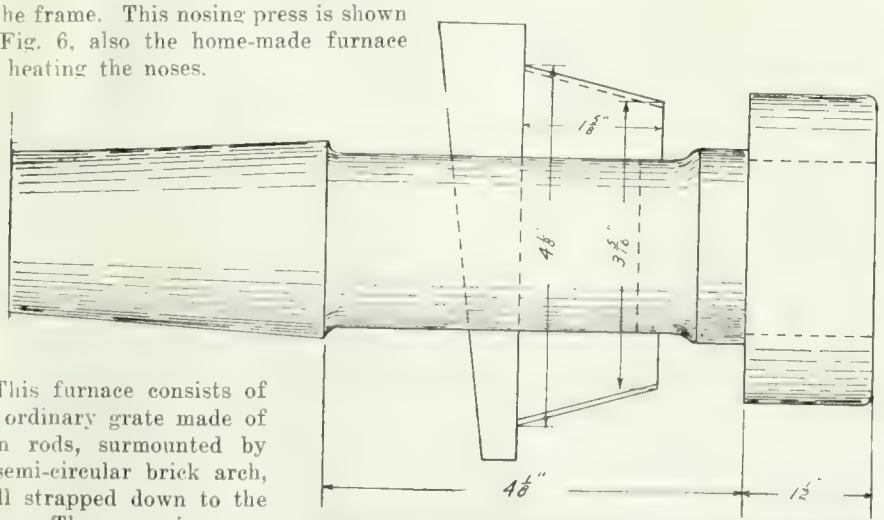


FIG. 5. CUTTER FOR BEVELLING INSIDE OF NOSE BEFORE CLOSING.

This furnace consists of an ordinary grate made of iron rods, surmounted by a semi-circular brick arch, well strapped down to the base. Three openings are provided for the graphite crucibles, which are supported on brick blocks, resting on the grate bars. A coke fire is used, which surrounds the crucibles on all sides. No chimney is required, the draft being maintained by a gentle pressure of air from the air line, the products of combustion emerging through the space around the top edge of the crucibles. Such an arrangement would be objectionable in some shops, but in a spacious well ventilated building, such as is shown here, it is quite suitable. The work is all that can be desired, the resultant hole being parallel and close to size, while the profile also approximates very closely to the finished outline. During the operation, the shell is securely held in an open-sided vise-block, with a swing gate in front, which is tightened up by a lever with a cam end on the boss.

The eighth operation is performed with the shell chucked by the base and supported in a steady rest. A turret lathe is employed, two faces only being used. One is fitted with a boring bar having a cutter of suitable shape which bores the hole and faces the end of the nose. The other face of the turret carries a Murchey collapsing tap which threads the hole.

Profile Turning.

In the next operation, the shell assumes its final size and shape on the outside. The arrangement of the profiling attachment will be understood from Fig. 7. A supporting bar is fixed to two supporting blocks which are clamped over the front vees of the lathe bed at suitable points. A roller is mounted on the side of the cross slide. Two powerful springs pull the cross slide forward, and keep the roller in contact with the profile bar which is mounted on the supporting bar.

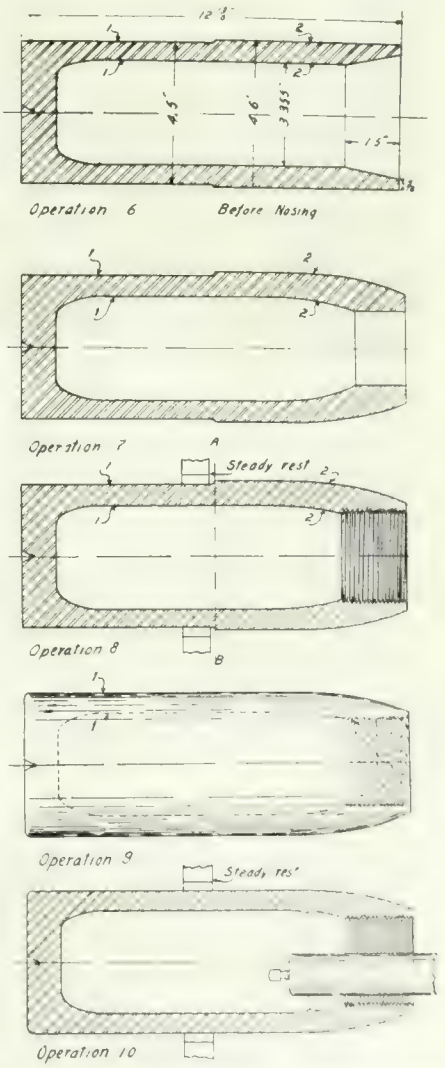


FIG. 9. ILLUSTRATING OPERATIONS 6, 7, 8, 9 AND 10.

The means adopted for driving the shell is simple and efficient. At this stage of manufacture the shell has had

its overall length finally determined, the nose having been machined in relation to the base. In the operation under discussion, the shell is located by bringing the finished end of the nose in contact with a surface which has a fixed location in reference to the profile templet, so that each shell will occupy the same position in reference to the templet and insure a uniform thickness of wall in the nose.

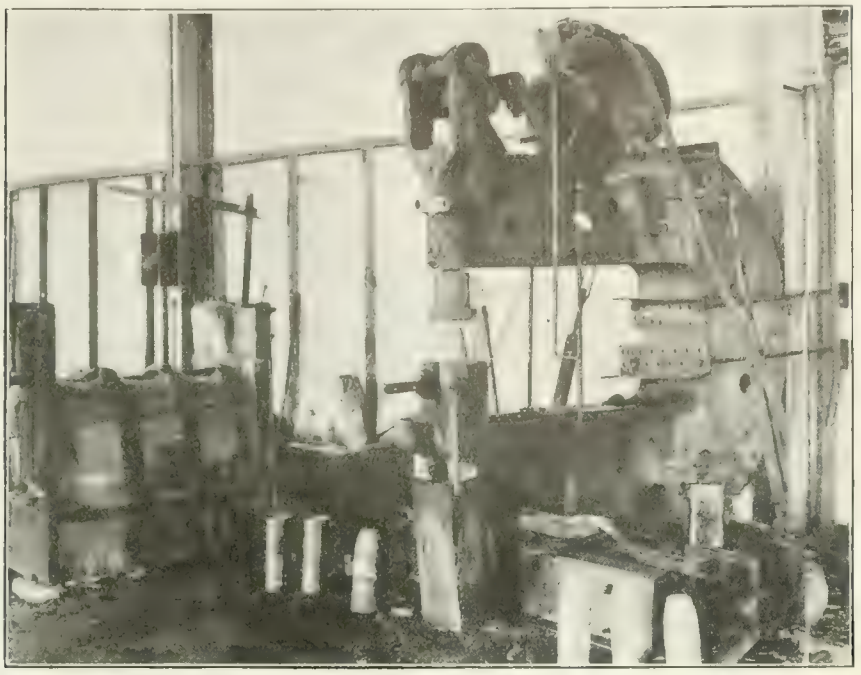


FIG. 6. PNEUMATIC RIVETER USED FOR NOSING 4.5 INCH H. E. SHELLS.

Fig. 8 shows the arrangement of driving plate and method of locating it accurately again, after it has been slackened off to allow removal of shell. A cast iron arbor, A, is threaded to fit the nose of lathe spindles. Diameter B, is machined to fit the index plate C, which carries a spring index pin or plunger D. This plate C, is secured in position by a set screw. The nose of arbor A has a left hand thread 2.6 in. diameter, which fits the threaded portion of hole in driving plate E.

The point of the arbor is provided with a hardened steel cap F, 2.5 in. diameter, which is threaded to fit the nose of shell. The unthreaded portion of the arbor between the left and right hand thread is made a good close fit for the unthreaded portion of hole in driving plate E.

In assembling the device, a spot is recessed on back of driving plate E. to receive plunger D, plate E being located on arbor A so that a suitable amount of right hand thread will be available for receiving the nose of shell. Index plate C is now securely fastened in place. A shell is now screwed on to the end of the arbor till it tightens up against edge of driving plate E. The left hand thread automatically locks the parts together, and any tendency of the driving plate E to revolve, simply causes the left hand thread to wedge the driving plate tighter against the nose of the shell.

When the shell has been machined, the spring plunger D, is withdrawn from the driving plate E, which is now slackened back by means of a wrench, suitable slots being provided. After the shell has been screwed off the arbor, the driving plate E is turned back to its original position and locked by plunger E, thus insuring the next shell occupying the same location in regard to the profile copy.

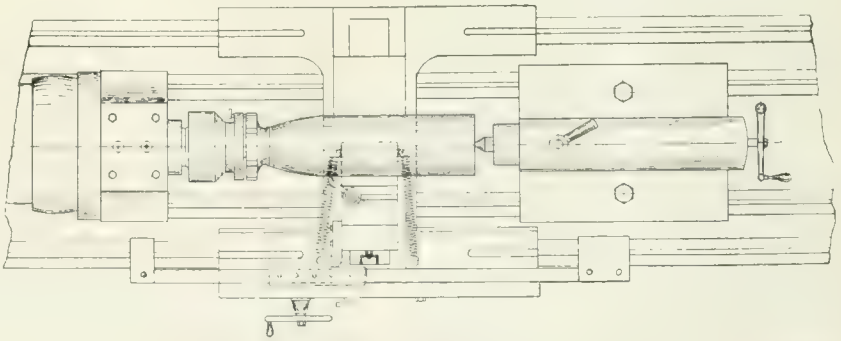


FIG. 7. PROFILE ATTACHMENT FOR TURNING OUTSIDE OF 4.5 INCH H. E. SHELL ON ENGINE LATHE.

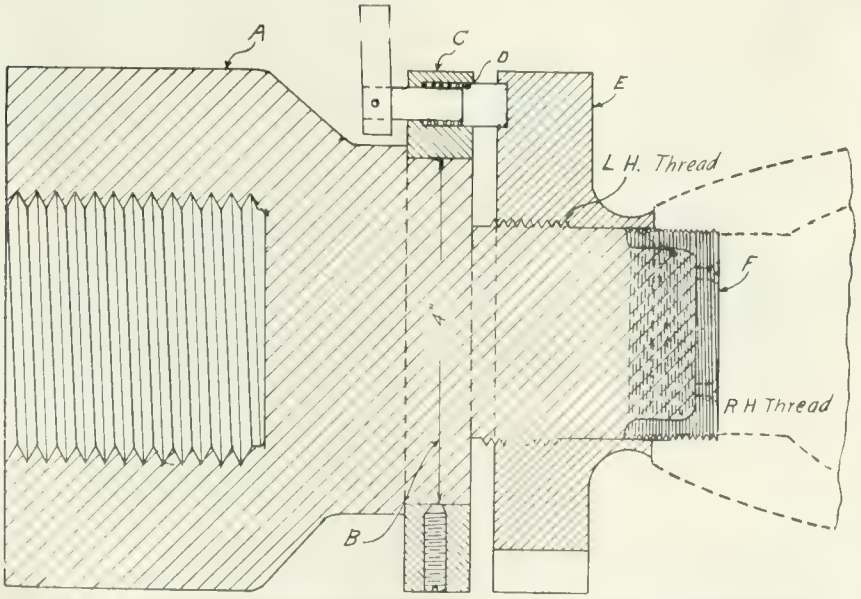


FIG. 8. DRIVING DEVICE FOR PROFILING LATHE, 4.5 INCH H. E. SHELLS

Operation 10 consists of machining the internal profile of the nose. This is a straight-forward job due to the fact that the curve is of a single radius thereby allowing the cross slide to be connected by a radius link of the specified length to a fixed point at the rear of machine. By fixing the line of this point at the correct distance back from the nose of the shell the internal curve is reproduced.

Interdependence of Operations.

Operations 7, 8, 9 and 10 should be considered carefully because the condition of the shell after operation 10 is entirely dependent on the degree of accuracy with which the previous operations have been performed. Fig. 9 shows the shell during these operations, from which it will be observed that be-

fore nosing, surfaces (1) are concentric with each other, and also with surfaces (2). After nosing, surfaces (2) may or may not be concentric with surfaces (1), while surfaces (1) will still be concentric with each other. In operation (8), therefore, care must be taken to see that the steady rest is sufficiently far back from the beginning of the curve so that the body of the shell from the base up to line A.B. is running true.

As the bore of the shell at this point is concentric with the outside, the thread which is now formed in the nose will be concentric with the parallel part of the bore. By working with a center plug in the nose for operation (9), the outline of the body is carried forward to the end of the nose in accurate relation to the thread. Therefore, when the shell is supported on the outside for operation (10), the parallel portion of the bore will still be running true as at the start. The action of the boring cutter is now to true up the inner wall of the nose making the wall concentric and of even thickness. Unless the sequence of operations at this stage be carefully planned and accurately carried out, the resultant product may easily get out of truth with objectionable effects on the balance of the shell when fired from a gun.

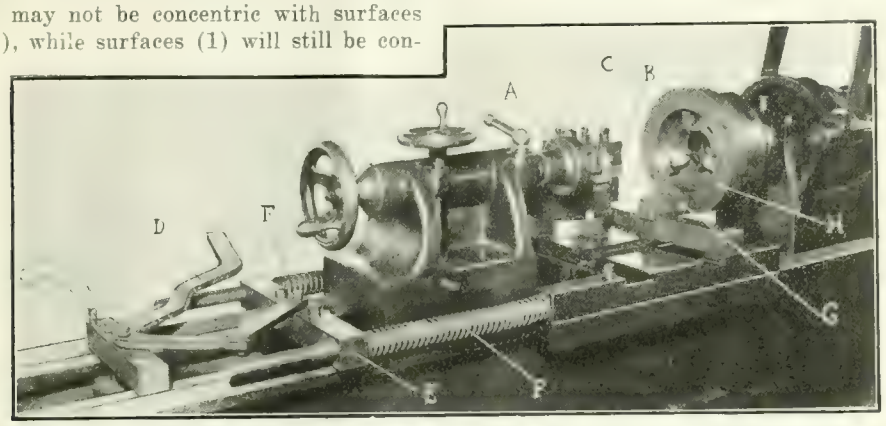


FIG. 10. WAVING EQUIPMENT ON ENGINE LATHE FOR 15 INCH H. E. SHELLS

Boring and tapping the recess in the base is done on a screw machine using a collet chuck and steady rest. "Murchey" collapsing taps perform this threading job in a satisfactory manner. The plug is next tightened home, the ends of joints riveted and then faced off in the usual way.

Efficient Waving Method.

Forming the groove, undercutting the sides, and waving the threads are done in an ordinary engine lathe which has been fitted with a well-designed combination tool box, and the now familiar cam ring on the chuck. Fig. 10 gives a good idea of the substantial nature of the equipment. The base of the shell is supported in a cup centre A, and is driven by a plug center, in the nose-end.

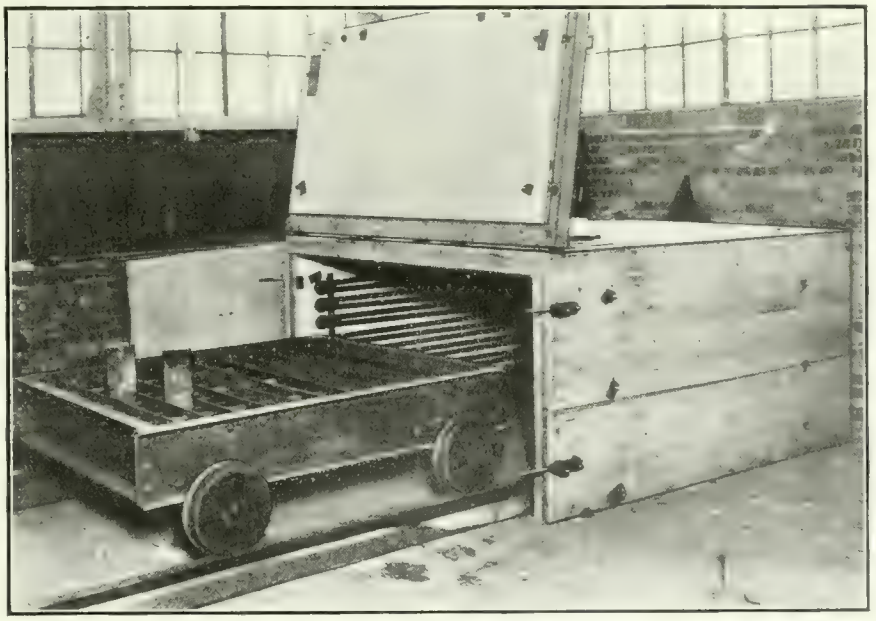


FIG. 11. STEAM HEATED BAKING OVEN.

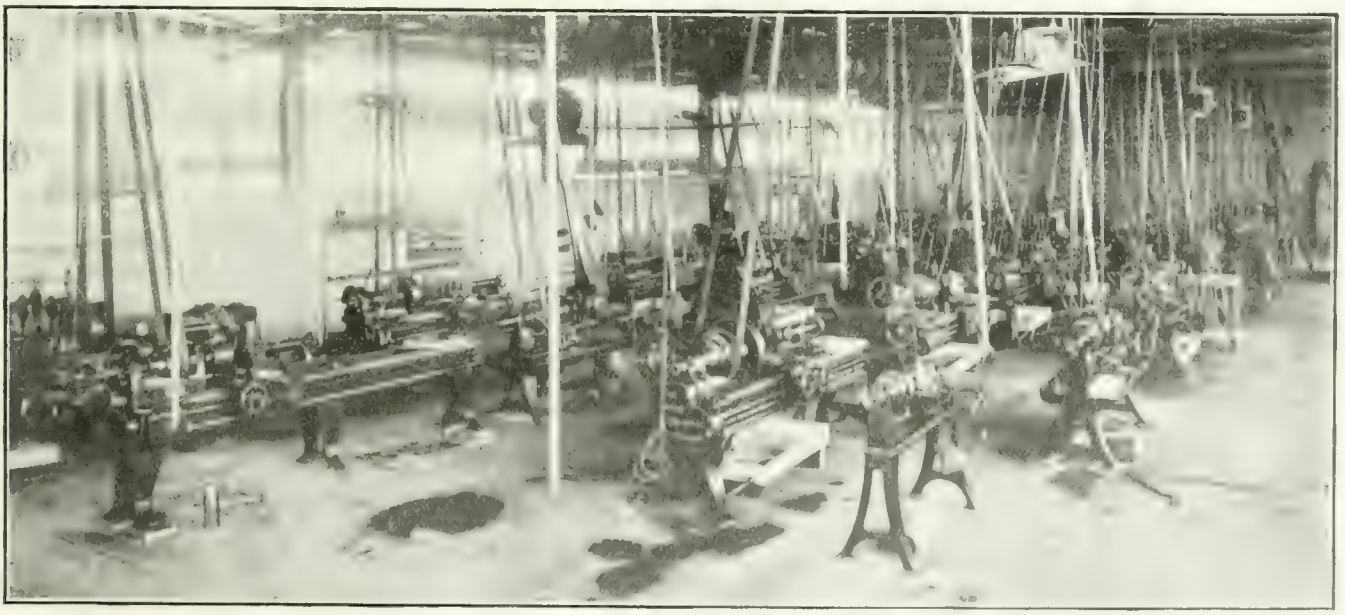


FIG. 12. GENERAL VIEW OF SHELL DEPARTMENT.

Tool B is formed of two parts so that if one corner is broken off in undercutting the whole tool is not scrapped, but just the broken half. In operation, tool B is fed straight into the shell to the required depth and then moved to each side to form the undercut.

A relieved portion in front of the tool leaves the proper amount of material which is formed into waved ribs or threads by tool C. After tool B has operated, the toggle joint is straightened out by moving hand lever D to position shown by dotted lines, causing crossbar E to compress the springs F and maintain the roller G, in contact with cam plate H, the revolving of which imparts the reciprocating motion to tool B necessary to form the required number of waves per revolution.

The remaining operations of banding, band turning and varnishing the interior of the shell are performed in conventional manners and complete the making of the shell to the point where it is ready to be fixed. The thorough manner in which the work has been planned and carried out and the modern methods employed as evidenced by the use of "Cooper-Hewitt" mercury vapor lamps for lighting, and "Chapman" transfer trucks for handling material, show that the firm in line with other Canadian shell makers is fully determined to supply shells to the utmost capacity of the plant, and of satisfactory quality.

SOCKET DRIVING MACHINE.

THE use of a drill press instead of a hand wrench for driving home the brass socket in the nose of shrapnel shells effects a double saving. In the first place, a workman can maintain a higher rate of output for an indefinite period with far less fatigue; and, secondly, the tool employed can be used to reduce the amount of work necessary on subsequent operations. A large drill press, Fig. 1, with powerful double gearing, was used for this work. The shell (a) is held securely in the hinged vise (b) fastened to the table of the machine. A hollow mill (c) is fixed in the spindle, and, when fed down on top of the socket (d), the inserted teeth dig into the metal and take hold firmly.

Continued pressure on the feed lever screws the socket home, the point of tightening being indicated by the teeth of the cutter beginning to cut up the edge of the socket. The cutter is shown in Fig. 2, from which it will be noted that, when suitably designed and carefully operated, it does the work of a roughing tool for machining the outside edge of the socket. Owing to the close limits on the finished sizes of sockets, it is hardly practicable to complete the work at this point.

The heavy dotted lines in Fig. 2 show the outline of the rough socket, while the lighter dotted lines indicate the amount

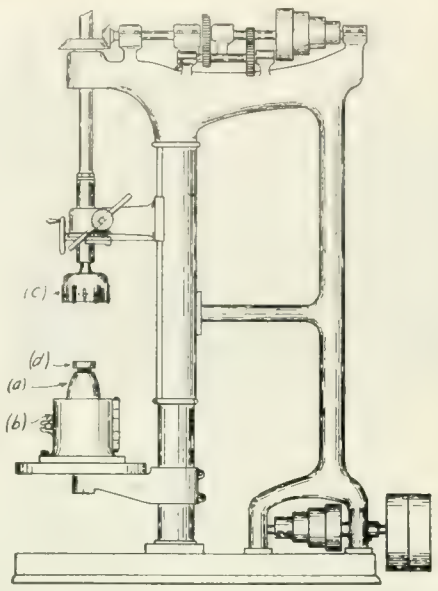


FIG. 1. TIGHTENING SHELL SOCKETS ON A DRILL PRESS.

left on for subsequent machining in lathe.

THE TEST OF WEAPONS

"IT is now the first birthday of the war, and as we look back the affairs of peace appear distant, vague and unreal. Once more the old world accepts violence and

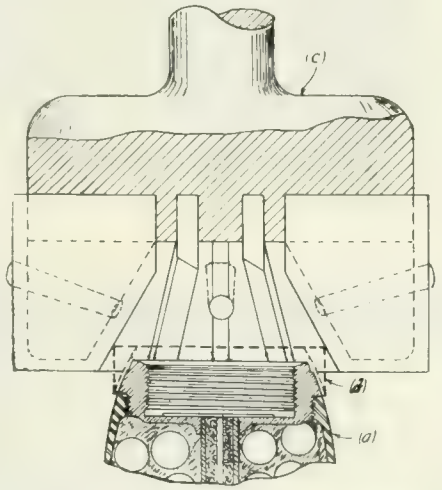


FIG. 2. HOLLOW MILL FOR SOCKET TIGHTENING MACHINE.

danger as its native element and puts everything to the test of weapons, and, if we may judge from the experience of a year, this great test shows mankind much as it always was and war much at it has always been. All the fine professions of peace have fallen away like a cloak, and nations fight after their customs of a thousand years.

"It may be food for the cynical philosopher to recollect that only eight years ago the delegates gathered at The Hague were full of busy ideas for making war humane and for civilizing violence, and expressing fine sentiments about 'the luminous star of peace' and the 'progress of human solidarity.'

"To-day the German public have made a song about the sinking of the Lusitania. In 1907 the Baron Marschall von Bieberstein was telling an admiring audience that 'the principles of humanity will be the surest guides for the conduct of seamen' and that 'the officers of the German navy—I say it with a high voice—will always fulfil in the strictest manner the duties which flow from the unwritten law of humanity and civilization.'

"War reveals nations and men in their true colors: it throws a searching light upon these fine professions, and it proves among other things that Germans at heart are much as they were in the time of Frederick Barbarossa, and that war is in its nature essentially the same as it was in the days of Rome."—Morning Post.

CANADA'S GAS AND OIL RESOURCES.

THE Mines Department, under the direction of Dr. Eugene Haanel, has completed a comprehensive and exhaustive investigation of the oil and gas resources of the Dominion, and it will be issued shortly in book form. The work of investigation has been carried on for the past year or so by a field survey staff under Mr. Clapp, one of the ablest petroleum experts of the United States. The Alberta oil fields has been thoroughly gone over and, while no large producing wells have yet been developed, promising indications have been found of the existence of petroleum in several districts in the Province.

A considerable portion of the report deals with the commercial possibilities of the development of the extensive and rich oil shale deposits of New Brunswick. If these deposits are exploited it is believed that a great industry can be built up, and a substitute found in Canada for the large quantities of petroleum and its derivatives now annually imported from the United States.

So important are these deposits and so great is the market for petroleum products in Canada, that the Federal Government has provided for a bounty of 1½ cents per gallon on oil recovered from oil shales in Canada. The distillation of oil shales in Scotland has been for many years a successful and flourishing industry. New Brunswick shales are on the average richer than the Scotch shales.

The total domestic production of petroleum is now under eight million gallons, while last year imports of gasoline totalled 27,451,379 gallons, and of petroleum in other forms over 200,000,000 gallons.

Why Steel is the Most Suitable Material for Shells

By J. M. W.

The exclusive use of steel for shell casings has occasioned inquiry by ironfounders into the possibility of cast iron being used as well. While the features of the case which have been brought to light by the discussion are so greatly in favor of steel, it must not be forgotten that steel is not perfect, and that any relaxation of stringent inspection, such as exists at present might be productive of results which must be avoided at any cost.

OCCASIONAL reports, chiefly from Belgium, that the Germans were using cast iron shells, have given rise to discussions on the merits of forged steel and cast iron as materials for shell bodies.

A momentary consideration of the requirements which must be met by either shrapnel or explosive shells is sufficient to make it obvious even to the lay mind why cast iron is quite unsuited for shell bodies except under extreme conditions such as now seem most unlikely to arise so far as the Allies are concerned. The purpose of shrapnel is to destroy men: the purpose of lyddite and other high explosive shells is to destroy the defences of the enemy so that infantry may attack. Entrenchments, fortifications, entanglements and other devices for defence are of such an effective nature that they must be literally blasted off the face of the earth before the opposing infantry can get into contact with each other. A hail of leaden bullets from shrapnel shell, no matter how fierce, has little or no effect on modern field works, consequently a copious stream of explosive shells must be distributed over the desired area so as to render the success of an infantry attack reasonably certain. Explosive shells which burst on contact may be used with delayed fuses, which allow a suitable space of time for the shell to sink into earth works to a desired depth, when the explosion of the charge resembles that of a mine. The immense hollows in the ground formed by the large siege guns firing half a ton of explosive are sufficient evidence of the power of high explosive ammunition. The disastrous results which would ensue from such an occurrence taking place in the barrel of a gun render necessary the absolute soundness of shell forgings, whether shrapnel or explosive.

Absolutely Safe Guns.

The absolute strength and safety of modern guns has been a wonder and mystery to the majority of laymen for many years; consequently the guns themselves have been discussed much more frequently than has the ammunition until the outbreak of hostilities.

Given good average material such as is procurable in the open market at the present moment, a good engineering education, and a high class engineering plant— and any resourceful man will produce a formidable gun with his personal experience and skill. The knowledge of ammunition manufacture, however, has for obvious reasons never been so widespread and available as that of guns. Even now with all their experience in shell work many producers have still to develop that patriotic interest in their product which is necessary to make them appreciate the strict inspection, and which would cause many so-called hardships to be viewed in their true light of precautions instead of being looked upon as hindrances to profit accumulation.

Rigid Inspection for Shells.

A true appreciation of the painstaking care and watchful economy which is necessary in producing shells at the present moment can only be obtained by a close study of the entire process from the time the iron ore enters the furnace until it leaves the muzzle of the gun as a shell. While the actual composition of the steel is decided on and controlled by a limited number of individuals, the mechanical and thermal treatment of the material is being performed by thousands of individuals, the majority of whom endeavor to effect every possible economy in time and material. That considerable economy in material has been accomplished is evident from published results obtained by a leading English metallurgist. Losses of 40 per cent. have been reduced to 15 per cent. with very little increase in cost, and no decrease in quality. The amount of labor lost on partly machined shrapnel forgings has been quite an item, but if shell makers calmly considered the matter from the steel makers point of view, they would not be so disposed to condemn offhand a product which represents the application of so much specialized knowledge and labor.

Steel Maker's Troubles.

The steel maker is not desirous of losing the profit as well as the actual cost of shell forgings which develop defects in course of machining. Government and personal inspection of material in all stages of manufacture is planned and carried out with the object of insuring perfect material and workmanship.

The results of Sir Robert Hadfield's investigations are of prime importance at this time. Steel which has been cast in ingots by ordinary methods may appear perfectly sound while not actually so—it may be rolled into billets—it may be forged into shells—and at all stages up to heat treating it may pass all physical tests satisfactorily with the one possible exception of an examination of the microstructure. After an ingot is cast, it is not again heated to a high enough temperature to cause the removal of piping defects, consequently the lack of what may be termed "cohesive density" persists in the metal till such time as it is finally heat treated.

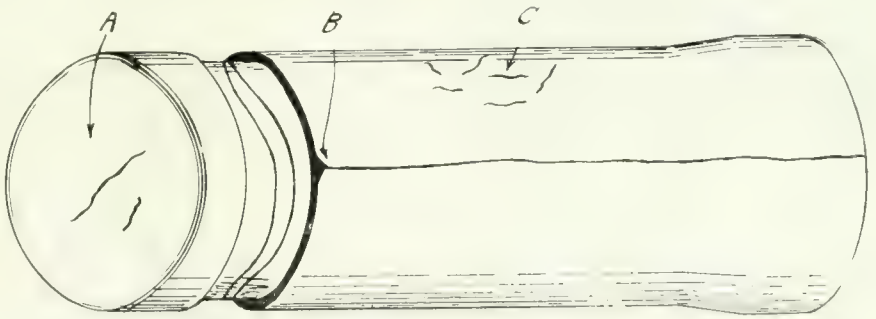


FIG. 1. DEFECTS IN SHELL FORGINGS.

When Defects Appear.

At this stage of manufacture hitherto unnoticed defects in shrapnel forgings, occasionally begin to appear. Flaws of various kinds become quite evident, although the most careful inspection before heat treating failed to reveal the slightest evidence. This trouble has caused considerable loss to both steel works and manufacturers, and the fact that it has occurred in spite of all inspection, etc., would indicate that the

steel makers are continually confronted with a serious problem. The hypotheses which the writer advances in explanation of well-known and recognized defects in shell forgings are based on personal experience in producing many thousands of shells and the conclusions arrived at are offered to manufacturers in the hope that a clearer knowledge of their cause may assist in timely detection and, ultimately, their complete elimination.

In Fig. 1 is shown a shrapnel shell with three distinct flaws, which are due to three entirely different causes. At A is indicated what is perhaps the commonest flaw. One or more cracks may open up and become visible after the shell is hardened. They may be only one-eighth inch long, or they may be one inch and eight. They may be less than one sixty-fourth inch wide, or they may be one-sixteenth inch. While most parties who have experienced this trouble seem agreed that it is developed in forging, there has not been advanced, so far as the writer is aware, any definite theory which satisfactorily accounts for their occurrence.

A Crack Theory.

It would seem not improbable that these cracks are formed when a certain combination of circumstances occurs in the course of forging operations. In starting up forging after say a week-end stoppage, the drawing punch and dies would be well cooled down, while some pierced billets might be soaking at a high heat. The combination of the cold punch inside, and cold dies outside would chill the walls of the forgings much more quickly than after running steadily for some time. The probability of an extra long billet would call for extra power, causing excessive tension in the metal on the outer layers of the base, which as suggested might possibly be at a rather high heat. While a rupture might take place at this time, it would not weld together again, but the close contact of the surfaces due to shrinkage would conceal the defect until the tension induced in the outer layers by their sudden contraction when quenched, would open them sufficiently to make their presence noticeable.

Forgings, in which the thickness of the base was well oversize, would be more or less immune from this trouble, not only because the extra metal would provide increased resistance to rupture while passing through the drawing die, but also because the extra metal is removed from the outside of the bore more conveniently than from the inside. Even if there were any slight cracks, in spite of the thicker metal in the base, they would in all probability be removed in facing the base of the shell to the required thickness.

Other conditions under which they would occur would be when the forging shop was working too closely to the minimum thickness of base. This would be most likely to happen when the forge shop was getting low on material and endeavoring to work in billets which might be a trifle undersize.

Neglect to clean out the piercing die also causes trouble through scale remaining on the bottom and getting pressed into the base. Shells have been observed with quite large defects from this circumstance, the cavities caused by the scale or other foreign matter, sometimes extending completely through the base.

Flaws Due to Rolling.

At B, Fig. 1, is indicated a flaw which occurs previous to forging. In the particular shell referred to, this flaw extended from the nose to the driving band groove. About 1-64 inch in width it could be felt distinctly with the finger nail, and, where it terminated at the driving band groove, it had broken away on either side leaving a scaley surface exposed. While at first sight it might be considered due to piping, the fact that it was only 1-16 inch deep, and did not extend over the base, would indicate rather the presence of some foreign substance or material which got worked into the bar during rolling operations, the end of the affected part happening to terminate at the groove as described.

Flaws of this kind are not dangerous in the sense of being concealed or difficult of detection. Had there been a smaller amount of foreign matter rolled into the bar, it would have been entirely removed in machining, but an internal flaw due to lack of homogeneity in the ingot could quite well remain undetected at all stages of the work.

Fissures.

At C, Fig. 1, are indicated a number of minute hair-like cracks or fissures from one-quarter to three-quarters of an inch in length. In some particular makes of forgings these fissures would be quite numerous. Their behavior was similar to flaws A, with the difference that they were more noticeable when the shells were ground instead of turned. At one period in the business, considerable trouble was experienced with hard streaks which were attributed to segregation of manganese. While opportunity did not afford full investigation at the time, the conclusion was accepted as probable.

The matter of fissures in shrapnel shells has been the subject of recent discussion in England, the theory advanced being that regions of low carbon and high phosphorus resulted in layers of different hardness. The low carbon layers being more elastic would accommodate themselves to strains brought about by quenching, while the high phosphorus layers owing to their different behaviour, would be subject to local strains which might develop in the form of fissures such as have been observed.

The fact that defects such as these mentioned can, and do occur in the handling of steel forgings, renders it obvious even to the lay mind, that the use of any material which is less reliable than steel, can only be justified by the exigencies of the situation.

Regarding Cast Iron.

The most that can be said for cast iron is that it is better than nothing. The almost entire absence of elongation results in such brittleness that in order to be absolutely safe, a cast iron shell would have walls so thick that the number of bullets contained would be so greatly reduced that the killing powers of the shell would be negligible. The probability of blow holes in the walls would disturb the balance of the shell during flight so as to destroy all accuracy of fire. The presence of cast iron shells on a modern battlefield indicates two possible contingencies:—either the demand for shells is so abnormal that a sufficient amount of raw material can not be obtained, or else the supply of steel is so much below normal that the normal consumption of shells cannot be met.

The inference is largely a matter of degree, but the results cannot be other than favorable to the cause of the Allies.

MUNITIONS INVENTION COMMITTEE

THE Minister of Munitions has constituted a Munitions Inventions Branch of the Ministry, and has appointed as Comptroller E. W. Moir, M. Inst. C.E., M. Am. Soc. C. E. The branch, which for the present is located in Armament Buildings, Whitehall-place, will have the duty of considering projects for inventions relating to munitions for warfare on land, or matters appertaining thereto. The Comptroller and staff of the branch will be assisted in their work of examination, and, if thought necessary, in the investigation and development of any projects that may be considered worthy of being developed, by a panel of honorary scientific and other experts.

In order to prevent time fuses from turning whilst in transit, Krupps solder a wire across them sufficient to hold them in place, but yielding easily to the pressure of a key in the gunner's hand.

H. E. Shell Production in Ventilating Equipment Plant

Staff Article

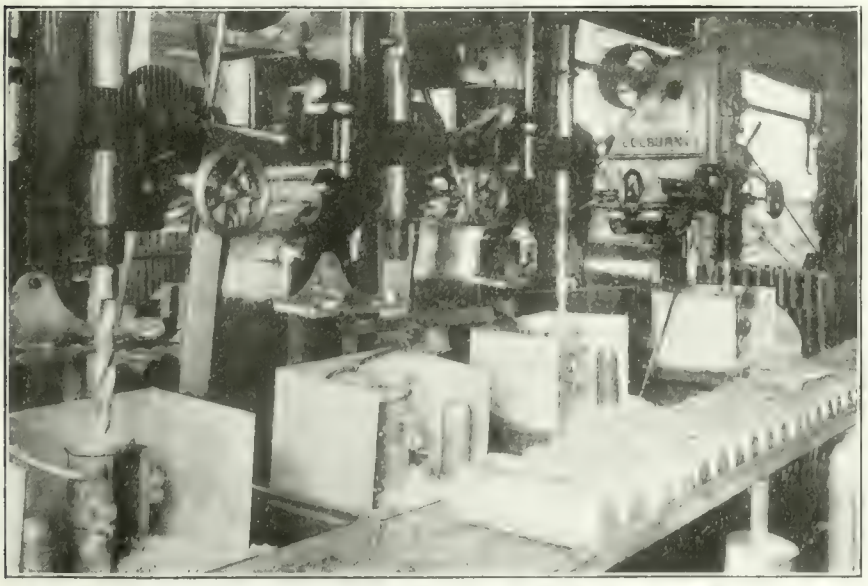
The plant which forms the subject of this article was among the first in Canada to undertake the production of 18-pdr. lyddite shells. Being accustomed, however, to manufacture machinery for special duty, little, if any difficulty was experienced in tackling successfully these war-time commodities. In addition to designing several ingenious fixtures and tools, a number of special machines have also been built and requisitioned for the work.

THE number of firms engaged in the manufacture of high explosive shells will no doubt increase, the demand for this type of shell having become quite insistent. Although some firms have reached the shipping stage and have overcome many of the difficulties with which they had to contend, there are others who have yet to go through the mill. The latter, however, will have the opportunity of benefiting from the experience gained by the pioneers and will no doubt take full advantage of it.

At the plant which is the subject of this article, 18-pdr. high-explosive shells are being made, the operations differing in many respects from those performed at plants which have already been described in **Canadian Machinery**. This feature will lend additional interest, especially in view of the fact that the results in most cases have been highly satisfactory. One feature worthy of notice is the method of centering the bar stock or billet at the base and using the centre instead of a chuck in practically all the more important operations, until the base recess is formed. This is done to obtain as concentric a shell as possible and at the same time increase production. The system of chutes between the machines in the earlier operations assists materially in speeding up production and reducing cost of handling.

The operations may be said to be divided into two sections. The first series are performed with practically only one exception on drilling machines which occupy a corner of the main shop on the ground floor. The second series, including rough turning the body, to the final operation, are all taken care of on the gallery over one bay of the main shop and extending the entire length. This arrangement was found to utilize the available space to the best advantage without interfering in any way with the ordinary or normal business of the concern. The layout of the plant is such that labor entailed in handling the billets and shells is reduced to a minimum with a consequent saving of time and money. The section of the plant used for making shells was laid out for this purpose, and it was thus possible to install each machine in its proper location to suit the sequence of operations.

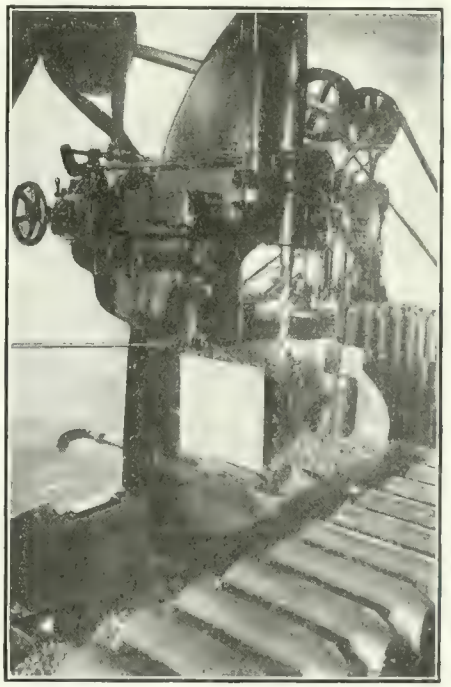
The drilling machines on the main floor already referred to are arranged as close together as is desirable, so that the shells can be conveyed from one machine to another by chutes in order to eliminate handling as much as possible. The billets are delivered to the shop and stored quite close to the machines, a supply thus being always at hand when required. In this section of the plant all the operations are performed from centering the bar stock to finishing inside, including threading the nose. A feature to be noted is the extensive use of drilling machines for the initial operations.



BATTERY OF DRILL PRESSES BORING SHELL BILLETS, TRANSPORTATION CHUTE SHOWN IN FOREGROUND

Centering Billets.

The billets are first prepared for centering by grinding the corners and ends



BORING OUT SHELL BILLETS ON A "COLBURN" DRILL PRESS

on a Canadian Buffalo Forge Co. grinder. They are then placed on a chute and passed along to a bench alongside which is a drill for centering the nose end of the billets. The drill was built by the Canadian Buffalo Forge Co., Berlin, Ont. The billet is held securely in a vise fastened to the drill table, and the centre drilled and countersunk in one end only. When this operation is completed, the billets are passed down another chute to the nosing machine. The nosing or rough turning the nose is done on three engine lathes. In this operation, one end of the billet is held in a collet chuck while the other end is being rough turned.

Rough Drilling Billet.

A battery of five heavy duty drilling machines is installed for the first drilling operation, which consists of a roughing cut only, the hole being finished later with a reamer. Four of these machines were built by Baker Bros., Toledo, O., and one by the Colburn Machine Co., Franklin, Pa. The "Baker" drills are all of the same type, and the "Colburn"

drill is very similar. Each machine is equipped with the same type of vise fastened to the table for holding the billet. The vise is a circular shaped device, one half being hinged and embracing a clamp. The stationary part of the vise has an extension bracket above with a hole in the centre through which the drill passes. The bracket supports a hardened steel collar used for keeping the drill central when beginning the cut.

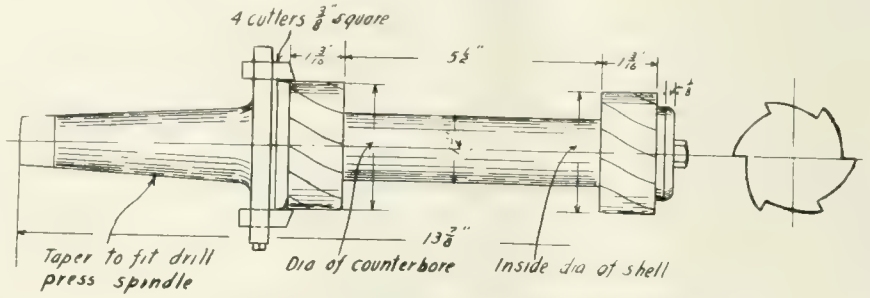
The billets are laid out on a chute in front of the drilling machines, and when drilled are passed along to a bench behind for the next operation. Some interesting figures are available on the drilling operation. The four "Baker" drills operate at 130 r.p.m. with .013 feed, and the "Colburn" at 160 r.p.m., .019 feed. Whitman & Barnes and John Morrow & Son twist drills are used with the above machines. The installation of more drill presses is contemplated, these to be made by the Buffalo Forge Co., of Buffalo, N.Y., and designed especially for this work to operate at 190 rev., .020 feed. The hole in the billet is 1 13-16 in. diameter by 8¾ in. deep, and with the new drills this operation will take 2 minutes and 30 seconds.

The bottom of the hole, after drilling, is of course the same shape as end of drill, and more metal must be removed in order to obtain the desired profile. For this reason the bottom of the hole is roughed out and reamed later. The roughing operation is done on a drill press supplied by the Aurora Tool Works, Aurora, Ind. The billet is held in a vise the same type as is used for the first drilling operation. The bottom of the hole is roughed to relieve the finishing tool at a later operation.

COMBINATION REAMER FINISHING BORE AND COUNTERBORE

Inside Finishing Operations.

The next operation consists of finishing the inside body, reaming the counterbore, and roughing fuse plug seat. A 20-in. drill press built by the Canadian Buffalo Forge Co. is installed for this work. An interesting feature of the operation is the combination reamer designed by the Canadian Buffalo Forge Co. The reamer is about 13⅞ in. long over all and has a taper shank for fitting into the drill press spindle. At the end of the shank the reamer widens out, and has slots for four fly cutters. These cutters are ⅜ in. square and have a bevelled cutting face for forming the fuse plug seat. The cutters are held securely in position by a ring with a set-screw for each. Under the set of cutters is a reamer for finishing the counterbore in the nose preparatory to being threaded. At the other end of the spindle, the exact distance away, is another reaming cutter for finishing the bore of the shell. The cutters are secured to the spindle by dowel pins. In operation, the bottom cutter starts at the top of the hole, and travels down with power feed, followed by the cutter above. When both have nearly finished their work, the four small cutters above begin the form of the fuse plug seat. This combination makes a very accurate and efficient tool.



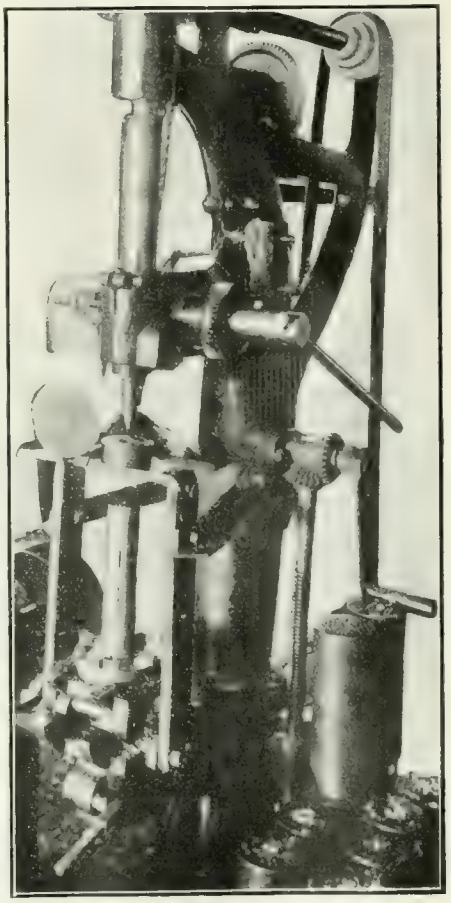
COMBINATION REAMER DETAIL.

Finishing Base Inside.

The bottom of the hole is finished on a 20-in. Canadian Buffalo Forge Co. drill press. The reamer has a long shank and is made with radius to suit the profile inside of the base. The shell is held in a hinged vise as in the previous operation.

In using unskilled labor it has been found advisable to do only one operation at each machine, and this principle has been followed as much as possible. Three drill presses, however, are equipped with a quick change "Wizard" chuck made by the McCroskey Reamer Co., and at the one setting of the shell the combination reamer is first inserted followed by the finishing reamer which can be inserted without stopping the drill.

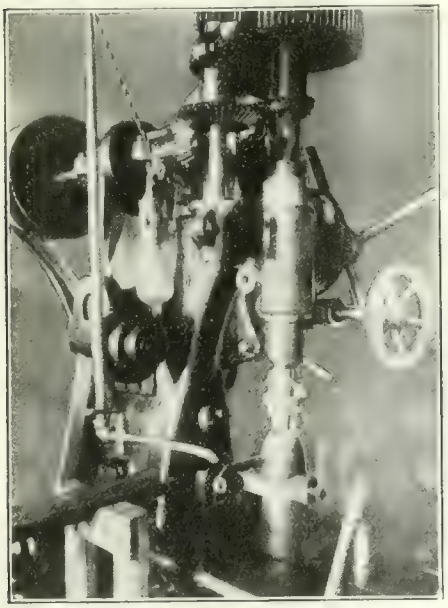
The shells are now moved to an adjoining machine to have the undercut or recess formed in the nose at the end of the counterbore. This undercut is necessary to give clearance for the threads. A 20-in. Canadian Buffalo Forge Co. drill press is installed for this operation. An expanding mandril fits into the drill press spindle. At the end of the mandril projecting out at the side is a small cutter the same shape as the undercut. The shell is held securely in a vise on the table, and the drill press spindle lowered until the cutter is in the correct position in the nose. A hand-wheel on the drill, when turned, causes the mandril to expand, and at the same time forces the cutter outwards, thus producing the undercut. This tool was made by the Toledo Twist Drill Co.



CENTERING OPERATION.

Centering Base.

It is necessary to centre the base end, as during several of the subsequent turning operations this centre is used. By always working from this same centre greater accuracy can be obtained and the



THREADING SHELL NOSE WITH COLLAPSIBLE TAP.

shell will be concentric. This centering operation is done on a Canadian Buffalo Forge Co. drill press equipped with a special fixture for holding the shell. The base of the fixture is fastened to an arm extending from the drill press, and an expanding mandril is mounted on this base and works on a hinge so that the operator can swing it out to put the shell on. The mandril expands inside the shell and when moved into the vertical position holds the latter steady while being centered, the shell, of course, being nose end down. A bracket attached to the base of the fixture comes up over the shell and has a hole in the centre for a hardened steel guide to keep the drill and countersink central.

Threading and Tapping Nose.

The nose is threaded on a "Baker" drill, having a "Murchey" collapsible tap fitted in the spindle. A specially designed fixture for holding the shell is fastened to the table. This fixture has a floating clamp which holds the shell firm, but permits side movement, and is therefore self-centering. The centre in base of shell rests on a centre on drill table, while the shell is held in a clamp connected to a bracket at the side by means of a swinging hinge. A set screw in the clamp keeps the shell from turning round while the nose is being tapped.

The sizing of the thread is done on a Canadian Buffalo Forge Co. 20-in. drill press with a standard sizing tap. The shell is held as before on a centre, with a floating clamp to keep it from turning. In the drill spindle, a Modern Tool Co. ball drive friction chuck is used, with a special bevelled facing milling cutter attached to the bottom of the chuck just above the tap. After the tap has been run down the full distance, the collar operating the ball drive is pushed up, which allows the milling cutter on the chuck to revolve, and there is sufficient clearance left to allow the cutter to be brought down to face the fuse hole seat on the end of the shell. This ensures a seat perfectly true with the thread. The drill is then reversed and the tap is backed off. One operator turns out 25 to 30 an hour.

After sizing, the shells are taken to a bench to have a centre plug screwed in the nose. They are then placed on a chute, at the end of which is a chain elevator, and are carried up to the floor above for the next series of operations. As the plugs are done with upstairs, they are sent back through a chute to be used again.

Rough Turning Shell Outside.

The lathes for performing this operation are situated at that end of the gallery above the drilling machines on the ground floor. They are, therefore, quite near the top of the elevator which brings the shells up to this floor. On leaving the elevator the shells travel down a chute within reach of the lathe operators. Four lathes, built by the Reed Prentice Co., Worcester, Mass, are installed for this operation, which consists of rough turning the body outside, roughing the copper band groove, and part of the base.

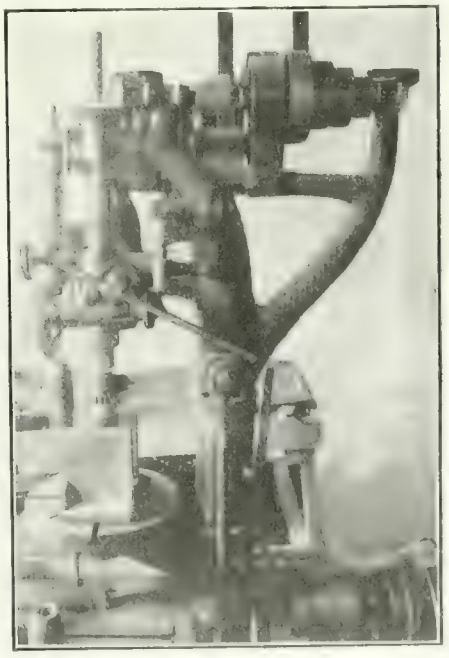
A centre plug has already been screwed into the nose of shell and fits the drive chuck. Both ends of shell are carried on the lathe centres. In front are two tool blocks mounted on separate cross slides, holding one and three tools respectively, the former for turning the nose, and the latter for the straight part of body. The tools are fed to the work by a cam device located under the cross slides, and attached to the lathe bed. A roller under the cross slide works in the cam. The left-hand tool rough turns the nose profile, the cam controlling the travel of cross slide. The three tools in the other tool block rough turn the straight part of body.

While the front tools are working, the back arm is brought forward with its two tools and roughs the groove for the copper band, also squaring up the base of shell. Sufficient metal is left in the groove for the undercut and wave lines, which are finished at the next operation. The arm is clamped to a heavy bar at the back of the lathe, working in bearing brackets on headstock and tailstock. A projecting piece from the bottom of the arm has a roller which moves in a cam attached to a bracket on the lathe carriage at the back. The cam determines the feed of the back arm tools by moving the arm forward as the carriage travels. A stop in the bed in front controls the travel of carriage. After this operation the shells are arranged in racks.

Waving and Undercutting Copper Band Groove.

The next operation consists of forming the wave lines and undercut in the copper band groove. This is done on two "Reed-Prentice" 14-in. lathes, equipped with suitable tooling fixtures for the work. The shell has a centre plug in the nose, and is carried on the lathe centres, as in the preceding operation. Each lathe is equipped with a combination three-point cam and drive chuck, the latter having a square hole in centre to take the head of plug centre in shell nose, the same method being used in the preceding operation.

The waving tool box is in front and moves in longitudinal slides, the whole fixture being mounted on a cross slide. A bracket with a roller projects from the left-hand side of the tool holder. The roller at the end of the bracket is held up against the cam face by a spring on the opposite side of the tool holder. The cam oscillates the tool and gives the necessary motion to the waving tool. The tool has a square face with two vees for forming the wave lines. For feeding in the tool a cam is fastened on the lathe carriage under the cross slide, which has a roller underneath moving in the cam. As the carriage travels along, the cam



SIZING THREAD IN NOSE AND FINISHING FUSE SEAT.

forces in the cross slide and also the tool.

The undercutting tools are carried in two holders mounted on a fixture at the back of the lathe. They are hook-nosed,

right and left-hand, and are inverted. The holders are located close together and move in diagonal slides. The feed is taken care of by a cam fixture similar to the one which operates the waving tool. When the tools are feeding in, they are gradually forced apart, thus forming the undercut.

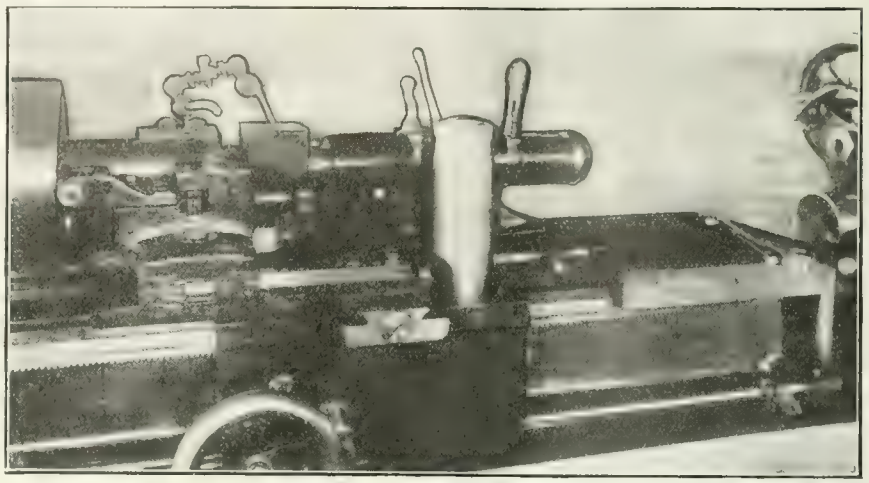
Finish Turning.

For the finish turning operation the same type of "Reed-Prentice" lathe is used as for rough turning. There are four of these lathes installed, and they are tooled up in a similar manner as the lathes used for the rough turning operation, with the exception of the back arm tools. In this case there are two arms, one having a tool for forming the corner at the base and the other for forming the fuse cap seat outside the nose. Three tools in one tool box in front finish turn the straight part of shell body, while a single tool, also in front, finishes the nose profile. The feeding-in cam is arranged in the same manner as on the roughing lathes.

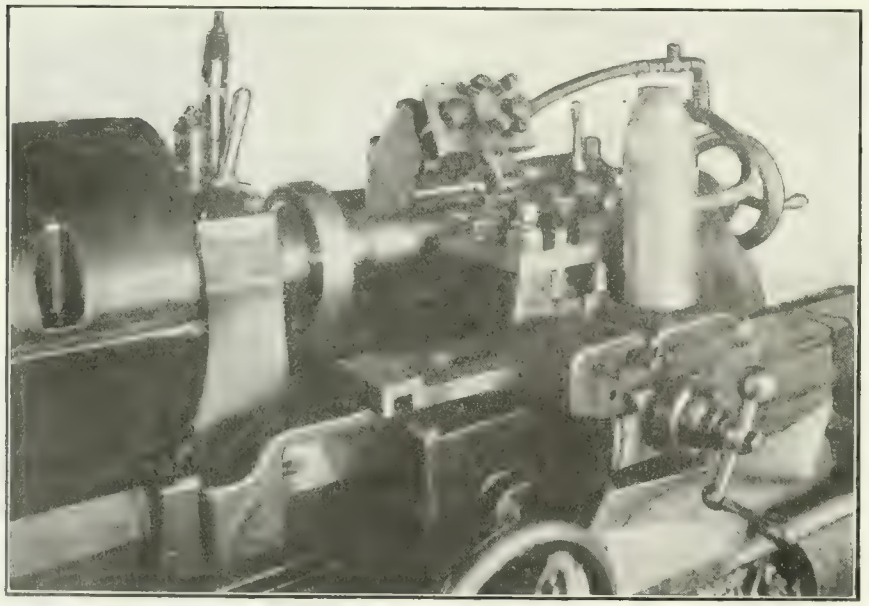
The back arms are operated, as in the roughing operation. The arm at the nose end holds a tool which forms the seat on the outside of the nose for the fuse cap, while the arm at the base end holds a tool for rounding the corner of base. These arms are brought forward when the front tools have nearly completed the travel. The shell has a plug centre in the nose, as in the two preceding operations, and is carried on the lathe centres, the same type of drive chuck being used as for the roughing operation. The lathe stops automatically when the tools have finished cutting. As the operation begins to move the carriage back, a catch on back of the carriage engages with a vertical rod connected to an attachment on the countershaft which throws over the belt. The time taken in this operation is 2 min. 15 sec. for one shell.

Driving Band Operations.

The shells now undergo the preliminary shop examination and Government inspection, when the body and wave lines are carefully examined. The wave lines are then nicked with a chisel and the shells taken over to the banding press. The latter was built by the Canadian Fairbanks-Morse Co., and is of standard design for shell work. The press is operated by hydraulic power from a belt-driven pump located close by. After the copper bands have been pressed on, the shells are taken over to a lathe for the bands to be turned.



WAVING AND UNDERCUTTING.



ROUGH TURNING BODY, NOSE PROFILE, DRIVING BAND GROOVE AND BASE.

The copper driving bands are turned on a "McDougall" engine lathe, equipped with a band-turning attachment built by Lymburner, Ltd., Montreal. The attachment is fixed to the lathe carriage. It has three tools—one in front for roughing, one under the work, also for roughing, and a tool at the back for finishing cut. The front tool and the one situated under the work are both operated by the screw under the front cross slide. The front tool feeds in towards the work, but the other feeds in a direction parallel to it. The underside tool roughs the back of the copper band, where the most metal has to be removed. The front tool then roughs the whole width of band.

The finishing tool is in a tool holder on the back of the attachment. The tool holder moves in vertical slides, and is operated by a lever. The tool passes down behind the work and is set so that it shaves off the required amount of metal while passing. The plug centre is still in the nose of shell, which is carried on the lathe centres. The lathe is equipped with a driving chuck to take end of nose plug.

Base Recess.

The base of shell up to this stage has retained the countersunk centre which was used during the various turning operations. This centre now disappears when the recess in base is formed. Before the actual work on the base recess begins, a flat 1 13-16 in. hole is drilled in the base to remove some of the metal, and so relieve the tools at the next operation. This relieving work is done on a 20-in. Canadian Buffalo Forge Co. drill press.

Four turret lathes, built by the Davis Machine Co., Rochester, N.Y., are installed for forming the base recess. The shell is held in a chuck, while on the turret are mounted the tools required for the operation. The turret is mounted on a cross slide, this feature being taken advantage of when boring out the recess and forming the undercut. The tool in the first turret face rough bores the recess. This tool is in the form of a cutter and is held in a boring bar. A stop with a roller at the end is fastened to the boring bar to regulate the depth

of the recess, the roller coming up against face of base, acting as a stop for cutter. The cross feed is taken care of by moving the turret. The second tool finishes the bottom of base and also the sides of recess for threading. This tool is of the same type as the roughing tool, zontal mandril, which is a sliding fit inside the shell, the mandril having a tightening device for holding base end of shell rigid. One end of the vise projects over nose of shell and carries a steel collar for guiding and locating the drill in the correct position. On a bench wrench. When the base plate has bottomed in the recess the square head is twisted off.

The shells are now taken over to a power riveter to have the joint between the base plate and base closed up. The riveter was built by the Grant Mfg. &

Shell Production Data

Operation.	Machine	Operators	Speed	Feed	Time
Grinding	1 Double grinder				1 min.
Drill	5 -Buffalo heavy duty drills	1	190	.020	2 min. 30 sec
Ream bottom	1 -Buffalo heavy duty drill	1	190	Hand	1 min.
Nosing ream sides	3 -24-in. engine lathes	2	100	1 32	2 min.
Counter bore and bevel face	5 -Buffalo 20-in. drills	2	130	.040	2 min.
Undercut	2 -Buffalo 20-in. drills	2	80	Hand	1½ min.
Ream finish bottom	2 -Buffalo 20-in. drills	2	120	Hand	1½ min.
Centre base	1 -Buffalo 20-in. drill	1	...	Hand	1 min
Tap fuse hole	2 -Buffalo heavy duty drills	2	40	Hand	1½ min
Size fuse hole	2—Buffalo 20-in. drills	2	60	Hand	2 min.
Inspection of interior and insert drive plugs					
Rough turn	4—Reed-Prentice automatics	2	100	1 64	2 min. 15 sec.
Wave ribs and undercut	2 -Reed-Prentice 14-in. lathes	2	100	Hand	1½ min.
Finish turn	4 -Reed-Prentice automatics	2	100	1 64	2 min. 15 sec.
Banding	1 -Fairbanks-Morse press	1	...	...	1 min.
Cut copper band to form	2 -14-in. lathes with forming attachment	2	100	Hand	1½ min
Drill 1 13-16 recess in base	1—Buffalo 20-in. drill	1	190	Hand	1 min.
Finish recess to 2¼-in. size	4 Davis 24-in. lathes	5	150	Hand	5 min.
Tap and size	1 -Gisholt 24-in. lathe	1	40	Hand	5 min.
Drill ¼ fixing screw hole	2 -Buffalo 20-in. drills	2	...	....	1½ min.
Tap ¼ fixing screw hole	2—Buffalo 20-in. drills	2	...	....	1½ min.
Assemble base plates	2—Jones & Lamson turret lathes	2	125	Hand	1½ min.
Cut off base plates	1 -Hamilton gear machine	1			
Marking	1 -Buffalo varnish tank and washing tanks				
Varnish	1 -Brantford Oven & Rack Co. oven				

and has a similar stop attached to the boring bar. The third turret face holds a boring bar, which has at the end a cutter for forming the undercut at the bottom of recess. In operation the tool is placed in position in the recess where the turret feeds across, thus forming the undercut. The fourth turret face holds a "Murchey" collapsible tap for threading the base recess.

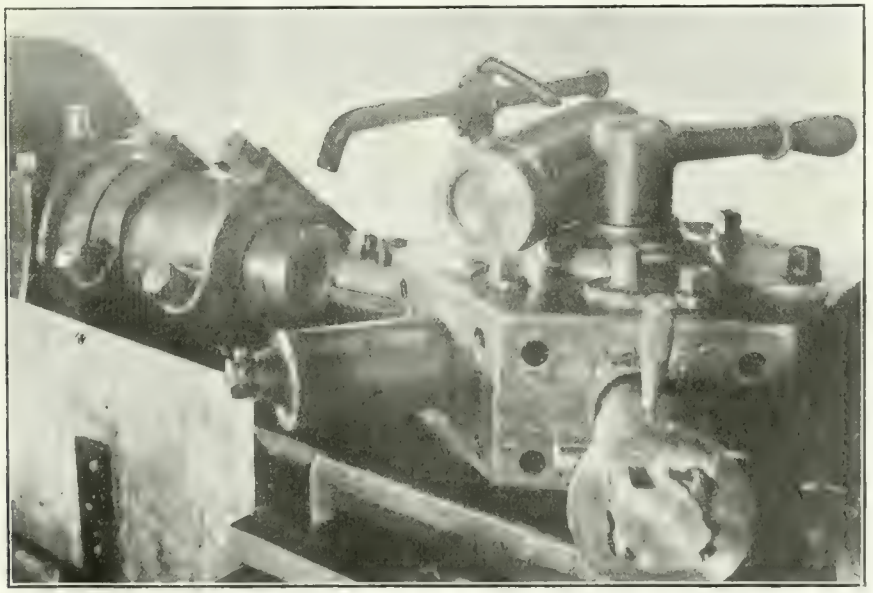
Fixing Screw.

A number of minor operations now follow. The first is the sizing operation near the drill the hole is hand-tapped and sized.

The shells are next cleaned and washed in a tank containing gasoline, afterwards undergoing another shop and Government inspection when the base recess is carefully examined.

Base Plate Operations.

The base plate operations consist of screwing the base plate into the recess, riveting the joint between base plate and base, and finishing the base. The



FORMING BASE RECESS.

when the base is hand-tapped, the shells being moved along to a bench for this purpose. The ¼-in. fixing screw hole is then drilled and tapped. The hole is drilled on a Canadian Buffalo Forge Co. drill press, equipped with a specially-designed vise. The latter has a horibase plate is a steel drop forging with a square head; the face has a slight camber and the periphery is threaded for about three-quarters of the width. The threads are covered with a cement composition before the base plate is screwed in, which is done by hand with a long

Machine Co., Bridgeport, Conn. The nose of the shell is placed on a cup-shaped block on the table while a bracket fixed to the frame above holds the shell steady. The hammer is operated by a friction pulley and is controlled by the operator by means of a foot lever. While the machine is working, the shell is turned round by hand one complete revolution.

The bases of the shells have now to be finished up, this being the last machining operation. A No. 3B "Milwaukee" miller is installed for this operation. A fixture is fastened to the table for holding 24 shells, two rows of 12 each, the shells being placed back to back with sufficient room in between for the cutter, and clamped to the fixture. The one cutter turns both rows of shells.

Marking.

After the base has been finished, the shells are taken along to a bench for the markings to be put on. The machine is fixed to the bench and was built by the Hamilton Gear & Machine Co., Toronto. This type of machine is installed in several shell plants.

Varnishing and Baking.

The shells while still on the bench have a brass ferrule screwed into the nose to prevent the varnish from coming in contact with the threads, the ferrule being taken out after the shells have been baked. The shells are filled with varnish from a tank, the tank used having been built by the Canadian Buffalo Forge Co. It consists of a double compartment, each side having a capacity of one barrel of varnish. The varnish is forced up from one compartment by compressed air. It flows up a pipe situated over the other compartment and the action is similar to a bot-

tle washer. The shell is simply slipped over the pipe, nose down, and, when lifted off, the inside is evenly coated with varnish free from air bubbles. The varnish runs down into the other compartment, and when the first compartment is empty and the other side full, the air pressure is diverted and the varnish is forced back in a similar manner.

It might be here stated that the object of the varnishing process is to protect the shell from the explosive, lyddite, which has a deleterious effect on steel. After the varnish has been poured out, the shells are placed nose down on a draining rack for a few hours preparatory to being baked.

A gas-heated oven built by the Brantford Oven & Rack Co., Brantford, Ont., is used for baking the shells. The oven is heated on the indirect system. On each side of the oven is a chamber with coils containing air which is drawn through ducts into the oven at the end by a Canadian Buffalo Forge Co. No. 2B exhauster. A gas burner is connected to each chamber and the hot gases flowing round the coils heat the air inside them. The air escapes through ducts located at the top of the oven. With this system, the gas fumes do not come in contact with the varnish in the shells, the hot air supplying the necessary heat. The shells remain in the oven eight hours, the temperature being 300 degs. Fah. The shells are arranged in racks before being placed in the oven.

Final Operations.

When the shells have cooled down, the ferrules are taken out and the shells are taken over to the Government inspector for final examination. The shells are carefully weighed, gauged and examined, and one from each series is selected for the firing test. The rest are then sent forward to the painting department where two coats of paint are applied, the priming coat being white and the second coat yellow ochre. A brass plug is then screwed into the nose, the threads being first covered with "luting." The shells next pass to the shipping room and are packed in boxes for shipment. The shell boxes used in this plant are made by the Hibner Furniture Co., Berlin, Ont., and the truck for moving the shell racks between the various operations on the gallery was supplied by the National Scale Co., Chicopee Falls, Mass.

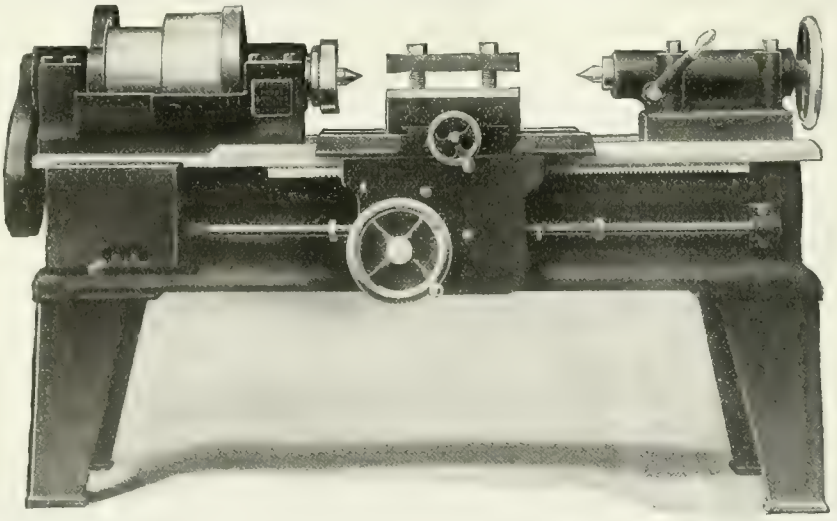
PROJECTILE MANUFACTURING LATHE.

THE opportunities afforded shell manufacture for the use of plain machines of limited capacity have been quickly recognized by machine tool builders. Among recent examples of these is the manufacturing lathe which has been put on the market by the Canadian Fairbanks-Morse Co.

It is designed to meet the demand for a plain heavy standard lathe, which can be easily handled by non-skilled labor, and in order to insure satisfactory service under severe and continuous duty, the provision of ample wearing surfaces and reliable lubrication, are distinctive features. The steel gearing is cut from the solid, and the headstock bearings are fitted with brass bushings and ring oilers. The lathe is regularly furnished with a solid spindle, having the nose bored for No. 5 "Morse" taper centre, but when desired it can be furnished with a hole 3⅛ inches diameter, and deep enough to hold a 3-inch shell.

The carriage has power longitudinal feed only. Automatic stops control this obtained by means of a shifting lever in the gear box. The feed is positively driven by gears from the spindle, all gears suitably covered. The tool box is of the European type, of ample proportions, and has hand cross-feed only. Two speeds only are furnished by the 6 in. wide cone steps, which are of 11 and 14 inches diameter respectively. The use of a two-speed countershaft provides eight speeds, the countershaft friction driving pulleys being both 16 x 6 inches.

The bed is 7 feet long and allows 21 inches between centres. A maximum swing of 16 inches diameter is available over the bed, and 10 inches over the carriage. The liberal proportions of spindle bearings—5 x 7⅜ inches front and 4½ feed in either direction; three changes of feed—⅛, 1-16 and 1-32-inch, being x 5⅜ inches rear—insure ample rigidity under severe service. When desired, this lathe can be furnished with various attachments for different operations.



16 INCH SWING, MANUFACTURING LATHE.

ENGINEERING IN GERMANY

THE Copenhagen correspondent of "Electrical Engineering" writes: "It is wrong to say that the electrical industry in Germany is disorganized. In my opinion it has never been so organized as at present, but the whole organization has been altered to meet the war requirements. The Government has taken over practically the whole supply of brass and copper and other metals useful for war purposes. A vast number of factories are working day and night on Government orders, and, as the German Government pays tremendous prices, the firms having this sort of work do not care for any other. However, in the electrical industry there are a large number of small firms, especially down in the Thuringen neighborhood. Most of these firms have no Government work, but they cannot supply the usual accessories because all their stocks of metals have been taken from them. Therefore, they have now to make lamp-holders, lamp-sockets, switches, and, in fact, all accessories, of brass-covered iron. With their usual technical thoroughness and cleverness they have succeeded in producing an article of first-class quality. The finished article looks exactly like brass, can be polished like brass, and, I believe, withstands moisture and other rough treatment. For a long time the Germans have been using insulated iron wires instead of copper wires."

Cheap Ammonia.—Ammonia, as ammonium sulphate, is produced cheaply as a by-product in the manufacture of coke in by-product ovens.

Steel and Shrapnel Bullets.—The least thickness of hardened steel that will keep out modern shrapnel bullets at fairly close range is ⅛ in. These bullets run forty-one to the lb.

Casting Steel Ingots for Production of 4.5 H.E. Shells

Staff Article

With a view to securing an increased output of 4.5 high explosive shells, cast steel billets are now being produced in our steel foundries through the medium of ingot moulds. Although in the earlier stages of the process considerable trouble and difficulty were met with, these have now been overcome and, in the particular plant under review, an output of over 4,000 shell blanks each 24-hour day is being achieved and continuously maintained.

WONDERFUL developments have been, and are still taking place in the iron and steel industry throughout the Dominion of Canada. While the manufacture of iron castings has for the most part in the past occupied the attention of foundrymen, that of steel castings is of comparatively recent date.

Prominent among Canadian concerns engaged in this production is to be noted the Canadian Steel Foundries, Ltd., of Montreal, etc. This company which was organized in 1910, have a large plant located at Longue Pointe on the outskirts of Montreal, for the express purpose of manufacturing steel castings of almost any size or shape, the meantime capacity being something over 3,000 tons per month.

The output had however been more or less restricted for some time owing to the generally prevailing industrial depression, but, on the advent of shell making, so great was the impetus imparted through the demand for shell steel billets, the plant is now running night and day to meet the new situation and at the same time do justice to its regular lines, among the latter of which may be mentioned locomotive frames, wheel centers, engine castings, high carbon rolls, dredge buckets, etc. A specialty is made of all kinds of steam and electric railway track work, such as frogs, switches, diamonds, intersections, etc. Vanadium steel is prominent in all products where great strength is desired.

The plant is located about a quarter of a mile from the St. Lawrence river and about a mile east of Montreal city boundary. The buildings are of structural steel and brick, erected on concrete foundations. A detail description of the constructional features was given in our October, 1912, issue of Canadian Foundryman.

The Steel Foundry.

This building is 436 feet long and has a width of 264 feet. It consists of five sections there being an aisle across one end of the shop.

The open hearth charging stock is brought into the shop and taken to the furnaces by a Morgan 5-ton, four motor high type charging machine. The two 25-ton acid furnaces, using oil fuel, are of the most modern design and construction, and should the oil fuel fail or be cut off a gas producer is arranged as a standby.

The first aisle on the east side is equipped with a 20-ton Dominion Bridge Co. crane and also a 30-ton "Morgan" crane, while jib cranes fitted with air hoists are on each side of every aisle for handling the flasks and moulds, all of the flasks being of heavy cast steel and in a variety of shapes and sizes.

Mould Drying and Pouring.

After the moulds are made they are taken on trucks to a battery of drying ovens equipped with "Kinnear" rolling doors. Following the drying, the moulds are removed to the casting floor and placed in readiness for pouring. Two 35-ton and three 24-ton steel ladles built by the John McDougall Caledonian Iron Works, are used in transferring the molten steel from the furnaces to the waiting moulds. One 20-ton Dominion Bridge Co., and two "Morgan" cranes of 30 and 40-ton capacity transport the above mentioned ladles.

Fettling Shop.

When the castings are sufficiently set they are shaken out and removed to the fettling shop which comprises the aisle at the end of the foundry. Here a variety of equipment prepares the casting for machining by removing all gates, fins, etc. This aisle is served by a 15-ton Dominion Bridge Co. and a 30-ton "Morgan" crane as well as by a "Whiting" electric travelling wall jib crane. A general view of this floor is shown in Fig. 1.

Billets for Shell Production.

Owing to the great difficulty on the part of many plants in obtaining rolled steel billets for the production of shrapnel and high explosive shells required

FIG. 1 GENERAL VIEW OF FETTLING SHOP FLOOR

for the various European nations, our steel foundries have been scheming and experimenting with a varying amount of success so as to produce a grade of steel casting that would meet the requirements.

While the art of making steel in metal moulds dates back to the days when crucibles were first used in making small tool steel ingots, the more general adoption of metal moulds dates back only a few years.

On first thoughts it did not appear to be practicable to produce the desired grade of steel required for shells by the ingot moulding process, especially as the rough shell had to be forged from the cast ingot. However, after much time spent in experimenting, a stage has been reached at which almost every requirement is fulfilled. It was believed that the use of metal moulds would chill the steel and cause it to be unserviceable for shell making, but with moulds of proper proportions, results otherwise have been achieved. No annealing has been found necessary after the ingots are shaken from the moulds.

Government Specifications.

Government specification requirements for 4.5 shell steel call for the same standard of product as in the case of 15 and 18 pounder shrapnel shells. The steel must have a tensile strength of between 35 and 49 long tons, an elongation of about 20%, a percentage of carbon between 0.45 and 0.55; the quantity of nickel must not exceed 0.50, manganese to be between 0.40 and 1.00, and phosphorus not over 0.05 per cent.

A mixture that gives close results is composed of about 20 per cent. Chautaugua or a similar low phosphorus pig iron, 40 per cent. open hearth scrap steel and the balance of heavy melting steel scrap.

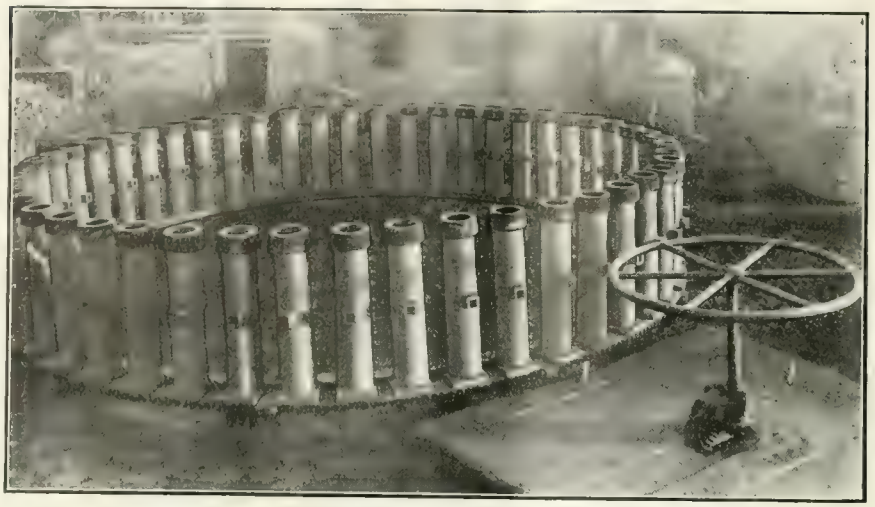


FIG. 4. BATTERY OF INGOT MOLDS READY TO BE POURED.

Melting the Mixture.

The steel is produced in two 30-ton furnaces by the open hearth process. They are fired with fuel oil at a pressure of 80 lbs. per sq. in. mixed with air at 100 lbs. per sq. in. The quantity of oil used is comparatively low, being about 3.3 or 3.4 gallons per ton of steel melted. One charge is melted in about 5 hours. The entire charge of about 25 tons is taken from the furnace by running it into a 40-ton bottom-pouring ladle shown in Fig. 2. This ladle, made by the John McDougall Caledonian Iron Works is built of heavy boiler plate lined throughout with fire-brick. The molten metal is poured from the ladle through an opening in the bottom which is stopped by a plug controlled by a series of rods and levers operated manually at some distance off. The stop plug which controls the flow of the metal from the ladle is made of graphite, the part entering the opening being conical in shape with the end somewhat rounded. This graphite plug is screwed on to a rod which extends down through the metal from the top of the ladle.

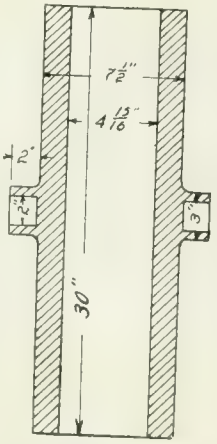


FIG. 3. INGOT MOLD.

To protect this rod from the action of the molten metal, it is covered with a series of fire-brick discs throughout its length. Owing to erosion the graphite plugs will only stand about 300 openings after which they are replaced by new ones.

FIG. 2. FILLING BOTTOM POURING LADLE AT OPEN-HEARTH FURNACE.

Shell Ingot Moulds.

A rough sketch of the moulds used for making the shell ingots is shown Fig. 3. At first the moulds were made somewhat shorter but as it was desired to get two blanks from each ingot, it became necessary to increase the length in order to get sufficient sound steel at the bottom. The trunnions are placed a little above the centre to facilitate handling with the crane, while both ends are faced off to obtain a good level surface. The caps for these moulds are made of facing sand in a core box and oven-baked. The general construction is shown in Fig. 6, the bottom end being narrowed down to facilitate removal.

Preparing the Moulds.

When the ingots were being first produced, it was the custom to stand them

in hit-and-miss fashion about the floor. This method was found unsatisfactory, however, as the crane operator had considerable difficulty in placing the opening of the ladle in the desired position. To overcome this trouble and also to facilitate the operations generally, the method shown in Fig. 4 was designed and is giving excellent results.

A rotary table with rack underneath is constructed to run on a track, and is operated by bevel gears and shafts leading to the large hand wheel shown in Figs. 4 and 5. These rotary tables are 16 ft. 8 ins. inside and 18 ft. 4 ins. outside diameter, and have flat surfaces upon which the moulds rest; the latter being held in position entirely by their own weight. At present there are four of these tables in use, each having a capacity of 50 moulds. There is also under consideration a new design which will involve a table to accommodate 2 concentric rows of 50 moulds each. This will do away with the handling of the crane after the first mould has been located.

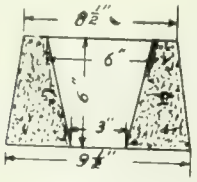


FIG. 6. INGOT MOLD CAP.

Pouring the Moulds.

After the charge has been taken from the furnace, the 40-ton ladle is picked up by the crane and taken to a position directly over the revolving table. When the proper location is found and the first mould poured, directions are given to the men at the controlling wheel and the table is revolved to the next mould. The man standing close to the ladle directs the movements of the crane operator and also the men at the wheel, his eyes being protected from the glare and heat by heavy blue glass goggles. The entire heat of around 25 tons is run off in about one hour.

FIG. 5. POURING A BATTERY OF INGOT MOLDS

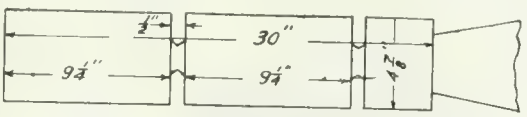


FIG. 8. SYSTEM OF CUTTING OFF BILLETS.

The magnitude of these operations can be best realized when it is known that an average of seven heats of 25 tons each, which is about 4,000 shell blanks, are run off every 24 hours.

Removing the Ingots.

When the ingots have properly set, although still quite hot, they are removed from the mould so that the latter can be prepared for the next pour. The ingots are raised by means of the crane and in most cases they drop out without any trouble, as the shrinkage, which

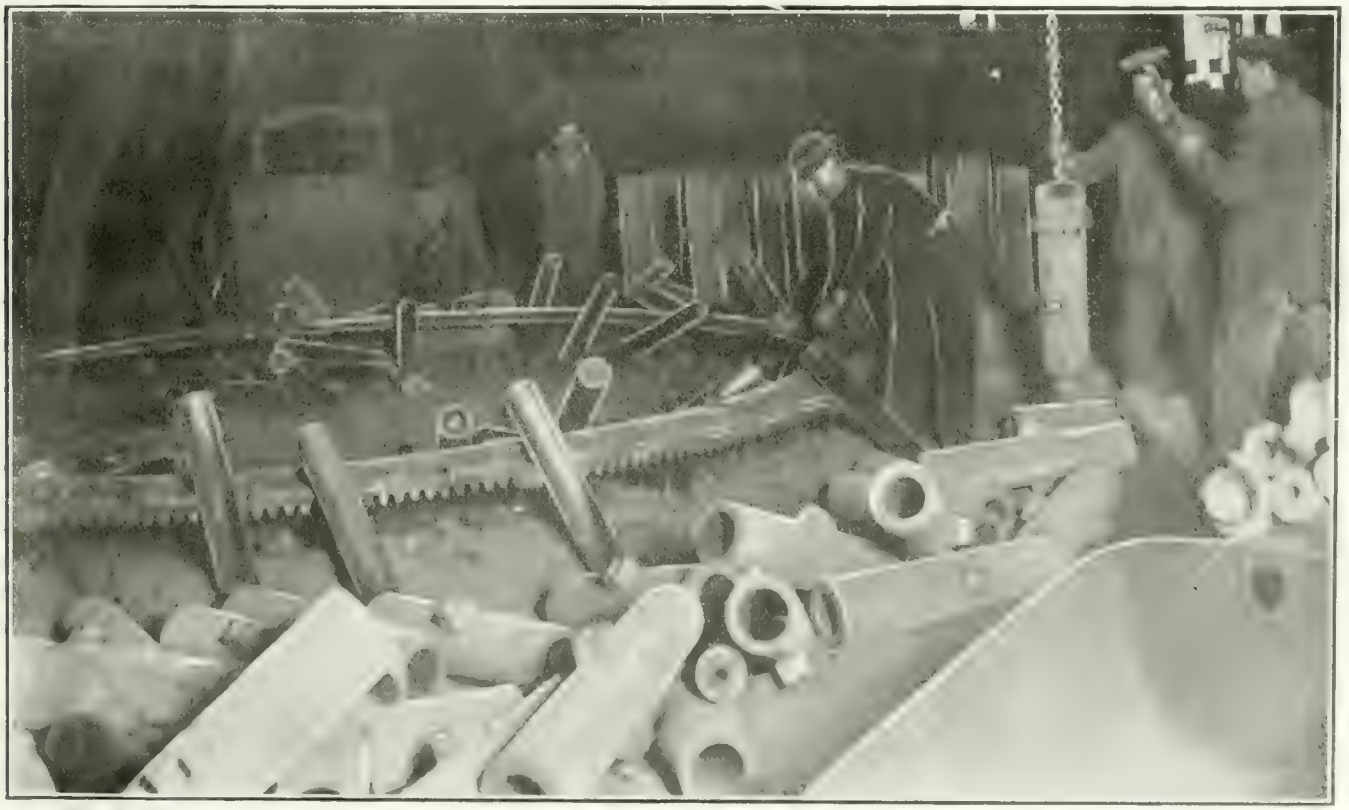


FIG. 7. SHAKING OUT THE INGOTS, SEVERAL OF WHICH MAY BE SEEN AGAINST THE TABLE

is about 3-32 of an inch in the diameter of 5 inches, is usually sufficient to thoroughly free the ingot from the mould. Sometimes however, it is necessary to hit the ingot a blow with a sledge. If they do not come out with the sledge treatment they are taken to a "Bertram" horizontal hydraulic press and forced out.

Occasionally an ingot seizes in the mould, and when this happens the contraction will cause the metal of the mould to crack in one or more places; however, the loss in this respect is very slight, being less than 3 per cent. The walls are left thick enough to withstand the action of the heated metal, because, if too thin, the molten steel would tend to heat the mould so rapidly that the two surfaces would incline to weld together. After the ingots are shaken out, they are inspected for defects, such as fractures "piping," etc. The life of the average mould is about 200 heats. A view of the shaking out process is shown in Fig. 7.

Cutting Off the Billets.

After the ingots have passed the preliminary inspection they are cut into billets on several axle lathes; the length being 9¼ inches, and the width of cut being from ⅜ to ½ inch wide. The cutting off tools are of "Firth" high speed steel. Six lathes are employed in this operation, two of them being "Bridgeford" products and another two of "Bertram" make. The depth of cut is approximately 2 ins., the tools being fed in by hand. The average time for four cuts is twelve minutes, and about 200 billets are obtained in 10 hours. Each ingot weighs about 156 lbs. and is handled by means of a jib crane and air hoist. The Government inspection calls for a portion equal to about 1-6 of the cross sectional area to be left in the centre, so that, when broken apart it can be examined for fracture. A sketch of one of these ingots as it comes from the lathe is shown in Fig. 8.

Heat No.	Description	Dia.	Area	Elastic limit actual	Elastic limit per sq. in.	Max Strength actual	Max Strength per sq. in	Elongation in	Elongation per cent.	Red. dimension dia.	Red. dimension area	Red. dimension %	Chemical Analysis Car	Phos	Man	Sul	Si	Va.
	4.5 How.	.461			19.2		40.70		25.7				.42	.031	.72	.032	.28	
	"	"			21.9	long tons	41.8	on 1.635"	27.6				.41	.036	.85	.032	.30	
	"	"			22.3		42.0		26.3				.40	.036	.87	.034	.27	

FIG. 9. RECORD SHEET COVERING CHEMICAL TEST.

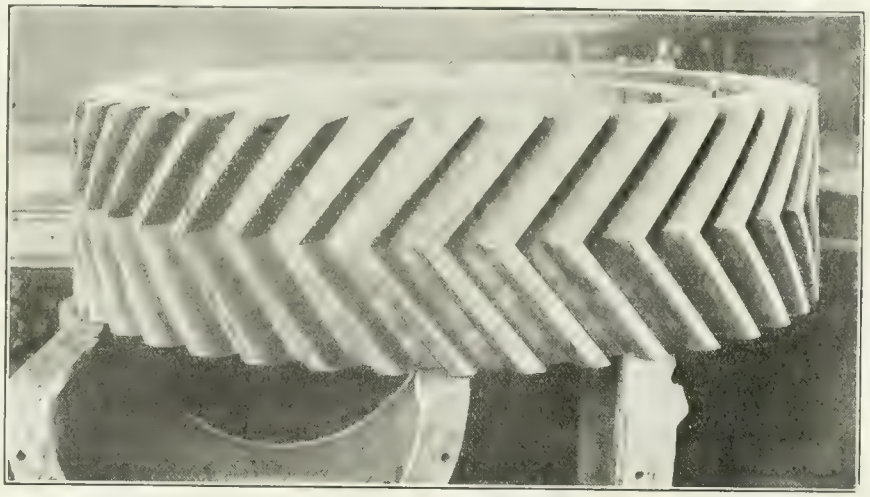


FIG. 10. PATTERN OF LARGE HERRING-BONE GEAR.

FIG. 11 PREPARING MOLD FOR LARGE STEEL HYDRAULIC CYLINDER.

Inspection.

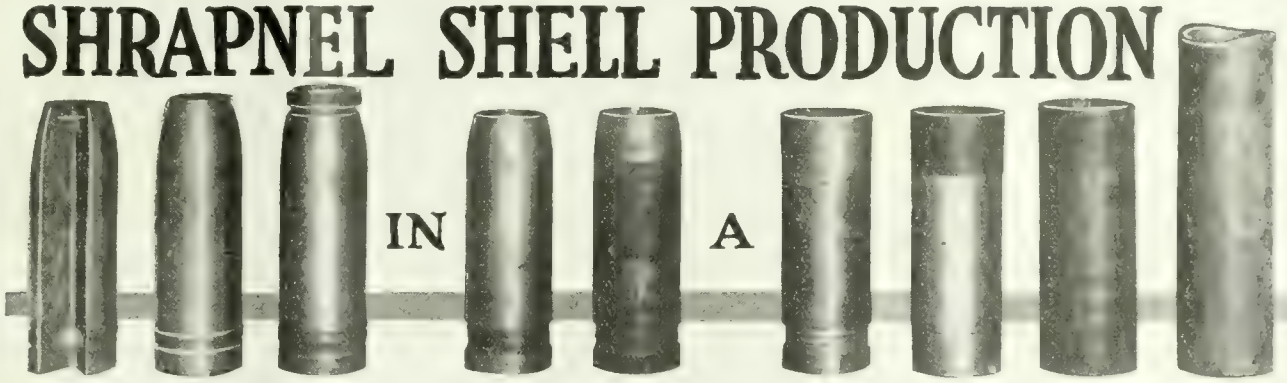
The billets are broken apart by laying across a 3 x 4 block and striking with a sledge. The crop end is returned to the furnace for remelting and the billets again inspected for defects. If rejected at this stage they are stamped with the letter R. The buttons are removed by planing or shaping, or, if very shallow, by grinding. Two sample ingots are taken from each heat for analysis. Drillings are also taken for tests of carbon, sulphur, phosphorus and manganese. The carbon test is derived by combustion, as the color test gives only an approximation. Chemical and physical tests are made of each heat by the works chemist, also by the Government chemist, and records of these are preserved. One of these record slips is shown in Fig. 9.

General.

While this plant is busy at present supplying machine shops with steel billets for the manufacture of 4.5 high explosive shells a general line of heavy steel castings is also being turned out. An idea of these latter may be got from Fig. 10, in which is shown the pattern of a large herringbone gear of about 8 feet in diameter, and in Fig. 11, the mould for a large hydraulic press cylinder in course of preparation.

The first contingent of volunteer munitions workers left Johannesburg, South Africa, on August 5, for England.

SHRAPNEL SHELL PRODUCTION IN A SHIPBUILDING AND MARINE ENGINEERING PLANT



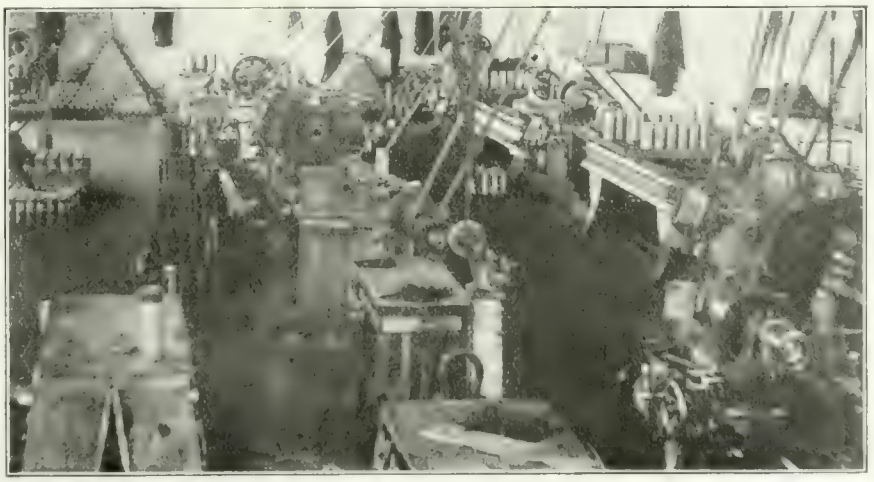
Staff Article

The sudden call from the manufacture of articles of a peaceful commerce to that of supplying the gods of war with provender of a prodigious amount and such as we never dreamed of producing, has been met by the administrations of our iron and steel industries in a manner that demands our whole-hearted admiration for their enterprise and resourcefulness. This particular plant is now making arrangements to manufacture 4.5 high explosive shells.

FROM building ships to making shrapnel shells represents somewhat a switching between extremes, and naturally called for changes in and additions to equipment. At the plant under review, however, little difficulty was experienced in finding room for a shell department which would not interfere with the ordinary work. A portion of the ground floor of the machine shop was taken over for the purpose and equipped with the necessary machinery. The floor or gallery above was also utilized for the making of shells. The heavier tools are installed on the ground floor and the operations up to and including the finish turning are done there.

On the gallery above, a banding press and band-turning lathe, a socket finishing lathe and a milling machine represent the machines installed, the greater part of the space being devoted to the assembling, painting and other hand operations, and to the housing of the inspection department. The entire plant is laid out so that the shells start at one end and are handled progressively until finished. "Chapman" elevating trucks distribute the shells between the various operations. Cutting compound supplied by the Cataract Refining Co., Toronto, Ont., is used exclusively on the various cutting tools. The heat treating department is located in a separate building outside of and adjoining the machine shop. This arrangement helps considerably in keeping the latter cool and free from fumes.

Although not among the first firms to undertake the manufacture of shrapnel shell, good progress has been made and little time has been lost in getting to the shipping stage. A number of "short cuts" and time-saving appliances have been introduced to increase production. The shops are equipped with electric motors using hydro power, and a spur from the G. T. R. runs through the yard to the machine shop, bringing the forgings right up to the door. The forgings are stored just outside, and the cutting-off machines are located at that end of the shop within a short distance of the pile.



PART OF MAIN FLOOR OF SHELL SHOP SHOWING MACHINES' LOCATION FOR FIRST SERIES OF OPERATIONS.

Cutting Off to Length.

The machining of the shell forging begins at the base, which is cut to length on a cutting-off machine supplied by John H. Hall & Son, Brantford, Ont. The advantage obtained by machining the base first before cutting off the open end is that it gives a square face to work to for the later operation, and also has the advantage of keeping the length of forging in a definite relation to the thickness of base. The machine is equipped with a universal chuck for holding the shell, and a bar stop inside the headstock spindle locates the forging in the correct position. The stop, of course, comes up against the base of the shell inside. On the bed of the machine is a saddle, on which are mounted two cross slides, with holder on each, front and back. The cross slides are operated by a spindle threaded right and left-hand respectively, so that the tools always feed in when cutting. The back tool is set slightly ahead of the front,

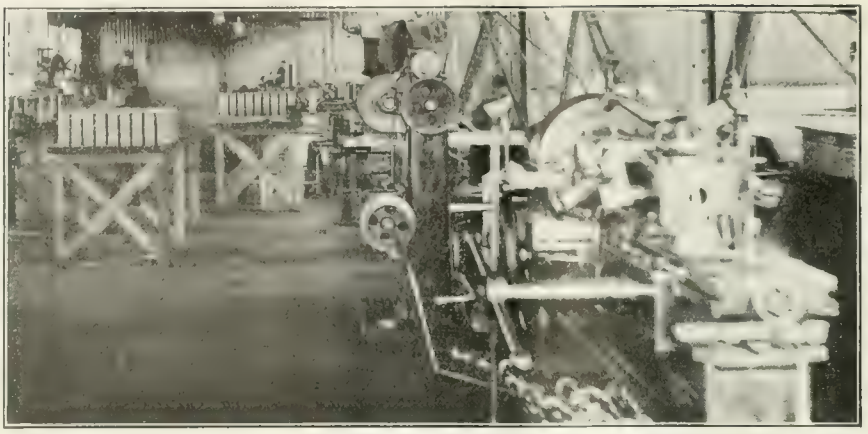
thus allowing a heavy cut being taken off. The hand screw at the right side traverses the saddle longitudinally.

Cutting Off Open End.

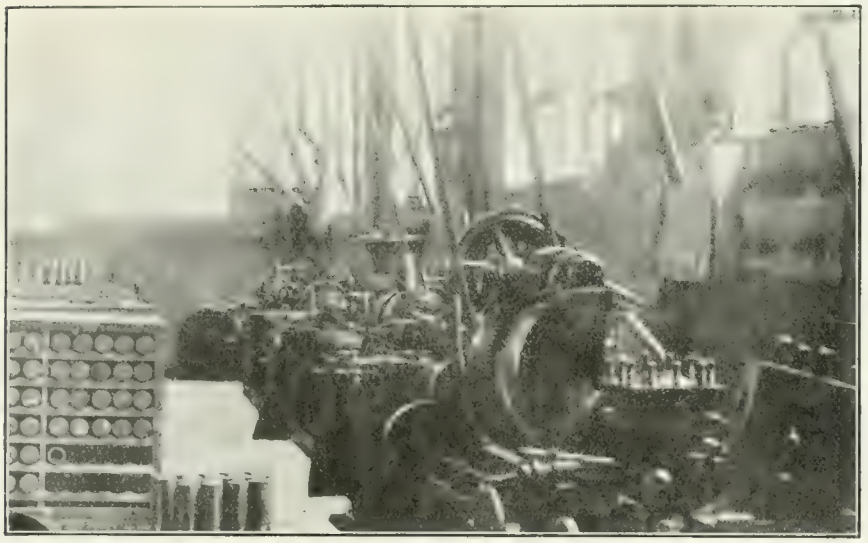
The open end of shell is cut off on the same type of machine as described above, the only difference being a shorter bar stop in the headstock and different cutting tools. The shell forging is placed in the chuck, the base end being up against the bar stop; the chuck is then tightened up. Both tool holders are used as in the previous operation, but in this case the parting tools are set in line with one another, the back tool being inverted to bring the cutting edge central. The shell forging is now the approximate length and ready for the body rough turned.

Rough Turning Body and Facing Up Base.

At the next operation the body is rough turned, the base faced up and corner rounded off, and the body up to the driving band groove finished. Two "Bertram" engine lathes are installed for this work, each being tooled up in identically the same manner. In order to have the outside of forging concentric with the inside, the shell is held on a mandril with a draw-back mechanism. The open end is also gripped in a universal chuck, which rotates the shell by means of a ring attached to the latter by three set screws.

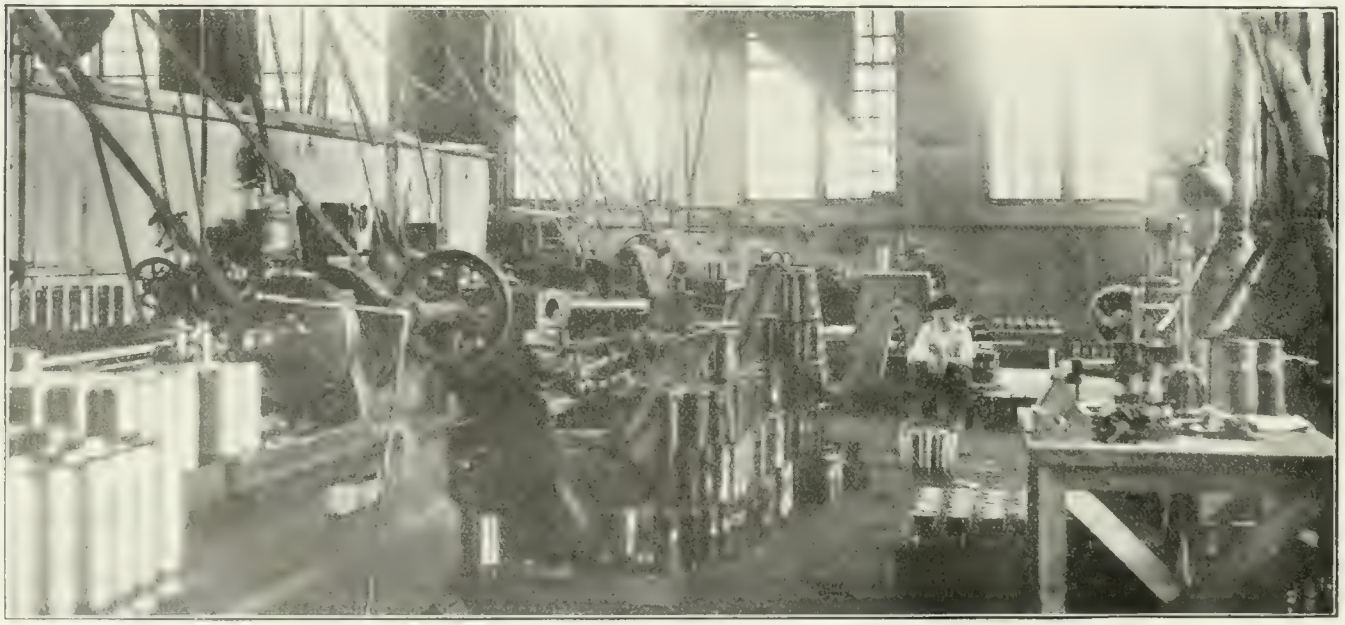


SHELL SHOP GALLERY SHOWING ASSEMBLY.



CORNER OF SHELL SHOP, SHOWING "WAVING" AND FINISHING LATHES.

On the cross slide is mounted a specially-designed fixture for holding the three tools for performing the operation. Two of the tools are set in line with the side of the shell and the third behind the base. The first tool held in an ordinary tool-holder rough turns the body of the shell for a distance of about 7 5/16 in. from the base, leaving the nose bevel to be machined later. The second tool, also at the side, is used for finishing the shell from the base to the driving band groove. This tool is held in a special holder, and can be moved back from the work at the end of the cut. The third tool is a broad cutter so formed that, while the base is being finished, the corner is rounded off at the same time. This tool is, as has already been stated, lo-



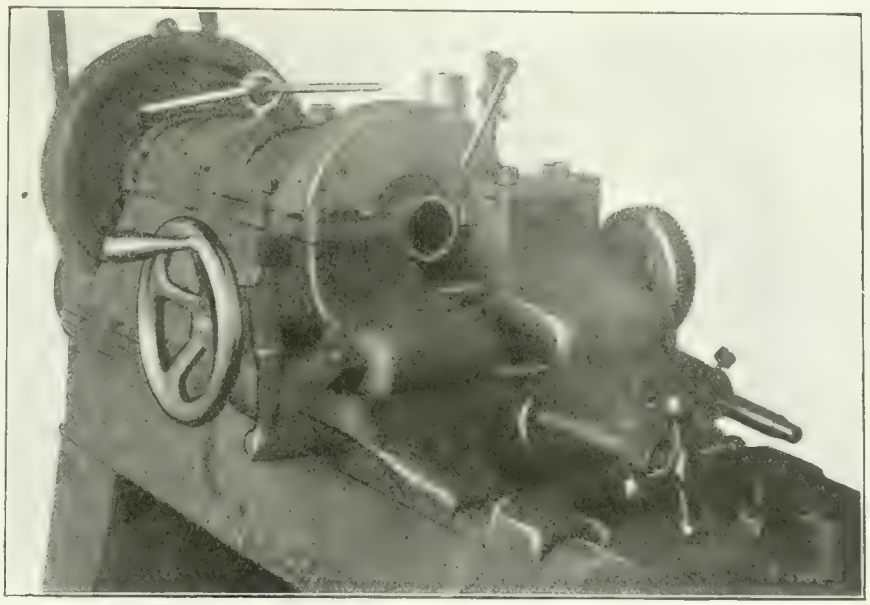
SHELL SHOP, MAIN FLOOR, BEFORE HEAT TREATING DEPARTMENT WAS MOVED TO A SEPARATE BUILDING.

cated behind the base of shell, and is shown at the right in the illustration.

Machining Powder Pocket, Diaphragm Seat and Outside Nose Bevel.

This, the first operation on the inside of the shell, is performed on a "Warner & Swasey" turret lathe, the turret holding the tools for the inside work, while a tool holder on the cross slide contains three tools for machining the outside of nose. The shell is held in a universal chuck, which has a bush inside conforming to the shape of the shell base, and is used for locating the shell in the required position for machining. In this case it is immaterial whether the outside or inside work is done first. The usual method of procedure, and done in order to save time, is to reverse the order for each shell—that is to say, if the nose bevel was formed last on one shell it would be the first operation on the next, with the same rotation for the powder pocket, etc. By this means, one setting of the tools does for two shells. As an illustration the inside boring will be described first.

On the first turret face is a boring bar with a cutter for roughing out the powder pocket and diaphragm seat. The second boring bar has a cutter of similar shape, conforming to the profile of inside base of shell, for finishing the powder pocket and diaphragm seat. The inside work at the base is now finished and the turret is moved back out of the way to permit of the nose bevel being formed. The tool holder on the cross slide contains three tools for rough turning the nose outside and cutting to length. It should be stated that the nose at this stage must be of a certain shape or bevel so that after the closing in operation it conforms to the required profile. The first tool cuts the shell to length, not, of course, the finished length, as this is done at a later operation. The second tool is a taper cutter for forming the bevelled part of nose behind the straight section at the front. This straight part is rough turned by the third tool. This operation is now completed, and when starting on the next shell, the nose bevel is machined first, followed by the powder pocket, etc.

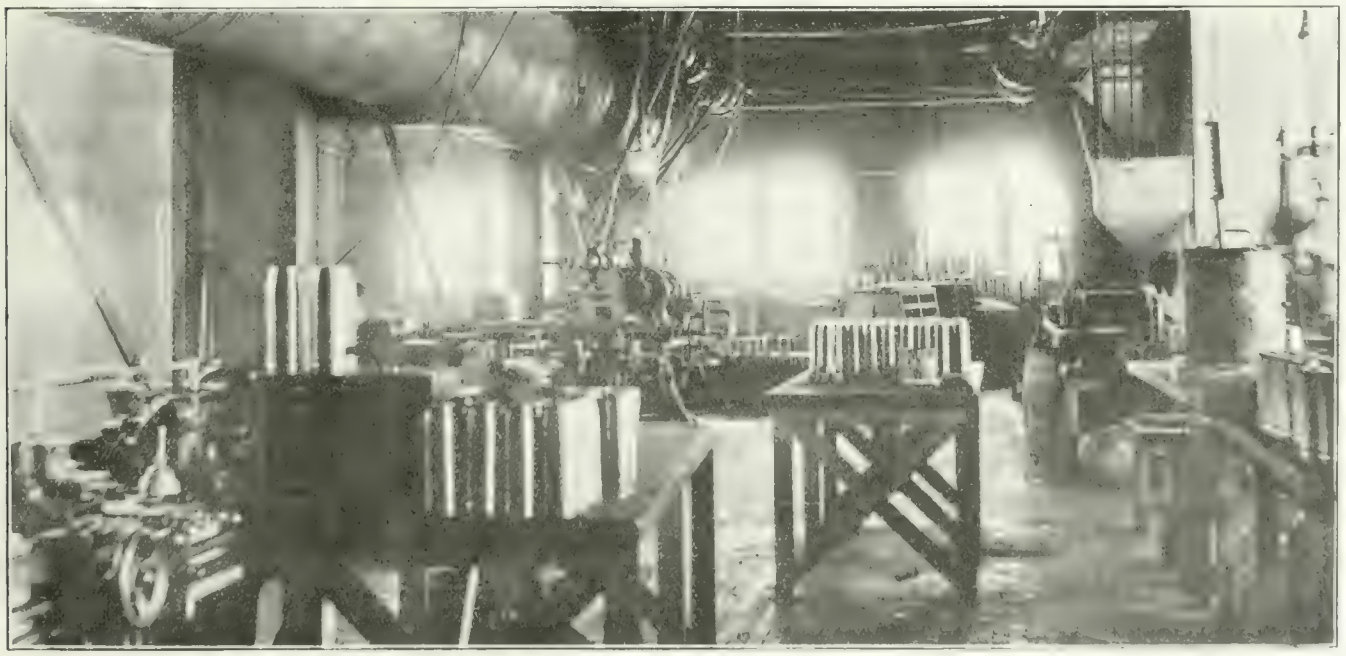


TRIMMING OPEN ENDS AND BASES OF SHELLS

Waving, Grooving and Undercutting.

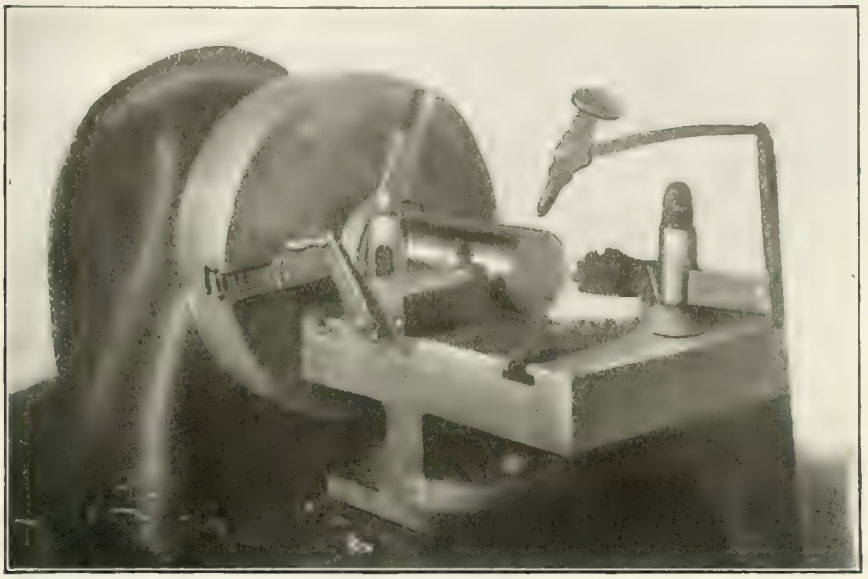
For this operation two engine lathes are installed, built respectively by the Canada Machine Corporation, Galt, Ont., and Flather & Co., Nashua, N.H. Both machines are equipped with a "Bertram" waving and undercutting attachment with a three-point cam, also a bar stop in the centre of chuck for fixing the position of the shell. The nose end of the shell is, of course, held in the chuck, while the base is carried in a cup-shaped revolving centre on the tailstock mandril. The waving and grooving tool is situated in front, while the undercutting tools are at the back. All the tools are cutting at the same time, and the method of operation is as follows:—

The tool boxes are mounted on a fixture fastened to the lathe bed. The front tool is held in a specially-designed tool box mounted on a cross slide, the tool box working laterally in a slide. A



SHELL SHOP GALLERY SHOWING ASSEMBLY AND LOADING FEATURES

bracket projects from the left hand side of the tool box, and has a roller which is held up against the chuck cam by means of a strong spring at the right-hand side. The tool itself has a square face for cutting the groove with two



ROUGH TURNING SHRAPNEL SHELL BODIES.

vees for forming the wave lines. The undercutting fixture is mounted at the back, and has two tool holders, each having a hook-nosed tool. The tool holders work in diagonal slides in order to feed in at an angle to form the undercut. The tools are left and right-hand respectively and are inverted when cutting.

The feed is taken care of by cams on front and back brackets fastened to the lathe saddle. The cam on the inside of the front bracket engages with the cross slide of front tooling fixture, forcing the tool in as the saddle travels. The bracket at the back has two cams on the inside face, one for each of the undercutting tool holders. These cams also force the tools in as the saddle travels. The cam feeding in the waving tool operates on the cross slide underneath so as not to interfere with the oscillating motion of the tool box while the wave lines are being formed. This motion is imparted to the tool by the cam on chuck face.

Heat Treating.

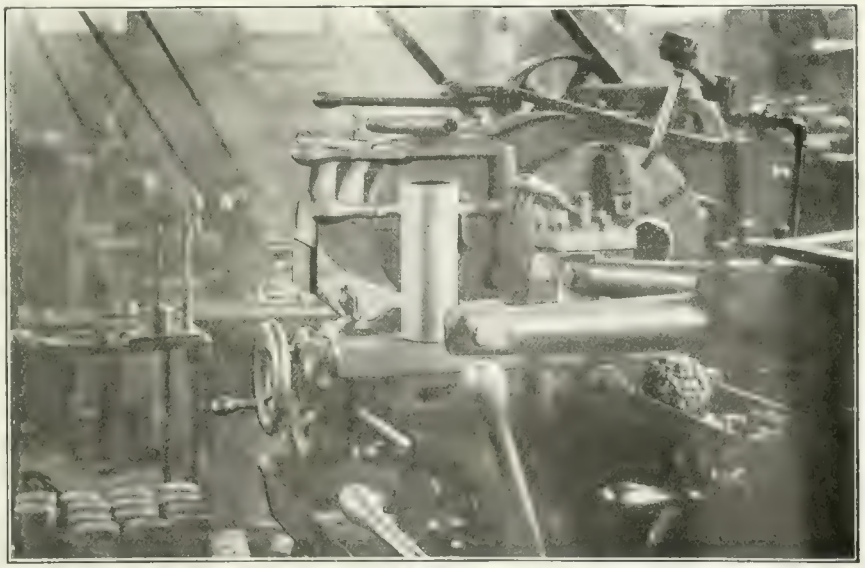
The heat-treating department is in a separate building adjoining the machine shop. In this shop is the nosing press and also the scleroscope testing bench; the furnaces are thus all together. There are four gas furnaces, not including the nosing furnaces installed—two for hardening and two for the drawing process. One furnace was supplied by the Tate-Jones Co., Pittsburgh, Pa., and the other three were built by the Collingwood Shipbuilding Co. The furnaces are heated by gas and air, no lead pot being used; the air is supplied at 2 lbs. pressure by a "Roots" rotary blower. The oil quenching tank is situated alongside the furnaces, and the oil in the tank is agitated by a belt-driven propeller to keep the oil cool. For the same purpose a number of coils with cold water circulating through them are fitted around the side of the tank on the inside.

The shells on coming from the machine shop are first of all hardened. They are heated in the furnace for about 20 minutes in a temperature of approximately 1,560 degrees Fah. They are then quenched in the oil tank and put on racks on the tank for a short time to dry. The shells are next drawn or tempered to produce the required degree of hardness. For tempering, the shells are heated in a gas furnace for about 12 minutes at a temperature around 800 degrees Fah. They are then cooled down gradually in a place free from draughts, the nose end standing in powdered lime. Previous to the drawing process, the shells are washed in a soda bath to remove the oil which clings to them after being quenched. A pyrometer, supplied by the Canadian Hoskins Co., Walkerville, Ont., is connected to all the furnaces in this department and indicates the temperature in each.

Scleroscope Test.

When sufficiently cool to handle, each shell is tested under a "Shore" scleroscope in order to ascertain the degree of hardness. By this means it is possible to tell the tensile strength of the metal, which should be approximately 80,000 pounds. The connection between the scleroscope readings and the tensile strength is that they bear a definite relation to each other, the degrees of hardness being proportional to the tensile strength of the metal. By keeping the hardness within certain limits it is possible to figure approximately what the tensile strength will be under test. This is definitely ascertained by having a test piece cut out of a shell and sent to a laboratory to be tested out on a testing machine. One shell is selected at random from each series of 120 and a suitably shaped test piece cut out of the shell at that part which has previously been tested on the scleroscope. The test piece is milled out on a milling machine supplied by the Ford-Smith Machine Co., Hamilton, Ont.

Before being tested on the scleroscope, the shells are cleaned on a polishing wheel, at the point to be tested, so that greater accuracy may be obtained in the readings. A number of the latter are taken at different points, the shell being turned round by the operator for this

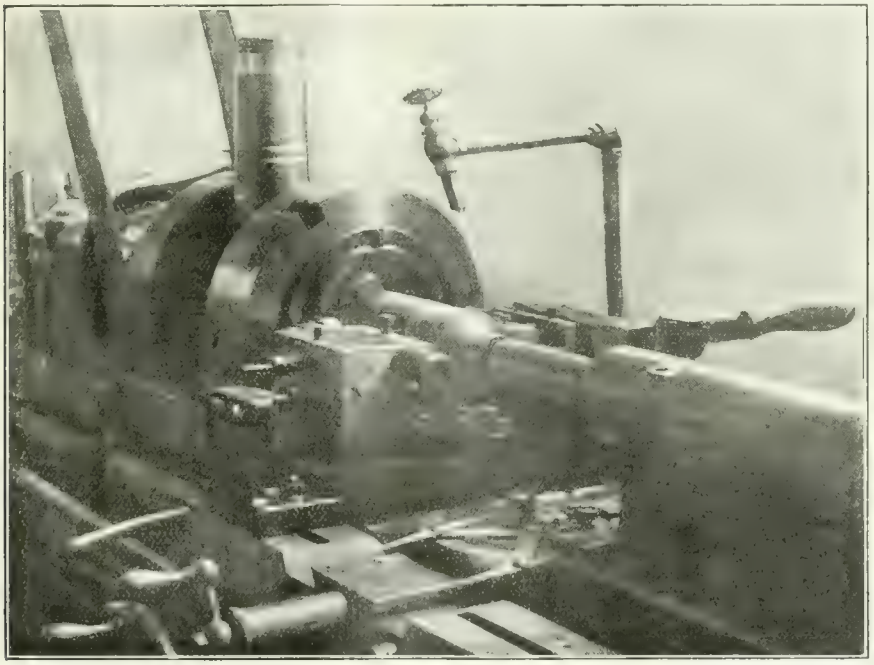


BORING POWDER POCKET AND DIAPHRAGM SEAT, FORMING OUTSIDE NOSE BEVEL

purpose. All the shells are tested and afterwards arranged in their series.

Closing in Nose.

The nosing press is located in the heat treating department, the furnace being in line with the others and connected to the "Hoskins" pyrometer already referred to. The press was built by the Goldie & McCulloch Co., Galt, Ont., and is hydraulically operated. The lead pot is heated by gas and air, and is beside the press. The nose of the shell is heated to a dull red, then placed on the press, the steel diaphragm having been dropped in. The press is put in operation and the nose closed in by being forced up into the die at the upper end, thus closing in the nose. The shell is now taken off the press and allowed to cool slowly previous to being taken back to the machine shop.



"BERTRAM" WAVING, GROOVING AND UNDERCUTTING ATTACHMENT ON "C M C" LATHE.

Boring and Threading Nose, Inside and Outside Profiling.

The next operation consists of rough boring and reaming the nose preparatory to threading, forming inside profile behind the threads, rough turning nose profile outside, and cutting to length. The work is done in the foregoing order. Two engine lathes built by Flather Co., Nashua, N.H., are installed, each being equipped with a turret. After the shell is chucked, the nose is first of all rough bored by means of a cutter fixed in a boring bar held in the first turret face. A reamer now reams out the nose preparatory to threading. The third turret face holds a "Murchey" collapsible tap for threading the nose. The inside profile behind the threads is next formed by means of a forming cutter fixed to a bar held in the fourth turret face. The outside nose profile is then rough turned, a small cutter fixed in a boring bar being used. To obtain the correct profile, a roller is held in a piece projecting from the cross slide on which the turret is mounted. The roller engages with a small cam mounted on a bracket attached to the lathe bed, and, as the tool travels along, it follows the profile given by the cam. The sixth turret face holds a boring bar with a cutter for facing the shell to length.

Finish Body Turning.

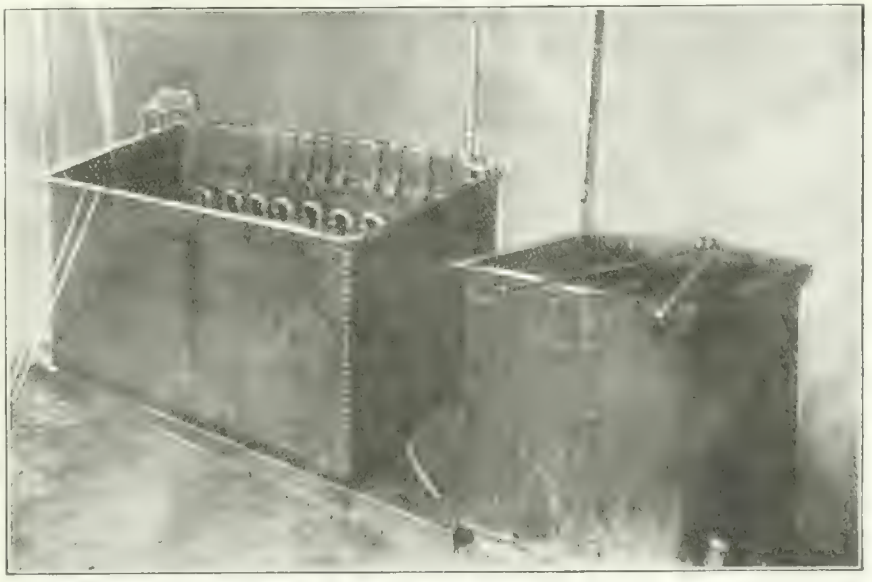
In this operation, a light cut is taken off the body and nose in a lathe and finished on a grinder. The shell is finished from the driving band groove to the end of the nose, the part behind the groove, it will be remembered, having already been finished. Three engine lathes are installed for this operation, two built by the "Canada Machinery Corporation" and one by "Flather & Co." All the lathes are fitted up in the same manner, having the same type of chuck and a forming cam under the cross slide.

The chuck is of special design and holds the base of shell behind the driving band groove. In the nose of shell is a threaded plug for the tailstock centre. A forming cam is fastened to the lathe bed under the cross slide, while a roller underneath the cross slide projects and engages with both faces of the cam. As the saddle travels, the turning tool follows the direction given by the cam, and thus forms the body of shell to the required profile.

The shells are finished on a grinder built by the Ford-Smith Machine Co., Hamilton, Ont., the wheels being supplied by the Canadian Hart Wheels, Ltd., Hamilton, Ont. The base of shell is held in a chuck which has a locating stop for correct position, and the nose has the same plug screwed in as it had when being turned. The shell is ground from the driving band groove to the end of the nose at one operation, the grinding wheel being the same shape as the finished shell profile.

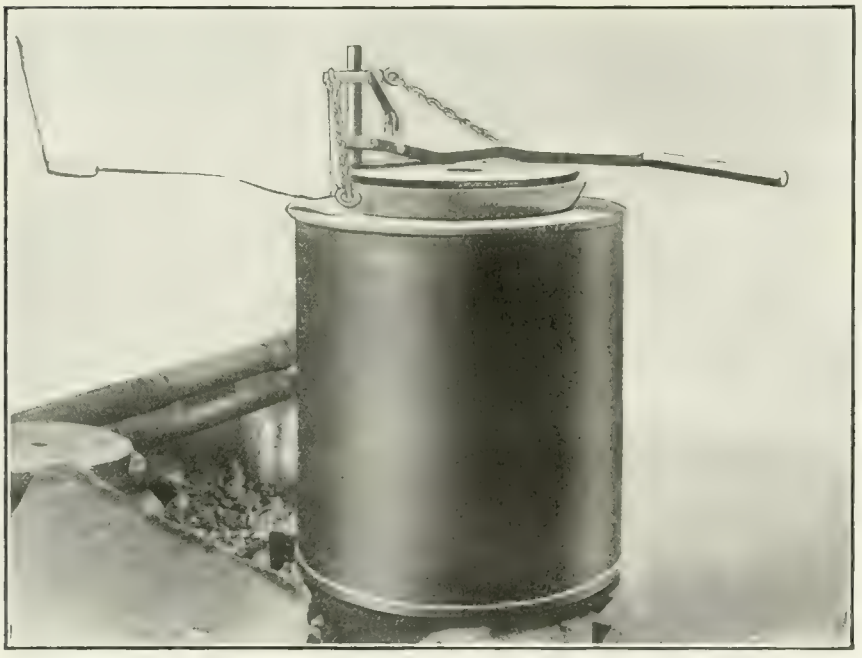
Copper Band Pressing and Turning.

The shells now undergo a preliminary Government inspection preparatory to being taken to another department where the copper bands are pressed on and turned. The banding press was built by the "Goldie & McCulloch Co." and is operated hydraulically at a pressure of about 900 pounds per square inch. The press is of standard design, as used in many shell plants; a full description is,

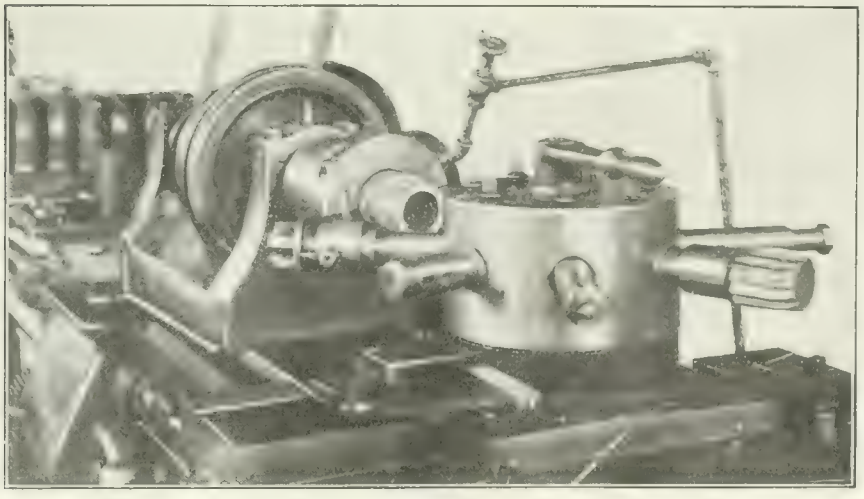


QUENCHING TANK TO LEFT AND SODA TANK ON RIGHT

INTERIOR OF HEAT TREATING DEPARTMENT.



"TATE-JONES" GAS AND AIR FURNACE FOR SHELL HARDENING OPERATION.



INSIDE PROFILING, THREADING AND FINISHING SHELL NOSE.

therefore, unnecessary at this juncture. In operation, the copper band is placed in the groove, the shell put on the press, and the pressure applied three times, the shell being moved around slightly after each. The band fills up the groove entirely, and is permanently in position.

The copper bands are turned on a "Warner & Swasey" turret lathe, which also has a cross slide for holding the turning tools. The turret holds a hollow centre which fits the nose of shells up to the shoulder, the centre revolving with the shell. This is the only purpose for which the turret is used. The base of shell is held securely in a collet chuck operated by a draw-back mechanism. The turning tools are mounted on the cross slide. The back tool makes the first cut, and the front tool then deepens the groove in the band, at the same time trimming the band at the edges. The back tool is set very low on the cross slide and cuts the band on the underside while travelling in a horizontal direction towards the operator, cutting the copper band as it passes underneath. This tool is of steel rolled to a special section to give the required form to the band, and only needs grinding on the cutting face to keep the cutting edge sharp. Above the back tool is mounted a gauge which projects over the work, and is used by the operator to place the back tool in the right position. The tool cannot be seen very clearly when cutting; for this reason the gauge, which is set in line with the tool, is used to place the latter in the correct position in relation to the band before beginning the cut. The front tool is set at the ordinary level, and is of special shape in order to deepen the groove in band and trim up the edges.

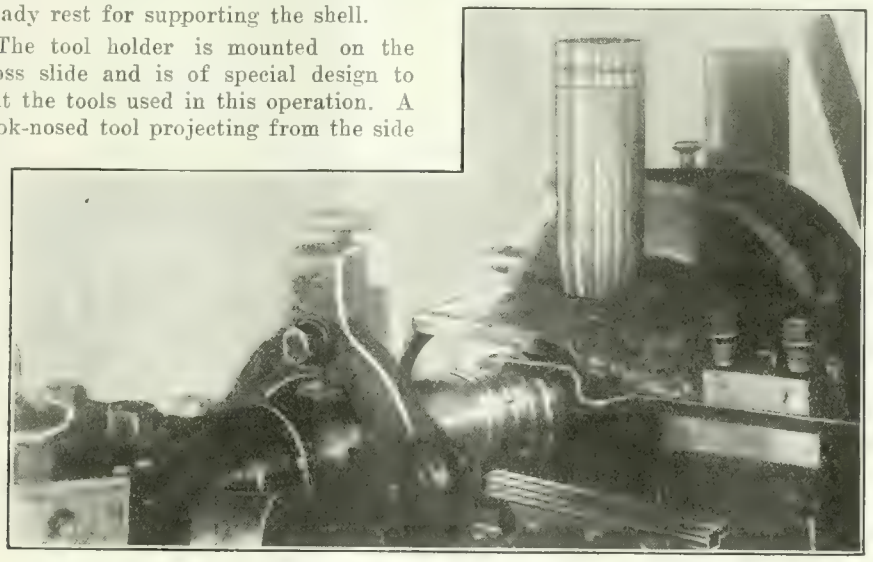
Assembling and Filling Shells.

When the shells arrive in the assembling department they are first of all hand-tapped at the nose. The tin powder cup is then slipped in past the diaphragm in the powder pocket, and the brass fuse tube screwed into the diaphragm. The shell is then placed under an overhead box or hopper containing bullets. The shell when being filled is placed on a mechanical jarring machine, which causes the bullets to settle down or consolidate. After being weighed and having had necessary adjustment made, the shells are taken over to the resin kettle and filled with hot resin, following which they are weighed again. The brass socket is then screwed into the nose, a "Chapman" ball bearing tightening nut being used for this operation. Afterwards the fuse tube is plugged with a small piece of rope, and soldered to the socket by an electric soldering iron.

Finishing Socket.

The brass socket which has been screwed into the shell nose is now finished on the outside, and the fuse seat formed. The sockets when they arrive at the plant are finished with the exception of the outside face. The fuse fixing screw hole has also been drilled and tapped. The socket finishing operation is performed on a "Flather" engine lathe, equipped with a collet chuck and steady rest for supporting the shell.

The tool holder is mounted on the cross slide and is of special design to suit the tools used in this operation. A hook-nosed tool projecting from the side

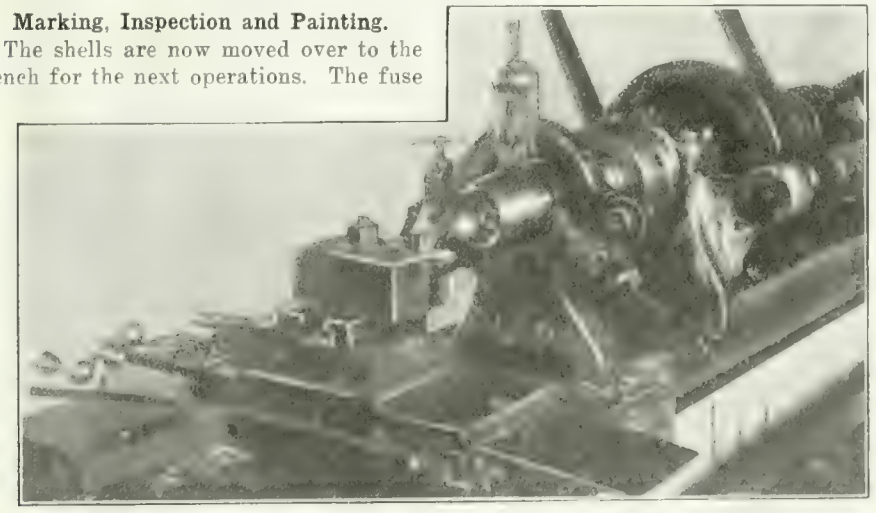


COPPER BAND TURNING

of the tool holder faces up the end of the fuse tube in the socket, and at the corner of the tool holder on the front face is a small bevelled cutter which forms the socket to the same profile as nose of shell. To the right of this cutter and on the same face of tool holder is another cutter which forms the fuse seat outside the socket. After the end of fuse tube has been faced up, the tool holder is moved back into position for the other tools to be used and cross slide locked.

Marking, Inspection and Painting.

The shells are now moved over to the bench for the next operations. The fuse



FINISHING BRASS SOCKET AND FORMING FUSE SEAT.

tube hole is first reamed out with a "Hisey-Wolfe" portable air drill, and afterwards the socket and fixing screw hole are hand-tapped. The markings are put on by a "Holden-Morgan" marking machine. This is fixed on a bench, and is of the same type as is installed in several other, already described, shell plants.

After being cleaned inside with compressed air, the shells undergo the final Government inspection, during which they are weighed, gauged and carefully examined. They are then passed on to the painting department for the final operation. The painting machine consists of a cup-shaped holder on a bench attached to a vertical spindle under the bench. The spindle has a pulley attached to it, which is driven by a belt from the line shaft. While the holder is revolving, the shell is placed on it nose down and the paint applied by hand. In the centre of the holder is a spindle which goes up the fuse tube and helps to keep the shell steady while being painted. Two coats are applied, the first grey and the final coat black, the nose being painted red. When the shells are dry, a brass plug is screwed into the socket, the threads first being covered with a preparation called "luting." Packing for shipment constitutes the final operation.

OUR SEA POWER TRIUMPH

WRITING in the Daily Telegraph of August 18, Archibald Hurd says:

The sinking of the British transport Royal Edward in the Ægean Sea suggests not the failure but the triumph of our sea power. Not until the war is at an end will the British public realize the harassing burdens which the transport services have thrown on their Navy, which was not planned on a scale corresponding with the liabilities which were suddenly thrown on it in August, to be still further increased when it was decided to land an Expeditionary Force in the Gallipoli Peninsula

The submarine—failure as the blockade has proved—has been an embarrassment. A little over a year ago not a naval officer would, I believe, have contemplated without serious misgivings the various tasks which in the course of the war have been allotted to our naval forces.

Let no one exclaim, Why was not this particular transport better protected? That is the comment of the armchair critic, who, for his own reputation's sake, had better stick to his armchair, and not venture to sea. War consists of a series of incidents, some favorable to one side and some to the other, until the tally is complete—and then the balance is cast up, and the nation which has been the least injured is the victor.

A people which learnt in one day of the sinking of three large cruisers in the North Sea, which heard of the battleship Bulwark and the Princess Irene being reduced to nought by violent explosions, which received calmly the news of the sinking of the Ocean, Irresistible, Majestic, Triumph and Goliath, and did not lose its balance of mind when the Good Hope and Monmouth went down in honor off Coronel will not be dismayed by this latest blow.

It is a success to the enemy, but it represents no such failure to us as can exert any permanent check on our victorious movement against the foe. The ship! What does it matter? The lives? They are irreplaceable. For those who will be mourning in the next few days—after a period of anxious hopes and doubts—for the brave spirits offered up on the altar of the highest cause in which any country waged war, the sympathy not only of the nation but of the Empire will be poured out. They have died for us and those who will come after us.

The Production of Sound Ingots for Shell Requirements*

By Sir Robert A. Hadfield, F.R.S.

It is shown by the following detail of the research work carried out by the author during recent years that there is no necessity for unsound material being produced for either rail or shell purposes, slight, but highly important changes in procedure reducing losses to zero.

FIG. 1 represents two 18-in. ingots made by the Hadfield system, weighing about 2¾ tons each. These ingots were cast with the small end up, as in ordinary practice. The photograph is interesting, as it gives an excellent view of the cavity produced by the sound steel in these ingots as it settles down into the body of the ingot proper; that is, below the feeding head. In these ingots it is not necessary, in order to determine whether they are sound or not, that machining or other observation by mechanical methods should be carried out, and at least 88 per cent. to 90 per cent. of sound usable and saleable material is obtained.

Fig. 2 shows an ingot made in the present and ordinary manner; not even the most experienced expert could say whether the exterior of the ingot was sound or unsound, whereas the ingot in Fig. 1 shows the steel to have settled or sunk down. When steel so sinks it is a definite proof that the material is sound and free from blow-holes. The following results further illustrate this important advance in the production of sound steel:—

Measuring the Cavity.

To show how considerable is the cavity which forms in piping steel, nine 15-in. ingots were taken (weighing about 3,600 lbs. each), each of which had the sand head and the writer's method of feeding carried out on them. After the ingots had cooled down, the hollows or cavities in the sand heads were filled with water, then the water was poured out and carefully measured. Table I. shows the results obtained.

Table I.

Ingot Number.	Cubic inches.	Lbs. of Steel.	Percentage of weight of ingot.
1	457	128	3.57
2	549	154	4.30
3	457	138	3.57
4	457	128	3.57
5	472	132	3.68
6	488	137	3.82
7	518	145	3.05
8	579	162	4.52
9	488	137	3.82
Average	496	139	3.88
Maximum	579	162	4.52
Minimum	457	128	3.57

Weight of ingot, 3, 600 lbs.

The average weight for the nine 15-in. ingots showed that 139 lbs., with a minimum of 128 lbs. and a maximum of 162 lbs., passed from the head portion into the ingot itself. This percentage is represented by an average of 3.88 per cent. In other words, about 4 per cent., or 140 lbs. of the total weight of the ingot or ingots cast passed from the upper or feeding head into the body of the ingot. Let it be assumed that the cubic capacity of each of the 15-in. ingots was approximately 12,500 cub. in. But for this feeding there would be a general want of solidity, chiefly at the upper portion of the ingot, to the extent of, say, 500 cub. in.—say, 4 per cent.—of the whole capacity. It is surely readily apparent why an ingot which is not fed must perforce be deficient in homogeneity.

There is, of course, a certain amount of feeding effect from the steel in the upper portion of the ordinary ingot, but this is not done efficiently, as the steel quickly freezes on the outside of the mould and on the surface of the liquid steel exposed to the air. Moreover, there is always an uncertainty as to how good or how bad is the resulting material. In any case, as the steel solidifies in an ingot of this size, the natural law of contraction demands that about 500 cub. in. have to be dealt with on an ingot of the weight and size mentioned.

While the results necessarily vary slightly, because the sizes of the head portion nearest the top of the mould formed in sand are not always uniform in length, as the steel shrinks down slightly more on the outside in some cases than others, on the whole the maximum and minimum figures of 4½ and 3½ per cent. of the total weight of the ingot having passed from the head into the ingot itself show very uniform working; if the heads were absolutely the same depth in each case, there would be practically no difference. If not treated, the piping would have probably run down the ingot itself, requiring a discard of probably 25 to 33 per cent. Although water cannot be poured into the cavity of a red-hot ingot, yet the cavity can be determined in each ingot by a cursory examination while at a red or yellow heat, involving only a few seconds of time.

*Abstract of paper communicated to the Franklin Institute.

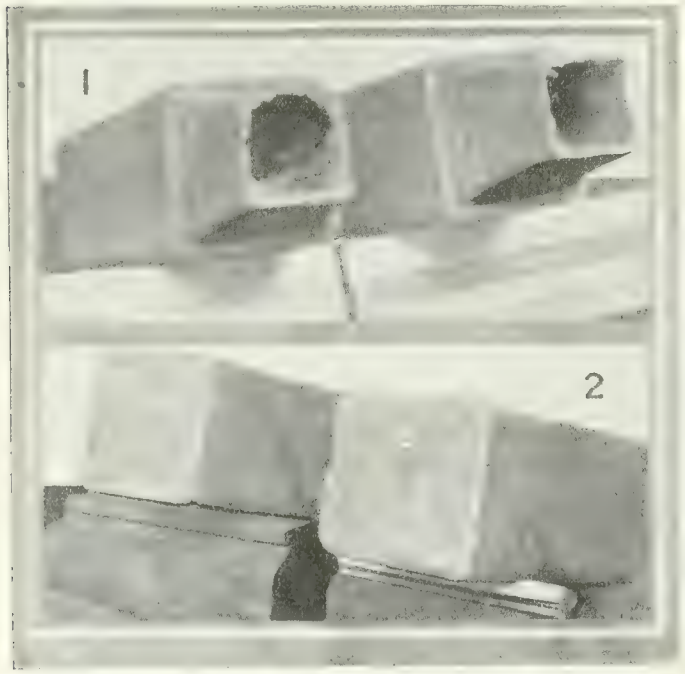


Fig. 1. 18-in. ingots of about 2¾ tons made by the "Hadfield" process. Fig. 2. 18-in. ingots of about 2¼ tons. A—Unsound ingot. B. Piped ingot

Upper Portion Defective.

While in ingots made in the ordinary way as above mentioned a certain amount of fluid steel passes from the upper portion to the lower, still in doing so, it is robbing the quality of the upper portion of the ingot itself, which has no fluid metal above it to feed or take the place and supply the deficiency thus created. It will readily be understood, therefore, why the upper portion of ingots is so seriously affected as regards their soundness, also why segregation occurs. This is shown in a remarkably clear manner by ingot B (fig. 4). The steel in the "fed" ingots being maintained fluid in the head portion continues to exercise its ferro-static pressure, whereas with ingots made in the ordinary way the ferro-static pressure on the centre portion of the ingot is so slight that it produces very little beneficial effect. Further, without the feeding head above the ingot proper, the outside of the ingot in the ordinary ingot mould becomes rapidly chilled and frozen, so that it cannot contribute its proper share to the feeding of the remaining portion of the ingot. It is not, therefore, to be wondered at that rails rolled from the A and B portions of an ingot made in the ordinary way are liable to unsoundness or piping, or both, and are also often full of impure segregated material. There would probably be more dangerous ingots but for the fact that the steel maker tries to avoid this type of steel, and aims to make steel which will not pipe when poured into the ingot. Nevertheless, he is still fighting against a natural law. If piping steel is checked or avoided, he runs from the upper portion, the centre, or that portion on the axis line of the ingot, must be of inferior nature, as the piping characteristics persist for quite a long way down the ingot.

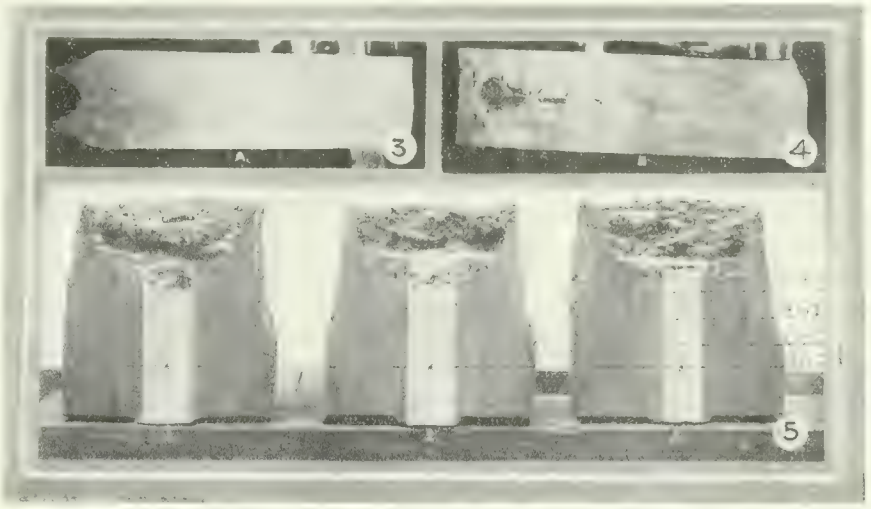


Fig 3. Ingot made by "Hadfield" process; perfectly sound, free from blow holes, piping and segregation. Fig. 4. Ingot made in ordinary manner; unsound, having blow holes, piping and segregation. Fig. 5. Upper portions of three ingots made by the "Hadfield" process.

Ferro-Static Pressure Necessary.

This, as before mentioned, is for the reason that, owing to want of ferro-static pressure, the ingot lacks feeding from above, which, in the system of casting ingots now described, is maintained to a very late stage; that is, until or close upon actual solidification. There is always fluid steel in the upper portion of the ingot to feed the piping and shrinkage, both of which must occur, as they follow a natural law. Check or hinder ferro-static pressure, and segregation with its bad effects at once commences. In the case of "fed" ingots, the smaller amount of segregation which occurs takes place outside the ingot proper; that is, in the head.

The experiment, carried out by the writer some years ago, of pouring copper into the upper portion of an ingot 15 or 20 minutes after casting, showed how serious is this want of ferro-static pressure in the material situated on or near the centre or axis line of the ingot in ingots which have not been properly fed. The copper finds its way down to the bottom of the ingot, although added 15 minutes after casting. In any case, if there is no definite pipe at the bottom portion of such ingot, there is still material of loose or open structure, which means weak steel. Although this may not be apparent by fracture to the naked eye, nevertheless it exists, and can generally be detected by an examination of the micro-structure. In other words, notwithstanding that the product to be used may come from the lower half of the ingot, yet in unfed ingots it will be weak and not able to stand severe stresses.

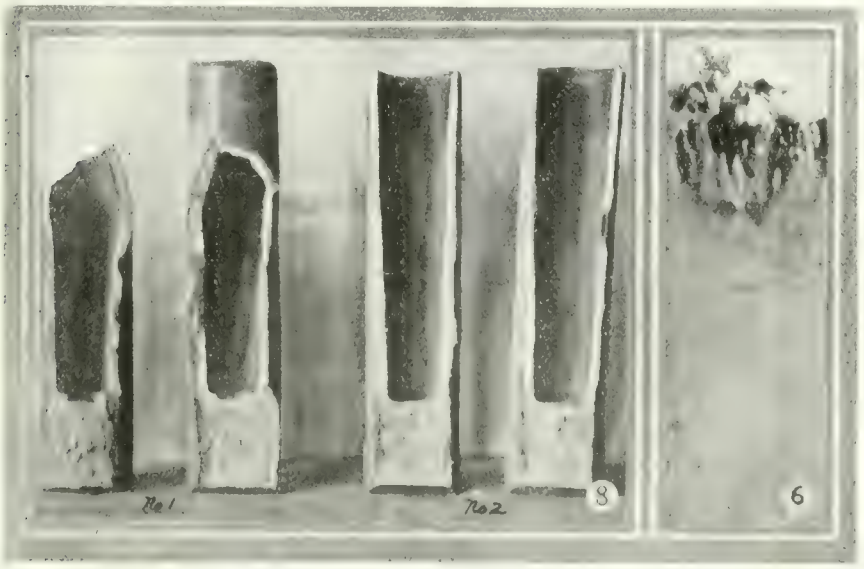


Fig. 6. Etching on axis line to determine amount of segregation. Fig. 8. Steel forgings from blanks (1) and (2) of Fig. 7, split open for inspection.

It is true that some portions of the cavities in ingots have been measured, but probably not in the manner described by the writer. Although in the examination of the top of an ingot cast in the ordinary manner, and from steel which "settles" there is external evidence of some piping, this is irregular and varies considerably. Therefore, in the "best" ordinary ingot evidence is slight as to how much or how little the steel has piped.

Kinds of Piping.

Dr. Dudley has pointed out that such piping is divided into two kinds: the upper, or what may be termed the visible pipe, and the lower or hidden pipe, the extent and character of which can be determined only by cutting open the ingot. In the ingots cast under the writer's system, all the cavity or pipe is open and can be rapidly inspected from

the risk of producing unsound steel, especially in the upper portion of the ingot, more or less permeated with blowholes. Thus, owing to lack of feeding

the top, its extent can be readily determined whether in the hot or cold condition. It is therefore not necessary to cut open the ingot.

Dr. G. K. Burgess, of the Bureau of Standards, Washington, is at present working with the writer on a joint research relating to this subject, and, though the full details of the work done cannot at the present time be given, it may be stated that ingots made under the writer's system were carefully cut up by the Bureau and compared with similar ingots produced at rail mills and made in the ordinary manner. The comparisons are shown in Figs. 3 and 4, in which A (Fig. 3) represents the ingot made under the writer's system, as described in the various papers, and B (Fig. 4) represents an average ingot made by one of the rail-makers.

Piping Defects Incurable.

While it is true that in unsound steel of very mild character the process of forging or rolling closes up the blowholes, and probably, if the heating temperature for rolling or forging is hot enough, the blowholes are welded together, even then it is doubtful whether such material can ever afterwards possess exactly the same tenacity and ductility as the same steel worked up from a sound ingot. In the case, however, of rail steel in which the carbon percentage is high, the same amount of welding does not take place; in fact, it is doubtful whether the blowholes are more than merely pressed together.

Sound Steel Imperative.

As large quantities of high-explosive steel shell are used by various governments, it is most necessary to obtain steel of the highest quality and yet at not too high cost. In other words, there is required steel of superior quality to that ordinarily used for rails, ship and boiler plates, angles, bars, etc. The system of manufacturing ingots of sound steel, described in the present paper, exactly meets these special requirements. Moreover, it can be used for making the comparatively lower quality of steel referred to. Several important governments, after making exhaustive tests, have been so satisfied with the Hadfield system of making sound ingots that, both for their land and sea services, they have now authorised explosive shell being made from ingots (afterwards forged into necessary billets) produced in the manner described in this paper.

As will be understood, an explosive shell, whether of small or large calibre, must be absolutely safe; that is, it must be (a) sound (that is, free from blowholes); (b) free from pipes; (c) free from segregation. Any flaw in the shell to its premature bursting would be most disastrous. In order to be absolutely certain of obtaining this combination of desirable qualities, it has been insisted upon by the user concerned that something like 40 per cent. to 50 per cent. of the ingot made in the ordinary manner—in fact sometimes more than this—must be discarded. Ingots made by the writer's method, however, are now allowed after discarding only 15 per cent.

It would also be quite possible under the system to give perfectly safe shell steel with only 10 per cent. to 12 per

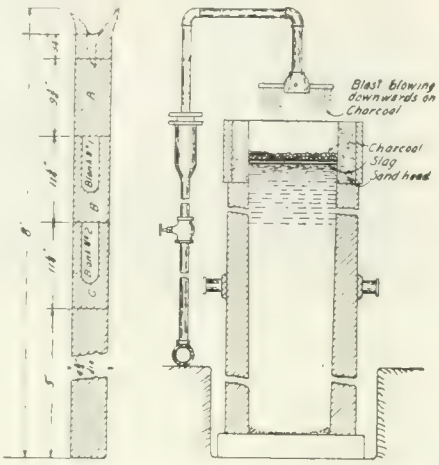


Fig. 7. Sketch showing upper portion of ingot forged and drawn out into a bar 4¾ in. diar. and about 8 ft. long. Fig. 9. Apparatus employed in producing sound ingots.

cent discard, and to ensure the qualities under the headings (a), (b) and (c) just referred to. This means a reduction in discard from 40 per cent. to 15 per cent. This decision has been arrived at after carefully cutting up and examining over one hundred ingots made by the Hadfield system, produced in the ordinary course of working. Each of these ingots on being cut up, was found to be perfectly sound.

Ascertaining Soundness of Ingots.

The following demonstration was made to show the importance and efficiency of the system:—Fig. 5 shows the upper portion of three 15-in. ingots made under the Hadfield system. This place shows the soundness and freedom from piping of the ingots. If this is compared with the section of the ordinary rail ingot shown in B (Fig. 4), representing average and current practice, it will be seen how great is the difference. While sound material, whether rails or other articles, can be expected from ingots made as shown in Fig. 5, it can be well understood that if steel for explosive shell were made from an ordinary steel ingot cast in the usual manner, as shown in B (Fig. 4), there would have to be at least 50 per cent. discard in the ingot, and even then it is doubtful if the material could be safely used.

To further prove this, Fig. 6 shows an etching of the fractured portion of a 15-in. ingot (marked No. 3 in Fig. 5), on the centre or axis line, where segregation is usually met with to the greatest extent. This being so sound and free from segregation, it was necessary to continue the etching beyond the fractured portion. The analysis of this particular 15-in. ingot is shown in Table II. From this table it will be seen that there are no signs of segregation, unsoundness, or piping of any kind until the extraordinarily small discard of 7½ per cent. has been reached. Even in this case the difference in composition is very slight, whereas the composition of an ingot made in the ordinary manner and with only 7½ per cent. discard, to

Table II.

	Analysis. C.	Si.	S.	P.	Mn.
Original steel	0.36	0.19	0.031	0.031	0.96
A. Discard of 7½ per cent. (sand or feeding head of ingot)	0.54	—	0.056	0.031	—
B. Discard of 10 per cent.	0.46	—	0.040	0.031	—
C. Discard of 12½ per cent.	0.39	—	0.040	0.031	—
D. Discard of 15 per cent.	0.39	—	0.033	0.031	—
E. Bottom of ingot	0.38	0.19	0.031	0.031	0.96

It should be remembered that steel produce from the ingots to be used for the requirements of various governments is most critically examined by many inspectors supervising the material produced and the work done, not on the ingot only, but on each projectile, also including a considerable number of mechanical tests from each ingot, and from a certain number of projectiles made from each ingot. Moreover, each individual ingot is cut up and has to be passed on its own discard; if this say nothing of the unsoundness, would show probably 0.60 to 0.70 per cent. carbon and 0.07 per cent. each of sulphur and phosphorus.

Table III. shows a number of analyses taken during the ordinary course of working) that is, they are not in any way special) from the centres of different ingots as above described, the drillings for analysis being taken exactly at the parting line where the 15-per cent. discard has been made. The figures obtained clearly show the important fact that the

steel is as pure and free from segregation at this part as it is at the bottom or at any other portion of the ingot.

As a further test, the following interesting experiment was made:—The portion of one of the ingots representing the usual 40 per cent. of the discard hitherto demanded in the manufacture of high-explosive shell was taken from an 11-in. ingot having the following analysis:—C, 0.38 per cent.; Si., 0.18 per cent.; S, 0.024 per cent.; P, 0.035 per cent.; Mn., 0.85 per cent. This was forged into bar 4¾ in. in diameter and about 8 ft. in length, as shown by Fig. 7. Projectiles were forged from this bar as indicated.

The length marked A is the portion of the material from the top part of the ingot head which, in the writer's system is cast in sand; that is, above the ingot itself. This portion, about 13 in. in length, and representing 7.1 per cent. of the discard, was cut off. Below this the projectile forging known as "Blank No. 1" was prepared, as shown by the dotted lines in Fig. 7. Below this, "Blank No. 2" was taken after 10.4 per cent. discard had been allowed. In other words, "Blank No. 1" was made from the material now not used (that is, after 7.1 per cent. of the whole ingot was discarded) and "Blank No. 2" after discarding 10.4 per cent. This is also not now used. The further and following blanks, No. 3, 4, and upwards, are not shown, because this is unnecessary, as such blanks then formed part of the current work. As will be seen, even "Blank No. 2" could also have been safely used.

It is remarkable to find that the fracture from "Blank No. 1" (that is, at the discard of only 7.1 per cent.) was perfectly sound, free from piping, and showed no signs of segregation. In the interior of the blank, after forging, there were some slight skin cracks proceeding from the hollow portion of the ingot top. The projectile from "Blank No. 2" was perfectly sound in every way, whether as regards surface fracture, freedom from segregation, piping, or any other defects; the interior was also perfectly sound. In other words, from this "Blank No. 2" (that is, with only 10.4 per cent. discard) a perfectly sound projectile was obtained.

The two projectiles from "Blanks Nos. 1 and 2" after being split open, are shown in Fig. 8. It will be seen that the fractures are sound, and that in each case, even including the blank from the portion of the ingot with only 7.1 per cent. discard, the material would have etched quite sound and free from segregation. The writer has now produced close upon 40,000 tons of ingots by the plan referred to in this paper.

Description of the Hadfield Process.

The following is a description of the author's method of casting steel ingots, castings, etc. which ensures soundness, freedom from piping, and absence of segregation: The process is illustrated in Fig. 9. As will be seen, it consists in heating the fluid steel in the upper part of the ingot or other mould, and maintaining it in a liquid condition by the combustion, in contact therewith, or in close proximity thereto, during the cooling and shrinkage of the metal in the lower part of the mould, of solid fuel, for example charcoal, by means of a blast of compressed air which is caused to impinge on the fuel while this is directly or indirectly supported by the metal below; and the interposition of a layer of fusible material, such as cupola slag, which has little or no injurious action on the metal, between the metal and the fuel. This slag largely prevents radiation of heat, the loss of which is much greater than is ordinarily supposed to be the case.

Belligerent Resources.

Of the ten munition metals, the enemy countries can certainly produce five without having resource to imports—namely, iron (the basis of the various steels used for war purposes), manganese, chromium, zinc, and lead; on the other hand, it is doubtful whether they can produce sufficient nickel, copper, aluminium, tin, and antimony from domestic ores. In view of the fact, however, that they prepared for this war with extreme care and foresight, it may safely be concluded that large stocks, either of ores or the corresponding metals or both, will have been accumulated in those countries.

However confident the higher German command may ostensibly have been of a rapid victory, they will quite certainly have laid their plans to wage a prolonged war if it should prove to be necessary, and such plans will have included the accumulation of munition ores and metal of which their countries produced an insufficient amount. There is, accordingly, no adequate reason for concluding that the enemy countries are likely—in spite of the prodigious scale upon which the war is being conducted—to run short of metals which are essential for war purposes for some time to come. Moreover, it may safely be concluded that their technical metallurgists will have been mobilized in the direction of discovering substitutes for any of the above metals of which a shortage is liable to occur in a long war.

The allies for their part can produce from their own resources all the iron, manganese, nickel, chromium, tin, and most of the aluminium they require; their command of the seas enables them to obtain, principally from the United States, their deficiencies in aluminium, copper, and lead; China furnishes the requisite antimony. Zinc is the only important munition metal of which there is a shortage, in spite of the great speed with which the American furnaces are being operated. Wherever it is possible to substitute another metal for zinc, it is of national importance that it should be done.

Table III.

	Analysis made by Hadfield of drillings from the usual ladle ingot tests.					Analysis made by the inspector from drillings taken from the centre or axis line of each ingot after cutting off 15% discard				
No.	C	Si.	S.	P.	Mn.	C.	Si.	S.	P.	Mn.
1229	0.40	0.22	.030	0.033	0.89	0.37	0.24	0.031	0.035	0.87
1231	0.38	0.21	.031	0.037	0.88	0.40	0.21	0.029	0.036	0.88
1233	0.40	0.21	.033	0.035	0.90	0.39	0.20	0.035	0.036	0.88
1234	0.39	0.21	.032	0.033	0.89	0.39	0.21	0.036	0.038	0.88
1243	0.40	0.26	.034	0.029	0.91	0.39	0.23	0.026	0.034	0.88
1244	0.38	0.23	.031	0.032	0.93	0.43	0.22	0.038	0.034	0.91
1245	0.39	0.25	.030	0.030	0.99	0.38	0.24	0.030	0.032	0.91
1246	0.40	0.21	.029	0.029	0.95	0.39	0.19	0.025	0.030	0.87
1247	0.37	0.19	.030	0.032	0.89	0.39	0.18	0.025	0.033	0.81
1248	0.41	0.20	.026	0.036	0.87	0.45	0.20	0.027	0.029	0.81

MUNITION METALS.

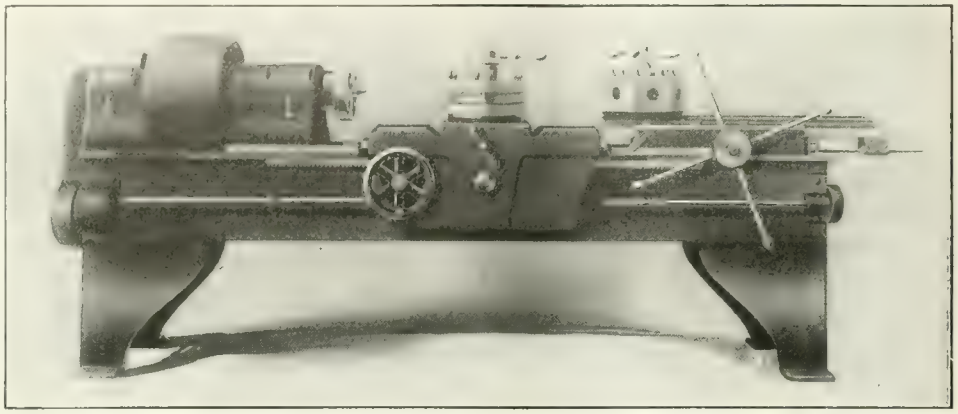
A PREPONDERANCE of raw material from which to manufacture munitions of war is of vital importance to a belligerent, and if, as many persons hope, the allies can maintain the advantage in this respect at the expense of the enemy, the raw material assumes a doubled value. Professor H. C. H. Carpenter, writing to "Nature," compares the resources of the different countries in munition metals, and sums up the position as follows:—

PROGRESS IN NEW EQUIPMENT

A Record of New and Improved Machinery and Accessories for the Machine, Pattern, Boiler and Blacksmith Shops, Planing Mill, Foundry and Power Plant

SINGLE PURPOSE SHELL LATHE

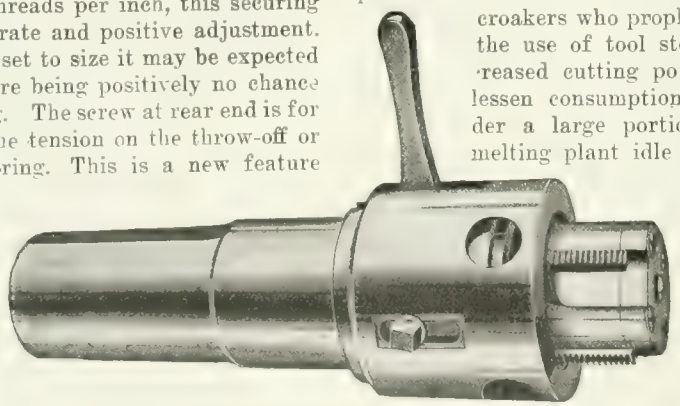
THE description and illustration refer to a new "Made in Canada" lathe which is being put on the market in response, we understand, to the demand for a heavy, sturdy tool with suitable attachments for producing the various machining operations required in shell work. This lathe is specially designed for the latter and is complete with all attachments necessary to rapid production of completely machined shells. Strength, rigidity, and weight, and a large swing just sufficient for the purpose for which it is designed, are the leading features of this product. The two sizes in which the lathe is to be built are reckoned to amply cover the requirements for machining shells up to and including 12 in., and the general scheme of manufacture is aimed to satisfy the present keen demand for quick delivery. The exclusive Canadian distributors of the lathes are Kellogg & Co., Traders Bank Building, Toronto.



NEW SINGLE PURPOSE SHELL LATHE.

COLLAPSIBLE TAP FOR SHELLS

THE accompanying cut shows the "Victor" collapsible tap which has been specially designed to tap shrapnel shells. It is made of a tough grade of machinery steel so as to stand the strain of hard usage. The tap is adjusted from the front end by means of a hardened set-screw, 32 threads per inch, this securing a fine, accurate and positive adjustment. When once set to size it may be expected to stay, there being positively no chance for slipping. The screw at rear end is for adjusting the tension on the throw-off or tripping spring. This is a new feature and a desirable one. All parts of the tap subject to wear are hardened and ground. The object in designing this tool was to make a tap that would cut threads accurately, and have sufficient strength and durability to make it an economical tool for the shell maker. The chasers are made of the best grade of high-speed steel; they are strong and heavy, and will stand the strain of threading shrapnel or high-explosive shells. This tap may be used in a turret head or attached to a live spindle, working satisfactorily in either condition. It is manufactured and sold by the Victor Tool Co., Waynesboro, Pa.



COLLAPSIBLE TAP FOR SHELLS.

THE ALLOYS OF HIGH-SPEED STEEL.

NO subject probably is receiving more attention in the steel trade of Sheffield to-day, says a correspondent of The Engineer, than that of alloys used for making high-speed steel. Since the discovery that certain rare metals gave to high-speed steel its essential property, and also the method of applying them successfully in manufacture, the trade in question has been revolutionized. The croakers who prophesied that the use of tool steels of increased cutting power would lessen consumption and render a large portion of the melting plant idle have been completely discredited. Although the modern variety of steel will do treble the work of the old, there has been a big increase of demand and output, and makers have enjoyed a measure of prosperity never dreamed of before.

Metallic Tungsten Production

With these facts in view, one can appreciate the anxiety that is felt on the subject of the supply of ingredients, without which high-speed steel cannot be produced. For metallic tungsten, the most important of them, the trade had for years relied upon the German metallurgical chemists to keep it supplied, but the war has taught it a sharp lesson in the necessity of being in a position to meet its own needs, or at any rate, not to be dependent upon a single source. Whatever happens in the future, it is certain that an adequate supply of tungsten is assured, and the question of whether Germany ever resumes its premier position in the manufacture of the alloy is of secondary importance. Germany may influence the market, but it will never again control supplies. Half a dozen works in England are engaged in its manufacture, several of them turning out the alloy in its metallic form, which is preferred by the local users.

The production of the latter is the great problem facing the trade. There is a large and ample output of ferro-tungsten, but to make the metal of the high standard of purity required in the form of metal necessitates much experiment and experience. Four firms are grappling with the problem. One of them is sending out considerable quantities. A second has supplied a small quantity of the right quality, and a steady increase is promised until a maximum of some 30 tons a month is reached. That, we believe, exceeds the output of any of the German works in the past. Hence on the completion of the experiments and developments now in hand, steel makers will be under no necessity to go outside the country to get supplied. The factor of price may, of course, arise, but there is no reason to doubt that British makers will be in a position eventually to hold their own against Germany even in this matter.

EXPLOSIVES AND GUNS.

THE establishment of factories in Canada to manufacture high explosives from raw material produced in the country, marks another step forward in the ammunition industry of this country. Cordite, which forms the propelling agency in British shells, is of special interest to thousands of Canadians engaged in shell making. This material gets its name from the form in which it is produced. It is a mixture of gun-cotton, nitro-glycerine and a mineral jelly. The jelly is employed to convert the gun-cotton into a plastic substance which can be squeezed or rolled into any form desired, but which becomes hard and horn-like when dried. When the material is in a suitable state it is put into presses which squirt it through dies of the required size suitable for any bore of rifle or gun.

Rifle cordite is produced in the form of a thin cord, and is wound on a reel; the thicker forms of cordite for guns are cut into suitable lengths. The final stage of manufacture is drying, which takes as long as two months in some cases.

John B. C. Kershaw, writing in Cassiers' Engineering Monthly, makes the following interesting statements on the subject of modern explosives:

The required muzzle velocities and pressures for rifles and guns can be obtained, with variations that are exceedingly small. Thus for rifles, the velocity prescribed is 2,380 foot-seconds with a plus or minus of only 40 feet, and a pressure of 19.5 tons with a maximum of 20 tons per square inch; for larger guns it may be 1,500 foot-seconds, and the pressure must not exceed 19 tons per square inch.

Application of Explosives in Warfare.

Great developments have occurred in the application of explosives to warfare during the last thirty years, for the introduction of elongated projectiles, rifled guns, and high explosives has practically revolutionized land and naval warfare. It is difficult to realize now that at the battle of Waterloo the effective range of cannon was less than 2-3rds of a mile, and that as solid iron balls were employed, the destructive effect of artillery fire was confined to the individual or building hit. One round from a modern field-gun firing a 3-inch shell, in fact, will do more material damage, and kill or wound more men, than twelve hours' firing with the form of cannon used in 1815. It is also a fact that when the Dardanelles were last forced by a British fleet (in 1807) the Turkish guns were firing stone shot, and that in Nelson's day, naval actions were rarely commenced at a range of more than one thousand yards.

Explosives are divided into two distinct classes known as "high" explosives and "low" explosives, the chief function of the latter in warfare being as a propellant, while that of the former is to destroy life and fortifications, by the shattering effects of the explosion, which occurs when they are detonated. "Low" explosives, as a general rule, are employed in the form of cartridges in order to generate a steadily increasing force in the chamber of the rifle or gun, sufficient to project and carry the bullet or shell to its mark. "High" explosives are employed in a casing or canister of steel, and are detonated either by a time-fuse, or by percussion on striking the ground or the object aimed at.

The weight of the shell differs according to the size of the gun; that fired from the ordinary 3-inch field-gun varies in weight from 15 to 18½ pounds. An explosive shell differs from shrapnel in that it contains no bullets, and the damage done by it to buildings and human beings, when the charge is detonated, is due to the force of the explosion and to the flying fragments of the steel case when it bursts. The detonator employed for high explosives is fulminate of mercury mixed with potassium chlorate and enclosed in a copper container.

Types of Guns.

The quick-firing 3-inch field-gun is the most important weapon used by the opposing forces, and it is estimated that Germany at one period of the war had 5,000 guns of this type in the field. The German gun is a converted breech-loader, and fires a 15-pound shell with a muzzle velocity of 1,525 feet per second. It is light and of simple construction, but possesses several disadvantages which render it a second-class gun.

The French 75-millimeter and the English 3-inch field-guns are of more modern type than the German gun; the rate of firing can be maintained at 20 rounds per minute, if desired, for a short period. The English gun fires a shell weighing 18½ pounds, whereas the French gun fires a shell of 15 pounds with a muzzle velocity of 1,740 feet per second. The Allies' 3-inch field-guns are superior, therefore, in range, accuracy and firing speed to the German guns, and it was only by their greater number that the Germans gained many of their successes in the early stages of the war.

It is reported that the Germans have developed a new type of field-gun which is fed automatically with shells on the machine-gun principle, and that this gun can fire double or treble the number of shells per minute that was possible with the older pattern. This new weapon, it is stated, will be used against the Allies on the Western battle front, and time will show how far the claims for the new gun are substantiated.

The Howitzer.

A howitzer, it may be explained, is the short, heavy type of gun used for throwing shells at a high angle in order that they may fall vertically into the enemies' lines or entrenchments with a high striking velocity. Both the Allies and the Germans have been making great use of this type of gun in their attacks in Flanders and Northern France. The British field howitzer fires a 4.5-inch 35-pound shell, and has a range of 3,400 yards. The German weapon of this class is 4 inches in diameter and fires a shell weighing 31 pounds with a muzzle velocity of 985 feet per second. The projectile fired by this latter howitzer is shrapnel charged with bullets embedded in tri-nitro-toluol, and this is the shell which has accounted for many casualties in the British and French lines.

The British army in addition to the light field-howitzer, possesses a heavier gun, throwing a 60-pound shell with a range of 9,500 yards; while opposed to this the Germans have a 6-inch howitzer throwing a 90-pound shell, and capable of firing at an elevation of 65 degrees. The range to which a shell carries is, of course, diminished as the angle of fire is increased above 45 degrees, and the object of firing at such an acute angle as 65 degrees is to obtain a steep angle of descent, and to ensure penetration of any overhead cover by the shell when it strikes the ground.

Although it is not generally recognized, it is a fact that the application of explosives to warfare in the past has tended to keep the opposing forces far apart, and to diminish the amount of hand-to-hand fighting. This tendency has resulted in diminished casualty lists in proportion to the numbers engaged in conflict, for it is only when engaged at close quarters in hand-to-hand fighting that the proportion of killed and wounded in armies can rise to fifty or more per cent.

This stage of warfare appears, however, to be passing away, and with the development of trench warfare and the use of poisonous gases, in addition to hand grenades and bombs filled with high explosives, we are once more confronted with conditions of combat which resemble those of earlier time. How far this development will proceed it is impossible to say. The powers of destruction that have been placed by the advances of science in man's hands are terribly effective, and it is quite possible that the limit has not even yet been reached.

Machinery Display at the Canadian National Exhibition

Staff Article

Machinery and supplies exhibited are particularly interesting in view of the peculiar conditions which have existed during the past year. Exhibitors are to be congratulated on their efforts to maintain the former high standard of equipment display. Progress in standard lines, and much that is new in special lines, are the two features which impress the visitor,

THE disturbing influence of the war is not so apparent as might be expected in the display of machinery and kindred equipment in the Machinery Hall and elsewhere at this year's Canadian National Exhibition in Toronto. A number of former exhibitors are unable to be present, but their places have been filled by several new comers, the variety of whose product augurs well for the future of the Canadian machinery industry.

Interesting Exhibits

The A. R. Williams Machinery Co. are to be found in their familiar location. Shell machinery and a "Williams" quick-firing field gun give quite a warlike atmosphere to the exhibit.

Cowan & Co. make their usual interesting exhibit of woodworking tools and machines, while the Preston Woodworking Machinery Co. show a tenoning machine in addition to their last year's products.

The Chapman Double Ball Bearing Co. exhibit a "Perrin" hydraulic pump and press in operation on actual shells destined for the battlefields in Europe. The Dodge Mfg. Co. are receiving visitors at their exhibit, which contains numerous examples of their widely-known products.

The Victor Saw Works, Hamilton, Ont., have two power hack saws working on shell material which make the exhibit attractive as well as instructive.

The Pratt & Whitney Co. show a special set of small tools for shell manufacture, while the Carter Welding Co. have a machine in operation, and carving armor plate quicker than the ordinary person can saw wood. L'Air Liquide Society again show the samples of work done by their apparatus in the welding and cutting metals.

At the Canadian Ice Machine Co. stand is a domestic ice box of ordinary proportions which is equipped with a complete automatic self-contained refrigerating plant of ½ horse-power capacity in operation. A further anti-heat demonstration is in constant operation at the exhibit of the Armstrong Cork & Insulation Co., where the benefits due to the use of their "Nonpareil" Insulating Brick are made evident through the use of an electric furnace.

Belting exhibits are staged in an effective manner by the Dominion Belting Co., Hamilton, Ont., and D. K. McLaren, Ltd., Montreal, while the many excellent features of the Elliot Wood Worker are again demonstrated under actual conditions of use.

Machinery Hall

Armstrong Cork and Insulation Co., Toronto.—Electric furnace in operation, demonstrating insulating power of "Nonpareil" insulating brick, specimens of diatomaceous earth, cork products, etc.; models of insulated furnace settings. Representatives: G. C. Albertson, J. Kent.

Aylmer Pump and Scale Co., Aylmer, Ont.—Hand and power pumps, scale trucks, domestic water supply systems.

L'Air Liquide Society, Toronto.—Demonstrating oxy-acetylene welding: hand and power welding machines, acetylene generators, specimens of work, etc. Representatives: A. Turnbull, M. Harch, N. Smith.

Boiler Repair and Grate Bar Co., Toronto.—20th Century Grate Bars; "Coppus" Steam Turbo Blower for chimney draft. Representatives: C. W. Andrews, A. H. Hetts.

British Aluminum Co., Toronto.—Aluminum products, samples of bauxite, cryolite, aluminum powder for bombs, etc. Representative: E. Pannel.

Baines & Peckover, Toronto.—Exhibit of "Triumph Superb" tool steel; crucible, vanadium and cold rolled steel; expanded metal, babbitt metal, chain, wire rope, etc. Representatives: W. M. David, T. A. Steven, H. W. Marshall, A. McGregor, W. P. Williams.

The Canadian Automatic Wrench Co., Toronto.—"Dickson" automatic pipe and nut wrenches. Representatives: H. L. Dickson, J. Henderson, Fred C. Fowler.

Cowan & Co., Galt, Ont.—Two chain morticers, power feed rip saw, four side molding machine. Representatives: W. Cowan, S. F. Barrows.

Canadian Mill Supplies and Steam Specialties, Ltd., Toronto.—"Morehead" back to boiler system, United States graphite preparations, "Griscom-Russel" heaters and generators, "Everlasting" blow-off valves. Representatives: J. G. Abraham, L. O. Smith.

Cling Surface, Buffalo, N.Y. — Apparatus demonstrating the efficiency of slack belt drives when treated with "Cling Surface." Representative: J. B. Faatz.

Cleveland Pneumatic Tool Co., of Canada.—New Cleveland stope drills, portable foundry grinding machines, and a full line of pneumatic hammers, drills, riveters, Bowes and

CANADIAN NATIONAL EXHIBITION SHOWING SECTION IMMEDIATELY BEHIND MAIN ENTRANCE

Neverleak couplings, etc. Representative: J. A. Day.

Canadian Ice Machine Co., Toronto.—Domestic refrigerating plant in operation, installed in Arctic refrigerator. Various sizes of York ice machines, apparatus and fittings, etc. Representatives: C. E. Allison, C. H. Bower.

Canadian General Fire Extinguisher Co., Toronto.—Demonstration of automatic sprinkler system in operation. Control apparatus for both wet and dry systems, sprinkler heads, fittings, etc. Representatives: W. Roos, W. Kay.

Carter Welding Co., Toronto.—Davis-Bowmanville oxy-acetylene apparatus, generators, blowpipes, armor plate cutting demonstration, etc. Representatives: H. W. Carter, P. Sorley.

Canadian Pneumatic Tool Co., Montreal — Pneumatic tools and fittings.

Geo. W. Cole Co., Toronto.—Cole heaters, boiler feeders and steam specialties. Representative: G. W. Cole.

Canada Machinery Corporation, Ltd., Galt, Ont.—Woodworking tools, viz: 48 in. band resaw, tenoning machine, 32 in. knife grinder, sash morticer and relisher, hollow chisel morticer, chain morticer, New Pattern light variety saw bench, set of sample knives; ironworking tools, viz.: 36 in. vertical drill, 25 in. vertical drill, 24 in. backgeared crank shaper, No. 20 geared power press. Representatives: D. King, P. V. Burton, W. J. Irving, M. Preston.

Chapman Double Ball Bearing Co. of Canada, Ltd., Toronto.—"Chapman" elevating trucks for factories and warehouses. Shell machinery in operation. Complete line of ball bearings for all purposes. Illuminated display board. Representatives: W. J. Murray, C. M. Murray, W. C. Hockin and H. O. Edwards.

The Dodge Mfg. Co., Toronto. Complete line of transmission machinery, including steel and wood pulleys, bearings, hangers, etc. Representative: J. F. Haas.

Dominion Belting Co., Hamilton, Ont. — Maple Leaf stitched cotton duck belting for power transmission and conveyors. Representative: J. Scott.

Len Edmonds, Smiths Falls, Ont. Maple sugar evaporators and supplies for the industry made by Small Brothers.

Elliot Wood Worker, Ltd., Toronto. No. 3 machine with tilting table and graduated index plate for revolving, wood drilling machine, scroll saw and shaper. Representative: W. A. Elliot.

General Machinery Co., Toronto. G.M.C. automatic water systems; demonstration of Luitweiler pumps. Representative: W. McLachlan. **G. Walter Green Co., Peterborough, Ont.** Woodworking machinery and saws.

The Holden Co., Montreal.—Complete line of portable electric and air tools, rock drills and railway supplies. Representative: J. B. Wilson.

The Hare Engineering Co., Toronto.—Full size installation, demonstrating the operation of the Fulton water-cooled mechanical stoker. Terry steam turbines, and Swartwout steam separators. Representative: J. F. Wood.

Jones & Glassco, Ltd., Montreal.—One 150 horsepower "Renold" silent chain drive, one 60 horsepower "Renold" roller chain drive.

Jones & Moore, Toronto.—Full line of electric motors, for 1, 2 and 3 phase and direct current. Shoe finishing machinery in operation. Representative: W. Dalton.

D. K. McLaren, Ltd., Montreal.—British oak tanned belting, D.K. balata belting, Philips pressed steel pulleys, D.K. wood pulleys, etc. Representative: W. S. Hamilton.

J. L. Morrison Co., Toronto.—Full line of bookbinders' and paper machinery. Representative: W. Doldring.

The Massey-Harris Co., Toronto. Portable saw outfits, gasoline engines in operation, 1 No. 15 self governing grinder driven by gasoline engine. Representatives: B. Graham, N. A. McIntosh, A. Verity.

Pratt & Whitney Co., of Canada, Ltd., Dundas, Ont. Special exhibit of small tools for high explosive and shrapnel shells, full line of milling cutters, taps, dies, drills, and reamers. Representatives: T. R. Whitehead, A. Webb.

Preston Woodworking Machine Co., Preston, Ont. Tenoning machine, power feed saw, 12 in. molder, 36 in. band saw, 24 in. panel planer, 36 in. high speed ball bearing shaper and Newport attachment for molding machines. Representatives: W. J. Murray, W. E. Near, A. M. Kerr.

Tallman Brass & Metal Co., Hamilton, Ont. Arctic antifriction metal, brass and aluminum ware and castings.

Twin City Oil Co., Berlin, Ont. Feed crushers in operation. Marzel oil pumps and compressors. Representative: A. V. Phipps.

Victor Saw Works, Hamilton, Ont. Power hack saws operating on shell material, Victor saw blades. Representatives: W. F. Pollock, A. V. Wilson.

A. R. Williams Machinery Co., Toronto.—Boyd belting machine for high explosive shells, Chapman transfer truck, Hobbs Morgan thread milling machines, 14 inch Le Blond engine lathe, Reeves wood pulleys, marine gasoline engines, rowboat motors etc. Representatives: Messrs. Cronk, Klechel and McDonald.

GENERAL SECTION.

The Canadian Fairbanks-Morse Co., Toronto, are exhibiting in the agricultural machinery section oil and gasoline engines for electric lighting, pumping and general purposes, also marine engines. A 25-barrel "Midget" mill is in operation. Representative, G. Wheeler.

The Dennis Wire & Iron Works Co., London, Ont., located in the Process Building, have an interesting line of "Dennisteel" clothes lockers, filing cabinets, safe cabinets and steel stools. Representative, M. B. MacNeely.

Consumers Gas Co., Toronto, have two exhibits in the Process Building, one being devoted to a display of gas-hardening furnaces for tool room, also forging and soft metal furnaces. "Tyco" and "Taylor" recording pyrometers are also to be seen. Representative, H. E. G. Watson.

The International Time Recording Co. of Canada, Ltd., Toronto, are demonstrating in the Process Building cost systems and time clocks. Representatives, F. Mutton, L. B. Morton, H. B. Lukens and J. F. MacBride.

The W. S. Mahaffy Co., Toronto, are exhibiting in the Grand Stand Section the "Lifton" transporting truck, also a number of warehouse and factory trucks of various types. Representative, F. G. Mahaffy.

CANADIAN NATIONAL EXHIBITION SHOWING SECTION OF THE GROUNDS AND LAKE FRONT

The James Morrison Brass Mfg. Co., Toronto, are exhibiting in the Process Building a full line of brass steam goods, including safety and reducing valves, gauges, locomotive injectors and valves, etc. Representatives, A. Betton and W. Dobbin.

W. A. Drummond & Co. are showing in the Grand Stand Section an exhibit of dairy and refrigerating machinery and supplies, including a 2-ton and 4-ton machine, the latter being in operation. Representative, A. P. Macdonald.

S. F. Bowser & Co., Inc., Toronto, have exhibits in the Transportation and Process Buildings. These include gasoline and lubricating oil systems, "Red Sentry" pump for automobile and other filling stations. Representatives: R. W. Wilson, H. F. Stone and A. E. McGill.

A. H. Wynter-Joiner, Ltd., Toronto, are showing in the Transportation Building a full line of the well-known Weston portable electrical instruments. Representative, S. E. Fife.

The Tygard Rotary Engine Co., Toronto, are demonstrating in the Agricultural Machinery Section, the "Tygard" rotary engine. Two units, 22 h.p. and 30 h.p., are being shown. Representatives: Professor James W. Tygard and F. G. Moore.

The MacLean Publishing Company

LIMITED

(ESTABLISHED 1888)

JOHN BAYNE MACLEAN - - - - - - President
H. T. HUNTER - - - - - - - General Manager
H. V. TYRRELL - - - - - Asst. General Manager

PUBLISHERS OF

CANADIAN MACHINERY AND MANUFACTURING NEWS

A weekly newspaper devoted to the machinery and manufacturing interests.

PETER BAIN, M.E., Editor.

Associate Editors.

A. G. WEBSTER, J. M. WILSON, J. H. RODGERS,

B. G. NEWTON - - - - - Advertising Manager

OFFICES:

CANADA—

Montreal—Rooms 701-702 Eastern Townships Bank Building. Telephone Main 1255.
Toronto—143-153 University Ave. Telephone Main 7324.
Winnipeg—34 Royal Bank Building. Telephone Garry 2313.

UNITED STATES—

New York—R. B. Huestis, 115 Broadway. Phone 8971 Rector.
Chicago—A. H. Byrne, Room 607, 140 South Dearborn St. Telephone Randolph 3234.
Boston—C. L. Morton, Room 733, Old South Bldg. Telephone Main 1024.

GREAT BRITAIN—

London—The MacLean Company of Great Britain, Limited, 88 Fleet Street, E.C. E. J. Dodd, Director. Telephone Central 12960. Address: Atabek, London, England.

SUBSCRIPTION RATES:

Canada, $2.00; United States, $2.50; Great Britain, Australia and other Colonies, 8s. 6d. per year; other countries, $3.00. Advertising rates on request.

Subscribers who are not receiving their paper regularly will confer a favor by letting us know. We should be notified at once of any change in address, giving both old and new.

Vol. XIV. SEPTEMBER 2, 1915 No. 10

PRINCIPAL CONTENTS.

Combined Shrapnel and High Explosive Shell Manufacturing Plant 215-221

General 222
Cartridge Case Cooling Conveyors....Forging Plant for 6 in. Shell Forgings.

4.5 Howitzer Shell Production in a Structural Steel Plant 223-228

General 228
Socket Driving Machine....The Test of Weapons... Canada's Gas and Oil Resources.

Why Steel is the Most Suitable Material for Shells 229-230

General 230
Munitions Invention Committee.

H. E. Shell Production in Ventilating Equipment Plant 231-236

General 236
Projectile Manufacturing Lathe. Engineering in Germany.

Casting Steel Ingots for Production of 4.5 H. E. Shells 237-240

Shrapnel Shell Production in a Shipbuilding and Marine Engineering Plant 241-247

General 247
Our Sea Power Triumph.

The Production of Sound Ingots for Shell Requirements 248-251

General 251
Munition Metals.

Progress in New Equipment 252
Single Purpose Shell Lathe. Collapsible Tap for Shells.

General 252-253
The Alloys of High Speed Steel... Explosives and Guns.

Machinery Display at the Canadian National Exhibition 254-255

Editorial 256
War Effect on Machine Shop Methods and Equipment

Our Manufacturers' Honor Roll 257

Selected Market Quotations 258-259

The General Market Conditions and Tendencies 260-261
Montreal Letter....Toronto Letter....Allies' Purchasing Agents. Canadian Government Purchasing Commission....Ocean Tonnage Shortage....Machine Tool Opening in Russia. S.S. "Ontario" No. 2 Trial Trip ....Canadian Commercial Intelligence Service.

Industrial and Construction News (Advtg. Section) 121-132

WAR EFFECT ON MACHINE SHOP METHODS AND EQUIPMENT

IN the midst of numerous speculations as to the future of Canada's manufacturing industry, it may not be amiss to draw attention to the changed conditions under which in the coming time business problems will have to be approached and solved.

In a number of ways, the shell industry has been an eye-opener to us. Many firms which a year ago did but a limited business in machine work—iron founders, tinsmiths, structural workers and others, are now running a modern machine shop on most modern lines.

The requirements of a shop which must produce accurate work at a given figure, and also in a quantity, are understood more thoroughly now than ever before. Toolmakers are no longer frowned upon, the tool-room being recognized as something more than a mere luxury. The necessity for employing skilled help in maintaining output has been so borne in upon us that the application of scientific methods and labor-saving devices will be prosecuted with increased vigour when our manufacturing resources are again normally operated.

When such a time comes, there will doubtless be many who, having been fortunate in their selection of machines, will be able to adapt them to the more economical production of their various specialties. Plants which have installed automatic and semi-automatic machines, turret lathes, screw machines, etc., may be classed in this reckoning.

In competition with these, however, will be found others, and they may constitute a substantial majority, who, having a more varied assortment of equipment, evidenced their ingenuity in converting, adapting, and utilizing in numberless fearful and wonderful ways, anything that happened to be available. Regarding such, instances have come to light where machines by standard makers have been put to work on shell operations, the proper performance of which required, according to existent ideas, the utilization of complex machinery of ten times the value. Further, and as if to add insult to injury, the amount of tooling necessary was cut in half as a result of judicious experiment in methods and selection of materials, until the output of obscure machines became many times greater and was obtainable at a trifling cost.

When shells are a thing of the past, the activities of our plants will diverge and radiate in many directions. There will be a parting of the ways, and only balanced judgment will decide between success and failure—between a continued activity, rich in progress and development, and a helpless floundering in the mire of misdirected effort and inexperience. While naturally proud of our new, modern tool equipped plants, we must bear in mind that not a few other people have been using these same machines for years past, earning their living through them, and know just what they can do, and how much it costs to do it. Shell work may pay a fair return on the investment, but it offers no wide field of experience on different classes of work, either as regards materials or labor. The results obtained in shell manufacture indicate in moderate degree what may be accomplished in the direction of specialization of operations rather than of machines.

Specialization of equipment is exemplified by some recent productions in the United States where machines of the multiple type have been developed to a marked degree. The use of such machines, or even a tendency in that direction can, however, be justified only by a demand which would keep a sufficient number of them busy, and warrant the employment of the expert help necessary for maintaining their operation reliability and up-keep expense.

Our Manufacturers' Honor Roll

Representative of Canadian manufacturers, their families and administrative staffs who have heeded the call of Empire for active service on our various overseas contingents.

LIEUT. W. S. DREWRY,
E. L. Drewry, Ltd., Winnipeg

CAPT. G. D. McLAUCHLAN,
McLauchlan & Sons, Ltd., Owen Sound.

MUNITIONS WORKER AND SOLDIER

SPEAKING recently at a meeting of emp loyees of Swan, Hunter & Wigham Richardson, Wallsend-on-Tyne, Dr. Hunter challenged the accuracy of the oft-repeated assertion that men in the factory were as useful as those at the front, and declared: "It is not true. A man at the front is twice as good as a man in the factory. These men are making sacrifices, and it will be a shame and a crime if, through any slackness on our part, even one of these brave lives is lost."

CAPTAIN J. STEWART GRAFTON,
Grafton & Co., Dundas, Ont.

CAPT. H. C. TRENAMAN,
Domestic Specialty Co., Hamilton, Ont.

LT.-COL. J. BRUCE PAYNE,
J. Bruce Payne, Ltd., Granby, Que.

SELECTED MARKET QUOTATIONS

Being a record of prices current on raw and finished material entering into the manufacture of mechanical and general engineering products.

PIG IRON.

Grey forge, Pittsburgh		$14 45
Lake Superior, charcoal, Chicago		16.25
Ferro Nickel pig iron (Soo)		25 00
	Montreal.	Toronto.
Middlesboro, No. 3	22 00	
Carron, special	23 00	
Carron, soft	23 00	
Cleveland, No. 3	22 00	
Clarence, No. 3	22 50	
Glengarnock	26 00	
Summerlee, No. 1	28 00	
Summerlee, No. 3	27 00	
Michigan charcoal iron	26 00	
Victoria, No. 1	23 00	19 00
Victoria, No. 2X	22 00	19 00
Victoria, No. 2 plain	22 00	19 00
Hamilton, No. 1	22 00	19 60
Hamilton, No. 2	22 00	19 00

FINISHED IRON AND STEEL.

Per Pound to Large Buyers.	Cents.
Common bar iron, f.o.b., Toronto	2.20
Steel bars, f.o.b., Toronto	2.20
Common bar iron, f.o.b., Montreal	2.20
Steel bars, f.o.b., Montreal	2.20
Twisted reinforcing bars	2.20
Bessemer rails, heavy, at mill	1.25
Steel bars, Pittsburgh	1.30
Tank plates, Pittsburgh	1.30
Beams and angles, Pittsburgh	1.30
Steel hoops, Pittsburgh	1.40
F.O.B., Toronto Warehouse.	**Cents.**
Steel bars	2.10
Small shapes	2.35
Warehouse, Freight and Duty to Pay.	**Cents.**
Steel bars	1.90
Structural shapes	1.95
Plates	1.95

Freight, Pittsburgh to Toronto.

18.9 cents carload; 22.1 cents less carload.

BOILER PLATES.

	Montreal.	Toronto.
Plates, ¼ to ½ in., 100 lb.	$2 35	$2 25
Heads, per 100 lb.	2 55	2 45
Tank plates, 3-16 in.	2 60	2 45

OLD MATERIAL.

Dealers' Buying Prices.	Montreal.	Toronto.
Copper, light	$11 00	$11 75
Copper, crucible	12 00	12 50
Copper, unch-bled, heavy	12 00	12 50
Copper, wire, unch-bled	13 00	13 50
No. 1 machine compos'n	11 00	11 00
No. 1 compos'n turnings	9 00	9 00
No. 1 wrought iron	6 00	6 00
Heavy melting steel	7 00	7 00
No. 1 machin'y cast iron	10 50	10 50
New brass clippings	11 00	11 00
No. 1 brass turnings	9 00	9 00
Heavy lead	4 50	4 75
Tea lead	$ 3 25	$ 3 50
Scrap zinc	8 50	9 00

W. I. PIPE DISCOUNTS.

Following are Toronto jobbers' discounts on pipe in effect June 25, 1915:

	Buttweld Black	Buttweld Gal.	Lapweld Black	Lapweld Gal.
Standard				
¼, ⅜ in.	63	32½	....	....
½ in.	68	41½	....	....
¾ to 1½ in.	73	46½	....	....
2 in.	73	46½	69	42½
2½ to 4 in.	73	46½	72	45½
4½, 5, 6 in.	....	....	70	43½
7, 8, 10 in.	....	....	67	40½
X Strong P. E.				
¼, ⅜ in.	56	32½	....	....
½ in.	63	39½	....	....
¾ to 1½ in.	67	43½	....	....
2, 2½, 3 in.	68	44½	....	....
2 in.	....	....	63	39½
2½ to 4 in.	....	....	63	42½
4½, 5, 6 in.	....	....	66	42½
7, 8 in.	....	....	59	35½
XX Strong P. E.				
½ to 2 in.	44	20½	....	....
2½ to 6 in.	....	....	43	19½
7 to 8 in.	....	....	40	16½
Genuine Wrot Iron.				
⅜ in.	57	26½	....	....
½ in.	62	35½	....	....
¾ to 1½ in.	67	40½	....	....
2 in.	67	40½	63	36½
2½, 3 in.	67	40½	66	39½
3½, 4 in.	....	....	66	39½
4½, 5, 6 in.	....	....	63	36½
7, 8 in.	....	....	60	33½

Wrought Nipples.	
4 in. and under	77½%
4½ in. and larger	72½%
4 in. and under, running thread	57½%
Standard Couplings.	
4 in. and under	60%
4½ in. and larger	40%

MILLED PRODUCTS.

Sq. & Hex. Head Cap Screws	65%
Sq. Head Set Screws	65 & 10%
Rd. & Fil. Head Cap Screws	45%
Flat & But. Head Cap Screws	40%
Finished Nuts up to 1 in.	70%
Finished Nuts over 1 in. N.	70%
Semi-Fin. Nuts up to 1 in.	70%
Semi-Fin. Nuts over 1 in.	72%
Studs	65%

METALS.

	Montreal.	Toronto
Lake copper, carload	$20 00	$19 50
Electrolytic copper	19 75	19 25
Castings, copper	19 00	19 00
Tin	40 00	39 00
Spelter	19 00	19 00
Lead	6 25	6 25
Antimony	40 00	40 00
Aluminum	40 00	40 00

Prices per 100 lbs.

BILLETS.

	Per Gross Ton
Bessemer, billets, Pittsburgh	$22 00
Openhearth billets, Pittsburgh	22 00
Forging billets, Pittsburgh	28 00
Wire rods, Pittsburgh	25 50

NAILS AND SPIKES.

Standard steel wire nails, base	$2 40	$2 35
Cut nails	2 50	2 70
Miscellaneous wire nails	75 per cent.	
Pressed spikes, ⅝ diam., 100 lbs.	2 85	

BOLTS, NUTS AND SCREWS.

	Per Cent.
Coach and lag screws	75
Stove bolts	80
Plate washers	40
Machine bolts, ⅜ and less	70
Machine bolts, 7-16 and over	60
Blank bolts	60
Bolt ends	60
Machine screws, iron, brass	35 p.c.
Nuts, square, all sizes	4¼c per lb. off
Nuts, Hexagon, all sizes	4¾c per lb. off
Iron rivets	72½ per cent.
Boiler rivets, base, ¾-in. and larger	$3.25
Structural rivets, as above	3.25
Wood screws, flathead, bright	85, 10, 7½, 10 p.c. off
Wood screws, flathead, Brass	75 p.c. off
Wood screws, flathead, Bronze	70 p.c. off

LIST PRICES OF W. I. PIPE.

Standard. Nom. Diam.	Price. per ft.	Extra Strong, Sizes Ins.	Price per ft.	D. Ex. Strong, Size Ins.	Price per ft.
⅛in	$ .05½	⅛in	$ .12	½	$ .32
¼in	.06	¼in	.07½	¾	.35
⅜in	.06	⅜in	.07½	1	.37
½in	.08½	½in	.11	1¼	.52½
¾in	.11½	¾in	.15	1½	.65
1 in	.17½	1 in	.22	2	.91
1¼in	.23½	1¼in	.30	2½	1.37
1½in	.27½	1½in	.36½	3	1.86
2 in	.37	2 in	.50½	3½	2.30
2½in	.58½	2½in	.77	4	2.76
3 in	.76½	3 in	1.03	4½	3.26
3½in	.92	3½in	1.25	5	3.86
4 in	1.09	4 in	1.50	6	5.32
4½in	1.27	4½in	1.80	7	6.35
5 in	1.48	5 in	2.08	8	7.25
6 in	1.92	6 in	2.86	....	.....
7 in	2.38	7 in	3.81	....	.....
8 in	2.50	8 in	4.34	....	.....
8 in	2.88	9 in	4.90	....	.....
9 in	3.45	10 in	5.48	....	.....
10 in	3.20	....	....	....	.....
10 in	3.50	....	....	....	.....
10 in	4.12	....	....	....	.....

COKE AND COAL.

Solvay Foundry Coke	$5.75
Connellsville Foundry Coke	4.85-5.15
Yough, Steam Lump Coal	3.83
Penn. Steam Lump Coal	3.63
Best Slack	2.99

Net ton f.o.b. Toronto.

COLD DRAWN STEEL SHAFTING.

At mill	45%
At warehouse	40%

Discounts off new list. Warehouse price at Montreal and Toronto.

MISCELLANEOUS.

Solder, half-and-half	24.75
Putty, 100-lb. drums	2.70
Red dry lead, 100-lb. kegs, per cwt.	9.67
Glue, French medal, per lb.	0.18
Tarred slaters' paper, per roll	0.95
Motor gasoline, single bbls., gal.	0.18
Benzine, single bbls., per gal.	0.18
Pure turpentine, single bbls.	0.64
Linseed oil, raw, single bbls.	0.65
Linseed oil, boiled, single bbls.	0.68
Plaster of Paris, per bbl.	2.50
Plumbers' Oakum, per 100 lbs.	4.00
Lead wool, per lb.	0.10
Pure Manila rope	0.16
Transmission rope, Manila	0.20
Drilling cables, Manila	0.17
Lard oil, per gal.	0.73
Union thread cutting oil	0.60
Imperial quenching oil	0.35

POLISHED DRILL ROD.

Discount off list, Montreal and Toronto 40%

PROOF COIL CHAIN.

¼ inch	$8.00
5-16 inch	5.35
⅜ inch	4.60
7-16 inch	4.30
½ inch	4.05
9-16 inch	4.05
⅝ inch	3.90
¾ inch	3.85
⅞ inch	3.65
1 inch	3.45

Above quotations are per 100 lbs.

TWIST DRILLS.

	%
Carbon up to 1½ in.	60
Carbon over 1½ in.	25
High Speed	40
Blacksmith	60
Bit Stock	60 and 5
Centre Drill	20
Ratchet	20
Combined drill and c.t.s.k.	15

Discounts off standard list.

REAMERS.

	%
Hand	25
Shell	25
Bit Stock	25
Bridge	65
Taper Pin	25
Centre	25
Pipe Reamers	80

Discounts off standard list.

IRON PIPE FITTINGS.

Canadian malleable, 35 per cent.; cast iron, 60; standard bushings, 60; headers, 60; flanged unions, 60; malleable bushings, 60; nipples, 75; malleable, lipped unions, 65.

TAPES.

Chesterman Metallic, 50 ft.	$2.00
Lufkin Metallic, 603, 50 ft.	2.00
Admiral Steel Tape, 50 ft.	2.75
Admiral Steel Tape, 100 ft.	4.45
Major Jun., Steel Tape, 50 ft.	3.50
Rival Steel Tape, 50 ft.	2.75
Rival Steel Tape, 100 ft.	4.45
Reliable Jun., Steel Tape, 50 ft.	3.50

SHEETS.

	Montreal	Toronto
Sheets, black, No. 28	$3 00	$2 90
Canada plates, dull, 52 sheets	3 25	3 50
Canada Plates, all bright	4 40	4 60
Apollo brand, 10¾ oz. galvanized	6 40	5 95
Queen's Head, 28 B.W.G.	6 00	6 25
Fleur-de-Lis, 28 B. W. G.	5 75	5 75
Gorbal's Best, No. 28	6 50	6 50
Viking metal, No. 28	6 00	6 00
Colborne Crown, No. 28	5 38	5 30

BOILER TUBES.

Size	Seamless	Lapwelded
1 in.	$11 00	.....
1¼ in.	11 00	.....
1½ in.	11 00	.....
1¾ in.	11 00	.....
2 in.	11 50	9 20
2¼ in.	13 00	.....
2½ in.	14 00	12 10
3 in.	16 00	12 70
3¼ in.	.....	13 90
3½ in.	20 00	15 00
4 in.	25 50	18 90

Prices per 100 feet, Montreal and Toronto.

WASTE.

WHITE.	Cents per lb.
XXX Extra	0 11
X Grand	0 10½
XLCR	0 09¾
X Empire	0 09
X Press	0 08¼
COLORED.	
Lion	0 07½
Standard	0 06¾
Popular	0 06
Keen	0 05½
WOOL PACKING.	
Arrow	0 16
Axle	0 11
Anvil	0 08
Anchor	0 07
WASHED WIPERS.	
Select White	0 08½
Mixed Colored	0 06¼
Dark Colored	0 05¼

This list subject to trade discount for quantity.

BELTING RUBBER.

Standard	50%
Best grades	30%

BELTING—NO. 1 OAK TANNED.

Extra heavy, sgle. and dble.	50%
Standard	50 & 10%
Cut leather lacing, No. 1	$1.20
Leather in sides	1.10

ELECTRIC WELD COIL CHAIN B.B.

3-16 in.	$9.00
¼ in.	6.25
5-16 in.	4.65
⅜ in.	4.00
7-16 in.	4.00
½ in.	4.00

Prices per 100 lbs.

PLATING CHEMICALS.

Acid, boracic	$ .15
Acid, hydrochloric	.05
Acid, hydrofluoric	.06
Acid, Nitric	.10
Acid, sulphuric	.05
Ammonia, aqua	.08
Ammonium carbonate	.15
Ammonium chloride	.11
Ammonium hydrosulphuret	.35
Ammonium sulphate	.07
Arsenic, white	.10
Copper sulphate	.10
Cyanide of potassium (95 to 96%)	.35
Iron perchloride	.20
Lead acetate	.16
Nickel ammonium sulphate	.10
Nickel carbonate	.50
Nickel sulphate	.20
Potassium carbonate	.40
Potassium sulphide	.30
Silver chloride (per oz.)	.65
Silver nitrate (per oz.)	.45
Sodium bisulphite	.10
Sodium carbonate crystals	.04
Sodium cyanide	.35
Sodium hydrate	.04
Sodium hyposulphite (per 100 lbs.)	3.00
Sodium phosphate	.14
Tin chloride	.45
Zinc chloride	.20
Zinc sulphate	.08

Prices Per Lb. Unless Otherwise Stated.

ANODES.

Nickel	.47 to .52
Cobalt	1.75 to 2.00
Copper	.25 to .28
Tin	.45 to .50
Silver	.55 to .60
Zinc	.30 to .33

Prices Per Lb.

PLATING SUPPLIES.

Polishing wheels, felt	1.50 to 1.75
Polishing wheels, bullneck	.80
Emery in kegs	.4½ to .06
Pumice, ground	.05
Emery glue	.15 to .20
Tripoli composition	.04 to .06
Crocus composition	.04 to .06
Emery composition	.05 to .07
Rouge, silver	.25 to .50
Rouge, nickel and brass	.15 to .25

Prices Per Lb.

The General Market Conditions and Tendencies

This section sets forth the views and observations of men qualified to judge the outlook and with whom we are in close touch through provincial correspondents

Montreal, Que., Aug. 30, 1915.—There is a firmer tone in the metal market, due to the fact that the demand is increasing without definite assurances of increased supplies. A general increase of $1 a ton is announced on pig iron and an increase of $1 a hundred on spelter. The demand for pig iron is fairly quiet, there being supplies available for all requirements.

High Speed Steel.

The high speed steel situation has reached a point that is looked upon by many as serious. It is becoming daily more difficult for dealers to fill orders, although some firms are fortunate in having a fairly large stock on hand. The representatives of one British firm are feeling very optimistic over the fact that they have a shipment on the ocean which will be due here shortly, but in this respect they seem to be entirely alone. It is freely prophesied that owing to the embargo against shipping steel from the Old Country containing tungsten or molybdenum the high speed steel situation here will become more and more acute, and two dollars a pound steel is looked for at a quite early date. In some cases larger-sized bars and unusual sizes have been re-rolled, but the amount of this additional supply of stock will not affect the situation to any extent. It would be wise for manufacturers to look into the future a little as far as their stock of high speed steel is concerned, and assure themselves that they will not have to suspend operations owing to the possible inability of securing a suitable supply.

A notable feature at present is that antimony which has been quoted around 40 cents has been steadily declining. There is little British antimony on the market, but recently it has become apparent that it is possible to secure fairly large quantities of Chinese and Japanese material. While 30 cents has been the figure quoted in the United States, this is even shaded at present by Montreal dealers. Another factor is also apparently affecting the situation, it being rumored that shrapnel bullets will be made in the near future without the use of antimony. A gentleman in close connection with the Government informed your representative that shrapnel bullets which were being tested by the Government were apparently giving most satisfactory results, and if these are adopted, the use of antimony will be eliminated from the manufacture of shrapnel shells altogether. This will have a tendency to depress the market still further. British antimony is scarce at 40 cents a pound, and Chinese and Japanese is quoted at from 27 to 29 cents.

Machine Tools and Supplies.

A striking indication of the scarcity of machine tools is illustrated by the fact that a Montreal firm have a large order for Canadian-made machine tools from Great Britain. Although they have made a special effort to fill it, so far they have been unable to get any quotations representing what would be considered a reasonable time for delivery. As far as the Montreal market is concerned, Canadian-made machine tools, except an occasional second-hand unit, are not to be had, and it is apparent that this condition will continue for some months to come. Some Montreal dealers are well supplied with second-hand tools, and a fair amount of new American machines; for these a good demand is reported.

ALLIES' PURCHASING AGENTS.

The Trade and Commerce Department, Ottawa, has published the following list of purchasing agents for military purposes for the allied Governments:—

International Purchasing Commission, India House, Kingsway, London, Eng.

French.—Hudson Bay Co., 56 McGill Street, Montreal; Captain Lafoulloux, Hotel Brevort, New York; Direction de l'Intendance Ministere de la Guerre, Bordeaux, France; M. De la Chaume, 28 Broadway, Westminster, London.

Russian.—Messrs. S. Ruperti and Alexsieff, care Military Attache, Russian Embassy, Washington, D.C.

Leather belting manufacturers report that the great scarcity of raw material has made it next to impossible to secure enough leather to enable them to fill orders. At the beginning of the war the saddlery manufacturers and boot and shoe dealers secured practically all the available stock, and in some instances were helped out by the leather belting manufacturers, who could now use large quantities to advantage, but are unable to secure same. There is demand for all kinds of small belting in connection with the manufacture of war munitions; in fact, this market is extremely active. The demand for small-sized belts is greater in Montreal than it has been for a great many years, and there seems no sign of a diminished activity along this line.

Toronto, Ont., Aug. 31.—It is generally believed that the British Government will continue to place orders for war equipment in Canada while the need lasts. The prospects for further improvement in business are therefore bright, more particularly with regard to the export trade. The indications point, especially in the West, to a heavy crop, which will have an exceedingly beneficial effect on business generally. There have been no developments of importance in the shell industry recently, but there appears to be little doubt that further orders will be placed, particularly for high explosive shells as soon as Canadian plants are in a position to turn out fixed ammunition. It is understood that David A. Thomas, the representative of the British Government, is favorably impressed with what he has seen during his investigations as to what can be done in Canada towards making shells.

With regard to domestic trade, conditions generally speaking are quiet, but considerably better than earlier in the year. The large increase in the export trade will no doubt in time have a stimulating effect in the domestic business. There has lately been a more active demand for agricultural implements and consequently a few iron foundries have been doing better business; the majority of plants, however, are feeling the effects of the depression. The building trade locally has picked up a little, but is still considerably below normal. Municipal work all over Canada has been very light this season on account of the difficulty in financing improvements.

Steel Market.

Conditions in the steel trade continue favorable, due to the increase in the export business and the large demand for bars and forgings for shells. The recent orders for railway cars have also created a demand for steel. It is announced that the Nova Scotia Steel & Coal Co. are working day and night on shell orders and are also making a large number of forgings for Clyde shipbuilders. Prices on all steel products are holding very firm although there are no changes to note this week.

The recent strength in the spelter market has had an unsettling effect on the sheet market, and prices are irregular. Following the decline in the spelter market, prices of sheets weakened, but are

now firmer, and some mills are refusing to quote for contract delivery because of the uncertainty of the price for spelter.

The high-speed tool steel situation shows no improvement and prices for the finer grades of tool steel have advanced again due to the increasing cost of tungsten and scarcity of supplies.

Conditions in the steel trade in the States continue very active. The heavy demand for steel rounds for shells is the leading feature, and specifications are coming in so fast that the mills are getting further behind on deliveries, notwithstanding the heavy shipments. Prices on bars and shapes are firmer, and some business is being done at 1.35c Pittsburgh.

Pig Iron.

Pig iron prices in the States have advanced in all markets, grey forge being now quoted at $14.45 Pittsburgh. The situation locally has not changed materially and the demand for foundry iron is light. Hamilton and Victoria brands are unchanged at $19.

Scrap Metals.

Prices on various scrap metals are unchanged with the exception of heavy melting steel, which has declined and is now quoted at $7; this is accounted for by an excess of supply over demand. Copper and brass scrap are in good demand and the market is firm.

Machine Tools.

There is no change in the situation, the demand for new tools is less active, but deliveries are no better. Prospective shell manufacturers are in many cases keeping out of the market until more orders for shells are distributed. Some firms already engaged in producing shells are buying tools from time to time to readjust their plants, or for extensions. There is a good demand for second-hand tools, and deliveries are better on this class of equipment, especially for lathes.

Supplies.

A brisk demand for small tools such as cutters, dies, taps, etc., is reported, and good business is being done in almost all lines of machine shop supplies. An advance in the prices of waste has been made, varying from ¼c to ¾c per pound. The new prices are given in the selected market quotations. The increased cost of raw stock is the reason for higher prices.

Metals.

The feature of the market this week is the recovery of spelter following heavy buying. Although there is a good demand, indications point to an attempt by sellers to advance the market. The tin market is unsettled with a weak tendency. The copper market is unsettled, and prices are slightly higher. Lead is stronger and aluminum are quiet and firm at unchanged quotations. There is a good demand for metal for munitions, but ordinary business is only moderate.

Tin.—The New York market is dull and unsettled with a weak tendency. This dullness is caused by the failure of the London market to advance in this metal in proportion to copper and spelter. Local quotations are unchanged at 19c per pound.

Copper.—The market is unsettled and the situation uncertain owing to prices being advanced for no apparent reason. Copper consumers have been out of the market for some time and a buying movement may follow as a result. The market has advanced ½c locally, and lake copper is being quoted at 19c per pound.

Spelter.—The market has re-acted and prices are higher, some large orders having been placed in New York for prompt and early delivery. The market is excited and indications point to manipulation. The advance is 3c locally at a nominal quotation of 19c per pound.

Lead.—The market is more active and lighter. The Trust has advanced their price to 4.90c New York. Locally lead has advanced ¼c and is quoted at 6¼c per pound.

Antimony.—The market is quiet but firm for future, and unsettled for spot delivery. Quotations are unchanged at 40c per pound.

Aluminum.—The market is quiet but firm and unchanged at 40c per pound.

CANADIAN GOVERNMENT PURCHASING COMMISSION.

The following gentlemen constitute the Commission appointed to make all purchases under the Dominion $100,000,000 war appropriation:—George Gault, Winnipeg; Henry Laporte, Montreal; A. E. Kemp, Toronto. Thomas Hilliard is secretary, and the commission headquarters are at Ottawa.

OCEAN TONNAGE SHORTAGE.

IT is said that an agreement has been reached between the Governments of Great Britain and Canada whereby the former will recognize the urgency of the situation and refrain as much as possible from commandeering ships that are needed for grain. So far as the ocean tonnage is concerned, however, the shortage is by no means so serious as has been claimed in some quarters; but while the passenger service has in some cases vanished, and in general has been reduced to a minimum, there has sprung up in its place a freight service that far surpasses any that Canada has owned in the past. The big liners have been replaced by large freighters.

Investigation has shown that at the present time the Cunard Company has four of these vessels, two of which have already visited the port of Montreal, although under changed names. This fact is also testified to by officials of Lloyds. In this way the absent passenger boats have to a considerable extent been replaced. That the available tonnage to carry grain will compare not altogether unfavorably with past years is illustrated by the fact that while the Victorian, one of the largest of the passenger boats (an Allan liner) could carry only about 4,000 tons of grain, the Monarch (one of the freighters replacing passenger ships) can accommodate between 8,000 and 9,000 tons. So, while the number of ships may be less, the carrying capacity will be much greater than has generally been believed.

MACHINE TOOL OPENING IN RUSSIA.

THE Department of Trade and Commerce, Ottawa is in receipt of a communication from the office of the High Commissioner for Canada at London, enclosing the name of an English firm, with connections in a number of the important centres of Europe, who desire to get into touch with a reliable Canadian merchant firm or manufacturing house to act as purchasing agents for machine tools and other plants. The firm in question has recently sold some machine tools to Russia for the manufacture of ammunition and have received additional inquiries for shell-making plant, but on account of the taking over of the English tool-makers by the English Government, it is not possible at present to offer English-made machines for some types of shells.

This English firm therefore would like to communicate with one large manufacturing house in Canada, which could supply the major part of the plant itself and get tenders for the remaining part, or else with a merchant house in Canada, who are thoroughly acquainted with the machine tool business and who could give them tenders for plant, getting the machines from the various manufacturers, with whom they are acquainted. Canadian firms, who may be interested in supplying the equipment that is asked for, will obtain the name and address of the firm in question, who are making the inquiry on behalf of their Russian clients, by applying to the Department of Trade and Commerce, Ottawa.

S. S. "ONTARIO NO. 2" TRIAL TRIP. CAR ferry Ontario No. 2, which will ply between Cobourg and Port Charlotte in connection with the Grand Trunk Railway, made her initial trip, the builders' trial, on Saturday, Aug. 28, with about 200 guests aboard. The behavior of the new vessel was most satisfactory in every respect. The Ontario No. 2 was built and engined in Toronto at the yards of the Polson Iron Works, Ltd.

The new ferry is 318 feet long; beam moulded 54 feet; depth to main deck, 20 ft. 6 in.; draft loaded, 16 ft. 3 in.; tonnage, 5,400; horse-power, 4,500. She has two propellers, each driven by a jet condensing triple-expansion engine having cylinders 20½ in., 30 in. and 54 in. by 36-in. stroke, and making 110 r.p.m. The boilers are Scotch type, four in number, each being 14 ft. diameter by 12 ft. long, and giving a working pressure of 180 lbs. per sq. in.

Captain F. D. Forrest, Commodore of the Ontario Car Company's fleet, was at the helm, and W. H. Smith, manager of the company, represented Vice-President Kelly of Chicago, who was unable to be present. The new ferry will go into commission on October 1, taking the place of the car ferry Ontario No. 1, which will be laid up for the winter.

The new vessel has accommodation for thirty cars, each carrying seventy tons, also accommodation for one thousand passengers. The guests were entertained to a buffet luncheon. A Boy Scouts' pipe band provided music as the visitors inspected the various sections of the new vessel. Upon the return of the ferry to her moorings at the Polson Iron Works, Ltd., yards, a vote of thanks was tendered Col. J. B. Miller, president and general manager of the latter company.

Guests.

Among those on board, which included a large number of ladies, were: Col. J. B. Miller, W. H. Smith, J. W. Griemer, fleet engineer of the Ontario Car Ferry Co., and W. F. Crawford, the chief steward; Captain Harry Polson; William Newman, naval architect and works manager of the Polson Company, who superintended the construction of the new vessel; A. H. Jeffrey, A. E. Matthews, Captain W. J. Bassett, J. T. Mathews, Captain M. Corcoran, Mayor Church, Alderman Ramsden, Alderman Ryding, J. W. Somers, George Stevenson, Captain Evans, John Dodds; H. E. Wittenberg, General Superintendent, G. T. R.; W. H. Farrell, Superintendent of G. T. R. Terminals; E. C. Horning, District Passenger Agent, G. T. R.; Edmund Bristol, M.P.; W. C. Seeley, Master Mechanic of the Middle Division, G. T. R.; J. R. Leckie, Assistant Master Mechanic, G. T. R.; W. S. Wilson, Superintendent of Transportation, G. T. R.; W. Hamilton, L. Grabbel, Assistant General Baggage Agent, G. T. R.; J. D. O'Connor, J. W. McClintock, James Stewart, ex-Alderman James McCausland, Frank Ryding, Jack Edmunds, A. G. Webster, "Marine Engineering of Canada," etc.

INDUSTRIAL AND CONSTRUCTION NEWS

Establishment or Enlargement of Factories, Mills, Power Plants, Etc.; Construction of Railways, Bridges, Etc.; Municipal Undertakings; Mining News.

Engineering

Embro, Ont.—H. McDonald will establish a general blacksmith shop here.

Brampton, Ont.—The Pease Foundry has received an additional order for shells.

Ridgeville, Ont.—The Chippewa Gas Co. propose to lay gas mains from Cayuga to St. Catharines.

Ottawa, Ont.—The Russell Natural Gas & Oil Co. is in the market for drilling equipment and pumps.

Calgary, Alta.—The Canadian Western Foundry & Supply Co., with plants in Alberta cities, have received a large order for shells.

Brantford, Ont.—A building permit has been issued to the Brantford Emery Wheel Co. for a $1,500 brick addition to their factory here.

Wingham, Ont.—Owing to increased business, the Western Foundry Co. expects to recommence operations in the new portion of their plant.

London, Ont.—The Wortman & Ward Co. will build an addition to its factory to cost $20,000. The company manufactures iron force and lift pumps, etc.

Welland, Ont.—It is reported that the Electric Steel & Metals, Ltd., are considering building an extension to their plant and installing another furnace.

St. Mary's, Ont.—Additions will be made to the plant of the Thames Quarry Co. A new crusher building, 30 x 60 ft., will be built and new machinery installed.

Lake Megantic, Que.—P. H. Renaud is preparing plans for the erection of a pulp mill. New machinery, including "Baker" cut-off saws, a 70-h.p. engine, etc., will be required.

Nelson, B.C.—The Ivanhoe concentrator at Sandon, B.C., was totally destroyed by fire on Aug. 30. The plant, valued at about $50,000, was treating ore from the Lucky Jim and Surprise mines.

Municipal

Brandon, Man.—The City Council has authorized the extension of the street lighting system.

Beeton, Ont.—The town council contemplate the purchase of boiler and power house equipment.

Guelph, Ont.—The city council will take immediate steps to secure a pulmotor, which will be placed at the fire-hall.

Oshawa, Ont.—The town council have passed the first reading of a by-law dealing with the steel plant which it is proposed to establish here.

Petrolea, Ont.—The town council has ordered the Hydro-Electric Power Commission to proceed with the construction of an entirely new outfit for the distribution of the hydro light and power.

Sudbury, Ont.—The town council have given permission for the Sudbury and Copper Cliff Suburban Electric Railway Co. to install an electric generating unit in the civic waterworks pumping station.

New Toronto, Ont.—The town will extend its intake 350 feet farther out in the lake, where the water is 25 feet deep. Upon the recommendation of Engineer E. A. James, a tender to do the work for $5,000 was accepted.

Brockville, Ont.—Work is progressing favorably on the preliminary operations necessary for laying the new intake pipe for the Waterworks Department. The Donnelly Wrecking Co., of Kingston, Ont., are the contractors.

Prince George, B.C.—The ratepayers of this city passed four money by-laws as follows:—$80,000 on waterworks; $45,000 on electric light and power system; $15,000 on street improvements, and $10,000 on a city hall.

St. Catharines, Ont.—The ratepayers of St. Catharines will on September 21 vote upon a by-law to grant a franchise to the Relief Natural Gas Co., composed of local capitalists, for the supply of gas to the civic gas plant system.

Moose Jaw, Sask.—The council has decided to purchase from the Turbine Equipment Co., of Toronto, a new electrically-driven pump. The pump is to have a capacity of 700 Imperial gallons per minute, and is for use in pumping crude sewage at the disposal plant.

Markham, Ont.—The village council has decided to install new water mains in the village, also a new tank and collecting basin. The tank is to be 150 feet high and the capacity will be 60,000 Imperial gallons. This new scheme, it is estimated, will cost slightly under $15,000.

Berlin, Ont.—Plans for extension of Berlin's sewage disposal plant have been approved by the Provincial Board of Health. They were prepared by Engineer W. Chapman, of Toronto, and it is expected that when the work is completed the city sewage disposal problem will be solved for some years to come. The cost of the extension will be about $75,000.

Markham, Ont.—At a special meeting of the village council held on Aug. 27, it was decided to submit a by-law to the ratepayers, authorizing the raising of $20,000 for the construction and installation of a modern waterworks system, for both domestic and fire protection purposes. The measure will be given its first reading on Wednesday next, and the vote will be held on October 2nd.

Petrolea, Ont.—The town council on Aug. 23 ordered the Hydro Commission to proceed with the construction of an entirely new outfit for the distribution of the incoming hydro light and power. This action followed the expiry of the time set in which the Petrolea Co. had the option of selling to the town its plant for $15,000. The council turned down the proposed compromise of $16,200 offered by the company.

Weston, Ont.—Providing the Etobicoke Township Council will guarantee sufficient private contracts to secure the Weston Water, Power and Light Commission financially, the latter are quite willing to proceed with the proposed Hydro extension to Thistletown according to their decision at a special meeting held on Aug. 24. The linking up of Thistletown with the local system will involve an expenditure of about $3,200.

Electrical

Granton, Ont.—The vote on the hydro by-law will be taken on September 28, and there seems no doubt that it will pass by a large majority.

St. Thomas, Ont.—The local Hydro-Electric Commission has purchased the property at the corner of Gas and St. Catharine streets for $3,000, and will erect a modern power-house and transmission station. Plans and specifications for this structure are now being prepared by the Provincial Commission.

Trade Gossip

Hespeler, Ont.—The employees of A. B. Jardine & Co. have contributed over $100 towards the purchase of a machine gun.

The Canada Forge Co. and Canadian Billings & Spencer Co. employees and officials have raised $1,000 for a machine gun.

Owen Sound, Ont.—The Northern Bolt & Screw Co. have taken over the Dominion Bolt Co. of West Toronto and will remove the machinery here.

The Cleveland-Sarnia Sawmills have now in their booms in Sarnia Bay, Ont., about 12,000,000 board feet of logs, which are to be sawn up this fall and winter.

The Canadian Fairbanks-Morse Co., Montreal, have been awarded the contract for the conveying machinery for the addition to the No. 1 elevator for the Montreal Harbor Commission.

Windsor, Ont.—The Windsor Industrial Bureau was organized on Aug. 19 in the Board of Trade rooms. Ald. Winter was chosen chairman and T. C. Ray will be the secretary-treasurer. The Board of Trade has raised $960 in subscriptions so far.

The Boving Hydraulic and Engineering Co., Ltd., has been reorganized with the following directorate:—President, Major R. W. Leonard; vice-president, Wm. Flavelle; secretary-treas., T. H. Stinson; directors, Alex. Longwell, Sydney B. Kendall, W. K. George, Jens Orton, Boving, London, England.

Montreal, Que.—Bondholders of the Canadian Cereal and Milling Co. met here on Aug. 26 and decided upon definite plans of reorganization. It was decided to apply to Ottawa for incorporation papers and to organize a new company, which will start with a bond issue of $300,000 and a common stock issue of about $500,000.

The Canadian Locomotive Co., Kingston, Ont., are working on orders for thirty large locomotives for the Russian Government. Russia is thoroughly re-organizing its railway system, which will involve a standardizing of roads, and this will facilitate the filling of later orders by Canadian concerns. The Canadian Locomotive is also filling orders for the Federal Government.

Hamilton, Ont.—In addition to the 400-foot extension to the plant of the Steel Company of Canada, in which have been installed a number of presses for making shells, the company is at work now on a new open hearth furnace for the purpose of supplying raw material for shell making. This new departure will enable the company to secure a primary profit in addition to that of mere assembling of shells.

The Canada Steamship Lines have about twenty per cent. of their vessels serving on the ocean traffic at the present time. While the passenger business of the company, taken altogether, has not been quite up to normal this season, revenue from ocean freight traffic has been substantial. Lake freight rates are high this season, and traffic from the west will be a paying proposition. It is stated that after the interlake season closes a considerable proportion more of the freighter fleet will be transferred to the ocean trade, and in this way a revenue will be maintained during some four months that is usually a blank on the company's books.

General Industrial

London, Ont.—Beatty Bros. will build an addition to their factory to cost $3,000.

Ridgetown, Ont.—D. P. McNorgan of London, Ont., contemplates erecting a flour and grist mill here.

St. Marys, Ont.—William Weir has bought the old Brown Milling Co. property and will convert it into a knitting mill.

Hamilton, Ont.—The Frost Wire Fence Co. will build an addition to their factory. G. E. Mills is the general contractor.

East Toronto, Ont.—One thousand dollars damage was done by a fire which broke out in the drying plant of the Chapman Brock Co., Dawes Road, on August 30.

Vancouver, B.C.—The W. H. Malkin Co. will build a factory. Machinery for the manufacture of food products, etc., will be required.

Parry Sound, Ont.—A fire caused by lightning destroyed two drying houses at the Canadian Explosive Co. plant here on Aug. 24.

Montreal, Que.—C. H. Johnson & Sons, Ltd., will build an addition to its factory to cost $3,000. The company manufactures wire guards for machinery and other wire goods.

Railways-Bridges

Hamilton, Ont.—A hydro-radial line to St. Catharines and intermediate points is projected.

Three Rivers, Que.—Operations have commenced on the construction of a

street railway. The Three Rivers Traction Co. are the owners.

Guelph, Ont.—The Toronto Suburban Railway have almost completed the new electric railway from Toronto to Guelph. Some overhead construction has still to be finished at this end.

Trenton, Ont.—The council will probably submit a by-law shortly for the purpose of authorizing an issue of debentures for $40,000 to cover the town's share of a new bridge. The total cost is estimated at $127,183, the Government paying the balance.

Windsor, Ont.—Plans for a $45,000 bridge on Wyandotte Street, across the M. C. R. tracks, have been approved of by the city council, and the city solicitor has been instructed to make application to the Dominion Railway Board for an order directing the work to be done.

Winnipeg, Man.—The laying of steel on the twenty-five miles of grade east of Foremost, Alta., on what will ultimately be known as the Lethbridge-Weyburn branch of the Canadian Pacific Railway will be started immediately, it has been announced. It is the intention of the company to rush the work to completion as fast as possible.

Refrigeration

Amherstburg, Ont.—The Falls Barron Co. will build a cold storage plant to cost $10,000.

Victoria, B.C.—The establishment of a public abattoir is being considered by the city council. Estimated cost of plant is $20,000.

Amherstburg, Ont.—The erection of a cold storage plant, at an estimated cost of $10,000, is contemplated by the Falls Barron Co. of this town.

St. Thomas, Ont.—The St. Thomas Packing Co., Ltd., may rebuild a portion of their plant, which was recently destroyed by fire. General Manager, J. Moody.

Tenders

Tavistock, Ont.—Tenders will be called at once for the erection of a distribution station in Tavistock for hydro-electric power.

Winnipeg, Man.—Tenders are now being called for the construction of a bridge at Headingly, to be built by the municipality of Assiniboia, with assistance under the Good Roads Act.

Toronto, Ont.—Tenders will be received up to Tuesday, September 7th, 1915, for constructing radial brick chimney for incinerating plant on Don Roadway. Specifications and form of tender may be obtained at Street Commissioner's Office.

Regina, Sask.—Tenders will be received by the City Commissioners up till Monday, September 6, 1915, for the supply, delivery and erection of a 7,000,000-gallon pumping unit at the city power house. Specifications and other information may be obtained from J. M. MacKay, superintendent of waterworks, Regina, Sask.

Quebec, Que.—Tenders for storage dam at the outlet of Lake St. Francis will be received at the office of the Quebec Streams Commission, Room 264, Parliament Buildings, Quebec, until Tuesday, September 7, 1915. Plans and specifications can be seen at the above office or at the Quebec Streams Commission's office, Room 803, McGill Building, Montreal.

Berlin, Ont.—Tenders will be received by the City Clerk until Tuesday, September 7th, 1915, for the construction of sewage disposal works, comprising tanks, filters, sludge beds and pumping station. Plans and specifications may be seen at the office of the Consulting Engineers, Chipman & Power, 204 Mail Building, Toronto, also at the City Engineer's Office, Berlin.

Toronto, Ont.—Tenders for underground work, addressed to the Chairman of Toronto Electrical Commissioners, will be received until Tuesday, Sept. 7. Details of work to be performed consisting of laying cable ducts, building manholes and transformer vaults. Plans specifications and form of tender may be obtained at the Purchasing and Engineering Dept., 15 Wilton avenue.

Ottawa, Ont.—Tenders will be received at this office until Wednesday, September 8, 1915, for the construction of station, water tank, engine-house, transfer platform, standpipe pit, ash pit and turntable foundations for the Carleton Point Car Ferry Terminal, Prince Edward Island. Plans, specifications, and form of tender may be obtained from the chief engineer, Department of Railways and Canals, Ottawa; the chief engineer, Canadian Government Railways, Moncton, N.B.; and the engineer in charge, Car Ferry Terminals, Carleton Point, P.E.I.

Personal

R. A. Spawton, of Halifax, N. S., is to be appointed purchasing agent of the Department of Marine and Fisheries at Halifax.

P. J. Flynn, present manager of the Winnipeg joint terminals, has been ap-

pointed superintendent at Winnipeg for the Canadian Northern Railway.

W. J. Doherty has resigned the position of general sales manager of the Northern Electric Co., Montreal, with a view to going into business in Chicago.

John McMillan, formerly manager of the Ontario factory of L'Air Liquide Society, Paris, France, is now handling the oxygen department of Lever Brothers, Ltd., Toronto.

Major C. N. Monsarratt, who is chief of the board of engineers of the Quebec Bridge, has succeeded Lieut.-Col. J. G. Ross as officer commanding the 5th Royal Highlanders of Canada.

Thomas R. Hilyard, surviving member of the original firm of Hilyard Brothers, shipbuilders and mill owners of St. John, N.B., died at his residence on Douglas avenue on Aug. 19. Mr. Hilyard was in his 74th year.

F. W. Wegenast, barrister, announces that he has severed his official connection with the Canadian Manufacturers' Association, and has opened an office for consultation and general practice at 901 Traders Bank Building, Toronto.

Hon. Frank Cochrane, Minister of Railways, leaves on the 5th of September for a tour of inspection of the Transcontinental and Grand Trunk Pacific Railways. It is expected that Mr. Cochrane will go through to the coast.

John A. Carrick of Port Arthur, and at one time assistant general manager of the Queen City Oil Co., died in Toronto on Aug. 24. Mr. Carrick was the father of Lieut.-Col. J. J. Carrick, M.P., of the headquarters staff of the Canadian Expeditionary Force.

William Leach, president and manager of the Leach Concrete Co., Toronto, died at his home, 353 Palmerston Boulevard, on August 27. He was in his 48th year. Deceased was born in London, Eng., and had lived in Toronto for 35 years, establishing the business fifteen years ago.

A. B. Stanbury, who has been measuring surveyor of shipping for the Port of Toronto since 1908, has resigned. William Evans, inspector of hulls and equipment; John Dodds, James B. Stewart and George M. Arnold, inspectors of boilers and machinery, all of Toronto, have been appointed as officers to superintend the survey and measurement of ships and surveyors of accommodation for seamen at the Port of Toronto.

R. W. ASHCROFT HONORED

A NUMBER of American manufacturers, such as the Winchester Repeating Arms Co., the Yale & Towne Mfg. Co., Berry Brothers, Ltd., L. S. Starrett & Co., and thirty-six others, who are members of an organization known as the Rice Leaders of the World Association, have conferred a high honor on one of Montreal's business men.

Somewhat over a year ago, they offered nearly $3,500 cash prizes for ideas and suggestions. This was open to anybody, and the ideas and suggestions could relate to production, sales, advertising or anything else.

The object of the offer was to develop suggestions that would tend to improve the methods or products of these American manufacturers.

But one idea could be submitted to each manufacturer, no two ideas could

R. W. ASHCROFT.
Manager of publicity for the Canadian Consolidated Rubber Co., Limited.

be alike, and each idea had to be compressed into fifty words.

Thousands of Americans entered the contest, together with a few Canadians, Britishers and others, and the Second Prize of $500 cash has been won by a Canadian, R. W. Ashcroft, of Montreal, who is manager of publicity for the Canadian Consolidated Rubber Co., Limited, and Associated Companies.

In presenting the prize, Elwood E. Rice, president of the association, wrote Mr. Ashcroft as follows:

"To have earned this second prize in this international competition where people in all walks of life from all parts of the world entered, is cer-

tainly a great evidence of your unusual ability, and in which you are indeed justified in taking exceptional pride.

"I extend to you my best wishes for the continued success your able efforts so richly deserve."

This is not only a feather in Mr. Ashcroft's cap, but is also a compliment to the business ability of Canadians, particularly in view of the fact that Mr. Ashcroft only heard of the contest a few weeks before it closed last May, and therefore had but very little time in which to compile and submit his ideas.

No special publicity was given to the contest in Canada, so those resident in the United States, who had a whole year in which to evolve ideas, naturally had a better opportunity than Canadians to successfully compete.

Contracts Awarded

Brampton, Ont.—The Copeland-Chatterson Co. have let the contract for an addition to their factory to Hill & McCulloch.

Renfrew, Ont.—The Renfrew Electric Co. recently received a large order from the Northern Electric Co., which hitherto had been buying these particular goods from an American concern.

Montreal, Que.—The contract for the structural steel for the addition to No. 1 elevator for the Harbor Commission has been let to the Dominion Bridge Co., Lachine, Que.

The Canadian Brakeshoe Co., of Sherbrooke, Que., have placed an order for the installation of a Snyder electric furnace for the melting of steel. The steel will be used for the manufacture of 4 in. rounds to be forged into shells for the British Government. The Snyder electric furnace is being installed under guarantee as to operating cost. These furnaces are built by the Snyder Electric Furnace Co., Chicago, Ill.

Wood-Working

Matsqui, B.C.—T. Z. Smith will build a factory for the manufacture of boxes.

Sidney, N.S.—Wrights, Ltd., will build a furniture factory to cost $25,000.

Petrolia, Ont.—R. D. Hall will build a factory for the manufacture of gates and woodenware of all kinds.

Montreal, Que.—H. A. Brochu, 294 St. Catherine street, east, is asking information and prices on wood-working machinery, etc.

Bishops' Falls, Nfld.—The Albert F. Reed Co. plans the erection of a factory for the manufacture of wood pulp, lumber, timber, etc.

Classified Advertisements

¶ Those who wish to sell or buy a business, obtain competent help, connect with satisfactory positions, or secure aid in starting new enterprises, should not fail to use the Want Ad Page of "CANADIAN MACHINERY."

ONE DOUBLE END PUNCH AND SHEARS, 22" throat, about 7,000 lbs. This is new; punched one bridge, $700.00; also one 9" throat punch, ½" A. Dick & Sons, Alton, Ont.

WANTED—DRAWINGS OR BLUE PRINTS of turrets suitable to go on carriages and also on shears of 14", 16", 18" and 20" engine lathe. Box 154, Canadian Machinery.

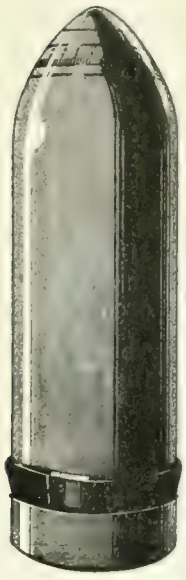
Bury, Que.—**L. H. Martin,** whose sawmill was recently destroyed by fire, with a loss of $8,000, will rebuild and will be in the market for new machinery.

Catalogues

Norton Ball Bearing Jack made by A. E. Norton, Ltd., Coaticook, Que. Catalogue No. 28 describes a complete line featuring the various types of ball-bearing jacks. Tables give the principal dimensions, weight and list price of each size, and are accompanied by illustrations of the different types and repair parts. Interested readers may obtain copies by writing the company.

Link-Belt and Sprocket Wheels.—The Link-Belt Co., Philadelphia, Pa., are distributing Section A of general catalogue No. 110, dealing with the original "Ewart" detachable link-belt and sprocket wheels. A large number of full-size cuts are shown of standard and special sizes of "Ewart" link-belts and a number of attachments are also illustrated. The catalogue also contains a brief description and price list of attachments, also price lists of sprocket wheels and "Ewart" detachable link-belts.

Betson's Plastic Fire Brick for one-piece boiler furnace linings is the title of a 20-page booklet being distributed. The Betson Plastic Fire Brick Co. Rome, N.Y., make this material. The booklet tells how to construct a solid gas-tight, one-piece boiler furnace lining throughout from this plastic refractory material without the use of any special tools. It gives directions for the testing of boiler settings for air leaks, and for the immediate repair, without shut-down, of cracks and holes, to preserve the life of ordinary brick linings to the time when they can be replaced. Illustrations and diagrams show the one-piece lining as applied to the several types of boilers in general use. Copies of this book will be sent on request to those concerned with the management of boilers.



HYDRAULIC
BANDING AND NOSING
PRESSES

FOR SHRAPNEL AND LYDDITE SHELLS

Illustration No. 1,

The Goldie & McCulloch Banding Press.

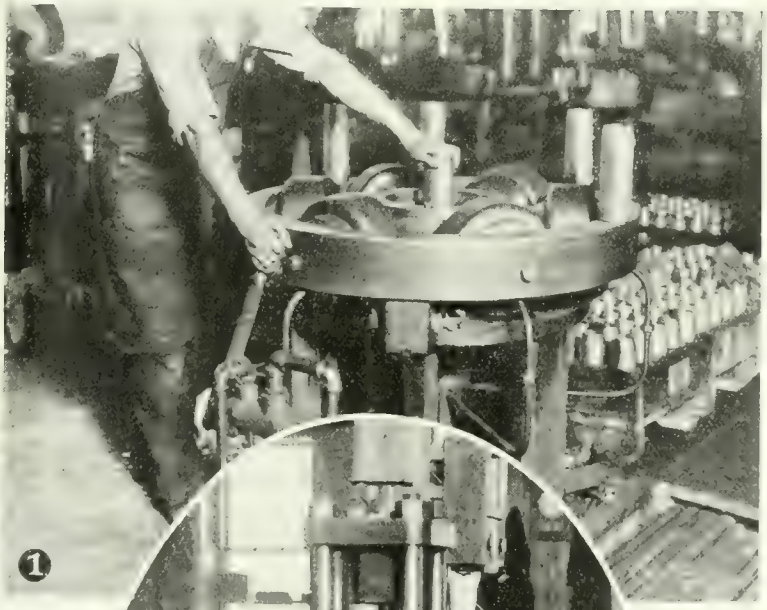
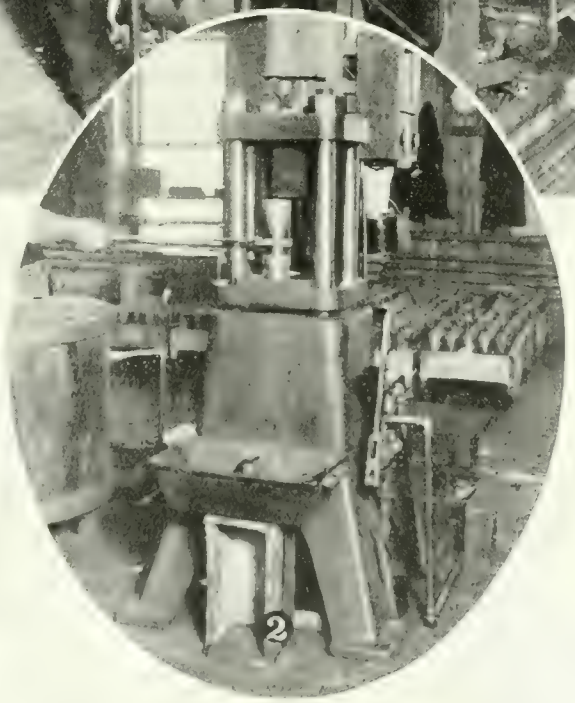


Illustration No. 2,

The Goldie & McCulloch Nosing Press.



MADE FROM THE BEST GRADE OF MATERIAL, AND EVERY STEP IN THEIR MANUFACTURE IS WATCHED WITH GREAT SCRUTINY TO ASSURE THE HIGHEST DEGREE OF EFFICIENCY, ACCURACY AND DURABILITY.

USED IN QUITE A NUMBER OF SHOPS IN CANADA, AND ARE GIVING HIGHEST SATISFACTION. DROP US A LINE FOR INFORMATION REGARDING THE NECESSARY HYDRAULIC EQUIPMENT FOR OPERATING THESE MACHINES.

The GOLDIE & McCULLOCH CO., Limited

Head Office and Works: GALT, ONTARIO, CANADA

Toronto Office: Suite 1101-2, Traders Bank Bldg.

Quebec Agents: Ross & Greig, 412 St. James St., Montreal, Que.

Western Branch: 248 McDermott Ave., Winnipeg, Man.

British Columbia Agents: Robt. Hamilton & Co., Vancouver, B.C.

Builders of High-Grade Power Equipment, Steam Engines, Turbines, Water Tube and Return Tubular Boilers and Transmission Machinery

If what you want is not advertised in th is issue consult the Buyers' Directory at the back.

HINTS TO BUYERS

IS YOUR RIVETING PROFITABLY DONE?

Our Elastic Rotary Blow Riveting Machine does profitable work, because one machine will do the work of several hand riveters, and do it better.

Every head is perfectly formed, any shape, round, flat, oval, rectangular, etc.

Catalogue C tells more about it.

The F. B. SHUSTER COMPANY
New Haven, Conn.

Formerly John Adt & Son. Established 1866

Also makers of Wire Straighteners and Cutter, Cotter Pin Machines, etc.

THE DUPONT
Patent
Power Hammer

BEST FOR Durability, Economy of Power, Simplicity of Adjustment.

Seven Sizes
from 35 to 300 lbs.

Only High-Class Material Used and Satisfaction Guaranteed.

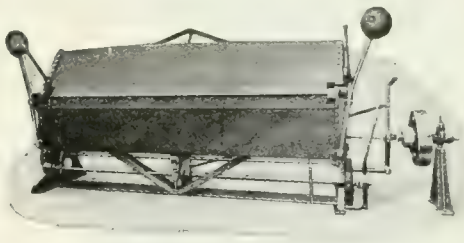
ASK FOR CATALOGUE.
SENT FREE

The PLESSISVILLE FOUNDRY
Plessisville, Que.

Ontario and Western Agents:
The General Supply Co. of Canada Ltd.
Ottawa Toronto Winnipeg

Chicago Steel Bending Brakes

We are exclusive Manufacturers of Steel Bending Brakes, and our product shows it.



10 ft. for 10 Ga.

Only about three horse-power is required to operate this brake full capacity.

Catalog giving full description mailed upon request.

The Steel Bending Brake Works, Ltd., Chatham, Ontario

Allen
Safety Set Screws

Any length, point or thread. We make a specialty of short lengths.

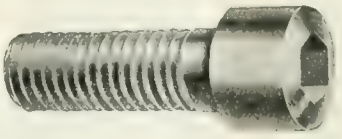
ALLEN SOCKET CAP SCREWS

are very neat in appearance and exceedingly strong.

Send for circular No. 3 and free sample screws.

The ALLEN MFG. CO.
Hartford, Conn.

173 Princess St., Manchester, England



Genuine Armstrong Stocks and Dies

Hinged Pipe Vises.
Pipe Cutters. Steam and Gas Fitters' Tools.
Pipe Machines for Threading Pipe.
Either Hand or Power.

Manufactured by

THE ARMSTRONG M'F'G CO.

328 KNOWLTON ST. BRIDGEPORT, CONN.
NEW YORK, 248 CANAL ST.

The Garvin Machine Co.

Manufacturers of

Milling Machines; Profiling Machines; Cam Cutting Machines; Screw Machines; Monitor Lathes; Die Slotting Machines; Screw Slotters; Tapping Machines; Duplex Horizontal Drills; Gang Drill Presses; Four-Head Right-Angle Drills; Wrenchless Chucks; Spring Coilers; Cutter Grinding Machines; Surface Grinders; Hole Grinders; Hand Lathes and Special Machinery.

We Want All To Have Our Catalog—Send For It To-day.

Spring and Varick Streets NEW YORK CITY

The advertiser would like to know where you saw his advertisement—tell him.

CANADIAN MACHINERY BUYERS' DIRECTORY

TO OUR READERS—Use this directory when seeking to buy any machinery or power equipment. You will often get information that will save you money.

TO OUR ADVERTISERS—Send in your name for insertion under the headings of the lines you make or sell.

TO NON-ADVERTISERS—A rate of $5 per line a year is charged non-advertisers.

Abrasive Materials.
Can. Fairbanks-Morse Co., Montreal.
Carborundum Co., Niagara Falls, N.Y.
Canadian Hart Wheels, Ltd., Hamilton, Ont.
Ford-Smith Machine Co., Hamilton, Ont.
Gardner Machine Co., Beloit, Wis.
Norton Co., Worcester, Mass.
Stevens, F. B., Detroit, Mich.

Acetylene.
L'Air Liquide Society, Montreal, Toronto.
Lever Bros., Toronto.

Acetylene Generators.
L'Air Liquide Society, Montreal, Toronto.
Lever Bros., Toronto.

Accumulators, Hydraulic.
Can. Foundry & Boiler Press Co., Montreal.
Charles F. Elmes Eng. Wks., Chicago.
Mesta Machine Co., Pittsburg, Pa.
Wm. R. Perrin Co., Toronto.
Wm. Tod Company, Youngstown, O.
Watson-Stillman Co., Aldene, N.J.

Air Compressors.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
Cleveland Pneumatic Tool Co. of Canada, Toronto.
Curtis Pneumatic Machinery Co., St. Louis, Mo.
Smart-Turner Machine Co., Hamilton, Ont.

Air Hoists.
Whiting Foundry Equipment Co., Harvey, Ill.

Air Hose.
Can. H. W. Johns-Manville Co., Limited, Toronto.
Cleveland Pneumatic Tool Co. of Canada, Toronto.
Can. Ingersoll-Rand Co., Montreal.

Air Receivers.
Can. Ingersoll-Rand Co., Montreal.

Air Washers.
Buffalo Forge Co., Buffalo, N.Y.
Can. Sirocco Co., Ltd., Windsor, Ont.

Ammeters.
Can. H. W. Johns-Manville Co., Limited, Toronto.

Aluminum.
Tallman Brass & Metal Co., Hamilton.

Alloys, Steel.
H. A. Drury Co., Ltd., Montreal
Hawkridge Bros. Co., Boston, Mass.
Vanadium Alloys Steel Co., Pittsburg, Pa.
Vulcan Crucible Steel Co., Aliquippa, Pa.

Annunciator Systems.
Lintz-Porter Co., Toronto.

Arbors.
Can. Fairbanks-Morse Co., Montreal.
Cleveland Twist Drill Co., Cleveland.
Morse Twist Drill and Machine Co., New Bedford.
Plessisville Foundry, Plessisville, Que.
Pratt & Whitney Co., Dundas, Ont.

Assembling Stands.
Skinner Chuck Co., New Britain Conn.

Automatic Chucks.
Garvin Machine Co., New York.

Asbestos Packing.
Can. H. W. Johns-Manville Co., Limited, Toronto.

Autogenous Welding and Cutting Plants.
L'Air Liquide Society, Montreal, Toronto.
Lever Bros., Toronto.

Automatic Index Milling Machines.
Garvin Machine Co., New York.
National Machinery and Supply Co., Hamilton.

Automatic Machinery.
Baird Machine Co., Bridgeport, Conn.
A. R. Williams Machy. Co., Toronto.
Gardiner, Robt. & Son, Montreal.
Girard Machine & Tool Co., Philadelphia, Pa.
Motch & Merryweather Machy. Co., Cleveland, O.
National Machinery & Supply Co., Hamilton.
Pratt & Whitney Co., Dundas, Ont.
Owen Sound Iron Works Co., Owen Sound.
Windsor Machine Co., Windsor, Vt.

Automatic Multiple Spindle.
Windsor Machine Co., Windsor, Vt.

Automatic Wood Screw Machines.
Asa F. Cook Co.

Axle Cutters.
Butterfield & Co., Rock Island, Que.
A. B. Jardine & Co., Hespeler, Ont.

Babbitt Metal.
Can. Fairbanks-Morse Co., Montreal.
Hoyt Metal Co., Toronto.
Magnolia Metal Co., Montreal.
Tallman Brass & Metal Co., Hamilton.

Baking Ovens.
Oven Equipment & Mfg. Co., New Haven, Conn.
Owen Sound Iron Works Co., Owen Sound.

Ball Bearings.
Can. Fairbanks-Morse Co., Montreal.
Chapman Double Ball Bearing Company, Toronto.

Ball Burnishing Machines.
Baird Machine Co., Bridgeport, Conn.

Banding Machines, Hydraulic.
West Tire Setter Co., Rochester, N.Y.

Barrels, Steel Shop.
Baird Machine Co., Bridgeport, Conn.
Cleveland Wire Spring Co., Cleveland.

Bars, Boring.
Charles F. Elmes Eng. Works, Chicago
Niles-Bement-Pond Co., New York.
Owen Sound Iron Works Co., Owen Sound.

Bar Benders and Straight Edges.
Steel Bending Brake Works, Ltd., Chatham, Ont.

Bar Benders, Hydraulic.
Charles F. Elmes Eng. Works, Chicago
Watson-Stillman Co., Aldene, N.J.

Bar Twisting Machines.
Mesta Machine Co., Pittsburg, Pa.

Batteries and Accessories.
Lintz-Porter Co., Toronto.

Bell Systems.
Lintz-Porter Co., Toronto.

Belt Benches.
Tabor Mfg. Co., Philadelphia, Pa.

Belt Dressing and Cement.
Graton & Knight Mfg. Co., Montreal.

Belt Lacing, Leather.
Graton & Knight Mfg. Co., Montreal.

Belting, Chain.
Can. Fairbanks-Morse Co., Montreal.
Graton & Knight Mfg. Co., Montreal.
Jones & Glassco, Montreal
Morse Chain Co., Ithaca, N.Y.

Belting, Cotton.
Dominion Belting Co., Hamilton.

Belting, Leather.
Can. Fairbanks-Morse Co., Montreal.
Girard Machine & Tool Co., Philadelphia, Pa.
Graton & Knight Mfg. Co., Montreal.
Main Belting Co., Montreal
Morse Chain Co., Ithaca, N.Y.
D. K. McLaren Ltd., Montreal.
J. C. Wilkinson & Co., Montreal.

Belting, Stitched Cotton Duck.
Dominion Belting Co., Hamilton, Ont.
Main Belting Co., Montreal

Belting, Rubber.
Can. H. W. Johns-Manville Co., Limited, Toronto.

Benders, Angle and Tee Iron.
Can. Buffalo Forge Co., Montreal.
Watson-Stillman Co., Aldene, N.J.

Bending Machinery.
John Bertram & Sons Co., Dundas.
Bertrams, Limited, Edinburgh, Scotland.
Bliss, E. W., Co., Brooklyn, N.Y.
Brown, Boggs Co., Ltd., Hamilton, Canada.
Can. Buffalo Forge Co., Montreal.
Can. Machinery Corporation, Galt, Ont.
Charles F. Elmes Eng. Works, Chicago
Jardine, A. B., & Co., Hespeler, Ont.
National Machinery Co., Tiffin, Ohio.
National Machinery & Supply Co., Hamilton.
Niles-Bement-Pond Co., New York.
Owen Sound Iron Works Co., Owen Sound.
Toledo Machine & Tool Co., Toledo, O.
Steel Bending Brake Works, Chatham, Ont.
Watson-Stillman Co., Aldene, N.J.

Bins, Steel.
Dennis Wire & Iron Works Co., Ltd., London, Canada.
Toronto Iron Works, Ltd., Toronto.

Bit Brace Tools.
Wells Bros. Co., Greenfield, Mass.
Wilt Twist Drill Co. of Canada, Ltd., Walkerville, Ont.

Blast Gauges, Cupola.
Can. Buffalo Forge Co., Montreal.
Sheldons, Ltd., Galt, Ont.
Whiting Foundry Equipment Co., Harvey, Ill.

Blocks, Lifting.
Northern Crane Works, Walkerville.

Blowers.
Can. Buffalo Forge Co., Montreal.
Can. Sirocco Co., Ltd., Windsor, Ont.
Chicago Flexible Shaft Co., Chicago, Ill.
Girard Machine & Tool Co., Philadelphia, Pa.
Sheldons, Ltd., Galt, Ont.
Southwark Foundry & Machine Co., Philadelphia.

Blow Pipes and Regulators.
L'Air Liquide Society, Montreal, Toronto.
Lever Bros., Toronto.

Bluing Ovens.
Oven Equipment & Mfg. Co., New Haven, Conn.

Boilers.
Can. Locomotive Co., Kingston, Ont.
National Machinery & Supply Co., Hamilton.
Owen Sound Iron Works Co., Owen Sound.
Plessisville Foundry, Plessisville, Que.

Boiler Compounds.
Can. H. W. Johns-Manville Co., Limited, Toronto.

Boiler Graphite.
Dixon Crucible Co., Jersey City, N.J.

Boiler Makers' Supplies.
Jno. F. Allen Co., New York.

Bolt Cutters and Nut Tapers.
Wells Brothers Co., Greenfield, Mass.

Bolts.
Galt Machine Screw Co., Galt, Ont.
London Bolt & Hinge Works, London, Ont.

Bolt and Nut Machinery.
A. R. Williams Machy. Co., Toronto.
John Bertram & Sons Co., Dundas, Ont.
Owen Sound Iron Works Co., Owen Sound.
Gardiner, Robt., & Son, Montreal.
Landis Machine Co., Waynesboro, Pa.
National Machinery Co., Tiffin, O.
National Machinery & Supply Co., Hamilton.
Wiley & Russell Co., Greenfield, Mass.

Books
MacLean Publishing Co., Toronto.

Boring Machines, Upright and Horizontal.
John Bertram & Sons Co. Dundas.
Can. Machinery Corporation, Galt Ont.
Colburn Machine Tool Co., Franklin, Pa.
Girard Machine & Tool Co., Philadelphia, Pa.
Hill, Clarke & Co., of Chicago, Chicago, Ill.
Motch & Merryweather Machy. Co., Cleveland, O.
National Machinery & Supply Co., Hamilton.
Newton Machine Tool Works, Philadelphia Pa
Niles Bement Pond Co., New York.
Stow Mfg. Co., Binghamton, N.Y.

Boring Machines, Pneumatic, Cylinder.
Baker Brothers, Toledo, O
Cleveland Pneumatic Tool Co. of Canada, Toronto.
Can. Fairbanks Morse Co., Montreal.
Can. Ingersoll Rand Co., Montreal.
Independent Pneumatic Tool Co., Chicago, Ill.
Newton Machine Tool Works, Philadelphia, Pa.
Stow Mfg. Co., Binghamton, N.Y.

Boring and Turning Mills.
John Bertram & Sons Co., Dundas.
Colburn Machine Tool Co., Franklin, Pa.
Girard Machine & Tool Co., Philadelphia, Pa.
National Machinery & Supply Co., Hamilton.
Niles-Bement-Pond Co., New York.

Boxes, Annealing, Charging.
Mesta Machine Co., Pittsburg, Pa.

Box Puller.
Jardine, A. B., & Co., Hespeler, Ont.

Boxes, Steel Shop.
Cleveland Wire Spring Co., Cleveland.

Boxes, Tote.
Cleveland Wire Spring Co., Cleveland.

Brakes.
Brown, Boggs & Co., Hamilton, Can.
Whiting Foundry Equipment Co., Harvey, Ill.

Brakes, Heavy Plate Bending and Cornice.
Steel Bending Brake Works, Ltd., Chatham, Ont.

Brass Working Machinery.
A. R. Williams Machy. Co., Toronto.
Gardner, Robt., & Son, Montreal.
Girard Machine & Tool Co., Philadelphia, Pa.
National Machinery & Supply Co., Hamilton.
Warner & Swasey Co., Cleveland.
Niles-Bement-Pond Co., New York.

Brick Cars.
Can. Buffalo Forge Co., Montreal.
Sheldons, Ltd., Galt, Ont.

Brick Dryers.
Can. Buffalo Forge Co., Montreal.
Can. Sirocco Co., Ltd., Windsor, Ont.
Sheldons, Ltd., Galt, Ont.

Brick Machinery.
Eastern Machinery Co., New Haven.
Sheldons, Ltd., Galt, Ont.

Bridges, Railway and Highway.
Can. Bridge Co., Walkerville, Ont.

Buckets, Clam Shell, Crab and Dump.
Whiting Foundry Equipment Co., Harvey, Ill.

Buffing and Polishing Machinery.
Canadian Hart Wheels, Ltd., Hamilton, Ont.
Ford-Smith Machine Co., Hamilton Ont.
Girard Machine & Tool Co., Philadelphia, Pa.
Gray Mfg. & Machine Co., Toronto.
New Britain Machine Co. New Britain, Conn.

Bulldozers.
John Bertram & Sons Co., Dundas.
E. W. Bliss Co., Brooklyn, N.Y.
Canada Mach. Corporation, Galt, Ont.
National Machinery & Supply Co. Hamilton, Ont.
Watson-Stillman Co., Aldene, N.J.

Burners, Enclosed Flame Gas.
Oven Equipment & Mfg. Co., New Haven, Conn.

Burners, Fuel, Oil and Natural Gas.
Whiting Foundry Equipment Co., Harvey, Ill.

Burring Reamers.
Wells Brothers Company, Greenfield Mass.
Wilt Twist Drill Co. of Canada, Ltd., Walkerville, Ont.

Butterises.
Wells Brothers Company, Greenfield Mass.

Burrs, Iron and Copper.
Parmenter & Bulloch Co., Gananoque.

Canners' Machinery.
Bliss, E. W., Co., Brooklyn, N.Y.
Brown, Boggs & Co., Hamilton, Can
National Machinery & Supply Co. Hamilton, Ont.

Caissons.
Toronto Iron Works Ltd Toronto.

Cars, Charging Box Ingot.
Mesta Machine Co., Pittsburg, Pa.

Cars, Industrial.
Can. Buffalo Forge Co., Montreal
Can. Fairbanks-Morse Co., Montreal
Sheldons, Limited, Galt, Ont.
Whiting Foundry Equipment Co. Harvey, Ill.

Castings, Aluminum.
Cunningham & Son, St. Catharines, Ont.
Owen Sound Iron Works Co., Ltd., Owen Sound, Ont.
St. Lawrence Foundry, Galt, Ont.
Tallman Brass & Metal Co., Hamilton

Castings, Air Furnaces.
Wm. Tod Company, Youngstown, O.

Castings, Brass.
Cunningham & Son, St. Catharines, Ont.
Alexander Fleck, Ltd., Ottawa.
T. C. Lawrence Foundry, Galt, Ont.
Mesta Machine Co., Pittsburg, Pa.
Owen Sound Iron Works Co., Owen Sound.
Pittsburg Valve Foundry & Construction Co., Pittsburg, Pa.
Plessisville Foundry, Plessisville, Que.
Tallman Brass & Metal Co., Hamilton
Wm. Tod Company, Youngstown, O.

Castings, Bronze.
Cunningham & Son, St. Catharines, Ont.
Mesta Machine Co., Pittsburg, Pa.
Tallman Brass & Metal Co., Hamilton
Wm. Tod Company, Youngstown, O

Castings, Copper.
Cunningham & Son, St. Catharines, Ont.
Tallman Brass & Metal Co., Hamilton, Ont.

Castings, Gray Iron.
Brown, Boggs Co., Ltd., Hamilton, Canada.
Erie Foundry Co., Erie, Pa.
Alexander Fleck, Ltd., Ottawa.
Gardner, Robt., & Son, Montreal.
Hull Iron & Steel Foundries, Ltd., Hull, Quebec.
Mesta Machine Co., Pittsburg, Pa.
Owen Sound Iron Works Co., Owen Sound.
Pittsburg Valve Foundry & Construction Co., Pittsburg, Pa.
Plessisville Foundry, Plessisville, Que.
Wm. Tod Company, Youngstown, O.

Castings, Steel Chrome and Manganese Steel.
Hull Iron & Steel Foundries, Ltd., Hull, Quebec.
Mesta Machine Co., Pittsburg, Pa.
Wm. Tod Company, Youngstown, O.

Castings, Malleable.
Galt Malleable Iron Co., Galt.

Castings, Nickel Steel.
Hull Iron & Steel Foundries, Ltd., Hull, Quebec.
Mesta Machine Co., Pittsburg, Pa.

Cement, Disc Wheel.
Gardner Machine Co., Beloit, Wis.

Cement, Iron.
Can. H. W. Johns-Manville Co., Limited, Toronto.
Shelton Metallic Filler Co., Derby, O.

Cement Machinery.
Can. Fairbanks-Morse Co., Montreal.
Gardner, Robt., & Son, Montreal.
National Machinery & Supply Co., Hamilton, Ont.
Owen Sound Iron Works Co., Owen Sound.

Centre Reamers.
Wells Brothers Co., Greenfield, Mass.

Centering Machines.
John Bertram & Sons Co., Dundas.
Gardner, Robt., & Son, Montreal.
Girard Machine & Tool Co., Philadelphia, Pa.
National Machinery & Supply Co., Hamilton.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Dundas, Ont.

Centrifugal Pumps.
Can. Buffalo Forge Co., Montreal.
Pratt & Whitney Co., Dundas, Ont.
Southwark Foundry & Machine Co., Philadelphia, Pa.
Smart-Turner Machine Co., Hamilton, Ont.

Chain Blocks.
Can. Fairbanks-Morse Co., Montreal.
National Machinery & Supply Co., Hamilton.

Chains, Silent and Transmission.
Jones & Glassco, Montreal.
Morse Chain Co., Ithaca, N.Y.
Plessisville Foundry, Plessisville, Que.

Chemists.
Toronto Testing Laboratory, Ltd., Toronto.

Chucks, Aero, Automatic.
Garvin Machine Co., New York.

Chucks, Drill, Lathe and Universal.
John Bertram & Sons Co., Dundas, Ont.
Buffalo Forge Co., Buffalo, N.Y.
Can. Fairbanks-Morse Co., Montreal.
Cleveland Twist Drill Co., Cleveland.
Cushman Chuck Co., Hartford, Conn.
Gardner, Robt., & Son, Montreal.
Girard Machine & Tool Co., Philadelphia, Pa.
Wells Brothers Co., Greenfield, Mass.
Jacobs Mfg. Co., Hartford, Conn.
Ker & Goodwin, Brantford.
Modern Tool Co., Erie, Pa.
Morse Twist Drill & Machine Co., New Bedford.
National Machinery & Supply Co., Hamilton.
Skinner Chuck Co., New Britain, Conn.
D. E. Whiton Machine Co., New London, Conn.
Wilt Twist Drill Co. of Canada, Ltd., Walkerville, Ont.

Chucks, Drill, Automatic and Keyless.
Buffalo Forge Co., Buffalo, N.Y.

Chucks, Ring Wheel.
Gardner Machine Co., Beloit, Wis.

Chucking Machines.
Garvin Machine Co., New York.
Girard Machine & Tool Co., Philadelphia, Pa.
New Britain Machine Co., New Britain, Conn.
Niles-Bement-Pond Co., New York.
Turner Machine Co., Danbury, Conn.
Warner & Swasey Co., Cleveland, O.

Clocks, Time and Watchman's.
Lintz-Porter Co., Toronto.

Cloth and Wool Dryers.
Canada Wire & Iron Goods Co., Hamilton, Ont.
Sheldons, Limited, Galt.

Clutches.
Eastern Machinery Co., New Haven, Conn.
Jones & Glassco, Montreal.
Owen Sound Iron Works Co., Owen Sound.
Positive Clutch & Pulley Works, Ltd., Toronto.

Coal Handling Machinery.
Whiting Foundry Equipment Co., Harvey, Ill.

Coke and Coal.
Hanna & Co., M. A., Cleveland, O.

Collectors, Pneumatic.
Can. Buffalo Forge Co., Montreal.
Sheldons, Limited, Galt.

Compressors, Air.
Cleveland Pneumatic Tool Co. of Canada, Toronto.
Independent Pneumatic Tool Co., Chicago.
Mesta Machine Co., Pittsburg, Pa.
National Machinery & Supply Co., Hamilton.
Southwark Foundry & Machine Co., Philadelphia, Pa.
The Smart-Turner Machine Co., Hamilton.

Concentrating Plant.
Gardner, Robt., & Son, Montreal.

Concrete Mixers.
A. R. Williams Machy. Co., Toronto.
Can. Fairbanks-Morse Co., Montreal.
National Machinery & Supply Co., Hamilton.

Concrete Reinforcement.
Canada Wire Goods Mfg. Co., Hamilton.

Condensers.
Can. Buffalo Forge Co., Montreal.
Mesta Machine Co., Pittsburg, Pa.
The Smart-Turner Machine Co., Hamilton.
Southwark Foundry & Machine Co., Philadelphia.
Wm. Tod Company, Youngstown, O.

Contracting Engineers, Electrical
Lintz-Porter Co., Toronto.

Controllers and Starters, Electric Motor.
A. R. Williams Machy. Co., Toronto.
Toronto & Hamilton Electric Co., Hamilton, Ont.

Conveyor Machinery.
Can. Fairbanks-Morse Co., Montreal.
Can. Mathews Gravity Carrier Co., Toronto.
National Machinery & Supply Co., Hamilton, Ont.
Plessisville Foundry, Plessisville, Que.
The Smart-Turner Machine Co., Hamilton.

Coping Machines.
Can. Buffalo Forge Co., Montreal.
John Bertram & Sons Co., Dundas.
National Machinery & Supply Co., Hamilton, Ont.
Niles-Bement-Pond Co., New York.

Cornice Brakes.
Brown Boggs Co., Ltd., Hamilton, Canada.
Steel Bending Brake Wks., Chatham.

Counting Machines.
National Scale Co., Chicopee Falls, Mass.
C. J. Root Co., Bristol, Conn.

Counterbores and Countersinks.
Cleveland Twist Drill Co., Cleveland.
Morse Twist Drill & Machine Co., New Bedford.
Pratt & Whitney Co., Dundas, Ont.
Wells Bros. Co., Greenfield, Mass.
Whitman & Barnes Mfg. Co., St. Catharines, Ont.
Wilt Twist Drill Co. of Canada, Ltd., Walkerville, Ont.

Countershafts.
Baird Machine Co., Bridgeport, Conn.
Wells Bros. Co., Greenfield, Mass.

Country House Lighting and Cooking.
Can. Blaugas Co., Montreal.

Couplings.
Can. H. W. Johns-Manville Co., Ltd., Toronto.
Eastern Machinery Co., New Haven, Conn.
Gardner, Robt., & Son, Montreal.
Owen Sound Iron Works Co., Owen Sound, Ont.

Couplings, Air Hose.
Cleveland Pneumatic Tool Co. of Canada, Toronto.

Crabs, Travelling.
Owen Sound Iron Works Co., Owen Sound.

Cranes, Locomotive.
Northern Crane Works, Walkerville.

Cranes, Gantry.
Northern Crane Works, Walkerville.
Smart-Turner Machine Co., Hamilton, Ont.
Whiting Foundry Equipment Co., Harvey, Ill.

Cranes, Goliath.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Northern Crane Works, Walkerville.
Whiting Foundry Equipment Co., Harvey, Ill.

Cranes, Hydraulic.
Watson-Stillman Co., Aldene, N.J.

Cranes, Pneumatic.
Northern Crane Works, Walkerville.
Whiting Foundry Equipment Co., Harvey, Ill.

Cranes, Post Jib.
Northern Crane Works, Walkerville.
Smart-Turner Machine Co., Hamilton, Ont.
Whiting Foundry Equipment Co., Harvey, Ill.

Cranes, Portable.
Northern Crane Works, Walkerville.
Whiting Foundry Equipment Co., Harvey, Ill.

Cranes, Swing Jib.
Northern Crane Works, Walkerville.
Smart-Turner Machine Co., Hamilton, Ont.
Whiting Foundry Equipment Co., Harvey, Ill.

Cranes, Transfer.
Northern Crane Works, Walkerville.
Smart-Turner Machine Co., Hamilton, Ont.
Whiting Foundry Equipment Co., Harvey, Ill.

Cranes, Wall.
Northern Crane Works, Walkerville.
Smart-Turner Machine Co., Hamilton, Ont.
Whiting Foundry Equipment Co., Harvey, Ill.

Cranes, Travelling Electric and Hand Power.
Dominion Bridge Co., Montreal.
Niles-Bement-Pond Co., New York.
Northern Crane Works, Walkerville.
Whiting Foundry Equipment Co., Harvey, Ill.

Crane, Chain.
Northern Crane Works, Walkerville.

Cranes, All Kinds.
Northern Crane Works, Walkerville.
Owen Sound Iron Works Co., Owen Sound, Ont.
Southwork Foundry & Machine Co., Philadelphia.
Whiting Foundry Equipment Co., Harvey, Ill.

Crank Pin Turning Machine.
Niles-Bement-Pond Co., New York.

Crimps, Leather.
Graton & Knight Mfg. Co., Montreal.

Cupolas.
Can. Buffalo Forge Co., Montreal.
Northern Crane Works, Walkerville.
Sheldons, Ltd., Galt, Ont.
Whiting Foundry Equipment Co., Harvey, Ill.

Cupola and Blast Gate Blowers.
Can. Sirocco Co., Ltd., Windsor, Ont.

Cupola Blast Gauges & Blowers.
Sheldons, Ltd., Galt, Ont.

Cutters, Angle, Tee Iron and Bar.
Can. Buffalo Forge Co., Montreal.

Cutters, Flue.
Independent Pneumatic Tool Co., Chicago.
Cleveland Pneumatic Tool Co. of Canada, Toronto.

Cutters, Pipe.
Can. Fairbanks-Morse Co., Montreal.
A. B. Jardine & Co., Hespeler, Ont.
Trimont Mfg. Co., Roxbury, Mass.

Cutting Compound & Cutting Oil.
Can. Economic Lubricant Co., Montreal.
Can. Oil Companies, Toronto.
Cataract Refining Co., Buffalo, N.Y.
Crescent Oil Co., New York.
Racine Tool & Machine Co., Racine, Wis.

Cutter Grinders and Attachments.
Cincinnati Milling Machine Co., Cincinnati.
Garvin Machine Co., New York.
Girard Machine & Tool Co., Philadelphia, Pa.

Cutters, Milling.
A. R. Williams Machy. Co., Toronto.
Can. Fairbanks-Morse Co., Montreal
Cleveland Twist Drill Co., Cleveland.
Garvin Machine Co., New York.
Morse Twist Drill and Machine Co., New Bedford.
Tabor Mfg. Co., Philadelphia, Pa.
Pratt & Whitney Co., Dundas, Ont.
Wilt Twist Drill Co. of Canada, Ltd., Walkerville, Ont.

Cutting-off Machines.
Armstrong Bros. Tool Co., Chicago.
John Bertram & Sons Co., Dundas.
Can. Fairbanks-Morse Co., Montreal.
Espen-Lucas Machine Wks., Philadelphia, Pa.
Foss & Hill Machy. Co., Montreal.
Garvin Machine Co., New York.
Girard Machine & Tool Co., Philadelphia, Pa.
Geo. Gorton Machine Co., Racine, Wis.
John H. Hall & Sons, Brantford, Ont.
Nutter & Barnes Co., Hinsdale, N.H.
Pratt & Whitney Co., Dundas, Ont.
Tabor Mfg. Co., Philadelphia, Pa.
L. S. Starrett Co., Athol, Mass.

Damper Regulators.
Can. Fairbanks-Morse Co., Montreal.

Derricks.
Dominion Bridge Co., Montreal.
Wilt Twist Drill Co. of Canada, Ltd., Walkerville, Ont.

Designers, Special Machinery.
Baird Machine Co., Bridgeport, Conn.

Dies and Die Stocks.
Armstrong Mfg. Co., Bridgeport, Conn.
Banfield, W. H. & Son, Toronto.
Butterfield & Co., Rock Island, Que.
Brown, Boggs & Co., Hamilton, Ont.
Can. Fairbanks-Morse Co., Montreal.
Duncan Electrical Co., Montreal.
Gardner, Robt., & Son, Montreal.
Greenfield Tap & Die Corporation, Greenfield, Mass.
A. B. Jardine & Co., Hespeler, Ont.
Modern Tool Co., Erie, Pa.
Morse Twist Drill and Machine Co., New Bedford.
Pratt & Whitney Co., Dundas, Ont.
Wiley & Russell, Greenfield, Mass.

Dies for Bit Brace Use.
Wells Brothers Co., Greenfield, Mass.

Die Sinkers.
Garvin Machine Co., New York.

Dies for Machines.
Wells Brothers Co., Greenfield, Mass.

Die Sinking Presses, Hydraulic.
Charles F. Elmes Eng. Works, Chicago
Watson-Stillman Co., Aldene, N.J.

Dies, Self-opening.
Duncan Electrical Co., Montreal.
Geometric Tool Co., New Haven.
Greenfield Tap & Die Corporation, Greenfield, Mass.
Landis Machine Co., Waynesboro, Pa.
Modern Tool Co., Erie, Pa.
Murchey Machine & Tool Co., Detroit

Dies, Opening.
W. H. Banfield & Sons, Toronto.
Can. Fairbanks-Morse Co., Montreal.
Duncan Electrical Co., Montreal.
Greenfield Tap & Die Corporation, Greenfield, Mass.
A. B. Jardine & Co., Hespeler, Ont.
Landis Machine Co., Waynesboro, Pa.
Modern Tool Co., Erie, Pa.
Murchey Machine & Tool Co., Detroit.
Pratt & Whitney Co., Dundas, Ont.

Dies for Screw Plates.
Wells Brothers Co., Greenfield, Mass.

Dies, Sheet Metal Working.
E. W. Bliss Co., Brooklyn, N.Y.
Brown, Boggs & Co., Hamilton, Can.

Dies, Screws and Thread.
Armstrong Mfg. Co., Bridgeport, Conn.
Greenfield Tap & Die Corporation Greenfield, Mass.
Landis Machine Co., Waynesboro, Pa.
Modern Tool Co., Erie, Pa.
Murchey Machine & Tool Co., Detroit.

Discs, Leather.
Graton & Knight Mfg. Co., Montreal.

Draughtsman's Tools.
Emmert Mfg. Co., Waynesboro, Pa.

Draft, Mechanical.
W. H. Banfield & Sons, Toronto.
Butterfield & Co., Rock Island, Que.
Can. Buffalo Forge Co., Montreal.
Can. Sirocco Co., Windsor, Ont.
A. B. Jardine & Co., Hespeler, Ont.
Pratt & Whitney Co., Dundas, Ont.
Sheldons, Limited, Galt, Ont.

Dritt Bolt Cutters.
Cleveland Pneumatic Tool Co. of Canada, Toronto.

Drill Presses.
Baker Bros., Toledo, O.
W. F. & John Barnes Co., Rockford.
Can. Buffalo Forge Co., Montreal.
Foss & Hill Machy. Co., Montreal.
Hill, Clarke & Co. of Chicago, Chicago, Ill.
Garvin Machine Co., New York.
Girard Machine & Tool Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
A. R. Williams Machinery Co., Toronto.

Drilling Machines, Locomotive and Multiple Spindle
Baker Bros., Toledo, O.
Barnes Drill Co., Rockford, Ill.
John Bertram & Sons Co., Dundas.
Can. Buffalo Forge Co., Montreal.
Can. Fairbanks-Morse Co., Montreal.
Colburn Mach. Tool Co., Franklin, Pa.
Garvin Machine Co., New York.
Girard Machine & Tool Co., Philadelphia, Pa.
A. B. Jardine & Co., Hespeler, Ont.
Niles-Bement-Pond Co., New York.

Drilling Machines, Radial and Turret.
Baker Bros., Toledo, O.
Barnes Drill Co., Rockford, Ill.
John Bertram & Sons Co., Dundas.
Can. Fairbanks-Morse Co., Montreal.
Motch & Merryweather Machy. Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Turner Machine Co., Danbury, Conn.

Drilling Machines, Sensitive.
Baker Bros., Toledo, O.
W. F. & John Barnes Co., Rockford.
Can. Fairbanks-Morse Co., Montreal.
Niles-Bement-Pond Co., New York.
Rockford Machine Tool Co., Rockford.

Drilling Machines, Upright and Herizontal.
Baker Bros., Toledo, O.
Barnes Drill Co., Rockford, Ill.
Colburn Mach Tool Co., Franklin, Pa.
A. R. Williams Machy. Co., Toronto
W. F. & John Barnes Co., Rockford.
John Bertram & Sons Co., Dundas.
Girard Machine & Tool Co., Philadelphia, Pa.
A. B. Jardine & Co., Hespeler, Ont.
Rockford Machine Tool Co., Rockford.
R. McDougall Co., Galt.
Motch & Merryweather Machy. Co., Cleveland, O.
Niles-Bement-Pond Co., New York.

Drilling Posts.
Keystone Mfg. Co., Buffalo, N.Y.

Drills, Bench.
W. F. & John Barnes Co., Rockford.
Can. Buffalo Forge Co., Montreal.
Can. Fairbanks-Morse Co., Montreal.
Pratt & Whitney Co., Dundas, Ont.
United States Electrical Tool Co., Cincinnati.

Drills, Blacksmith and Bit Stock.
Can. Buffalo Forge Co., Montreal.
Cleveland Twist Drill Co., Cleveland.
A. B. Jardine & Co., Hespeler, Ont.
Morse Twist Drill and Machine Co., New Bedford.
Wilt Twist Drill Co., of Canada, Ltd., Walkerville, Ont.

Drills, Centre.
Cleveland Twist Drill Co., Cleveland.
Morse Twist Drill and Machine Co. New Bedford.
Pratt & Whitney Co., Dundas, Ont.
L. S. Starrett Co., Athol, Mass.
Wilt Twist Drill Co., of Canada, Ltd., Walkerville, Ont.

Drills Corner (Pneumatic).
Cleveland Pneumatic Tool Co. of Canada, Toronto.

Drills, Electric and Portable.
A. R. Williams Machy. Co., Toronto.
Can. Buffalo Forge Co., Montreal.
Niles-Bement-Pond Co., New York.
Stow Mfg. Co., Binghamton, N.Y.
United States Electrical Tool Co., Cincinnati, O.

Drills, High Speed.
Baker Bros., Toledo, O.
Cleveland Twist Drill Co., Cleveland.
Can. Fairbanks-Morse Co., Montreal.
Morse Twist Drill and Machine Co., New Bedford.
W. F. & John Barnes Co., Rockford, Ill.
Pratt & Whitney Co., Dundas, Ont.
Whitman & Barnes Mfg. Co., St. Catharines, Ont.
Wilt Twist Drill Co., of Canada, Ltd., Walkerville, Ont.

Drills, Multiple Spindle.
Pratt & Whitney Co., Dundas, Ont.
Niles-Bement-Pond Co., New York.

Drills, Oil Tube.
Cleveland Twist Drill Co., Cleveland.
Morse Twist Drill and Machine Co., New Bedford.

Drills, Pneumatic.
John F. Allen Co., New York.
Cleveland Pneumatic Tool Co. of Canada, Toronto.
Independent Pneumatic Tool Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.

Drills, Ratchet and Hand.
Armstrong Bros. Tool Co., Chicago.
Can. Buffalo Forge Co., Montreal.
Can. Fairbanks-Morse Co., Montreal.
Cleveland Twist Drill Co., Cleveland.
A. B. Jardine & Co., Hespeler, Ont.
Morse Twist Drill and Machine Co., New Bedford.
National Forge & Tool Co., Erie, Pa.
Pratt & Whitney Co., Dundas, Ont.
Wilt Twist Drill Co. of Canada, Ltd., Walkerville, Ont.
Whitman & Barnes Mfg. Co., St. Catharines, Ont.

Drills, Rock.
A. R. Williams Machy. Co., Toronto.
Cleveland Pneumatic Tool Co. of Canada, Toronto.

Drills, Track.
Cleveland Twist Drill Co., Cleveland.
Morse Twist Drill and Machine Co., New Bedford.
Wilt Twist Drill Co. of Canada, Ltd., Walkerville, Ont.

Drills, Twist.
Armstrong, Whitworth of Canada, Ltd., Montreal.
Can. Fairbanks-Morse Co., Montreal.
Cleveland Twist Drill Co., Cleveland.
John Morrow Screw Co., Ingersoll, Ont.
Morse Twist Drill and Machine Co., New Bedford.
Pratt & Whitney Co., Dundas, Ont.
Wilt Twist Drill Co. of Canada, Ltd., Walkerville, Ont.

Drill Holders.
Wells Brothers Co., Greenfield, Mass.

Drill Sockets.
Modern Tool Co., Erie, Pa.
Morse Twist Drill and Machine Co., New Bedford.
Wilt Twist Drill Co. of Canada, Ltd., Walkerville, Ont.

Drying Appliances.
Can. Buffalo Forge Co., Montreal.
Can. Sirocco Co., Ltd., Windsor, Ont.
Sheldons, Ltd., Galt, Ont.

Drying Out Barrels.
Baird Machine Co., Bridgeport, Conn.

Drying Ovens.
Oven Equipment & Mfg. Co., New Haven, Conn.
Whiting Foundry Equipment Co., Harvey, Ill.

Dump Cars.
Can. Fairbanks-Morse Co., Montreal.
National Machinery & Supply Co., Hamilton, Ont.
Owen Sound Iron Works Co., Owen Sound.
Plessisville Foundry, Plessisville, Que.

Dust Separators.
Can. Buffalo Forge Co., Montreal.
Sheldons, Ltd., Galt, Ont.

Dust Arresters (for Tumbling Mills).
Whiting Foundry Equipment Co., Harvey, Ill.

Dynamos and Electrical Supplies.
A. R. Williams Machy. Co., Toronto.
Can. Fairbanks-Morse Co., Montreal.
Lancashire Dynamo and Motor Co., Ltd., Toronto.
Toronto & Hamilton Electric Co., Hamilton, Ont.

Electrical Supplies.
Duncan Electrical Co., Montreal.
Lintz-Porter Co., Toronto.

Elevator Enclosures.
Canada Wire & Iron Goods Co., Hamilton, Ont.
Dennis Wire & Iron Works, London, Ont.

Elevating and Conveying Machinery.
Can. Mathews Gravity Co., Toronto.
Plessisville Foundry, Plessisville, Que.

Emery Grinders (Pneumatic).
Cleveland Pneumatic Tool Co. of Canada, Toronto.
Stow Mfg. Co., Binghamton, N.Y.

Emery and Emery Wheels.
Can. Fairbanks-Morse Co., Montreal.
Canadian Hart Wheels, Hamilton, Ont.
Ford-Smith Machine Co., Hamilton.
Garvin Machine Co., New York.
Girard Machine & Tool Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.

Emery Wheels, Dressers and Stands.
Canadian Hart Wheels, Hamilton, Ont.
Gardner, Robt., & Son, Montreal.
National Machinery & Supply Co. Hamilton, Ont.
Norton Co., Worcester, Mass.

Emery Wheel Safety Flanges.
Canadian Hart Wheels, Hamilton, Ont.

Enameling Ovens.
Oven Equipment & Mfg. Co., New Haven, Conn.

Engines, Corliss, Compound, Pumping.
Mesta Machine Co., Pittsburg, Pa.
Wm. Tod Company, Youngstown, O.

Engines, Gas and Gasoline.
Can. Fairbanks-Morse Co., Montreal.
Jones & Glassco, Montreal.
Mesta Machine Co., Pittsburg, Pa.
National Machinery & Supply Co., Hamilton.
Wm. Tod Company, Youngstown, O.

Engines, Horizontal and Vertical.
Can. Buffalo Forge Co., Montreal.
Can. Sirocco Co., Ltd., Windsor, Ont.
Mesta Machine Co., Pittsburg, Pa.
A. R. Williams Machy. Co., Toronto.
Sheldons, Ltd., Galt, Ont.
Wm. Tod Co., Youngstown, O.

Engines, High-Speed, Automatic.
Can. Buffalo Forge Co., Montreal.

Engines, Steam.
Can. Buffalo Forge Co., Montreal.
Mesta Machine Co., Pittsburg, Pa.
Plessisville Foundry, Plessisville, Que.
Southwark Foundry & Machine Co., Philadelphia, Pa.
Wm. Tod Company, Youngstown, O.

Engines, Stationary and Marine.
Southwark Foundry & Machine Co., Philadelphia, Pa.

Engineering Books.
The MacLean Publishing Co., Ltd., Toronto.

Engraving Machines.
Geo. Gorton Machine Co., Racine, Wis.

Elevators and Buckets.
Eastern Machinery Co., New Haven, Conn.
Whiting Foundry Equipment Co., Harvey, Ill.

Equipment Shop.
Baird Machine Co., Bridgeport, Conn.
Garvin Machine Co., New York.
Wm. Tod Co., Youngstown, O.

Escutcheon Pins.
Parmenter & Bulloch Co., Gananoque.

Evaporators' Machinery.
Brown, Boggs & Co., Hamilton, Can.

Exhaust Heads and Hoods.
Can. Buffalo Forge Co., Montreal.
Can. Steel Products Co., Montreal.
Can. Fairbanks-Morse Co., Montreal.
Sheldons, Ltd., Galt, Ont.

Exhausters.
Can. Buffalo Forge Co., Montreal.
Can. Sirocco Co., Ltd., Windsor, Ont.

Experimental Machinery.
Owen Sound Iron Works Co., Owen Sound.

Extractors, Ingot.
Mesta Machine Co., Pittsburg, Pa.

Fans.
Can. Buffalo Forge Co., Berlin, Ont.
Baird Machine Co., Bridgeport, Conn.
Can. Sirocco Co., Ltd., Windsor, Ont.
Lintz-Porter Co., Toronto.
Plessisville Foundry, Plessisville, Que.
Sheldons, Ltd., Galt, Ont.
The Smart-Turner Machine Co., Hamilton.

Feed Water Heaters.
Can. Fairbanks-Morse Co., Montreal.
The Smart-Turner Machine Co., Hamilton.

Fence, Iron Factory.
Canada Wire & Iron Goods Co., Hamilton, Ont.
Dennis Wire & Iron Works Co., Ltd., London, Canada.
Standard Tube & Fence Co., Woodstock, Ont.

Files.
Delta File Works, Philadelphia, Pa.
Nicholson File Co., Port Hope, Ont.

Fire Alarm Apparatus.
Lintz-Porter Co., Toronto.

Fire Extinguishers.
Can. H. W. Johns-Manville Co., Limited, Toronto.

Fire Escapes.
Canada Wire & Iron Goods Co., Hamilton, Ont.
Dennis Wire & Iron Works, London, Ont.

Flash Lamps.
Lintz Porter Co., Toronto.

Flexible Shafts.
Chicago Flexible Shaft Co., Chicago, Ill.
Stow Mfg. Co., Binghamton, N.Y.

Flumes.
Toronto Iron Works, Ltd., Toronto.

Forges, Hand, etc.
Can. Buffalo Forge Co., Montreal.
Independent Pneumatic Tool Co., Chicago, Ill.
National Machinery & Supply Co., Hamilton.
Sheldons, Limited, Galt, Ont.

Forgings, Drop, Automobile and Locomotive.
Bliss, E. W., Co., Brooklyn, N.Y.
Canadian Billings & Spencer, Ltd. Welland.
Mesta Machine Co., Pittsburg, Pa.
Ready Tool Co., Bridgeport, Conn.
J. H. Williams Co., Brooklyn, N.Y.

Forging Hammers, Belt-Driven.
Bliss, E. W., Co., Brooklyn, N.Y.
Plessisville Foundry, Plessisville, Que.

Forging Hammers, Steam.
Erie Foundry Co., Erie, Pa.

Forging Machinery.
John Bertram & Sons Co., Dundas.
Bliss, E. W., Co., Brooklyn, N.Y.
Brown, Boggs Co., Ltd., Hamilton Canada.
National Machinery Co., Tiffin, Ohio.
Plessisville Foundry, Plessisville, Que.
Wm. Tod Company, Youngstown, O.
Watson-Stillman Co., Aldene, N.J.

Foundry Equipment.
Northern Crane Works, Walkerville
W. W. Sly Mfg. Co., Cleveland, O
Whiting Foundry Equipment Co Harvey, Ill.

Friction Leathers.
Graton & Knight Mfg. Co., Montreal.

Friction Clutch Pulleys etc
American Pulley Co, Philadelphia Pa.
Baird Machine Co., Bridgeport, Conn.
Eastern Machinery Co., New Haven, Conn.
D. K. McLaren, Ltd., Montreal.
Owen Sound Iron Works Co., Owen Sound.
Positive Clutch & Pulley Works, Toronto.

Furnace Engineers and Contractors.
Whiting Foundry Equipment Co. Harvey, Ill.

Furnaces, Blast.
Toronto Iron Works, Ltd., Toronto

Furnaces, Oil, Coal, Gas and Electric.
Canadian Hoskins, Limited, Walkerville, Ont.
Chicago Flexible Shaft Co., Chicago Ill.
Mechanical Engineering Co., 55 Cote St., Montreal, Que.
Tate, Jones & Co., Pittsburgh, Pa.
Whiting Foundry Equipment Co., Harvey, Ill.

Furnaces, Steel Heating and Brass Melting.
Can. Hoskins, Ltd., Walkerville, Ont.
Chicago Flexible Shaft Co., Chicago Ill.
Mechanical Engineering Co., 55 Cote St., Montreal, Que.
Tate, Jones & Co., Pittsburgh, Pa.
Whiting Foundry Equipment Co., Harvey, Ill.

IMMEDIATE DELIVERY

This Fine Lot of Machine Tools Now Available

WRITE FOR FULL DESCRIPTIONS

Look At This Opportunity—Look At The Prices

LATHES

- 72" x 19' Betts, triple geared, compound rest, power cross feed, solid spindle 8" diameter, face plate drive 70" x 5½", bed in two sections, 20' each, carriage 5' long ... $1500
- 64" x 12' John Roach (Morgan Iron Works), blocks to swing 84", triple geared, compound rest, power cross feed, internally geared face plate 60" x 10", spindle diameter about 10" ... 1750
- 52" x 12' Fifield triple geared, face plate drive, compound rest ... 1250
- 40" x 22' Bement & Dougherty, raising blocks to 47", 4 step cone 4½" belt, back geared, face plate drive ... 750
- Two 36" x 23' Farrell, back geared, compound rest, 17½' between centers, 5 step cone 4" belt, each 600
- Two 36" x 20' Farrell, triple geared, compound rest, 14' between centers, 5 step cone 4" belt, each. 600
- Two 36" x 20' Farrell, back geared, compound rest, 14' between centers, 5 step cone 4" belt, each... 550
- Two 36" x 18' Farrell, triple geared, compound rest, 12' between centers, 5 step cone 4" belt, each. . 550
- 36" x 16' Fifield, back geared, compound rest, power cross feed, 5 step cone 4" belt, diameter of spindle 4½", 19", 4 jaw chuck ... 900
- Two 36" x 16' Farrell, triple geared, compound rest, 10' between centers, 5 step cone 4" belt, each.... 500
- 36" x 16' Pond, compound rest, power cross feed, raising blocks to 42", 4 step cone 4" belt, 30" 4-jaw independent chuck ... 1000
- 32" x 18' Pond Screw Cutting Engine Lathe...... 1000
- 30" x 26' Lodge & Shipley, quick change gear, compound rest, power cross feed, 5" hole in spindle, 20' between centers, 5 step cone 4" belt. .. 1750
- 30" x 18' Ames, compound rest, power cross feed, 4 step cone 3½" belt ... 750
- 30" x 12' Pond, 4 step cone 4" belt, compound rest, power cross feed ... 700
- 30" x 14' Rowland, compound rest, hollow spindle, 4" belt, etc ... 550
- 30" x 16' Harrisburg, plain rest, hand cross feed, 4 step cone 3½" belt ... 550
- 26" x 10' Dustin & Hubbard, compound rest, power cross feed, 4 step cone 3½" belt, chuck, etc 600
- 22" x 10' Harrington, compound rest, power cross feed, solid spindle ... 325
- 20" x 12' Fifield, compound rest, power cross feed, solid spindle, 4 step cone ... 325
- 20" x 10' Rahn-Larmon, swings 26" in gap, compound rest, power cross feed, 1½" hole in spindle 600
- 20" x 9' Pratt & Whitney, power cross feed, hollow spindle, taper attachment, chuck and plain rest ... 400
- 20" x 10' Lathe & Morse, power cross feed, solid spindle, 4 step cone [illegible]" belt ... 35[illegible]
- 18" x 8' Star, compound rest, 1¼" hole in spindle, etc. ... 35[illegible]
- 16" x 8' Robbins, 1" hole in spindle, 4 step cone 2½" belt, plain rest, power cross feed, all attachments ... 350
- 16" x 6' Porter, hollow spindle, compound rest, power cross feed, etc. ... 325
- 16" x 6' Harrington, compound rest, 1⅛" hole in spindle ... 275
- 15" x 6' Bradford, rise and fall rest, 1¼" hole in spindle, 4 step cone, power cross feed ... 275
- 14" x 10' Wagner, compound rest, power cross feed, 1" hole in spindle, complete and like new ... 275
- 14" x 6' Fitchburg, compound rest, taper attachment, small hole in spindle, 5 step cone 2" belt, all attachments ... 300

TURRET LATHES

- 11" x 5' Coulter & McKenzie, 12" round turret with six 2½" holes, automatic feed to turret slide, 3" hole in spindle, 2-jaw chuck fitted to face plate, 3 step cone for 5½" belt ... 45[illegible]
- 14" x 4' Garvin, 7½" hexagon turret with six 1½" holes, plain head, hollow spindle, 2-jaw chuck, friction cone release and chuck opening attachment ... [illegible]
- Two No. 2½ Pratt & Whitneys, plain heads, with draw in attachments, 9" turret with eight 1¼" holes, 4 step cone 3" belt, pan bed, etc., each 20[illegible]
- 15" x 6½' Coulter & McKenzie 12½" round turret with six 3" holes, 3" hole in spindle, 2 step cone 6" belt, 2-jaw chuck fitted to face plate, automatic feed to turret slide ... [illegible]
- 16" x 5' Windsor No. 1 plain head, 2-jaw chuck, double cut-off rest, 8½" round turret with six 1¼" holes, 3 step cone 4" belt 1¼" hole in spindle, etc ... [illegible]
- 16" Jones & Lamson automatic chuck roller feed, geared friction head, 2⅛" hole in spindle, power feed to turret slide, double cut-off rest, 3 step cone 3½" belt ... 450
- 16" Pratt & Whitney No. 3, 1½" hole in spindle, back geared, friction head, power feed to turret, turret has six 1½" holes, pan bed, etc ... 35[illegible]
- 16" x 6' Pratt & Whitney, back geared, friction head, double cut-off rest, 9" round turret with six 1¼" holes, 2" hole in spindle, 3 step cone 3½" belt ... 350
- 16" Flather, 1¼" hole in spindle, 8½" turret with six ⅞" holes ... 150
- 16" Jones & Lamson, No. 2, plain head, 8" turret with six 1¼" holes, cut-off rest ... 200
- 16" x 5' Warner & Swasey, plain head, 1¼" hole in spindle, 8" turret with six 1¼" holes, cut-off rest, 3 step cone 3" belt ... 225
- 18" x 5' Warner & Swasey, plain head, double cut-off rest, 8½" turret with six 1⅜" holes ... 250
- Two 18" x 6' Draper, back geared, friction head, automatic feed to turret slide, 4 step cone, each.. 350
- 18" Windsor No. 5, Fox Monitor, plain head, 3 step cone 14½" x 3⅝", 1½" hole in spindle, hobb and followers, 2-jaw box chuck, double cut-off rest, set over turret slide, turret 9½" with 1¼" holes, double friction countershaft ... 300
- 18" x 6' American Fox Monitor, back geared, 1⅛" hole in spindle, 4 step cone, complete with hobbs and followers ... 275
- 20" Bridgeport, back geared, chuck, power feed to turret, 1⅝" hole in spindle, 9½" turret, 3 step cone 5½" belt, steady rest, etc. ... 375
- 20" x 7' Reed, back geared, 2⅜" hole in spindle, 12" round turret with four 1¾' holes, 3 step cone 3½" belt, 16" 3-jaw chuck, power feed to turret 500
- 20" x 5' Meriden, plain head, 1¾" hole in spindle, draw in attachment and lever, 3 step cone 4" belt, 9" round turret with six 1½" holes, fitted with extra combination and cut-off rest ... 250
- Two Potter & Johnson No. 4, 21" swing over the bed, 8" swing over carriage, 16" travel of carriage, 7½" travel of cross slides, 7" travel of tool slides, 4 step cone 4" belt, 1½" hole in spindle, 6" hexagon turret, bronze bearing 6" long, automatic feed to turret slide, pan bed, double friction countershaft, each ... 275
- 21" Gisholt, 18" 3-jaw Universal chuck, face plate drive, 3 step cone 3½" belt, 2" hole in spindle, six 2½" holes in turret, countershaft has 3 friction pulleys 14" x 4" ... 1000
- 22" x 6' Turret Lathe, 12 holes in round turret 1[illegible]
- 24" Garvin extra heavy, 4" hole in spindle, 3 step cone 5" belt, main spindle bearing about 8" diameter, 3-jaw 18" Universal chuck, very heavy double cutting-off and forming slide on each side operated separately by power feed, slides are 7½" wide and have double tool clamps instead of the ordinary tool posts and have automatic stop for the feed, hexagon turret 11" across flats, has six 2½" holes, turret slide 20" wide by 36" long, power feed to turret with automatic stop and adjustable stops for each station of turret, pan, pump and countershaft ... 115
- 28" x 8' Fish Prentiss 2" hole in spindle, 3 step cone 4½" belt, back geared friction head, 24" 3-jaw Universal chuck, positive gear feed, automatic stop, hexagon turret on carriage 14" across flats, has six 2½" holes, carriage is 38" long, power cross feed to turret, cabinet legs, double friction countershaft ... 1350
- 21" Gisholt Turret Lathe (Big Bore Lathe) 6½" hole in spindle, 2 step cone 21" x 4½", taper attachment, rapid traverse, hexagon turret, has six 3" holes, 4" jaw heavy chuck, turret tool post, etc ... 2000
- 28" Lodge & Shipley Turret Pulley Lathe, takes 26" between centers, heavily back geared, 24" travel of [illegible] with automatic feed attachments for [illegible], [illegible]" hole in spindle, 14" round turret with six [illegible]" holes, double cut-off rest, 5 step cone for [illegible]" belt, heavy duty 24" jaw chuck fitted, power feed to turret slide, hand feed to cross travel, complete with countershaft and in first-class condition ... 10[illegible]

DRILLS

- Baker Bros. style "[illegible]" 30" Drill, spindle nose [illegible]" diameter, No. 4 Morse taper, power feed to spindle, [illegible] step cone [illegible]" belt, table [illegible] raised and lowered by [illegible], overall diameter of table 24" x 21", working surface 17" x 20½" ... [illegible]
- [illegible] Drill mounted on one base, separate friction clutches for each machine, all [illegible] back geared, power feed, quick return ... [illegible]
- [illegible] heavy [illegible] 30" Drill, working surface of table 30" x 17", overall dimensions [illegible] x [illegible]", each table has [illegible] T slots, [illegible] Practically new condition [illegible] ... [illegible]
- [illegible] Best eight spindle heavy Drill ... 150

AUTOMATICS AND SCREW MACHINES

- National Acme [illegible]" capacity, [illegible] spindle automatic ... 10[illegible]
- National Acme No. [illegible] 1[illegible]" capacity, 4 spindle ... 600
- National Acme No. [illegible] 1⅝" capacity, 4 spindles ... 1000
- Thirty Hartford [illegible]" to ¾" capacity, each ... 200
- Hartford, 1[illegible]" [illegible] ... 500
- Hartford [illegible]" [illegible] ... [illegible]
- Hartford 2[illegible]" [illegible] ... [illegible]
- Three Brown & Sharpes No. 2, 21/32" capacity, each ... 375
- 1½" Pratt & Whitney, wire feed New Turret Lathe, 4 step cone 3" belt, back geared, 8" round turret with six holes, pan bed ... 450

RADIAL DRILLS

- 5' Rockford, swivel head with independent table. 500
- 5' American semi-universal Radial, back geared, No. 4 Morse taper in spindle ... 625
- 42" American Tool Works plain radial, tapping attachment, swivel box table, 4 step cone 3" belt, etc ... 525
- 42" Lambertsville Radial, drills to center of 84", Bement pattern, solid arm type, 2" spindle, 4" sleeve, hand wheel feed, 20" square T slotted heavy base plate ... 200
- 2½' American, automatic feed, back geared, quick return, tapping attachment, square swinging table, in A1 condition ... 425
- 3' Radial (gang), complete with countershaft .. 250

MILLING MACHINES

- Two 10" swing x 20" length capacity Automatic Threading Lathes, built by the Automatic Machine Co. of Bridgeport, Conn., capacity inside diameter 5", outside diameter 3", will handle larger work, but these sizes are usual, each.... 250
- No. 3 Brown & Sharpe plain Milling machine, 3 step cone 3½" belt, overhanging arm 4½" diameter, table 14" wide by 60" long, working surface length 48", 3 arbors and countershaft ... 550
- Large Manufacturers type, Pratt & Whitney pattern table 5' x 2' x 6" with four T slots, overhanging arm 40" long by 4" diameter, outside harness support to arm, 3 step cone 14" x 4⅛", complete and in A1 condition ... 500
- Two No. 2 American plain Milling machines, back geared, gear box feed, 15 changes, table 14" x 42" with four T slots, each ... 500
- Two No. 3 American plain Milling machines, back geared, gear box feed, 15 changes, table 14" x 52" with four T slots, each ... 600
- No. 2 Newton vertical Milling machines, diameter of round table over "T" slots 32", diameter of table overall 37½", table has automatic feed motion in all directions with four changes of speed, and can be clamped in position when milling. Greatest height under spindle 14", cross feed 26", distance center of spindle to column [illegible]" ... 750
- Rockford Hand Milling Machine, overhanging arm, table 13" long by [illegible]" wide, [illegible] complete. A first class machine and like new ... 125
- Two Garvin Lincoln type Millers, table 7½" x 28", not T slotted but tongue grooved for vise and jigs, 3 step cone 6" x 30" for 2½" belt, length of feed 14". Machines are back geared, each ... 225
- Five Pratt & Whitney No. 2 Lincoln type Millers, back geared, tables 6½" x 27½", not T slotted, but tongue grooved for vise and jigs, 3 step cone for 2½" belt, automatic feed 14", swings over table 8", each ... 225
- No. 7 Becker Brainard Lincoln type Miller, back geared, table 6" x 8", not T slotted, but tongue grooved for vise and jigs, 3 step cone, [illegible]" belt, automatic feed 14", swings over the table 8"... 225
- No. 2 O [illegible] back geared plain Miller with overhanging arm [illegible] ... 350
- Duplex Miller, table 12' long by 20" wide, 2 horizontal spindle 3½" diameter, spindle adjustable in and out, minimum distance between spindles 6", maximum distance between spindles 58". Very powerful drive [illegible] quick return [illegible] new. Cost new $[illegible]. Our price ... 2000

SHAPERS

- 15" Hendey, complete with vise and countershaft 20[illegible]
- 16" Smith & Mills [illegible] ... 200
- 20" Hendey [illegible] ... 25[illegible]
- 24" Hendey [illegible] with vise and countershaft ... [illegible]

PLANERS

- [illegible]" x [illegible]" x [illegible]' [illegible] wide by [illegible]" thick at edge, [illegible] T [illegible] ... 5[illegible]
- [illegible]" x 30" x 1[illegible]' New Bement Planer [illegible], automatic feed, [illegible] belt drive ... 600

GRINDERS

- No. [illegible] [illegible] Grinder, [illegible]" wheel on [illegible] ... [illegible]

BORING MACHINES

- Two No. [illegible] Beaman & Smith Standard Boring and Drilling Machines [illegible] two cross movements parallel with the spindle, [illegible] ... [illegible]
- [illegible] Vertical Boring Machine [illegible] under spindle, cost new $1[illegible] ... 17[illegible]

The Co-operative Used Machinery Company

TELEPHONE CORTLANDT 665 — 50 CHURCH ST., N. Y. CITY

Furnaces, Heat Treating, Hardening and Tempering.
Can. Hoskins, Ltd., Walkerville, Ont.
Chicago Flexible Shaft Co., Chicago, Ill.
Mechanical Engineering Co., 55 Cote St., Montreal, Que.
Tate, Jones & Co., Pittsburgh, Pa.
Whiting Foundry Equipment Co., Harvey, Ill.

Furnaces, Forging.
Whiting Foundry Equipment Co., Harvey, Ill.

Furnaces, Annealing, etc.
Can. Hoskins, Ltd., Walkerville, Ont.
Chicago Flexible Shaft Co., Chicago, Ill.
Mechanical Engineering Co., 55 Cote St., Montreal, Que.
Tate, Jones & Co., Pittsburgh, Pa.
Whiting Foundry Equipment Co., Harvey, Ill.

Furnaces for Baking, Bluing, Drying, Enameling, Japanning and Lacquering.
Oven Equipment & Mfg. Co., New Haven, Conn.

Furnace Lining.
Can. H. W. Johns-Manville Co., Limited, Toronto.

Fuse Cap Machinery.
Noble & Westbrook Mfg. Co., Hartford, Conn.

Gang Planer Tools.
Armstrong Bros. Tool Co., Chicago.
Ready Tool Co., Bridgeport, Conn.

Gaskets, Leather, etc.
Graton & Knight Mfg. Co., Montreal.
Can. H. W. Johns-Manville Co., Limited, Toronto.

Gas Blowers and Exhausters.
Can. Buffalo Forge Co., Montreal.
Can. Sirocco Co., Ltd., Windsor, Ont.
Sheldons, Limited, Galt.
Southwark Foundry & Machine Co., Philadelphia, Pa.

Gas Burners.
Oven Equipment & Mfg. Co., New Haven, Conn.

Gas Machines.
Brown, Boggs & Co., Hamilton, Can.

Gas Producer Plants.
Can. Fairbanks-Morse Co., Montreal.

Gauges, Hydraulic Pressure.
Charles F. Elmes Eng. Works, Chicago
Watson-Stillman Co., Aldene, N.J.

Gauges, Standard.
Can. Fairbanks-Morse Co., Montreal.
Cleveland Twist Drill Co., Cleveland.
Greenfield Tap & Die Corporation, Greenfield, Mass.
Holden-Morgan Co., Toronto.
Morse Twist Drill and Machine Co., New Bedford.
Pratt & Whitney Co., Hartford, Conn.
Garvin Machine Co., New York.
National Machinery & Supply Co., Hamilton.

Gear-Cutting Machinery.
Girard Machine & Tool Co., Philadelphia, Pa.
Hamilton Gear & Machine Co., Toronto.
Hill, Clarke & Co., of Chicago, Chicago, Ill.
Motch & Merryweather Machy. Co., Cleveland, O.
National Machinery & Supply Co., Hamilton.
A. R. Williams Machy. Co., Toronto.
Sheldons, Limited, Galt, Ont.
The Smart-Turner Machine Co., Hamilton.
Wm. Tod Co., Youngstown, O.
D. E. Whiton Machine Co., New London, Conn.

Gears, Cut, Mortise, Angle, Worm.
Gardner, Robt., & Son, Montreal.
Hamilton Gear & Machine Co., Toronto.
Hull Iron & Steel Foundries, Ltd., Hull, Quebec.
Jones & Glassco, Montreal, P.Q.
Mesta Machine Co., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Smart-Turner Machine Co., Hamilton, Ont.
Wm. Tod Co., Youngstown, O.

Gears, Rawhide.
Gardner, Robt., & Son, Montreal.
Hamilton Gear & Machine Co., Toronto.
Jones & Glassco, Montreal, P.Q.
Philadelphia Gear Works, Philadelphia, Pa.
Smart-Turner Machine Co., Hamilton, Ont.

Generators, Electric.
A. R. Williams Machy. Co., Toronto.
Can. Fairbanks-Morse Co., Montreal.
Lancashire Dynamo and Motor Co., Ltd., Toronto.
Toronto and Hamilton Electric Co., Hamilton.

Grain for Polishing.
Norton Co., Worcester, Mass.

Graphite.
Can. H. W. Johns-Manville Co., Ltd., Toronto.
Jos. Dixon Crucible Co., Jersey City.
Stevens, F. B., Detroit, Mich.

Grinders, Automatic Knife.
W. H. Banfield & Son, Toronto.

Grinders, Centre, Pedestal and Bench.
Canadian Hart Wheels, Ltd., Hamilton, Ont.
Cleveland Pneumatic Tool Co. of Canada, Toronto.
Ford-Smith Machine Co., Hamilton.
Foss & Hill Machy. Co., Montreal.
Gray Mfg. & Machine Co., Toronto.
Niles-Bement-Pond Co., New York.
Modern Tool Co., Erie, Pa.
Morse Twist Drill and Machine Co., New Bedford.
New Britain Machine Co., New Britain, Conn.
Norton Grinding Co., Worcester, Mass.
Stow Mfg. Co., Binghamton, N.Y.
United States Electrical Tool Co., Cincinnati, O.

Grinders, Cutter.
Brown & Sharpe Mfg. Co., Providence, R.I.
Foss & Hill Machy. Co., Montreal.
Greenfield Machine Co., Greenfield, Mass.
Pratt & Whitney Co., Dundas, Ont.

Grinders, Die Chaser.
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Landis Machine Co., Waynesboro, Pa.
Modern Tool Co., Erie, Pa.

Grinders, Disk.
Armstrong Bros. Tool Co., Chicago, Ill.
Gardner Machine Co., Beloit, Wis.
Norton Grinding Co., Worcester, Mass.

Grinders, Drill.
Garvin Machine Co., New York.
United States Electric Tool Co., Cincinnati, O.

Grinders, Cylinder, Internal.
Brown & Sharpe Mfg. Co., Providence, R.I.
Foss & Hill Machy. Co., Montreal.
Girard Machine & Tool Co., Philadelphia, Pa.
Grant Mfg. & Machine Co., Bridgeport, Conn.
Greenfield Machine Co., Greenfield, Mass.
Hill, Clarke & Co. of Chicago, Chicago, Ill.
Landis Tool Co., Waynesboro, Pa.
Modern Tool Co., Erie, Pa.
Motch & Merryweather Machy. Co., Cleveland, O.
Norton Grinding Co., Worcester, Mass.
Rivett Lathe & Grinder Co., Boston, Mass.

Grinders, Electric.
Lintz-Porter Co., Toronto.

Grinders, Pneumatic.
Cleveland Pneumatic Tool Co. of Canada, Toronto.
Independent Pneumatic Tool Co., Chicago, Ill.

Grinders, Portable, Electric, Hand, Tool, Post, Floor and Bench.
Baird Machine Co., Bridgeport, Conn.
Brown & Sharpe Mfg. Co., Providence, R.I.
Foss & Hill Machy. Co., Montreal.
Grant Mfg. & Machine Co., Bridgeport, Conn.
Greenfield Machine Co., Greenfield, Mass.
Hill, Clarke & Co. of Chicago, Chicago, Ill.
Hisey-Wolf Machine Co., Cincinnati, O.
Landis Tool Co., Waynesboro, Pa.
Motch & Merryweather Machy. Co., Cleveland, O.
Norton Co., Worcester, Mass.
United States Electrical Tool Co., Cincinnati.
A. R. Williams Machy. Co., Toronto.

Grinders, Swing, Portable, Electric.
Hisey-Wolf Machine Co., Cincinnati, O.
United States Electrical Tool Co., Cincinnati.

Grinders, Tool and Holders.
Armstrong Bros. Tool Co., Chicago.
W. F. & John Barnes Co., Rockford, Ill.
Blount, J. G., & Co., Everett, Mass.
Brown & Sharpe Mfg. Co., Providence, R.I.
Greenfield Machine Co., Greenfield, Mass.
Hill, Clarke & Co. of Chicago, Chicago, Ill.
Motch & Merryweather Machy. Co., Cleveland, O.
Ready Tool Co., Bridgeport, Conn.
Tabor Mfg. Co., Philadelphia, Pa.

Grinders, Universal, Plain.
Girard Machine & Tool Co., Philadelphia, Pa.
Landis Tool Co., Waynesboro, Pa.
Modern Tool Co., Erie, Pa.

Grinders, Vertical Surface.
Brown & Sharpe Mfg. Co., Providence, R.I.
Can. Fairbanks-Morse Co., Montreal.
Girard Machine & Tool Co., Philadelphia, Pa.
Pratt & Whitney Co., Dundas, Ont.

Grinding and Polishing Machines, Portable, Pneumatic and Spring Frame.
Can. Fairbanks-Morse Co., Montreal.
Canadian Hart Wheels, Ltd., Hamilton, Ont.
Gardner, Robt., & Son, Montreal.
Garvin Machine Co., New York.
Girard Machine & Tool Co., Philadelphia, Pa.
Gray Mfg. & Machine Co., Toronto.
Greenfield Machine Co., Greenfield, Mass.
Hall & Sons, John H., Brantford.
Hill, Clarke & Co. of Chicago, Chicago, Ill.
Motch & Merryweather Machy. Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Norton Co., Worcester, Mass.
Stow Mfg. Co., Binghamton, N.Y.

Grinding Wheels.
Can. Fairbanks-Morse Co., Montreal.
Canadian Hart Wheels, Ltd., Hamilton, Ont.
Carborundum Co., Niagara Falls.
Ford-Smith Machine Co., Hamilton, Canada.
Gray Mfg. & Machine Co., Toronto.
Norton Co., Worcester, Mass.

Guards, Window and Machine.
Canada Wire & Iron Goods Co., Hamilton, Ont.
Dennis Wire & Iron Works Co., Ltd., London, Canada.
Standard Tube & Fence Co., Woodstock, Ont.

Hack Saw Blades.
E. C. Atkins & Co., Hamilton, Ont.
Victor Saw Works, Ltd., Hamilton, Canada.
Diamond Saw & Stamping Works, Buffalo, N.Y.
Racine Tool & Machine Co., Racine, Wis.
L. S. Starrett Co., Athol, Mass.

Hack Saw Frames.
E. C. Atkins & Co., Hamilton, Ont.
Ford-Smith Machine Co., Hamilton, Canada.
Garvin Machine Co., New York City.
Mussens, Limited, Montreal.

Hammer High Speed.
High Speed Hammer Co., Rochester, N.Y.

Hammers, Drop and Belt Driven.
Bliss, E. W., Co., Brooklyn, N.Y.
Brown, Boggs Co., Ltd., Hamilton, Canada.
Canadian Billings & Spencer, Ltd., Welland.
A. B. Jardine & Co., Hespeler, Ont.
Girard Machine & Tool Co., Philadelphia, Pa.
National Machinery & Supply Co., Hamilton.
Niles-Bement-Pond Co., New York.
Plessisville Foundry, Plessisville, Que.
Toledo Machine & Tool Co., Toledo.

Hammers, Helve Power.
West Tire Setter Co., Rochester, N.Y.

Hammers, Pneumatic.
Cleveland Pneumatic Tool Co., of Canada, Toronto.
Pittsburg Pneumatic Co., Canton, Ohio.

Hammers, Steam.
John Bertram & Sons Co., Dundas.
Girard Machine & Tool Co., Philadelphia, Pa.
National Machinery & Supply Co., Hamilton.
Niles-Bement-Pond Co., New York.

Hand Hoists & Trolleys.
Whiting Foundry Equipment Co., Harvey, Ill.

Hand Leathers or Pads.
Graton & Knight Mfg. Co., Montreal.

Hangers.
Baird Machine Co., Bridgeport, Conn.
Gardner, Robt., & Son, Montreal.
The Smart-Turner Machine Co., Hamilton.

Hardness Testing Instruments.
Shore Instrument & Mfg. Co., New York.

Heating and Ventilating Engineers.
Can. Buffalo Forge Co., Montreal.
Can. Sirocco Co., Ltd., Windsor, Ont.
Sheldons, Ltd., Galt, Ont.

Heat Gauges, Hardening and Annealing.
Shore Instrument & Mfg. Co., New York.

Hinge Machinery.
Baird Machine Co., Bridgeport, Conn.

Hinges.
London Bolt & Hinge Works, London, Ont.

Hoists, Hydraulic.
Southwark Foundry & Machine Co., Philadelphia.
Watson-Stillman Co., Aldene, N.J.

Hoisting and Conveying Machinery.
Northern Crane Works, Walkerville.
Owen Sound Iron Works Co., Owen Sound.
Southwark Foundry & Machine Co., Philadelphia.
Whiting Foundry Equipment Co., Harvey, Ill.

Hoists, Chain, Electric and Pneumatic.
Northern Crane Works, Walkerville.
Whiting Foundry Equipment Co., Harvey, Ill.

Hoists, Electric.
Northern Crane Works, Walkerville.
Whiting Foundry Equipment Co., Harvey, Ill.

Hoppers.
Toronto Iron Works, Ltd., Toronto.

Hose Clamp Tool.
Cleveland Pneumatic Tool Co. of Canada, Toronto.

Hose, Pneumatic.
Cleveland Pneumatic Tool Co., of Canada, Toronto.

Hose, Steam, Suction and Water.
Can. H. W. Johns-Manville Co., Limited, Toronto.

Holders for Dies and Drills.
Wells Brothers, Company, Greenfield, Mass.
Wilt Twist Drill Co. of Canada, Ltd., Walkerville, Ont.

Hydraulic Accumulators.
Can. Boomer & Boschert Press Co., Montreal.
Can. Fairbanks-Morse Co., Montreal.
Niles-Bement-Pond Co., New York.
Wm. R. Perrin Co., Toronto.
The Smart-Turner Machine Co., Hamilton.
Southwark Foundry & Machine Co., Philadelphia.
Watson-Stillman Co., Aldene, N.J.

Hydraulic Machinery.
Can. Boomer & Boschert Press Co., Montreal.
Charles F. Elmes Eng. Works, Chicago.
Niles-Bement-Pond Co., New York.
National Machinery & Supply Co., Hamilton.
Southwark Foundry & Machine Co., Philadelphia.
Wm. Tod Co., Youngstown, O.
Watson-Stillman Co., Aldene, N.J.

Indicators, Speed.
Brown & Sharpe Mfg. Co., Providence, R.I.
L. S. Starrett Co., Athol, Mass.

Index Centres.
Fred. C. Dickow, Chicago, Ill.
Garvin Machine Co., New York.

Ingot Metals.
A. C. Leslie & Co., Ltd., Montreal.

Intensifiers.
Mesta Machine Co., Pittsburg, Pa.

Iron Filler.
Can. H. W. Johns-Manville Co., Ltd., Toronto.

Iron Ore.
Hanna & Co., M. A., Cleveland, O.

Jacks, Hydraulic.
Charles F. Elmes Eng. Works, Chicago
Southwark Foundry & Machine Co., Philadelphia.
Watson-Stillman Co., Aldene, N.J.

Jacks.
Can. Fairbanks-Morse Co., Montreal.
Northern Crane Works, Walkerville.
Norton, A. O., Coaticook, Que.
Plessisville Foundry, Plessisville, Que.

Jacks, Pneumatic.
Northern Crane Works, Walkerville.

Jacks, Pit and Track.
Can. Fairbanks-Morse Co., Montreal.
Northern Crane Works, Walkerville.
Watson-Stillman Co., Aldene, N.J.

Japanning Ovens.
Oven Equipment & Mfg. Co., New Haven, Conn.

Jaws, Face Plate.
Cushman Chuck Co., Hartford, Conn.
Skinner Chuck Co., New Britain, Conn.

IMMEDIATE DELIVERY

MACHINE TOOLS

2—10″x4′ South Bend
1—11″x4′ Monarch
1—13″x6′ Robbins
1—13″x6′ Blaisdell
1—13″x5′ Reed
1—13″x5½′ C. J. Quick-Change, new
1—14″x6′ C. J. Quick-Change, new
1—14″x8′ C. J. Quick-Change, new
1—14″x10′ Hendey, taper attachment
1—new 14″x6′ Cisco
1—14″x6′ Blaisdell
1—15″x6′ Wood & Light
1—15″x6′ Kelly
1—15″x7′ Porter
1—15″x6′ Bradford
6—new 16″x8′ 3-step cone D B C
2—16″x6′ Reed
1—16″x6′ Harrington
1—18″x10′ Lodge & Davis, rod feed
1—18″x10′ Cincinnati
2—19″x7′ Blaisdell, rod feed
2—19″x9′ Blaisdell, rod feed
1—20″x12′ Fifield
1—24″x12′ New Haven
1—24″x12′ Ames
1—24″x40″x14′ McCabe, double spindle
2—22″x10′ Pond
1—26″x13′ Bement
1—27″x22′ Pratt & Whitney
1—33″x13′ Bement
1—33″x12′ Gap
1—84″x30′ Bement

Subject to prior sale.

SPECIAL ATTENTION

Patterns, Drawings and partly finished stock of a set of 14″ 16″ 18″—20″ Standard Engine Lathe for sale, reasonable prices.

TURRET LATHES

40″ Conardeon Turret Lathe, 3¾″ hollow spindle
2—1″ Bardon & Oliver automatic chuck
1—1¼″ Bardon & Oliver wire feed screw machine
1—1¼″ Gridley automatic
No. 2 Pratt & Whitney
No. 1 Garvin
1—14″x4′ Dresco Lathe with cut-off slide
2—14″x5′ Warner & Swasey fox lathes
1—15″x5′ Johnson turret lathe
1—16″x5′ Windeur turret lathe, with cut-off slide
1—21″ Gisholt
1″ Cleveland Automatic screw machine

MILLING MACHINES

36″x12′ Heavy duty Slab milling machine
No. 13 Brainard universal, with index centres, 6½″x43″ table.
No. 23 Brown & Sharpe plain, 51″x7″ table.
No. 2 Cincinnati universal milling machine
No. 8 Kempsmith full Universal
Brainard plain No. 1, table 50″x12″.
Brainard No. 3 plain, table 30″x7″.
Vertical milling machine, table 15″x24″.
2—No. 3 Garvin plain, table 24″x6″.
Pratt & Whitney horizontal, will mill 27″ wide, 6′ long.
No. 3½ Fox
No. 3 set universal dividing heads complete, like new.
Several hand feed milling machines.

SHAPERS

8″ stroke Bement.
12″ Springfield
12″ stroke Fitchburg
14″ Walcott
16″ Pratt & Whitney
16″ Friction drive
18″ Bement traveling head
21″ B. G. Smith & Mills.

PLANERS

11′x9′x10′ Old Style
54″x48″x8′6″ Sellers, 2 heads
48″x48″x15′ Sellers, 2 heads
48″x36″x12′ Betts, 1 head
42″x36″x12′ Cincinnati, 2 heads
33″x33″x12′ Woodward & Powell

(Planers continued)

2—36″x36″x14′ Cincinnati, 2 heads
36″x32″x12′ New Haven
35″x42″x8′ Putnam, 1 head
32″x28″x11′ New Haven, 1 head
32″x32″x14′ Ponds, 2 heads
30″x30″x12′ Standard, 1 head
30″x30″x9′ Whitcomb, 1 head
30″x24″x6′ Freeland, 1 head
28″x28″x8′ New Haven, 1 head
24″x24″x6′ Flather
18″x18″x5′ Pond, 1 head
12″ Moore, crank.

BORING MILLS

2—36″ Bullard vertical, 2 heads
Baker Bros. vertical boring mill style 01
40″ Beaman & Smith, Horizontal cylinder borer, 2¾″ spindle
48″ Bement horizontal, 5″ spindle
48″ Sellers, vertical, 2 heads
60″ Sellers, vertical, 2 heads
60″ Harrington pulley boring mill, upright, single spindle
No. 0 Deitrick & Harvey, horizontal boring, drilling and milling machine, 4″ spindle.

RADIAL DRILL PRESSES

48″ Dreses
42″ Prentice Gear Box
33″ from wall to centre of spindle, boiler maker's wall drill
2—42″ Betts
36″ Hilbert
3′ Bickford plain radial.

MULTIPLE SPINDLE DRILLS

2—2-spindle plain drill press, power feed to spindle
3-spindle Barr sensitive drill
2-spindle Pilton sensitive drill
Several 3 and 4-spindle drills, old style.

DRILL PRESSES

2—10″ Dwight Slate sensitive drills, column type
10″ sensitive, square table
10″ friction drive drill press, column type
12″ sensitive, including chuck
13″-16″ Avey sensitive drill, high speed
14″-16″ Pilton sensitive drill
14″-16″ Barr
14″ sensitive drill, column type
15″ Barnes, plain
20″ Snyder, plain upright
20″ plain drill press, old style
20″ wheel and lever feed Superior, plain
20″ Barnes, back-geared and power feed
20″ Sibley & Ware, plain
20″ Silver plain wheel and lever feed
20″ Prentice
21″ Hoeffer B. G.
22″ Blaisdell
22″ Dodge & Day, back-geared
22″ Barnes, back-geared and power feed.
22″ Cincinnati, sliding head
3—24″ Sibley & Ware
24″ Bement
24″ Barnes, sliding head, back-geared
24″ Cincinnati, plain
24″ old style
24″ Lathe & Morse, plain
28″ stationary head, plain drill
1—30″ Prentice, back-geared and power feed.
36″ Snyder sliding head, back-geared and power feed.
Hisey & Wolf Electric drill press.

POWER AND FOOT PRESSES

No. 5 Stiles
No. 22 Adriance combined horning and wiring press.
Power press, table is 21″x24″, bed is movable
C-2 Ferracute
No. 126 Max Ams
No. 110 Max Ams
Mossberg & Granville Pendulum press
Ferracute heavy foot power press
Several foot power Ferracute presses, with and without stand.

GRINDERS

11″x20″ Landis plain grinder
Hisey & Wolf Electric Internal Grinder
10″ Builders' Iron Works plain emery grinder
2—2½″ spindle Blount Grinder
No. 3 Besley disc
Diamond Combination wet and surface
Wilmarth & Norman twist drill
3 Lancaster ½″ spindle grinders
Barnes wet 14″x2″ wheels
Barnes wet 20″x1¾″ wheels
Armstrong tool and cut-off grinder
16″ Challenge, double end
Whitney wet, 15″x2″ wheels.
Morse twist drill
Sellers twist drill
Diamond twist drill
Gisholt twist drill
Washburn No. 1 twist drill
Springfield surface, table 34″ between pockets, wheel is 12″x4″x1½″
14″ Builders' Iron Foundry head, column and countershaft (2).

SAWS AND HACK SAWS

6″ capacity Quincy, Manchester & Sargent Co., cold saw.
All sizes of second-hand hack saws
5″ capacity North Wales
6″ capacity North Wales
7″ capacity North Wales
5″ Marvel
6″ Marvel
5′ Capacity Cochrane, Blye, Civailar Saw.

HAMMERS

100-lb. Little Giant Belt
250-lb. Bement Miles single frame
350-lb. Bement Miles single frame
600-lb. Pratt & Whitney Board Lift
3500-lb. Bement Miles & Co., double frame.

HYDRAULIC PRESSES

15062—Ten 350-ton Boomer & Boschert extra heavy downward pressure Hydraulic Presses, steel beams, steel cylinders, iron platens. Inside diameter of cylinder 20″. Diameter of steel rods 4½″. Width between rods 72″. Movement of rams about 48″. Platen 62″ square.

15063—One 350-ton Boomer & Boschert extra heavy downward pressure Hydraulic Press, steel beams, steel cylinder, iron platen. Inside diameter of cylinder 15″. Diameter of steel rods 4½″. Width between rods 72″. Movement of ram about 48″. Platen 62″ square.

MISCELLANEOUS

No. 4 Williams & White Bulldozer
Whiton Hand Feed Gear Cutter
Die Filing Machine
Bar Universal tool grinding machine
30″ Niagara foot power squaring shear
Mossburg & Granville pendulum foot press
Putnam Nut Facing Machine
Hand rotary circular shears
30″ Peck, Stow & Wilcox tinners' rolls.
1 Press for disc grinder wheels
No. 3 set of universal dividing heads for Cincinnati milling machine.
6¾″x8″ Boring Bar
6 15/16″x6′7″ Boring Bar
11½″x10′ Boring Bar
Hand power lever shears, 10″ blade
Hand screw press, 3½″ screw
96″ Cornice Brake
1 Knuckle joint hot press complete with burner and brass plate
22″ swing lathe head
Hisey & Wolf Horizontal Tapping and Boring Machine mounted on bed
2″ to 1″ crane compound rest, tool and die
Patterns and drawings for 16″x6′ lathe, and castings for 4 lathes
2 spindle Pratt & Whitney Profiling Machine
10″ Lowell slotter.

PARTIAL LIST. SEND FOR COMPLETE BOOKLET.

FRANK TOOMEY, Inc., 127-131 N. 3rd Street, Philadelphia, Pa.

Jigs, Tools, etc.
Hamilton Gear & Machine Co., Toronto.

Joints, Expansion.
Pittsburg Valve, Foundry & Construction Co., Pittsburg, Pa.

Key Seaters.
Baker Bros., Toledo, O.
Garvin Machine Co., New York.
Morton Mfg. Co., Muskegon Height-Mich.
A. R. Williams Machy. Co., Toronto.

Kilns.
Can. Buffalo Forge Co., Montreal.
Sheldons, Limited, Galt, Ont.

Lacquering Ovens.
Oven Equipment & Mfg. Co., New Haven, Conn.

Ladles, Foundry.
Northern Crane Works, Walkerville.
Whiting Foundry Equipment Co., Harvey, Ill.

Lag Screw Gimlet Pointers.
National Machy. Co., Tiffin, Ohio.

Lamps, Arc and Incandescent.
Can. Fairbanks-Morse Co., Montreal.
Can. H. W. Johns-Manville Co., Limited, Toronto.
Ker & Goodwin, Brantford.

Lamps, Tungsten.
Lintz Porter Co., Toronto.

Lathe Chucks.
Ker & Goodwin, Brantford.

Lathe Attachment for Shells.
Lymburner, Ltd., Montreal.

Lathes, Automatic.
Windsor Machine Co., Windsor, Vt.

Lathe Dogs and Attachments.
Armstrong Bros. Tool Co., Chicago.
Fay & Scott, Dexter, Maine.
Hendey Machine Co., Torrington, Conn.
Ready Tool Co., Bridgeport, Conn.
National Forge & Tool Co., Erie, Pa.
J. H. Williams Co., Brooklyn, N.Y.

Lathes, Bench.
W. F. & John Barnes Co., Rockford.
Blount, J. G., & Co., Everett, Mass.
Can. Fairbanks-Morse Co., Montreal.
Pratt & Whitney Co., Dundas, Ont.

Lathes, Band Turning.
Jenckes Machine Co., Sherbrooke, Que.

Lathes, Engine.
American Woodworking Machy. Co., Toronto.
Canada Machinery Corp., Galt, Ont.
A. R. Williams Machy. Co., Toronto.
W. F. & John Barnes Co., Rockford, Ill.
John Bertram & Sons Co., Dundas.
Can. Fairbanks-Morse Co., Montreal.
Cincinnati Iron & Steel Co., Cincinnati, O.
Fay & Scott, Dexter, Maine.
Foss & Hill Machy. Co., Montreal.
Gardner, Robt., & Son, Montreal.
Garvin Machine Co., New York.
Girard Machine & Tool Co., Philadelphia, Pa.
Hendey Machine Co., Torrington, Conn.
Hill, Clarke & Co., of Chicago, Ill.
R. McDougall Co., Galt.
Motch & Merryweather Machy. Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Dundas, Ont.

Lathe Pans.
New Britain Machine Co., New Britain, Conn.

Lathes, Patternmakers'.
J. G. Blount Co., Everett, Mass.
Fay & Scott, Dexter, Maine
Foss & Hill Machy. Co., Montreal
Mussens, Limited, Montreal.

Lathes, Screw Cutting.
A. R. Williams Machy. Co., Toronto.
John Bertram & Sons Co., Dundas.
Canada Machinery Corp., Galt, Ont.
Cincinnati Iron & Steel Co., Cincinnati O.
Girard Machine & Tool Co., Philadelphia, Pa.
Mesta Machine Co., Pittsburg, Pa.
Motch & Merryweather Machy. Co., Cleveland, O.
Niles-Bement-Pond Co., New York.

Lathes, Spinning.
Bliss, E. W., Co., Brooklyn, N.Y.
Toledo Mach. & Tool Co., Toledo, O.

Lathe, Turret and Speed.
American Woodworking Machy. Co., Toronto.
John Bertram & Sons Co., Dundas.
Blount, J. G., & Co., Everett, Mass.
Brown & Sharpe Mfg. Co., Providence, R.I.
Can. Fairbanks-Morse Co., Montreal.
Canada Machinery Corp., Galt, Ont.
Cincinnati Iron & Steel Co., Cincinnati, O.
Colburn Machine Tool Co., Franklin Pa.
Fay & Scott, Dexter, Maine.
Foss & Hill Machy. Co., Montreal.
Garvin Machine Co., New York.
Girard Machine & Tool Co., Philadelphia, Pa.
Mesta Machine Co., Pittsburg, Pa.
Motch & Merryweather Machy. Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Dundas, Ont.
Rockford Milling Machine Co., Rockford, Ill.
Warner & Swasey Co., Cleveland, O.
Windsor Machine Co., Windsor, Vt.
A. R. Williams Machy. Co., Toronto.

Leather Strapping.
Graton & Knight Mfg. Co., Montreal.

Lifts, Pneumatic.
Whiting Foundry Equipment Co., Harvey, Ill.

Lighting Fixtures.
Lintz-Porter Co., Toronto.

Link Belting.
Can. Fairbanks-Morse Co., Montreal.
Graton & Knight Mfg. Co., Montreal.
Jones & Glassco, Montreal.

Linoleum Mill Machinery.
Bertrams, Ltd., Edinburgh, Scotland.

Liquid Air.
L'Air Liquide Society, Montreal, Toronto.
Lever Bros., Toronto.

Lockers, Steel Wardrobe and Steel Material.
Canada Wire & Iron Goods Co., Hamilton, Ont.
Dennis Wire & Iron Works Co., Ltd., London, Canada.

Lockers.
Canada Wire & Iron Goods Co., Hamilton, Ont.
Dennis Wire & Iron Works Co., Ltd., London, Canada.

Locomotive Equipment.
Can. Locomotive Co., Kingston, Ont.

Locomotives, Railroading, Contracting.
Can. Locomotive Co., Kingston, Ont.
National Machinery & Supply Co., Hamilton.

Lubricants.
S. F. Bowser & Co., Fort Wayne, Ind.
Can. Economic Lubricant Co., Montreal.
Can. Oil Company, Toronto.
Caraget Refining Co., Toronto.
Crescent Oil Co., Inc., New York.

Machine Tools.
Brown & Sharpe Mfg. Co., Providence, R.I.
Can. Fairbanks-Morse Co., Montreal.
Can. Machinery Corp., Galt, Ont.
Modern Tool Co., Erie, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Dundas, Ont.
J. H. Williams Co., Brooklyn, N.Y.

Machinery Dealers.
Can. Fairbanks-Morse Co., Montreal
Co-operative Used Machy. Co., New York
Hill, Clarke & Co., of Chicago
Marshall & Huschart Machinery Co., Chicago.
National Machinery & Supply Co., Hamilton.
Frank Toomey, Inc., New York.
A. R. Williams Machy. Co., Toronto
New York Machinery Exchange, New York.

Machinery Guards.
Jones & Glassco, Montreal, P.Q.
Canada Wire & Iron Goods Co. Hamilton, Ont.
A. R. Williams Machy. Co., Toronto.

Machinery Repairs.
Cunningham & Sons, St. Catharines, Ont.
Plessisville Foundry, Plessisville, Que.

Machinists' Scales, Small Tools and Supplies.
Can. Fairbanks-Morse Co., Montreal.
National Forge & Tool Co., Erie, Pa.
Ready Tool Co., Bridgeport, Conn.
Frank H. Scott, Montreal.
J. H. Williams & Co., Brooklyn, N.Y.

Magnetos.
Lintz Porter Co., Toronto

Mandrels.
Can. Fairbanks-Morse Co., Montreal
Cleveland Twist Drill Co., Cleveland.
A. B. Jardine & Co., Hespeler, Ont.
Morse Twist Drill and Machine Co., New Bedford.
Pratt & Whitney Co., Dundas, Ont.
Wilt Twist Drill Co. of Canada, Ltd., Walkerville, Ont.

Marine Engines.
Cunningham & Sons, St. Catharines, Ont.

Marking Machinery.
Brown, Boggs Co., Hamilton, Ont.
Holden-Morgan Co., Toronto.
Noble & Westbrook Mfg. Co., Hartford, Conn.

Marquisees.
Dennis Wire & Iron Works, London, Ont.

Measuring Tapes and Rules.
James Chesterman & Co., Ltd., Sheffield, Eng.

Metallurgists.
Canadian Inspection & Testing Laboratories, Ltd., Montreal.
Toronto Testing Laboratory, Ltd., Toronto.

Metal Cutting Machines.
Racine Tool & Machine Co., Racine, Wis.

Metal Stamping.
Duncan Electrical Co., Montreal.

Meters, Electrical.
Can. H. W. Johns Manville Co., Ltd., Toronto.
Lintz-Porter Co., Toronto.

Mill Machinery.
Cunningham & Sons, St Catharines, Ont.
Alexander Fleck, Ltd., Ottawa.

Milling Attachments.
John Bertram & Sons Co., Dundas.
Brown & Sharpe Mfg. Co., Providence.
Cincinnati Milling Machine Co., Cincinnati.
Hendey Mach. Co., Torrington, Conn.
Kempsmith Mfg. Co. Milwaukee, W.
Mesta Machine Co., Pittsburg, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Dundas, Ont.
Rockford Milling Machine Co., Rockford, Ill.

Milling Machines, Horizontal and Vertical.
A. R. Williams Machy. Co., Toronto.
Brown & Sharpe Mfg. Co., Providence.
Hill, Clarke & Co. of Chicago, Chicago, Ill.
John Bertram & Sons Co., Dundas.
Foss & Hill Machy. Co., Montreal.
Girard Machine & Tool Co., Philadelphia, Pa.
Gooley & Edlund, Cortland, N.Y.
Kempsmith Mfg. Co., Milwaukee, W.
Mesta Machine Co., Pittsburg, Pa.
Motch & Merryweather Machy. Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Dundas, Ont.
Rockford Milling Machine Co., Rockford, Ill.

Milling Machines, Plain, Bench and Universal.
Brown & Sharpe Mfg. Co., Providence, R.I.
Cincinnati Milling Machine Co., Cincinnati.
Foss & Hill Machy. Co., Montreal.
Garvin Machine Co., New York.
Gooley & Edlund, Cortland, N.Y.
Hill, Clarke & Co., of Chicago, Chicago, Ill.
Hendey Machine Co., Torrington.
Kempsmith Mfg. Co., Milwaukee, Wis.
Mesta Machine Co., Pittsburg, Pa.
Motch & Merryweather Machy. Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Dundas, Ont.
Rockford Milling Machine Co., Rockford, Ill.
A. R. Williams Machy. Co., Toronto.

Milling Machines, Profile.
Brown & Sharpe Mfg. Co., Providence.
Can. Fairbanks-Morse Co., Montreal.
Foss & Hill Machy. Co., Montreal.
Garvin Machine Co., New York.
Girard Machine & Tool Co., Philadelphia, Pa.
Mesta Machine Co., Pittsburg, Pa.
Motch & Merryweather Machy. Co., Cleveland, O.
Pratt & Whitney Co., Dundas, Ont.

Milling Tools.
Brown & Sharpe Mfg. Co., Providence.
Geometric Tool Co., New Haven, Conn.
Kempsmith Mfg. Co., Milwaukee, W.

Mine Cars and Hitchings.
Pratt & Whitney Co., Dundas, Ont.
Modern Tool Co., Erie, Pa.
Can. Fairbanks-Morse Co., Montreal.

Mining Machinery.
A. R. Williams Machy. Co., Toronto.
Can. Fairbanks-Morse Co., Montreal.
Cleveland Pneumatic Tool Co., of Canada, Toronto.
Toronto & Hamilton Electric Co., Hamilton, Ont.

Mixers, Hot Metal.
Mesta Machine Co., Pittsburg, Pa.

Mortising Machines.
Jones & Glassco, Montreal.

Motors, Electric.
A. R. Williams Machy. Co., Toronto.
Can. Fairbanks-Morse Co., Montreal.
Lancashire Dynamo & Motor Co., Ltd., Toronto.
Lintz-Porter Co., Toronto
Toronto & Hamilton Electric Co., Hamilton, Ont.

Motors, Pneumatic.
Cleveland Pneumatic Tool Co. of Canada, Toronto.
Independent Pneumatic Tool Co., Chicago.

Multiple Index Centres.
Garvin Machine Co., New York.

Nipple Threading Machines.
John H. Hall & Sons, Ltd., Brantford, Ont.
Landis Machine Co., Waynesboro, Pa.

Nitrogen.
L'Air Liquide Society, Montreal, Toronto.
Lever Bros., Toronto.

Nozzles, Spray.
Can. Buffalo Forge Co., Montreal.

Nuts, Semi-Finish and Finished.
Galt Machine Screw Co., Galt, Ont.
John Morrow Screw Co., Ingersoll Ont.

Nut Burring Machines.
National Machy. Co., Tiffin, O.
National Mach. & Sup. Co., Hamilton

Nut Machines (Hot).
National Machy. Co., Tiffin, O.

Nut Facing and Bolt Shaving Machines.
Garvin Machine Co., New York.
National Machy. Co., Tiffin, O.
National Mach. & Sup. Co., Hamilton

Nut Tappers.
John Bertram & Sons Co., Dundas.
Garvin Machine Co., New York.
Greenfield Tap & Die Corporation, Greenfield, Mass.
Hall, J. H., & Son, Brantford, Ont.
A. B. Jardine & Co., Hespeler.
Landis Machine Co., Waynesboro, Pa.
National Machy. Co., Tiffin, O.
National Mach. & Sup. Co., Hamilton

Nut Wrenches.
Wells Brothers Co., Greenfield, Mass.

Oil Separators.
Can. Fairbanks-Morse Co., Montreal.
Sheldons, Ltd., Galt, Ont.
Smart-Turner Machine Co., Hamilton, Ont.

Oil Stones.
Carborundum Co., Niagara Falls, N.Y.
Norton Co., Worcester, Mass.

Oil Filtering Systems, Etc.
S. F. Bowser & Co., Fort Wayne, Ind.

Ovens for Baking, Bluing, Drying, Enamelling, Japanning, and Lacquering.
Geo. Gorton Machine Co., Racine, Wis.
Oven Equipment & Mfg. Co., New Haven, Conn.
Whiting Foundry Equipment Co., Harvey, Ill.

Oven Trucks, Steel.
Oven Equipment & Mfg. Co., New Haven, Conn.

Ovens for Drying, Temper and Under Trucks.
Oven Equipment & Mfg. Co., New Haven, Conn.

Oscillating Valve Grinders (Pneumatic).
Cleveland Pneumatic Tool Co. of Canada, Toronto.

Oxy-Acetylene Welding and Cutting Plants.
L'Air Liquide Society, Montreal, Toronto.
Lever Bros., Toronto.

Oxygen.
L'Air Liquide Society, Montreal, Toronto.
Lever Bros., Toronto.

Packings, Leather, Hydraulics, Etc.
Graton & Knight Mfg. Co., Montreal.

Packing, Rubber, etc.
Can. H. W. Johns-Manville Co., Ltd., Toronto.

Pans, Lathe.
Cleveland Wire Spring Co., Cleveland

Pans, Steel Shop.
Cleveland Wire Spring Co., Cleveland

Paper Mill Machinery.
Bertrams, Ltd., Edinburgh, Scotland.
Can. Sirocco Co., Ltd., Windsor, Ont.

Partitions.
Canada Wire & Iron Goods Co., Hamilton, Ont.
Dennis Wire & Iron Works Co., Ltd., London, Canada.

Patent Solicitors.
H. J. S. Dennison, Toronto.
Fetherstonhaugh & Co., Ottawa.
Marion & Marion, Montreal.
Ridout & Maybee, Toronto.
Ross Thomson & Co., Ottawa, Ont.
Harold Shipman & Co., Ottawa.

Patterns.
Galt Malleable Iron Co., Galt.
Guelph Pattern Works, Guelph.
Hamilton Pattern & Foundry Co., Hamilton, Ont.
Owen Sound Iron Works Co., Owen Sound, Ont.
Plessisville Foundry, Plessisville, Que.
Toronto Pattern Works, Toronto.
Wells Pattern & Machine Works, Toronto.

Patterns, Metal and Wood.
Guelph Pattern Works, Guelph, Ont.

Perforated Metals and Ornamental Iron Goods.
Canada Wire & Iron Goods Co., Hamilton.

Phosphor Bronze Castings.
Tallman Brass & Metal Co., Hamilton.

Pig Iron.
Hanna & Co., M. A., Cleveland, O.
Stevens, F. B., Detroit, Mich.

Pinions, Mill Cut.
Mesta Machine Co., Pittsburg, Pa.
Wm. Tod Co., Youngstown, O.

Pipe, Bends and Fittings.
Pittsburg Valve, Foundry & Construction Co., Pittsburg, Pa.

Pipe Cutting and Threading Machines.
A. R Williams Machy. Co., Toronto.
Armstrong Mfg. Co., Bridgeport, Conn.
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Butterfield & Co., Rock Island ,Que.
Can. Fairbanks-Morse Co., Montreal.
Foss & Hill Machy. Co., Montreal.
Garvin Machine Co., New York.
Girard Machine & Tool Co., Philadelphia, Pa.
John H. Hall & Sons, Brantford.
A. B. Jardine & Co., Hespeler, Ont.
Landis Machine Co., Waynesboro, Pa.
R. McDougall Co., Galt.
Trimont Mfg. Co., Roxbury, Mass.
Williams Tool Co, Erie, Pa.

Pipe Cutters, Rolling.
Armstrong Mfg. Co., Bridgeport, Conn.
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
John H. Hall & Sons, Ltd., Brantford, Ont.

Pipe, Riveted Steel.
Toronto Iron Works, Ltd., Toronto.

Pipe Straightening Machines.
Watson-Stillman Co., Aldene, N.J.

Planer Drives, Electrical.
Lancashire Dynamo & Motor Co., Ltd., Toronto.
Niles-Bement-Pond Co., New York.

Planer Jacks.
Armstrong Bros. Tool Co., Chicago.
National Forge & Tool Co., Erie, Pa.
Ready Tool Co., Bridgeport, Conn.

Planers, Standard and Rotary.
John Bertram & Sons Co., Dundas.
Can. Fairbanks-Morse Co., Montreal.
Foss & Hill Machy. Co., Montreal.
Gardner, Robt., & Son, Montreal.
Garvin Machine Co., New York.
Girard Machine & Tool Co., Philadelphia, Pa.
Morton Mfg. Co., Muskegon Heights, Mich.
Niles-Bement-Pond Co., New York.

Planing and Shaping Machinery.
A. R. Williams Machy. Co., Toronto.
Can. Fairbanks-Morse Co. Montreal.
Fay & Scott, Dexter, Maine.
Foss & Hill Machy. Co., Montreal.
Garvin Machine Co., New York.
Niles-Bement-Pond Co., New York.

Planing Mill Exhausters.
Can. Buffalo Forge Co., Montreal.
Sheldons, Ltd., Galt, Ont.

Pliers.
Canadian Billings & Spencer, Ltd., Welland.

Pneumatic Tools.
Cleveland Pneumatic Tool Co. of Canada, Toronto.
Curtis Pneumatic Machinery Co., St. Louis, Mo.
Independent Pneumatic Tool Co., Chicago, New York.
Pittsburg Pneumatic Co., Canton, Ohio.

Polishing Machines, Electric and Band.
Can. H. W. Johns-Manville Co., Toronto.

Portable Vise Stands.
New Britain Machine Co., New Britain, Conn.

Portable Steel Tool Racks.
New Britain Machine Co., New Britain, Conn.

Portable Steel Work Stands.
New Britain Machine Co., New Britain, Conn.

Power Plant Equipments.
Can. Fairbanks-Morse Co., Montreal.

Power Transmission.
Mesta Machine Co., Pittsburg, Pa.
The Smart-Turner Mach. Co., Hamilton.

Press Screw (Adjustable).
W. F. & John Barnes Co., Rockford.
Wm. R. Perrin, Ltd., Toronto.

Presses, Bench Straightening.
Toledo Machine & Tool Co., Toledo.

Presses for Shells.
Can. Boomer & Boschert Press Co., Montreal.
Can. Locomotive Co., Kingston, Ont.
Wm. Cramp & Sons Ship & Engine Building Co., Philadelphia, Pa.
Charles F. Elmes Eng. Works, Chicago
Foss & Hill Machy. Co., Montreal.
Goldie & McCulloch Co., Galt, Ont.
Wm. R. Perrin Co., Toronto.
Southwark Foundry & Machine Co., Philadelphia, Pa.
Watson-Stillman Co., Aldene, N.J.
West Tire Setter Co., Rochester, N.Y.

Presses, Cam, Toggle, Eyelet.
Baird Machine Co., Bridgeport, Conn.
Toledo Machine & Tool Co., Toledo, O.

Presses, Broaching.
E. W. Bliss Co., Brooklyn, N.Y.
Toledo Machine & Tool Co., Toledo.
Watson-Stillman & Co., Aldene, N.J.

Presses, Drop.
W. H. Banfield & Son, Toronto.
E. W. Bliss Co, Brooklyn, N.Y.
Brown, Boggs Co., Ltd., Hamilton, Canada.
Can. Boomer & Boschert Press Co., Montreal.
Niles-Bement-Pond Co., New York.
Wm. R. Perrin, Ltd., Toronto.
Toledo Machine & Tool Co., Toledo.
Watson-Stillman Co., Aldene, N.J.

Presses, Filter.
Lymburner, Ltd., Montreal.
Wm. R. Perrin, Ltd., Toronto.

Presses, Forging.
Can. Boomer & Boschert Press Co., Montreal.
E. W. Bliss Co., Brooklyn, N.Y.
Brown, Boggs Co., Ltd., Hamilton, Canada.
Wm. Cramp & Sons Ship & Engine Building Co., Philadelphia, Pa.
Charles F. Elmes Eng. Works, Chicago, Ill.
Can. Fairbanks-Morse Co., Montreal.
Girard Machine & Tool Co., Philadelphia, Pa.
Mesta Machine Co., Pittsburg, Pa.
Niles Bement-Pond Co., New York.
Wm R. Perrin, Ltd., Toronto.
Southwark Foundry & Machine Co., Philadelphia, Pa.
Wm. Tod Co., Youngstown, O.
Toledo Machine & Tool Co., Toledo.
Watson-Stillman Co., Aldene, N.J.

Presses, Hydraulic.
Can. Boomer & Boschert Press Co., Montreal.
Wm. Cramp & Sons Ship & Engine Building Co., Philadelphia, Pa.
A. R. Williams Machy. Co., Toronto.
John Bertram & Sons Co., Dundas.
Charles F. Elmes Eng. Works, Chicago, Ill.
Mesta Machine Co., Pittsburg, Pa.
Niles-Bement-Pond Co., New York.
Wm. R. Perrin Co., Toronto.
Southwark Foundry & Machine Co., Philadelphia, Pa.
Wm. Tod Company, Youngstown, O.
Toledo Machine & Tool Co., Toledo.
Watson-Stillman Co., Aldene, N.J.

Presses, Pneumatic.
Toledo Machine & Tool Co., Toledo.

Presses, Power.
Baird Machine Co., Bridgeport, Conn.
Can. Boomer & Boschert Press Co., Montreal.
E. W. Bliss Co., Brooklyn, N.Y.
Brown, Boggs & Co., Hamilton, Can.
Can. Fairbanks-Morse Co., Montreal.
Charles F. Elmes Eng. Works, Chicago, Ill.
Geo. Gorton Machine Co., Racine.
Girard Machine & Tool Co., Philadelphia, Pa.
Wm. R. Perrin Co., Toronto.
Southwark Foundry & Machine Co., Philadelphia, Pa.
Toledo Machine & Tool Co., Toledo.
Watson-Stillman Co., Aldene, N.J.
A. R. Williams Machy. Co., Toronto.

Presses, Scrap Baling.
Can. Boomer & Boschert Press Co., Montreal.
Wm. R. Perrin, Ltd., Toronto.
Watson-Stillman Co., Aldene, N.J.

Presses, Spring Foot.
Baird Machine Co., Bridgeport, Conn.
Toledo Machine & Tool Co., Toledo.
Brown, Boggs & Co., Hamilton, Can.

Presses, Screw.
Can. Boomer & Boschert Press Co., Montreal
Wm. R. Perrin, Ltd., Toronto.

Pressure Regulators.
Can. Fairbanks-Morse Co., Montreal.

Protective Paint.
Jos. Dixon Crucible Co., Jersey City.

Pulleys.
American Pulley Co., Philadelphia, Pa.
Baird Machine Co., Bridgeport, Conn.
Brown & Sharpe Mfg. Co., Providence, R.I.
A. R. Williams Machy. Co., Toronto.
Can. Fairbanks-Morse Co., Montreal.
D. K. McLaren, Ltd., Montreal.
Positive Clutch & Pulley Works, Ltd., Toronto.
The Smart-Turner Mach. Co., Hamilton.

Pulley Machinery, Drilling and Tapping.
Can. Fairbanks-Morse Co., Montreal.
Niles-Bement-Pond Co., New York.

Pumps, Air.
Mesta Machine Co., Pittsburg, Pa.

Pumps, High Pressure.
Charles F. Elmes Eng. Works, Chicago
Wm. R. Perrin Co., Toronto.
Southwark Foundry & Machine Co., Philadelphia.
Watson-Stillman Co., Aldene, N.J.

Pumping Machinery.
A. R. Williams Machy. Co., Toronto.
Can. Buffalo Forge Co., Montreal.
Can. Fairbanks-Morse Co., Montreal.
Darling Brothers, Montreal.
D'Olier Centrifugal Pump & Mach. Co., Philadelphia, Pa.
National Mach. & Sup. Co., Hamilton.
Wm. R. Perrin Co., Toronto.
The Smart-Turner Mach. Co., Hamilton.
Southwark Foundry & Machine Co., Philadelphia.
Wm. Tod Company, Youngstown, O.

Pumps, all Kinds.
Can. Buffalo Forge Co., Montreal.
Charles F. Elmes Eng. Works, Chicago
Darling Brothers, Montreal.
D'Olier Centrifugal Pump & Mach. Co., Philadelphia, Pa.
Owen Sound Iron Works Co., Owen Sound.
Wm. R. Perrin, Ltd., Toronto.
The Smart-Turner Mach. Co., Hamilton.
Trahern Pump Co., Rockford, Ill.
A. R. Williams Machy. Co., Toronto.
Watson-Stillman Co., Aldene, N.J.

Pumps, Electrically Driven.
D'Olier Centrifugal Pump & Mach. Co., Philadelphia, Pa.
The Smart-Turner Mach. Co., Hamilton.

Pumps, Hydraulic.
Can. Boomer & Boschert Press Co., Montreal.
Charles F. Elmes Eng. Works, Chicago, Ill.
Darling Brothers, Montreal.
Wm. R. Perrin Co., Toronto.
Southwark Foundry & Machine Co., Philadelphia.
Wm. R. Perrin, Ltd., Toronto.
Wm. Tod Co., Youngstown, O.
Watson-Stillman Co., Aldene, N.J.

Pumps, Rotary, for Water and Oil.
Trahern Pump Co., Rockford, Ill.

Pumps for Oiling Systems.
S. F. Bowser & Co., Fort Wayne Ind.

Pumps, Steam.
Darling Brothers, Montreal.
Wm. Tod Company, Youngstown, O.

Pump Leathers.
Graton & Knight Mfg. Co., Montreal.
Southwark Foundry & Machine Co., Philadelphia.

Punches and Dies.
W. H. Banfield & Sons, Toronto.
E. W. Bliss Co., Brooklyn, N.Y.
Brown, Boggs Co., Ltd., Hamilton, Canada.
Can. Buffalo Forge Co., Montreal.
Can. Fairbanks-Morse Co., Montreal.
Scott Bros., Halifax, Eng.
Gardner, Robt., & Son, Montreal.
Globe Machine & Stamping Co.
A. B. Jardine & Co., Hespeler, Ont.
Pratt & Whitney Co., Dundas, Ont.
Toledo Machine & Tool Co., Toledo, O.

Punches, Power.
John Bertram & Sons Co., Dundas.
Bliss, E. W., Co., Brooklyn, N.Y.
Brown, Boggs Co., Ltd., Hamilton Canada.
Girard Machine & Tool Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Watson-Stillman Co., Aldene, N.J.

Punches, Pneumatic.
Jno. F. Allen Co., New York.

Punching Machines, Horizontal.
Bertrams, Ltd., Edinburgh, Scotland.
John Bertram & Sons Co., Dundas.
Bliss, E. W., Co., Brooklyn, N.Y.
Brown, Boggs Co., Ltd., Hamilton, Canada.
Long & Alstatter Co., Hamilton.
Niles-Bement-Pond Co., New York.

Pyrometers.
Canadian Hoskins, Limited, Walkerville, Ont.
Shore Instrument & Mfg. Co., New York City.
Thwing Instrument Co., Philadelphia, Pa.

Quartering Machines.
John Bertram & Sons Co., Dundas.
Niles-Bement-Pond Co., New York.

Ratchet Wrenches.
Wells Brothers Co., Greenfield, Mass.

Railing, Iron and Brass.
Canada Wire & Iron Goods Co., Hamilton, Ont.
Dennis Wire & Iron Works Co., Ltd., London, Canada.

Rail Benders.
Niles-Bement-Pond Co., New York.

Railroad Tools.
Can. Fairbanks-Morse Co., Montreal.
Niles-Bement-Pond Co., New York.

Railroad Tools, Hydraulic.
Watson-Stillman Co., Aldene, N.J.

Rapping Plates.
Stevens, F. B., Detroit, Mich.

Ratchets.
Keystone Mfg. Co., Buffalo, N.Y.

Raw Hide Pinions.
Gardner, Robt., & Son, Montreal.
Hamilton Gear & Machine Co., Toronto.
Jones & Glassco, Montreal.
Smart-Turner Machine Co., Hamilton, Ont.

Reamers, Adjustable.
Amalgamated Machinery Corporation, Chicago, Ill.
Can. Fairbanks-Morse Co., Montreal.
Cleveland Twist Drill Co., Cleveland.
Morse Twist Drill & Machine Co., New Bedford.
Pratt & Whitney Co., Dundas, Ont.
Wells Brothers Co., Greenfield, Mass.
Whitman & Barnes Mfg. Co., St. Catharines, Ont.

Reamers, Bridge, Expanding and High Speed.
Butterfield & Co., Rock Island, Que.
Can. Fairbanks-Morse Co., Montreal.
Cleveland Twist Drill Co., Cleveland.
Morse Twist Drill & Machine Co., New Bedford.
Pratt & Whitney Co., Dundas, Ont.
Wilt Twist Drill Co., of Canada, Ltd., Walkerville, Ont.

Reamer Fluting Machines.
Garvin Machine Co., New York.

Reamers, Pipe, Cylinder and Locomotive.
Butterfield & Co., Rock Island, Que.
Can. Fairbanks-Morse Co., Montreal.
Cleveland Twist Drill Co., Cleveland.
Morse Twist Drill & Machine Co., New Bedford.
Pratt & Whitney Co., Dundas, Ont.
Whitman & Barnes Mfg. Co., St. Catharines, Ont.
Wilt Twist Drill Co. of Canada, Ltd., Walkerville, Ont.

Reaming Machines, Pneumatic.
Cleveland Pneumatic Tool Co., of Canada, Toronto.
Independent Pneumatic Tool Co., Chicago.

Reamers, Steel Taper and Self-Feeding.
Butterfield & Co., Rock Island, Que.
Can. Fairbanks-Morse Co., Montreal.
Cleveland Twist Drill Co., Cleveland.
A. B. Jardine & Co., Hespeler, Ont.
Morse Twist Drill & Machine Co., New Bedford.
Pratt & Whitney Co., Dundas, Ont.
Wilt Twist Drill Co., of Canada, Ltd., Walkerville, Ont.

Rebuilt Machine Tools.
Cooperative Used Machy. Co., New York.
New York Machy. Co., New York.

Reels.
Baird Machine Co., Bridgeport, Conn.
Wilt Twist Drill Co., of Canada, Ltd., Walkerville, Ont.

Rheostats.
Toronto & Hamilton Electric Co., Hamilton, Ont.

Rivet Machines.
Buffalo Forge Co., Buffalo, N.Y.
National Machinery Co., Tiffin, O.
Pittsburg Pneumatic Co., Canton, Ohio.

Rivets, Tubular, Bifurcated.
Parmenter & Bulloch Co., Gananoque.

Rivets, Iron, Copper and Brass
Parmenter & Bulloch Co., Gananoque.

Riveters, Pneumatic, Hydraulic.

Hammer, Compression.
Jno. F. Allen Co., New York.
Can. Fairbanks-Morse Co., Montreal.
Cleveland Pneumatic Tool Co. of Canada, Toronto.
Independent Pneumatic Tool Co. of Chicago, Ill.
Mesta Machine Co., Pittsburg, Pa.
National Mach. & Sup. Co., Hamilton
Niles-Bement-Pond Co., New York
Pittsburg Pneumatic Co., Canton, Ohio.
Watson-Stillman Co., Aldene, N.J.

Riveting Machines, Elastic Rotary Blow.
Girard Machine & Tool Co., Philadelphia, Pa.
Grant Mfg. & Machine Co., Bridgeport, Conn.
High-Speed Hammer Co., Rochester, N.Y.
F. B. Shuster Co., New Haven, Conn.
Southwark Foundry & Machine Co., Philadelphia.

Rolls, Bending.
John Bertram & Sons Co., Dundas Ont
Brown, Boggs Co., Ltd., Hamilton, Canada.
Niles-Bement-Pond Co., New York
Toledo Machine & Tool Co., Toledo.

Rolling Mill Machinery.
Mesta Machine Co., Pittsburg, Pa.
Wm. Tod Co., Youngstown, O.

Roofing.
Can. H. W. Johns-Manville Co., Ltd Toronto.

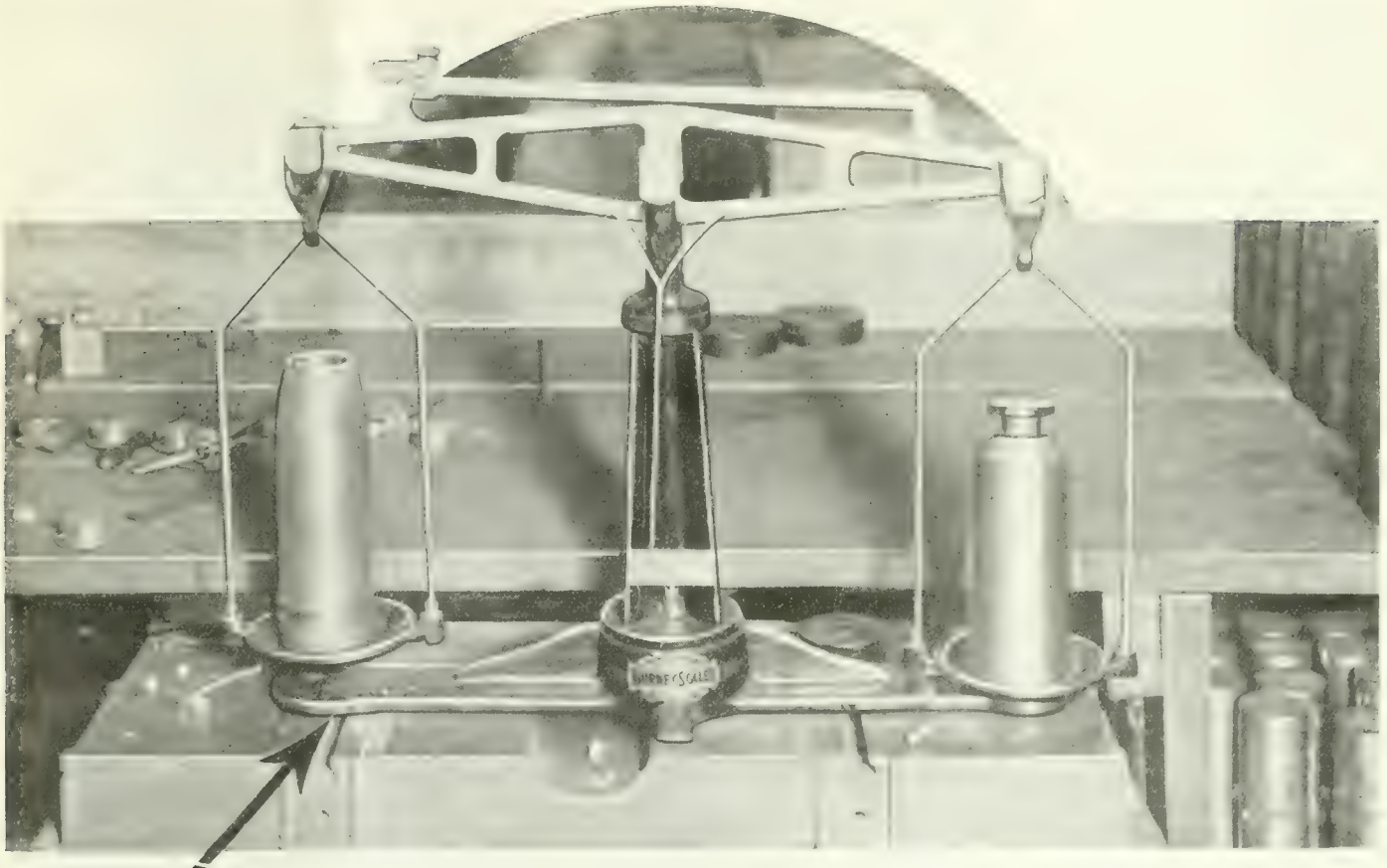
Rotary Converters.
A. R. Williams Machy. Co., Toronto
Toronto and Hamilton Electric Co. Hamilton.

Rubber Mill Machinery.
Bertrams, Ltd., Edinburgh, Scotland.
Can. H. W. Johns-Manville Co., Ltd., Toronto.

Rules.
Brown & Sharpe Mfg. Co., Providence, R.I.
James Chesterman & Co., Ltd., Sheffield, Eng.
L. S. Starrett Co., Athol, Mass.

Safety Set Screws.
Allen Mfg. Co., Inc., Hartford, Conn.

Sand Blasts.
Curtis Pneumatic Machinery Co., St. Louis, Mo.



SHELL SCALES

Capacity 25 and 60 lbs.

This Scale not only gave satisfaction to CANADIAN makers of shells, but AMERICAN makers of shells ordered Scales here for use in UNITED STATES, and paid 45% duty on the CANADIAN price.

Weighing Shells with a Gurney Bullion SCALE

MADE IN CANADA

Buy the Best
Automatic Scales

Something new for general use in factory and warehouse.

The use of this Scale prevents clerical errors, and saves the time of men, the loss of money and good-will.

Write for circular.

The Gurney Scale Co.

Hamilton, Ontario, Canada

Sand Rammers, Pneumatic.
Pittsburg Pneumatic Co., Canton, Ohio.

Saw Blades.
Diamond Saw & Stamping Works, Buffalo, N.Y.
E. C. Atkins & Co., Hamilton, Ont.

Saw Tables.
Hub Machine Welding & Contracting Co., Philadelphia, Pa.

Saw Sharpening Machines.
Nutter & Barnes Co., Hinsdale, N.H.

Saw Mill Machinery.
A. R. Williams Machy. Co., Toronto.
Can. Fairbanks-Morse Co., Montreal.
Gardner, Robt. & Son, Montreal.
Curtis Pneumatic Machinery Co., St. Louis, Mo.
Espen-Lucas Machine Works, Philadelphia, Pa.
National Mach. & Sup. Co., Hamilton.
Plessisville Foundry, Plessisville, Que.

Saws, High-Speed, Friction.
Espen-Lucas Machine Works, Philadelphia, Pa.
Hunter Saw & Machine Co., Pittsburg, Pa.
Mesta Machine Co., Pittsburg, Pa.
Nutter & Barnes Co., Hinsdale, N.H.

Saws, Inserted Tooth.
Espen-Lucas Machine Works, Philadelphia, Pa.
Q. M. S. Co., Chicago, Ill.
Tabor Mfg. Co., Philadelphia, Pa.

Saws, Hack.
E. C. Atkins & Co., Hamilton, Ont.
Can. Fairbanks-Morse Co., Montreal.
Diamond Saw & Stamping Works, Buffalo.
Ford-Smith Machine Co., Hamilton.
Garvin Machine Co., New York.
L. S. Starrett Co., Athol, Mass.

Saws, Circular Metal.
Espen-Lucas Machine Works, Philadelphia, Pa.
Hub Machine Welding & Contracting Co., Philadelphia, Pa.
Hunter Saw & Machine Co., Pittsburg, Pa.
Tabor Mfg. Co., Philadelphia, Pa.

Saws, Hot and Cold.
Hunter Saw & Machine Co., Pittsburg, Pa.
Nutter & Barnes Co., Hinsdale, N.H.

Scales.
Gurney Scale Co., Hamilton, Ont.

Scleroscopes.
Shore Instrument & Mfg. Co., New York City.

Screw Machine Products.
Wallace, Barnes Co., Bristol, Conn.

Screw Machines, Hand, Automatic.
Brown & Sharpe Mfg. Co., Providence, R.I.
Can. Fairbanks-Morse Co., Montreal
Garvin Machine Co., New York.
Girard Machine & Tool Co., Philadelphia, Pa.
Hill, Clarke & Co., of Chicago, Chicago, Ill.
A. B. Jardine & Co., Hespeler.
Moteh & Merryweather Machy. Co., Cleveland, O.
National Mach. & Sup. Co., Hamilton.
New Britain Machine Co., New Britain, Conn.
Pratt & Whitney Co., Dundas, Ont.
Warner & Swasey Co., Cleveland, O.
A. R. Williams Machy. Co., Toronto.
Windsor Machine Co., Windsor, Vt.

Screw Machines, Multiple Spindle.
New Britain Machine Co., New Britain, Conn.
Windsor Machine Co., Windsor, Vt.

Screw Plates.
Butterfield & Co., Rock Island, Que.
Can. Tap & Die Co., Galt, Ont.
A. B. Jardine & Co., Hespeler.
Morse Twist Drill & Machine Co., New Bedford.
Wells Brothers Co., Greenfield, Mass.
Wiley & Russell Co., Greenfield, Mass.

Screw Slotters.
Garvin Machine Co., New York.
Pratt & Whitney Co., Dundas, Ont

Set Screws, Safety.
Allen Mfg. Co., Hartford, Conn.

Second-Hand Machinery.
New York Machinery Co., New York.
Gardner, Robt. & Son, Montreal.
Can. Drawn Steel Co., Hamilton, Ont.
Gardner, Robt. & Son, Montreal.
National Mach. & Sup. Co., Hamilton.
Niles-Bement-Pond Co., New York.
Plessisville Foundry, Plessisville, Que.
The Smart-Turner Machine Co., Hamilton.
Union Drawn Steel Co., Hamilton.

Shanks, Straight and Taper.
Jacobs Mfg. Co., Hartford, Conn.

Shapers.
John Bertram & Sons Co., Dundas.
Can. Fairbanks-Morse Co., Montreal.
Canada Machy. Corp., Galt, Ont.
Foss & Hill Machy. Co., Montreal.
Gardner, Robt., & Son, Montreal.
Girard Machine & Tool Co., Philadelphia, Pa.
Hendey Machine Co., Torrington, Ct.
Hill, Clarke & Co., of Chicago, Chicago, Ill.

Shafting.
A. R. Williams Machy. Co., Toronto.
Can. Fairbanks-Morse Co., Montreal
Mesta Machine Co., Pittsburg, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Dundas, Ont.

Sharpening Stones.
Carborundum Co., Niagara Falls, N.Y.
Norton Co., Worcester, Mass.

Shavings, Separators.
Can. Buffalo Forge Co., Montreal.
Sheldons, Ltd., Galt, Ont.

Shearing Machines, Angle Iron, Bar and Gate.
John Bertram & Sons Co., Dundas.
Bertrams, Ltd., Edinburgh, Scotland.
Girard Machine & Tool Co., Philadelphia, Pa.
A. B. Jardine & Co., Hespeler.
Long & Alstatter, Hamilton, Ohio.
Mesta Machine Co., Pittsburg, Pa.
Niles-Bement-Pond Co., New York.
Scott Bros., Halifax, Eng.
Toledo Machine & Tool Co., Toledo.

Shears, Power.
John Bertram & Sons Co., Dundas.
Bliss, E. W., Co., Brooklyn, N.Y.
Brown Boggs Co., Ltd., Hamilton, Canada.
Buffalo Forge Co., Buffalo, N.Y.
Girard Machine & Tool Co., Philadelphia, Pa.
Mesta Machine Co., Pittsburg, Pa.
National Machy. Co., Tiffin, Ohio.
National Mach. & Sup. Co., Hamilton.
Niles-Bement-Pond Co., New York.
Scott Bros., Halifax, Eng.
Toledo Machine & Tool Co., Toledo.

Shears, Lever, Hydraulic.
Mesta Machine Co., Pittsburg, Pa.
Watson-Stillman Co., Aldene, N.J.

Shears, Pneumatic.
John F. Allen Co., New York.
Toledo Machine & Tool Co., Toledo, Ohio.

Shears, Squaring.
Brown, Boggs, & Co., Hamilton, Can.

Sheet Metal Working Tools.
Baird Machine Co., Bridgeport, Conn.
Bliss, E. W., Co., Brooklyn, N.Y.
Brown, Boggs & Co., Hamilton, Can.
Steel Bending Brake Works, Ltd., Chatham, Ont

Sheet Metal Stampings.
Duncan Electrical Co., Montreal.

Shell Banding Machines, Hydraulic.
Ault & Wiborg Co. of Canada, Ltd., Toronto.
Wm. Cramp & Sons Ship & Engine Bldg. Co., Philadelphia, Pa.
Can. Locomotive Co., Kingston, Ont.
Goldie & McCulloch Co., Galt, Ont.
Lyntburner, Ltd., Montreal.
Moteh & Merryweather Machy. Co., Cleveland, O.
Watson-Stillman Co., Aldene, N.J.
West Tire Setter Co., Rochester, N.Y.

Shell Lathes.
Amalgamated Machinery Corporation, Chicago, Ill.
American Woodworking Machy. Co., Toronto.
Jenckes Machine Co., Sherbrooke, Que.
Kellogg & Co., Toronto.

Shell Manufacturing Tools.
Amalgamated Machinery Corporation, Chicago, Ill.
Frank Toomey, Inc., Philadelphia, Pa.
New York Machinery Exchange, New York.
Hill, Clarke & Co., of Chicago
Co-operative Used Machinery Co., New York.

Shell Painting Machine.
Can. Buffalo Forge Co., Montreal
Can. Locomotive Co., Kingston, Ont.

Shell Screws, Headless.
Blake & Johnson, Waterbury, Conn.

Shell Riveters.
Grant Mfg. & Machine Co., Bridgeport, Conn.

Shell Weighing Scales.
Gurney Scale Co., Hamilton, Ont.

Shelving, Steel Partitions.
Canadian Steel Products Company, Montreal.

Shrapnel Shell Marker.
Brown-Boggs Co., Hamilton, Ont.
Holden-Morgan Co., Toronto.
Noble & Westbrook Mfg. Co., Hartford, Conn.

Shrapnel Sand Blasts.
W. W. Sly Mfg. Co., Cleveland, O.

Side Tools.
Armstrong Bros. Tool Co., Chicago.

Sirens, Electric.
Lintz-Porter Co., Toronto.

Silver Solder.
Geo. H. Lees & Co., Ltd., Hamilton, Ont.

Slotters.
Garvin Machine Co., New York.
Niles-Bement-Pond Co., New York.

Smokestacks.
Plessisville Foundry, Plessisville, Que.

Sockets.
Brown & Sharpe Mfg. Co., Providence, R.I.
Cleveland Twist Drill Co., Cleveland.
Keystone Mfg. Co., Buffalo, N.Y.
Modern Tool Co., Erie, Pa.
Morse Twist Drill & Machine Co., New Bedford.
Wilt Twist Drill Co. of Canada, Ltd., Walkerville, Ont.
Whitman & Barnes Mfg. Co., St. Catharines, Ont.
J. H. Williams Co., Brooklyn, N.Y.

Soldering Irons.
Brown, Boggs & Co., Hamilton, Can.

Solders.
Tallman Brass & Metal Co., Hamilton.

Specialties, Electric.
Lintz Porter Co., Toronto.

Special Machinery.
Armstrong Bros., Toronto.
W. H. Banfield & Sons, Toronto.
John Bertram & Sons Co., Dundas.
Baird Machine Co., Bridgeport, Conn
Bliss, E. W. Co., Brooklyn, N.Y.
Brown, Boggs & Co., Hamilton, Can.
Can. Fairbanks-Morse Co., Montreal.
Canada Machy. Agency, Montreal.
Cunningham & Sons, St. Catharines, Ont.
Charles F. Elmes Eng. Works, Chicago
Ford-Smith Machine Co., Hamilton.
Garvin Machine Co., New York.
Gooley & Edlund, Inc., Courtland, N.Y.
John H. Hall & Sons, Brantford.
Jardine, A. B., & Co., Hespeler.
National Electric Welder Co., Warren, Ohio.
National Forge & Tool Co., Erie, Pa.
National Mach. & Sup. Co., Hamilton
Plessisville Foundry, Plessisville, Que.
Smart-Turner Machine Co., Hamilton Ont.
Wm. Tod Company, Youngstown, O

Spike Machines.
The Smart-Turner Machine Co., Hamilton.

Spring Coilers.
Baird Machine Co., Bridgeport, Conn.
Garvin Machine Co., New York.

Springs, Machinery.
Cleveland Wire Spring Co., Cleveland
Jas Steele Ltd., Guelph Ont.
Wallace, Barnes Co., Bristol, Conn.

Spring Making Machinery (Automatic).
Baird Machine Co., Bridgeport, Conn.

Sprockets, Chain.
Morse Chain Co., Ithaca, N.Y.
Philadelphia Gear Works, Philadelphia, Pa.

Stairs, Iron.
Canada Wire & Iron Goods Co., Hamilton, Ont.
Dennis Wire & Iron Works Co., Ltd., London, Canada.

Stamping.
Duncan Electrical Co., Montreal.

Stamping Machinery.
Brown, Boggs & Co., Hamilton, Can.

Stationary Ladders.
New Britain Machine Co., New Britain, Conn.

Steam Specialties.
Sheldons, Ltd., Galt, Ont.

Steam Separators and Traps.
Can. Fairbanks-Morse Co., Montreal.
Can. Sirocco Co., Ltd., Windsor, Ont.
Pittsburg Valve, Foundry & Construction Co., Pittsburg, Pa.
Sheldons, Ltd., Galt, Ont.
The Smart-Turner Machine Co., Hamilton.

Steel Alloy.
Vanadium Alloys Steel Co., Pittsburgh, Pa.
Vulcan Crucible Steel Co., Aliquippa, Pa.

Steel Chains for Pulp Mill and Saw Mill.
Plessisville Foundry, Plessisville, Que

Steel Bench Legs.
New Britain Machine Co., New Britain, Conn.

Steel Bending Brakes.
Steel Bending Brake Works, Ltd., Chatham, Ont.

Steel, Cold Rolled.
Can. Drawn Steel Co., Hamilton, Ont
A. C. Leslie & Co., Ltd., Montreal.
Union Drawn Steel Co., Hamilton, Ont.
Wallace, Barnes Co., Bristol, Conn.

Steel Pressure Blowers.
Can. Buffalo Forge Co., Montreal.
Can. Fairbanks-Morse Co., Montreal.
Sheldons, Ltd., Galt, Ont.

Steel, all kinds.
Lackawanna Steel Co., Lackawanna, N.Y.

Steel, High Speed.
Armstrong Whitworth of Canada, Ltd., Montreal.
Can. Fairbanks-Morse Co., Montreal.
H. A. Drury Co., Ltd., Montreal.
Thos. Firth & Sons, Montreal.
Hawkridge Bros. Co., Boston, Mass.
National Mach. & Sup. Co., Hamilton.
Vanadium Alloys Steel Co., Pittsburg, Pa.
Vulcan Crucible Steel Co., Aliquippa, Pa.

Steel Die Engraving.
Noble & Westbrook Mfg. Co., Hartford, Conn.

Steel Machinery.
Hawkridge Bros. Co., Boston, Mass.

Steel Tube Fencing.
Standard Tube & Fence Co., Woodstock, Ont.

Steel Vanadium.
Vanadium Alloys Steel Co., Pittsburgh, Pa.
Vulcan Crucible Steel Co., Aliquippa, Pa.

Stock Racks for Bars, Piping, Etc.
New Britain Machine Co., New Britain, Conn.

Stocks for Dies.
Wells Bros. Co., Greenfield, Mass.

Stocks, Pipe.
Butterfield & Co., Rock Island, Que.
Greenfield Tap & Die Corporation, Greenfield, Mass.

Stools, Steel, Shop.
Dennis Wire & Iron Works Co., Ltd., London, Canada.

Storage Systems.
S. F. Bowser & Co., Fort Wayne, Ind.

Stoves, Electric.
Lintz-Porter Co., Toronto.

Straight Edges.
Steel Bending Brake Works, Ltd., Chatham, Ont.

Straightening Machinery.
Baird Machine Co., Bridgeport, Conn.
Bertrams, Ltd., Edinburgh, Scotland
National Mach. & Sup. Co., Hamilton.

Structural Steel.
Hamilton Bridge Works Co., Hamilton, Ont.
Lackawanna Steel Co., Lackawanna, N.Y.
Owen Sound Iron Works Co., Owen Sound, Ont.

Stud Driver.
Keystone Mfg. Co., Buffalo, N.Y.

Switchboards and Telephones.
Lintz-Porter Co., Toronto.
Toronto & Hamilton Electric Co., Hamilton.

Switches, Railway.
National Mach. & Sup. Co., Hamilton

Tanks, Oil, Etc.
S. F. Bowser & Co., Fort Wayne, Ind.

Tanks, Steel.
John Inglis Co., Toronto.
Plessisville Foundry, Plessisville, Que.
Toronto Iron Works, Ltd., Toronto.

Tanks, Pressure.
Toronto Iron Works, Ltd., Toronto.

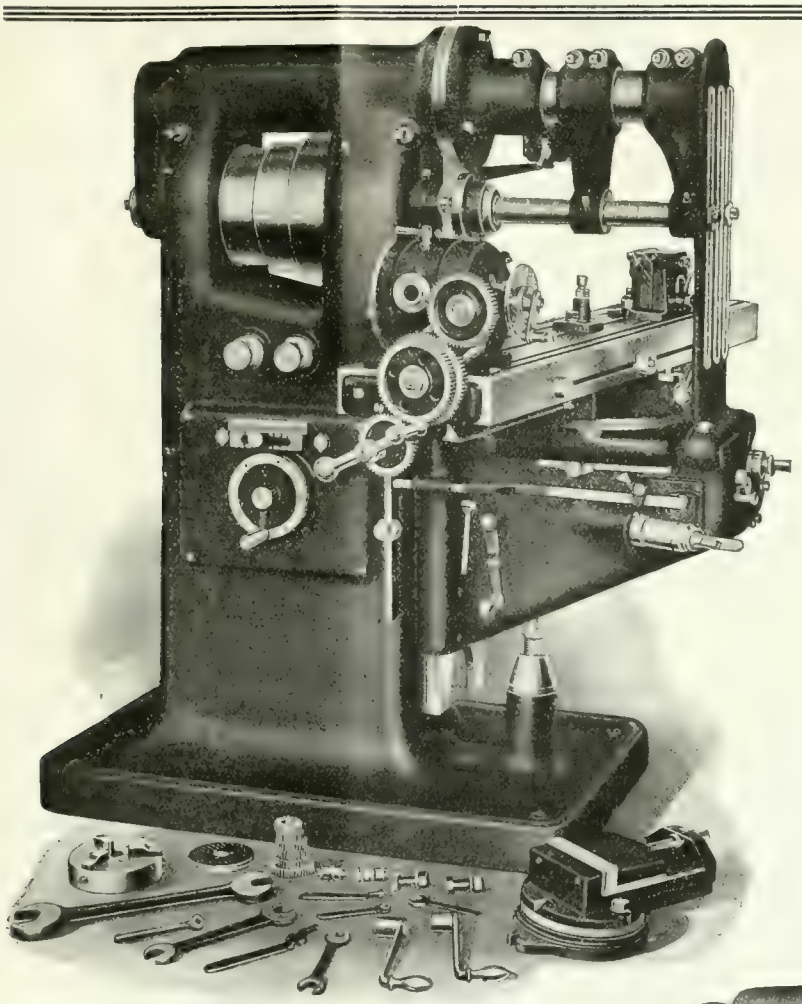
Tank Wagons.
Toronto Iron Works, Ltd., Toronto.

Tapes, Measuring.
James Chesterman & Co., Ltd., Sheffield, Eng.

Tapes, Friction.
Can. H. W. Johns-Manville Co., Ltd., Toronto.

Tapping Machines (Pneumatic).
Cleveland Pneumatic Tool Co. of Canada, Toronto.
Independent Pneumatic Tool Co. Chicago, Ill.

Tapping Machines and Attachments.
Amalgamated Machinery Corporation, Chicago, Ill.
Baker Brothers, Toledo, O.
John Bertram & Sons Co., Dundas.
Garvin Machine Co., New York.
The Geometric Tool Co., New Haven
Girard Machine & Tool Co., Philadelphia, Pa.
Greenfield Tap & Die Corporation, Greenfield, Mass.
J. H. Hall & Sons, Brantford, Ont.
A. B. Jardine & Co., Hespeler.
Landis Machine Co., Waynesboro, Pa.
Manufacturers Equipment Co., Chicago, Ill.
Modern Tool Co., Erie, Pa.
Murchey Machine & Tool Co., Detroit
Niles-Bement-Pond Co., New York.
Rickart Shaper Co., Erie, Pa.
L. S. Starrett Co., Athol, Mass.
Victor Tool Co., Waynesboro, Pa.



A big increase in stiffness and rigidity over ordinary construction.

The No. 2 ROCKFORD

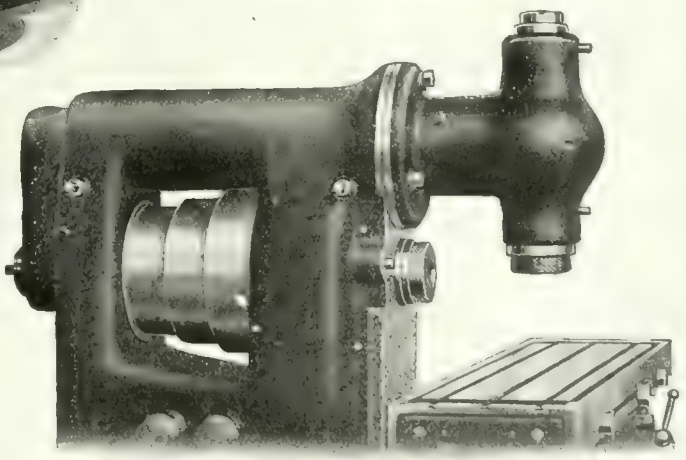
"UNIVERSAL" HEAVY DUTY DOUBLE BACK GEARED CONE MILLING MACHINE

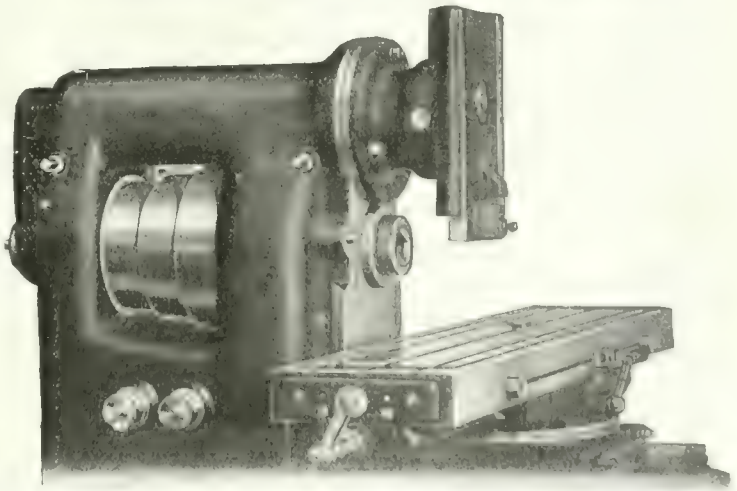
makes fast, deep cuts equal to those produced by the average No. 3 Miller.

The Double Back Gearing furnishes great power to spindle.

The **Patented Flanged Overhanging Arm** gives an exceptionally rigid support that reduces vibration and increases cutting capacity.

Hyatt Roller Bearings save the power loss of friction, eliminate wear and keep the center of gears constant and reduce friction.





THE MASSIVE, CLEAN-CUT CONSTRUCTION THROUGHOUT AND THE CONVENIENCE OF CONTROL ALLOW A SPEED OF OPERATION WHICH IS PRACTICALLY LIMITED ONLY BY WHAT THE CUTTER WILL STAND.

Rockford Attachments are also of heavy construction, bolted to seat of column, and provided with patented flanged support. These attachments can be used to the full cutting capacity of the machine.

There's a new circular which describes this machine fully. Jot down a line for it now.

Rockford Milling Machine Company

ROCKFORD, ILL., U. S. A.

Sales Agents for Canada: The Canadian Fairbanks-Morse Co. Ltd., Montreal, St. John, Toronto, Winnipeg, Calgary, Saskatoon, Vancouver.

FOREIGN AGENTS: A. A. Jones & Shipman, Ltd., Leicester, England. F. G. Kretschmer & Co., Frankfurt, a/M., Holland and Switzerland. Barandiaran, Metivier, Gozcue & Cia., San Sebastian, Spain. Aktiebolaget Rylander & Aspelund, Stockholm, Sweden. The Brazilian Representation Co., Rio de Janeiro, Brazil. Roku-Roku Shoten, Tokio, Japan.

Tap Chucks.
Wells Bros., Greenfield, Mass.

Taps, Adjustable.
Geometric Tool Co., New Haven.
Manufacturers Equipment Co., Chicago, Ill.
Murchey Machine & Tool Co., Detroit.
Victor Tool Co., Waynesboro, Pa.

Taps, Dies and Wrenches.
Butterfield & Co., Rock Island, Que.
Can. Fairbanks-Morse Co., Montreal.
Can. Tap & Die Co., Galt, Ont.
Cleveland Twist Drill Co., Cleveland
Geometric Tool Co., New Haven, Conn.
A. B. Jardine & Co., Hespeler.
Morse Twist Drill & Machine Co. New Bedford.
Murchey Machine & Tool Co., Detroit.
Pratt & Whitney Co., Dundas, Ont.
L. S. Starrett Co., Athol, Mass.
Victor Tool Co., Waynesboro, Pa.
Wells Brothers Co., Greenfield, Mass.
Wilt Twist Drill Co. of Canada, Ltd., Walkerville, Ont.

Technical Books.
The MacLean Publishing Co., Ltd. Toronto.

Telephone Systems.
Lintz-Porter Co., Toronto.

Testing Instruments, Metallurgical.
Shore Instrument & Mfg. Co., New York City.

Testing Laboratories.
Toronto Testing Laboratory, Toronto.

Thread Cutting Machines.
Can. Fairbanks-Morse Co., Montreal.
Garvin Machine Co., New York.
Geometric Tool Co., New Haven, Conn.
Girard Machine & Tool Co., Philadelphia, Pa.
Greenfield Tap & Die Corporation, Greenfield, Mass.
Landis Machine Co., Waynesboro, Pa.
Pratt & Whitney Co., Dundas, Ont.
National Machy. Co., Tiffin, Ohio.

Thread Milling Machines.
Holden-Morgan Co., Toronto.

Time Clocks.
International Time Recording Co Toronto.
Lintz-Porter Co., Toronto.

Tinsmiths' Tools.
Brown, Boggs & Co., Hamilton, Can.
Steel Bending Brake Works, Ltd., Chatham, Ont.

Tire Setting Machines, Hydraulic.
West Tire Setter Co., Rochester, N.Y.

Tire, Wheels.
Wells Bros. Co., Greenfield, Mass.

Toolmakers' Files.
American Swiss File & Tool Co., New York.

Tool Boxes, Steel.
Can. Steel Products Co., Montreal.

Tool Holders.
Armstrong Bros. Tool Co., Chicago.
Cleveland Twist Drill Co., Cleveland.
Modern Tool Co., Erie, Pa.
National Forge & Tool Co., Erie, Pa.
Pratt & Whitney Co., Dundas, Ont.
Ready Tool Co., Bridgeport, Conn.
J. H. Williams Co., Brooklyn, N.Y.

Tool Room Partitions.
Can. Wire & Iron Goods Co., Hamilton.

Tool Posts, Lathe.
Armstrong Bros. Tool Co., Chicago.

Tool Steel.
Armstrong, Whitworth, Ltd., of Canada, Montreal.
Can. Fairbanks-Morse Co., Montreal.
Thos. Firth & Sons, Montreal.
Hawkridge Bros. Co., Boston, Mass.
A. C. Leslie & Co., Ltd., Montreal.
National Mach. & Sup. Co., Hamilton.
Vulcan Crucible Steel Co., Aliquippa, Pa.

Tools, Blacksmiths', Etc.
A. R. Williams Machy. Co., Toronto.

Tools, Electrical.
A. R. Williams Machy. Co., Toronto.
Can. H. W. Johns-Manville Co., Ltd., Toronto.
United States Elec. Tool Co., Cincinnati, O.

Tools, Lathe, Planer and Slotter.
Armstrong Bros. Tool Co., Chicago.
National Forge & Tool Co., Erie, Pa.

Torches, Steel.
Stevens, F. B., Detroit, Mich.
Armstrong, Whitworth of Canada, Ltd., Montreal.

Track Bits.
Wilt Twist Drill Co. of Canada, Ltd., Walkerville, Ont.

Track Systems.
Northern Crane Works, Walkerville
Whiting Foundry Equipment Co., Harvey, Ill.

Track Tools.
Can. H. W. Johns-Manville Co., Ltd., Toronto.
Can. Fairbanks-Morse Co., Montreal.

Transformers and Converters.
A. R. Williams Machy. Co., Toronto.
Can. Fairbanks-Morse Co., Montreal.
Toronto & Hamilton Electric Co., Hamilton, Ont.

Transmission Machinery.
American Pulley Co., Philadelphia Pa.
A. R. Williams Machy. Co., Toronto.
Can. Fairbanks-Morse Co., Montreal.
Can. Drawn Steel Co., Hamilton, Ont.
Hamilton Gear & Mach. Co., Toronto.
Jones & Glassco, Montreal.
Main Belting Co., Montreal.
D. K. McLaren, Montreal.
Morse Chain Co., Ithaca, N.Y.
Plessisville Foundry, Plessisville, Que
E. Roddaway & Co., Montreal.
The Smart-Turner Machine Co., Hamilton.

Transmission Towers.
Can. Bridge Co., Walkerville, Ont.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
Curtis Pneumatic Machinery Co., St. Louis, Mo.
Northern Crane Works, Walkerville.
Tallman Brass & Metal Co., Hamilton.

Traveling Cranes.
Northern Crane Works, Walkerville.
Smart-Turner Machine Co., Hamilton, Ont.
Whiting Foundry Equipment Co., Harvey, Ill.

Trolley Hoists, Electric.
Northern Crane Works, Walkerville.
Whiting Foundry Equipment Co., Harvey, Ill.

Trucks, Lumber and Kiln.
Sheldons, Ltd., Galt, Ont.
Northern Crane Works, Walkerville.

Trucks, Factory, Freight, Etc.
Chambers, Ltd., Toronto.
Chapman Double Ball Bearing Co., Toronto.
National Scale Co., Chicopee Falls, Mass.
Whiting Foundry Equipment Co., Harvey, Ill.

Tube Expanders (Rollers).
A. B. Jardine & Co., Hespeler.
Watson-Stillman Co., Aldene, N.J.

Tumbling Barrels.
Baird Machine Co., Bridgeport, Conn.
Northern Crane Works, Walkerville.
Whiting Foundry Equipment Co., Harvey, Ill.

Turbines, Steam.
Southwark Foundry & Machine Co., Philadelphia, Pa.

Turnbuckles.
Canadian Billings & Spencer, Ltd., Welland.
Can. H. W. Johns-Manville Co., Ltd., Toronto.

Turret Machines.
Brown & Sharpe Mfg. Co., Providence, R.I.
Fay & Scott, Dexter, Me.
Girard Machine & Tool Co., Philadelphia, Pa.
Hill, Clarke & Co. of Chicago, Chicago, Ill.
Motch & Merryweather Machy. Co., Cleveland, O.
New Britain Machine Co., New Britain, Conn.
Pratt & Whitney, Hartford, Conn.
Turner Machine Co., Ltd., Danbury, Conn.
Warner & Swasey, Cleveland, O.

Turbines, Steam, Water.
Plessisville Foundry, Plessisville, Que.

Unions.
Pittsburg Valve, Foundry & Construction Co., Pittsburg, Pa.

Upsetting and Bending Machinery.
A. R. Williams Machy. Co., Toronto.
John Bertram & Sons Co., Dundas.
Brown, Boggs Co., Ltd., Hamilton, Canada.
A. B. Jardine & Co., Hespeler.
National Machy. Co., Tiffin, O.
Niles-Bement-Pond Co., New York.
Watson-Stillman Co., Aldene, N.J.

Vacuum Pumps.
Buffalo Forge Co., Buffalo, N.Y.
Smart-Turner Machine Co., Hamilton, Ont.

Valve Grinders (Pneumatic).
Cleveland Pneumatic Tool Co. of Canada, Toronto.

Valves, Air, Blow-off, Check and Gate.
Pittsburg Valve, Foundry & Construction Co., Pittsburg, Pa.

Valves, Hydraulic.
Can. Boomer & Boschert Press Co., Montreal.
Charles F. Elmes Eng. Works, Chicago, Ill.
Mesta Machine Co., Pittsburg, Pa.
Pittsburg Valve, Foundry & Construction Co., Pittsburg, Pa.
Watson-Stillman Co., Aldene, N.J.
R. D. Wood & Co., Philadelphia, Pa.

Valve Leathers.
Graton & Knight Mfg. Co., Montreal.

Valves, Back Pressure, Steam.
Mesta Machine Co., Pittsburg, Pa.
Pittsburg Valve, Foundry & Construction Co., Pittsburg, Pa.
Sheldons, Limited, Galt.

Vanadium Steel.
H. A. Drury Co., Ltd. Montreal
Hawkridge Bros. Co., Boston, Mass.

Varnishes.
Ault & Wiborg Co. of Canada, Ltd., Toronto.

Ventilating Apparatus.
Can. Sirocco Co., Ltd., Windsor, Ont.
Sheldons, Limited, Galt.
A. R. Williams Machy. Co., Toronto.

Vises, Bench.
Emmert Mfg. Co., Waynesboro, Pa.
Hollands Mfg. Co., Erie, Pa.
National Mach. & Sup. Co., Hamilton.
New Britain Machine Co., New Britain, Conn.

Vises, Pipe.
Armstrong Mfg. Company, Bridgeport, Conn.
Bignall & Keeler Mach. Works, Edwardsville, Ill.
Butterfield & Co., Rock Island, Que.
Emmert Mfg. Co., Waynesboro, Pa.
National Mach. & Sup. Co., Hamilton.
J. H. Williams Co., Brooklyn, N.Y.

Vises, Planer and Shaper.
Girard Machine & Tool Co., Philadelphia, Pa.
National Mach. & Sup. Co., Hamilton.
Skinner Chuck Co., New Britain, C.

Vises, Milling Machine.
National Mach. & Sup. Co., Hamilton.

Vises, Woodworking.
Emmert Mfg. Co., Waynesboro, Pa.

Washers.
Graton & Knight Mfg. Co., Worcester, Mass.
London Bolt & Hinge Works, London, Ont.
Wallace, Barnes Co., Bristol, Conn.

Washer Machines.
National Machy. Co., Tiffin, Ohio.

Waterproof Coating, Cement, Fabric.
Can. H. W. Johns-Manville Co., Ltd., Toronto.

Watchman's Clocks.
Lintz-Porter Co., Toronto.
A. R. Williams Machy. Co., Toronto.

Water Towers.
Toronto Iron Works, Ltd., Toronto.

Welding and Cutting Clamps.
Can. Blaugas Co., Ltd., Montreal.
Detroit Electric Welder Co., Detroit, Mich.
L'Air Liquide Society, Toronto.
Lever Bros., Toronto.
National Electric Welder Co., Cincinnati, O.

Welding and Cutting Work.
Can. Blaugas Co., Ltd., Montreal.
Detroit Electric Welder Co., Detroit, Mich.
L'Air Liquide Society, Toronto.
Lever Bros., Toronto.
Metals Welding Co., Cleveland, O
National Electric Welder Co., Cincinnati, O.

Welding, Autogenous.
Can. Blaugas Co., Ltd., Montreal.
Detroit Electric Welder Co., Detroit, Mich.
L'Air Liquide Society, Toronto.
Lever Bros., Toronto.
National Electric Welder Co., Cincinnati, O.

Welding, Acetylene and Oxygen
Can. Blaugas Co., Ltd., Montreal.
Detroit Electric Welder Co., Detroit, Mich.
L'Air Liquide Society, Toronto.
Lever Bros., Toronto.
Metals Welding Co., Cleveland, O
National Electric Welder Co., Cincinnati, O.

Welding Machines, Electric, etc
Can. Blaugas Co., Ltd., Montreal.
Detroit Electric Welder Co., Detroit, Mich.
Lever Bros., Toronto.
National Electric Welder Co., Cincinnati, O.
Tabor Mfg. Co., Philadelphia, Pa.

Wheels, Emery, Carborundam.
Can. Hart Wheels, Ltd., Hamilton, Ont.

Wheels, Belt, Fly, Gear and Rope.
Mesta Machine Co., Pittsburg, Pa.

Winches.
John H. Hall & Sons, Brantford.
Northern Crane Works, Walkerville.

Window Wire Guards.
Canada Wire & Iron Goods Co., Hamilton.
Standard Tube & Fence Co., Woodstock, Ont.

Wire Cloth and Perforated Metals.
Canada Wire & Iron Goods Co., Hamilton.
Dennis Wire & Iron Works Co., Ltd. London.
Standard Tube & Fence Co., Woodstock, Ont.

Wire Forms.
Wallace, Barnes Co., Bristol, Conn.

Wire Forming and Stamping Machinery.
Brown, Boggs Co., Ltd., Hamilton Canada.
F. B. Shuster Co., New Haven, Conn.
Baird Machine Co., Bridgeport, Conn

Wire Guards and Railings.
Canada Wire & Iron Goods Co., Hamilton, Ont.
Standard Tube & Fence Co., Woodstock, Ont.

Wire Fencing.
Standard Tube & Fence Co., Woodstock, Ont.

Wire Nails.
Parmenter & Bulloch Co., Gananoque.

Wire Nail Machinery.
National Machy. Co., Tiffin, Ohio.
A. R. Williams Machy. Co., Toronto.

Wire, Spring.
Wallace, Barnes Co., Bristol, Conn.

Wire Straighteners and Cutters.
Baird Machine Co., Bridgeport, Conn.
Brown, Boggs Co., Ltd., Hamilton Canada.
F. B. Shuster Co., New Haven, Conn.

Wire Coiling and Pointing Machines.
Baird Machine Co., Bridgeport, Conn.
F. B. Shuster Co., New Haven, Conn.

Wood Boring Machines.
Cleveland Pneumatic Tool Co. of Canada, Toronto.
Girard Machine & Tool Co., Philadelphia, Pa.

Woodworking Machinery.
Buffalo Forge Co., Buffalo, N.Y.
Can. Fairbanks-Morse Co., Montreal.
Girard Machine & Tool Co., Philadelphia, Pa.
New Britain Machine Co., New Britain, Conn.
Plessisville Foundry, Plessisville, Que.
A. R. Williams Machy. Co., Toronto.

Wrenches, Compression.
Lutz-Webster Engineering Co., Inc., Philadelphia, Pa.

Wrenches.
Armstrong Bros. Tool Co., Chicago, Ill.
Butterfield & Co., Rock Island, Que.
Canadian Billings & Spencer, Ltd., Welland.
Keystone Mfg. Co., Buffalo, N.Y.
Lutz-Webster Engineering Co., Inc., Philadelphia, Pa.
Wells Bros. Co., Greenfield, Mass.
Whitman & Barnes Mfg. Co., St. Catharines, Ont.
J. H. Williams Co., Brooklyn, N.Y.

Wrenches, Automobile Narrow Jaw and Monkey.
Bemis & Call Hardware & Tool Co., Springfield, Mass.
Trimont Mfg. Co., Roxbury, Mass.

Wrenches, Pipe, Monkey.
Bemis & Call Hardware & Tool Co Springfield, Mass.
Trimont Mfg. Co., Roxbury, Mass.

Wrenches, Ratchet and Basin.
Bemis & Call Hardware & Tool Co., Springfield, Mass.
Keystone Mfg. Co., Buffalo, N.Y.
Trimont Mfg. Co., Roxbury, Mass.

ADVERTISING INDEX

Allen Mfg. Co. 140
Allen, Edgar, & Co. 6
Allen, John F. Co. 56
American Wood Working Machinery Co. 37
Armstrong Bros. Tool Co. 141
Armstrong Mfg. Co. 140
Amalgamated Machinery Corporation. 145
Armstrong Whitworth of Canada 29
Atkins, E. C. & Co. 135
Ault & Wiborg Co. of Canada, Ltd... 157

Baker Bros. 53
Baird Machine Co. 141
Banfield & Sons, W. H. 132
Barrett Machine Tool Co. 30
Bertram, John & Sons Co. 1
Blake & Johnson 34
Bowser, S. F. & Co., Inc. 45
Brown Boggs Co. 55
Butterfield & Co. 39

Can. Blaugas Co., Ltd. 159
Can. Blower & Forge Co. 158
Can. Boomer & Boschert Press Co. 17-18-19-20
Can. Economic Lubricant Co. 40
Can. Fairbanks-Morse Co. 68
Can. Hart Wheels, Ltd. 125
Can. Hoskins, Limited 6
Can. Inspection & Testing Laboratories, Limited 54
Can. Mathews Gravity Carrier Co.... 41
Can. Machy. Corporation 127
Can. Locomotive Co. 142
Can. Oil Companies, Ltd. 42
Can. Wire & Iron Goods Co. 136
Carborundum Co. 63
Cataract Refining Co. 42
Chapman Double Ball Bearing Co... Outside back cover
Chambers, Ltd. 43
Chicago Flexible Shaft Co. 2-3
Cinn. Iron & Steel Co. 30
Cook Co., Asa S. 136
Co-operative Used Machy. Co. 147
Colburn Machine Tool Co. 131
Cramp. & Sons, Ship & Engine Bldg. Co., Ltd. 27
CuffeQuin, W. T. 130
Cushman Chuck Co. 34

Darling Brothers 61
Detroit Electric Welder Co. 56
Dickow, Fred. C. 130
D'Olier Centrifugal Pump & Machine Co. 44
Drury, H. A. Co., Ltd. 8

Elmes Eng. Works, Charles F. 138
Espen-Lucas Machine Works 13

Fairley Davidson Steel Co. 8
Fay & Scott 139
Ford-Smith Machine Co. 123
Foss & Hill Machinery Co. Inside back cover
Foundry & Machine Exhibition Co... 61
Galt Machine Screw Co. 134
Garvin Machine Co. 140
Geometric Tool Co. 120
Girard Machine Tool Co. 126
Gooley & Edlund, Inc. 134
Globe Machine & Stamping Co. 62
Goldie & McCulloch Co. 133
Gorton Machine Co. 11
Gray Mfg. & Machine Co. 7
Grant Mfg. & Machine Co. 62
Gurney Scale Co. 153

Hall, John H., & Son, Limited 15
Hamilton Gear & Machine Co. 6
Hanna & Co., M. A. 139
Hawkridge Bros. Co. 138
Hendey Machine Co. 160
Hill, Clarke & Co. of Chicago 151
Holden-Morgan Co., Ltd. 119
Hub Machine Welding & Contracting Co. 159
Hurlbut Rogers Machinery Co. 126
Hunter Saw & Machine Co. 12

Jenckes Machine Co. Front Cover

Kellogg & Company 31

ADVERTISING INDEX—(Continued)

Lackawanna Steel Co. 8
Lane Dynamos & Motor Co. 137
L'Air Liquide Society 137
Landis Machine Co. 141
Leslie, A. C., & Co. 128
Lever Bros. 34
Lintz Porter Co. 128
Lutz Webster Engineering Co., Inc.. 56
Lymburner, Ltd. 13

McLaren, D. K., Ltd. 4
McDougall Co., R. .....Inside Back Cover
McLaren Belting Co., J. C. 141
Main Belting Co. of Canada 137
Manufacturers' Equipment Co. 51
Marion & Marion 130
Marshall & Huschart Machy. Co. 52
Mesta Machine Co. 16
Mechanical Engineering Co. 5
Modern Tool Co. 38
Morton Mfg. Co. 132
Motch & Merryweather Machinery Co. 28
Murchey Machine & Tool Co. 36

National Electric Welder Co. 57
National Forge & Tool Co. 48
National Scale Co. 58
New York Machinery Exchange 134
New Britain Machine Co. 14
Nicholson File Co. 52
Northern Crane Works 136
Norton, A. O. 141
Norton Grinding Co. 66
Norton Co. 67
Nutter & Barnes 26
Oven Equipment & Mfg. Co. 4

Parmenter & Bulloch Co., The 136
Partridge, E. O. 137
Perrin, Wm. R. 52
Pittsburg Pneumatic Company 48
Plessisville Foundry 140
Pittsburg Valve Foundry & Construction Co. 35
Port Huron Engine & Thresher Co.. 132
Positive Clutch & Pulley Works 141
Pratt & Whitney Co...Inside Front Cover
Puro Sanitary Drinking Fountain Co. 130

Racine Tool & Machine Co. 10
Ready Tool Co. 128
Reddaway, F. & Co. 46
Rickert Shafer Co. 145
Ridout & Maybee 139
Rockford Milling Machine Co. 155
Root, C. J. Co. 141
Rumely-Wachs Machy. Co. 122

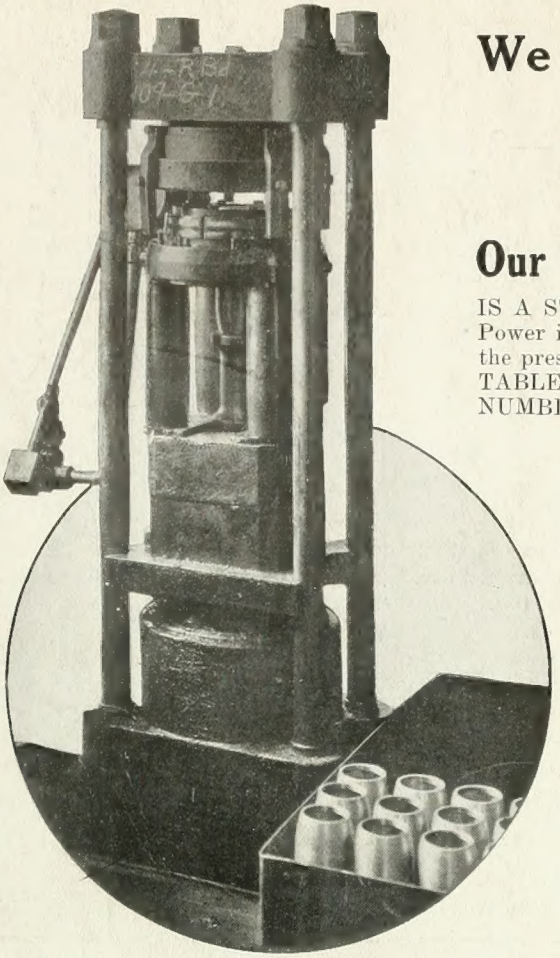
Shelton Metallic Filler Co. 50
Shipman, Harold C., & Co. ....130 and 136
Shore Ins. & Mfg. Co. 55
Shuster Co., F. B. 140
Simonds, Canada Saw Co. 12
Skinner Chuck Co. 34
Sly Mfg. Co., W. W. 62
Smart Turner Machine Co. 141
Southwark Foundry & Machine Co. 24-25
Standard Tube & Fence Co., Ltd. ... 35
Starrett Co., L. S. 49
Stow Mfg. Co. 138
Stevens, Frederic B. 60
Steel Bending Brake Works, Ltd..... 140
Stocker, H. A., Machinery Co. 124

Tabor Mfg. Co. 139
Tate-Jones & Co., Inc. 21
Toomey Inc., Frank 149
Tod, Wm. Co. 23
Toronto Iron Works, Limited 29
Toronto Testing Laboratory 141
Trahern Pump Co. 64
Turner Machine Co. 50

Vanadium Alloys Steel Co. 9
Victor Tool Co. 135
Vulcan Crucible Steel Co. 132

Warner & Swasey 53
Watson-Stillman Co. 26
Wells Bros. of Canada, Ltd. ..... 50.
West Tire Setter Co. 28
Whiting Foundry Equipment Co.-..... 141
White, A. D., Machinery Co. 132
Whitman & Barnes Mfg. Co. 129
Williams Tool Co. 118
Williams Machinery Co., A. R. 117-120
Williams Co., J. H. 65
Woods, Vallance Co. 51

If what you want is not advertised in this issue consult the Buyers' Directory at the back.



We are interested in your

SHELL OUTPUT

and can help you increase it.

Our Hydraulic Press for Shell Banding

IS A STRONG, SIMPLE AND RELIABLE MACHINE AT LOW COST. Power is obtained from continuous running belt-driven pump located near the press, and is applied to the ram underneath the table.

TABLE RISES AND FORCES STEEL TAPER WEDGES EIGHT IN NUMBER UP INTO THE HOLLOW CASTING AT THE TOP, THE WEDGES CONFORMING TO THE SHAPE OF THE COPPER BAND ARE THUS PRESSED IN EQUALLY AGAINST SAME. PRESSURE IS THEN RELEASED AND THE SHELL READILY TAKEN OUT.

Operates by lever shown on left-hand side.

Pressure gauge behind.

As this machine is a Standard Hydraulic Press it can be used in any other capacity.

Factory handling operations are a specialty of ours. Look at this

ELEVATING TRUCK

All material is stacked on the platforms. To move material the truck is backed under the platform; the handle of the truck is then pushed down, keeping the button depressed, which raises the truck bed, and with it the loaded platform, at the same time automatically locking it in its raised position. When hauled to the desired position the button is pressed and the handle raised, lowering the platform to the floor. The truck is then drawn from underneath and is ready to move another platform.

RAISING AND LOWERING OF THE TRUCK CAN BE OPERATED WITH ONE HAND ONLY

—can be raised or lowered at any angle.

Specially designed ball-bearings throughout.

We also manufacture **LOADING FUNNELS, BALL - BEARING TIGHTENING NUTS, BELT - DRIVEN LOADING VIBRATORS, BENCH VISES.** WE SHALL BE PLEASED TO SUBMIT PRICES AND GIVE ANY PARTICULARS REQUIRED.

The Chapman Double Ball Bearing Co. of Canada, Limited

339-351 Sorauren Avenue, Toronto, Canada

The advertiser would like to know where you saw his advertisement—tell him.