Coal Mining Kinks

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COAL AGE

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Preface

The kinks gathered together in this book appeared in the regular issues of *Coal Age*. They were originally contributed by men in the coal-mining and kindred fields after their value had been proved in service, so that the reader should feel no hesitancy in constructing any of the devices he may see fit to use. The compiler is indebted to *Power*, the *Engineering and Mining Journal*, and the *American Machinist* for permission to use kinks which were originally published in those journals, but which should serve a useful purpose in the coal-mining industry.

Sharpening Drills for Bad Ground

Sometimes when a miner encounters seamy or broken ground, especially when it is composed of hard, shattered rock, the ordinary drill, sharpened as shown in Fig. 2, does not give good results, for

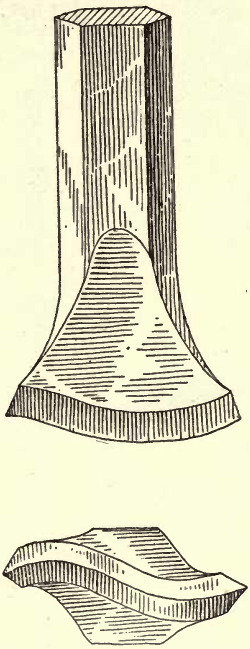


Fig. 1. Showing Drill As It Should Be Sharpened

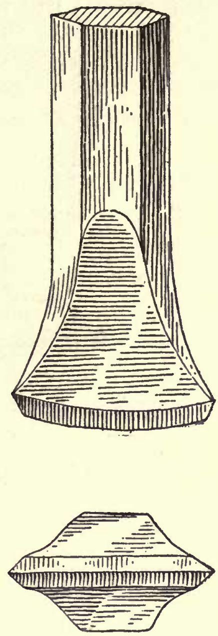


Fig. 2. The Old Way of Sharpening A Drill

the edge is frequently driven into a crack and it is practically impossible to loosen or remove the drill.

This difficulty may be overcome by sharpening the drill as shown in Fig. 1, where, it will be seen, the corners have been turned back so that the cutting edge assumes a curved outline. Such a drill point as this will not wedge in ordinary cracks and will thus prevent sticking.

The operation is not laborious. A few strokes of the blacksmith's hammer upon each wing of the cutting edge of the drill will put a sufficient curve in it to prevent sticking of the tool in any circumstances which are not exceptional. And the few moments spent in turning the edge will save much time and inconvenience in operation.

Home-Made Boring Jack

In mine work it is frequently necessary to drill vertical holes in the roof. For the spads in engineering work a brace and bit will usually suffice where the hole does not exceed ½ in. in diameter and 3 or 4 in. deep. But where deeper holes of greater diameter are re-

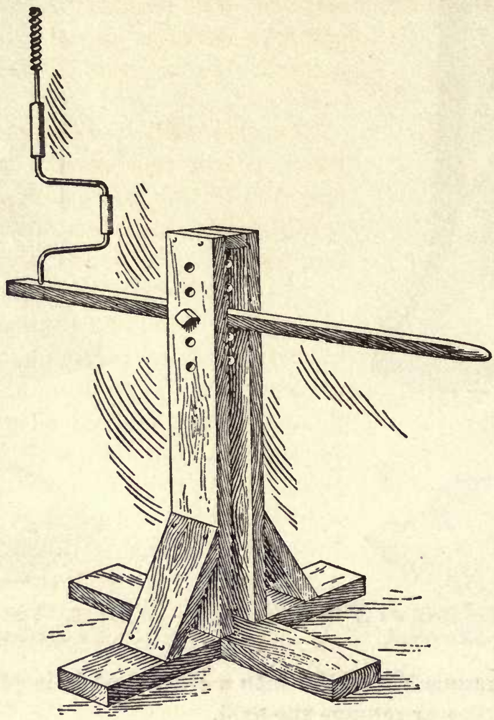


Fig. 1. *Simple Boring Jack*

quired for the insertion of trolley hangers, signal or telephone wires or any wiring that has to be hung from the roof, the drilling is often laborious and slow by the ordinary method, particularly so when the roof strata are flinty or tough.

A drill built on the lines of the ordinary lever-jack, as illustrated, although requiring two men to do the work—one at the drill and the other at the lever—will be found to expedite the work. Furthermore, if properly constructed the device may easily be moved from place to place, one man being able to carry the outfit, which is a decided advantage when drilling is to be done in a roadway where hauling is going on.

Holes closely bored in the uprights and lever and protected by metal bushings to prevent undue wear, with an efficient and easily removed cotter-pin, obviate any possible difficulty in driving the hole reasonably straight. The occasional adjustment of the lever in or out, up or down, neutralizes the tendency of the pressure point to describe an arc, and thereby prevents the bit from "binding" in the hole.

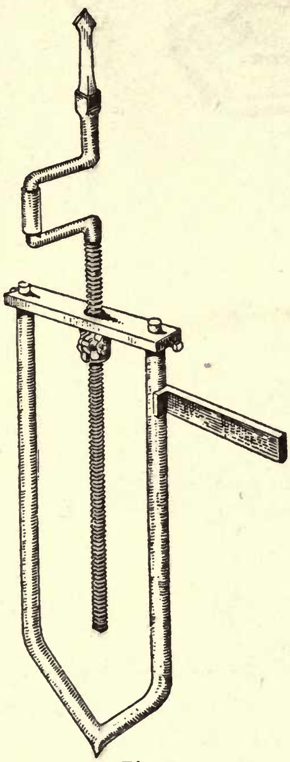


Fig. 2.
The Drill Ready for Operation

Another drill is illustrated in Fig. 2 which is less cumbersome, and can be operated by one man. The mine blacksmith should have no trouble in constructing it. The outfit weighs only 30 to 35 lb., allowing the operator easily to carry it from place to place. The materials needed consist of several feet of round or square iron ¾ to 1 in. in diameter, bent into the shape of an exaggerated tuning fork with a steel pick point at the foot to give a good hold in the bottom and prevent rapid wear. Propulsion is accomplished by a common coal or rock-drill thread bar with the bit-socket cut off and a crank welded on. The split-box is made with a thumbscrew to admit of the thread-bar being lowered or raised, and above this is affixed a piece of harness leather to prevent the drillings from falling in and clogging up the box threads. The frame need be only about 8 in. in spread and about 3 ft. high to be used where the seam runs from 5 to 7 ft. thick. A projection of iron about ½x2½ in. is welded onto the frame, which the operator straddles. This enables him to hold the machine firmly and rigidly and admits of the use of both hands if the hardness of the strata demands it when turning the crank. A steel bit 6 or 8 in. long completes the outfit.

In placing sight plugs in rooms and headings, in drilling holes for lights at switches, stations or sidetracks, and in putting up wire leading from the trolley to machines a drill constructed like the one illustrated in Fig. 3 may prove to be very convenient.

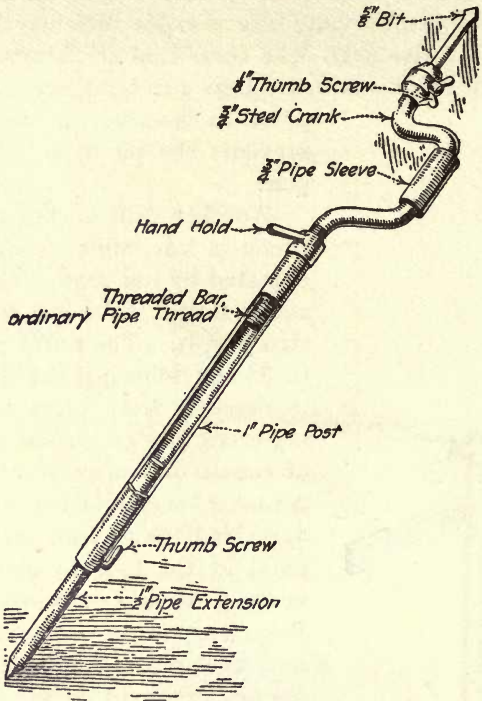


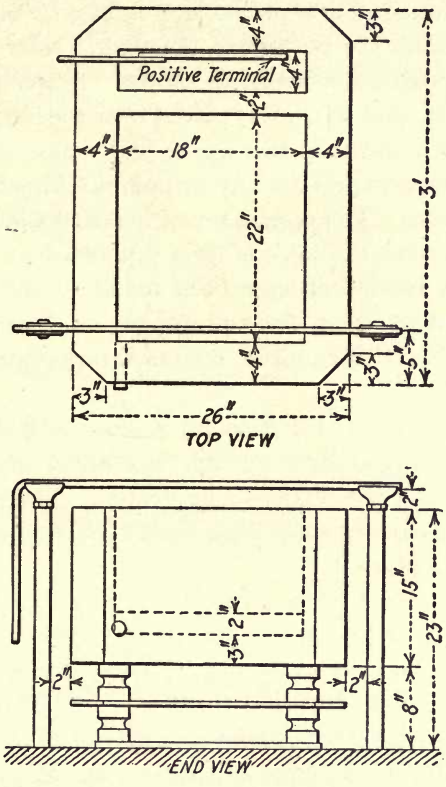
Fig. 3 A Cheap But Practical Drill

The drill weighs about 8 lb. and may easily be carried and operated by one man. It can be adjusted for use in places varying in height from 3 to 6 ft. and will drill even hard rock. It can be made in any ordinary mine blacksmith shop at small expense.

Electrolytic Forge

An electrically operated forge for use in mines is described and illustrated here. A forge similar in construction has given satisfactory service underground for over six years.

Essentially, the forge consists of a concrete tank mounted on suitable insulation, equipped with an iron plate for use as a positive terminal and supplied with the necessary wiring. The tank is 36 in. long, 26 in. wide and 15 in. high. The walls are 4 in. and the bottom 3 in. thick. For the purpose of preventing the piece to be heated from coming in contact with the positive plate and thereby causing a short-circuit, the tank is divided into two compartments by means of a 2-in. wall. This wall, however, does not extend to the bottom of the tank; there is an open space 2 in. high between the bottom



Top and End Views of the Electrolytic Forge

of the wall and the bottom of the tank to allow the passage of current and also to facilitate draining when necessary. A drain pipe stopped by a wooden plug is provided as shown in the figure.

The larger compartment of the tank, in which heating is done, is of ample size for most underground requirements. Although a smaller size will suffice for heating rivets only, experience has shown the necessity for a tank of the dimensions given in order to heat pieces longer than the ordinary sizes of rivets. In the smaller compartment of the tank a wrought-iron plate 14 in. long, 9 in. wide and ½ in. thick is placed, to which wire carrying the positive current is attached.

By means of two sets of four insulators in each set, the tank is insulated from the earth. The foundation is brought to the floor level. On the foundation is placed an iron plate of somewhat shorter dimensions than the bottom of the tank. Near each corner of the plate is located an insulator as shown. A second plate a little longer and wider than the first is placed over the insulators.

It has been found that this upper plate must extend over the lower one in order to prevent any drippings falling from the upper to the lower plate. The second set of insulators is placed directly above the first, and the tank is then supported on the upper set. In general, the insulators have been found to last about a year, when they must be taken out and cleaned or, if cracked, replaced by new ones. To change all of the insulators requires only a few minutes.

The return current is carried by a piece of 0000 trolley wire, which has been found large enough in current capacity and stiff enough to support the pieces to be heated. The wire is held by trolley hangers, rigidly supported near each side of the forge by pieces of 1½-in. pipe.

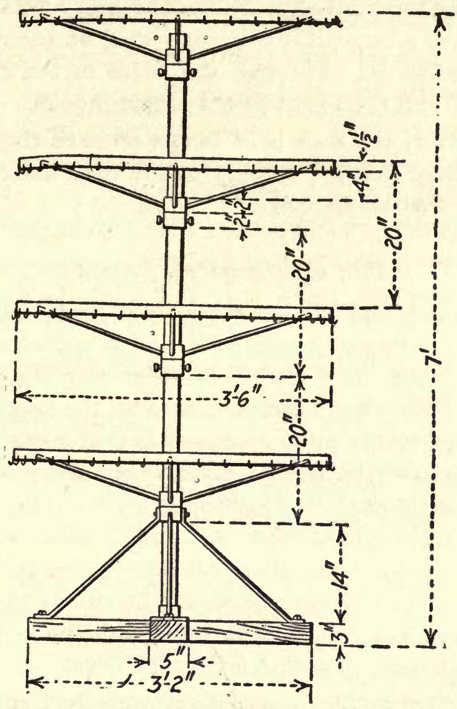
In operation the tank is filled with water to a depth of 6 in., which requires about 12 gal. Then about 5 lb. of common salt is added, the solution of salt and water forming the electrolyte. The current—which must always be direct current—having been turned on, the piece to be heated is held in a pair of tongs the handles of which are rested on the piece of trolley wire supported across the tank.

When the rivet or other metal to be heated is lowered into the electrolyte, current will flow from the positive terminal to the piece held in the tongs, which then becomes the negative terminal. A layer of hydrogen is formed around this terminal, causing a high resistance at the surface of the piece it is desired to heat. The resistance results in the development of heat, the amount being proportional to the I^2R loss.

In this manner a rivet or other similar piece of metal may be brought to a high temperature in a few seconds. After the current is shut off, the material may be quenched by thrusting it into the same solution in which it was heated.

Safety-Lamp Rack

The material necessary for making this simple lamp rack consists essentially of a piece of 2-in. pipe about 6 ft. 8 in. long; four



Simple and Practical Lamp Rack

pieces of strap iron ¼ in. thick, 1½ in. wide and 11 ft. 1 in. long; 24 rods for spokes, each of ½ in. diameter and 20¼ in. long, and four rods of ⅝-in. material and 24 in. long for braces.

The foundation of the rack is made up of two blocks of wood, each 38 in. long, 5 in. wide and 3 in. thick. Across the middle of each block a slot 5 in. wide and 1½ in. deep is cut, so that the two may be crossed and made to fit flush on top and bottom. A screwed flange to receive the pipe is attached to the center of the intersecting blocks. The pipe having been screwed into place, a loose sleeve of ½-in. material, drilled and threaded for four setscrews, is slipped over the pipe and made fast at a distance of 14 in. from the bottom, the braces being secured at the same time by the setscrews.

The straps are drilled at intervals of 3¹¹⁄₁₆ in. with holes of sufficient size to pass a 20-penny nail. Then the straps are bent into circular form and riveted, forming a circle 42 in. in diameter. The spokes, six in number, are riveted to the circular piece, the other ends being sunk into the hub. The hub fits loosely over the pipe and revolves around it, being supported on the clamp fastened by setscrews below it. Through the holes in the ring, 20-penny nails are placed and then bent over to form hooks.

The capacity of the rack is 36 lamps on each ring, or a total of 144 lamps. There is space enough beside each hook to stencil the number of the user of the lamp.

Repairing Steel Tapes

Many engineers and surveyors repair their own steel tapes, the repair outfit consisting of a combined punch and rivet set and copper rivets or eyelets. But few are familiar with the prope repair of a broken tape even when furnished with all the necessary facilities. The point requiring the most emphasis is that some of the original tape, no matter how it is broken, must be cut away and a new piece spliced in. This applies both to graduated ribbon tapes and to most of those made of heavy flat wire. Any mend which stiffens the tape at the splice weakens it and makes it more liable to break close by a second time, especially in the case of thin ribbon tapes. The only exception is wire tapes, ⅛ in. wide or less, which are usually so stiff that they can be mended with a soldered sleeve.

In Fig. 1, tapes Nos. 1, 2 and 3 illustrate defective splices. No. 1 is made by lapping the tape by 0.12 ft. and securing the lap with six eyelets. A little consideration would have shown that two eyelets and an 0.02-ft. lap would have done just as well.

No. 2 is another lap joint a little over 0.1 ft. long. In No. 3 the whole of the old tape has been retained and the repair made by riveting a piece 0.15 ft. long on the back. Solid rivets have been used, though eyelets would have been preferable. Nos. 2 and 3 also illustrate defective methods of fastening on the end rings, the laps for that purpose being too long. The handle in No. 2, however, would be correctly fastened if the laps were shorter, for two eyelets have been used to secure the lap, and that is the correct number.

Nos. 4 and 5 show conscientious attempts to insure flexibility, but by means not to be recommended. No. 6 is a crude but effective repair, no doubt made in camp. The sleeve was probably cut from a tin can, and it is likely that a nail was used for a punch, the motive

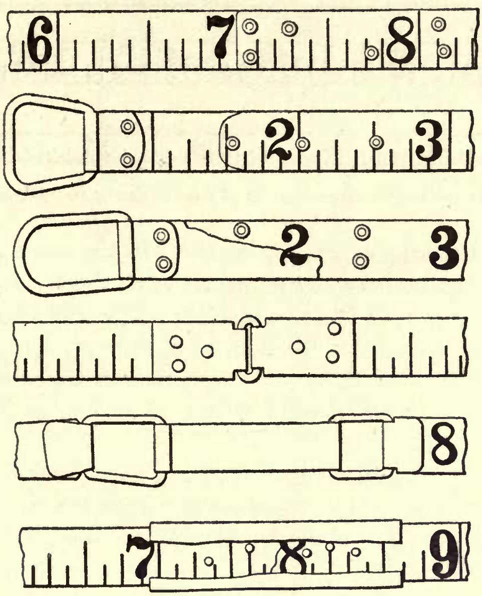


Fig. 1. *Examples of Incorrect Tape Repairs*

power being furnished by blows of an ax. There are no rivets, and the sleeve holds by depressions punched partly through the tape.

In Fig. 2 is illustrated the proper way to make tape repairs. First punch two holes in each of the broken ends 1 in. or more back from the break. Take a piece of tape about 2 in. longer than the completed splice is to be, lay one of the broken ends on the splice, tying it tightly to insure proper alignment, and punch holes in the splice through the holes already punched in the tape, placing and setting a rivet as soon as a hole is punched. Solid rivets are used for flat-wire or band tapes, and when the tape is ¼ in. or less wide, the rivets are placed in tandem, as shown in No. 1, Fig. 2. After the splice has been riveted to one end of the broken tape, lay the other broken end on it and, butting the two ends of the break together, tie it in place and rivet as before. When all rivets are driven, notch the ends of the tape close to the rivets with an edged

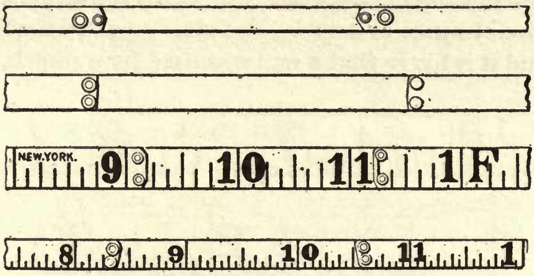


Fig. 2. Examples of Tapes Repaired So As to Preserve the Maximum Flexibility

file and break the tape on the file marks. In the same manner notch and break off the ends of the splice close to the rivets. The result is a lap of not over 0.03 ft. for a tandem splice and a little over 0.01 ft. (or $\frac{1}{8}$ in.) for rivets side by side, which means a tape practically as flexible as if it were new. For thin ribbon tapes eyelets should always be used instead of solid rivets, as shown in Nos. 3 and 4, Fig. 2.

To replace a broken ring or repair a tape broken at the ring, take a piece of similar tape showing any foot mark. Lay the ring with its clip or sleeve in place on this splice-tape, and hold it there by slipping a narrow piece of tape (or wire) under the splice-tape and over the ring (see Fig. 3). Punch one hole through the ring clip and tape, separate, and cut the tape close to the hole; insert the

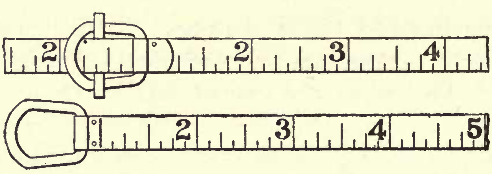
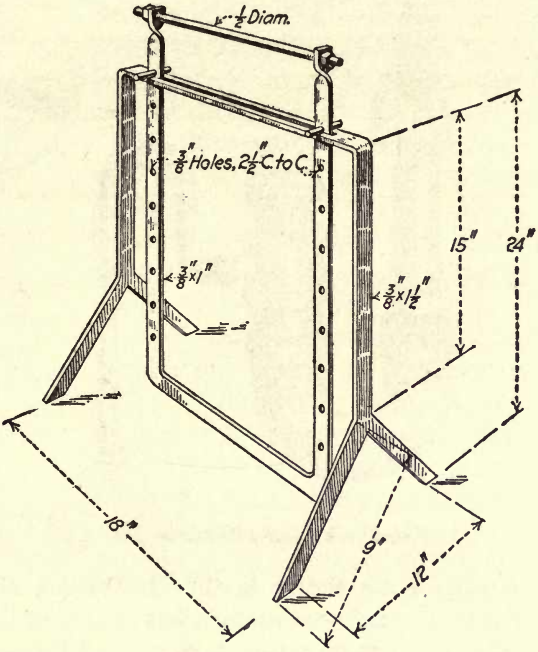


Fig. 3. How to Put the Ring End on a Tape

clip, and rivet, using a long eyelet. Then punch the second hole and rivet as before. Notch the clip with a file close to the eyelets and break it off on both sides of the tape. Rivet the new section to the broken end, not less than $2\frac{1}{2}$ in., or 0.2 ft., from the end, being careful to lay the new piece on top of the old tape.

Steel Rest for Blacksmith Shop

In the accompanying illustration is shown a stand for supporting long steel rods, etc., in the blacksmith shop when working with them at the forge or anvil. This stand has the advantages over the many "one-legged" forms used of being more stable and considerably

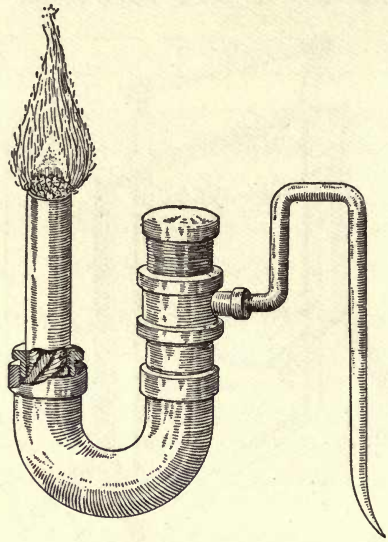


Details of the Steel Rest

wider, and yet it is simple to construct. The supporting piece is made of ⅜x1½-in. flat iron, the yoke of ⅜x1-in. flat iron. The latter is passed through a slot in the horizontal part of the supporting piece before the ends of the yoke are twisted at right angles, as shown, and the rod passed through these ends. By means of the holes in the vertical members of the yoke and two nails the support can be held at any desired height.

Rear-End Torch

Even if the mining laws of the state do not require it, the mine foreman should provide, if only for the sake of safety, a conspicuous light on the front and rear end of every trip or train of cars when in motion. It is usual to employ an oil torch for the rear light. As a rule the ones purchased for that purpose are almost too light for the rough handling they receive, and consequently replacements are frequent.



This Torch Cannot Be Blown Out

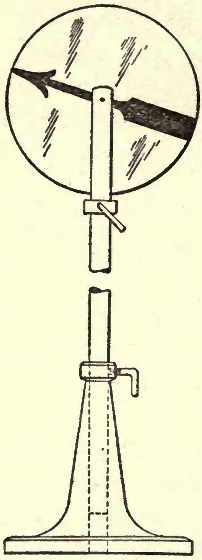
The home-made torch shown in the illustration, although its first cost may seem somewhat too much, has proved in the long run to be less expensive and more satisfactory. The following pipe and fittings are needed to build this torch:

1—1-in. nipple 5 in. long
1—1½x1-in. bushing
1—1½-in. nipple 4 in. long
1—1½x1½x⅜-in. reducing tee
1—1½-in. pipe cap
1 hanger hook
1—1½-in. open-pattern return bend

The hook shown in the illustration, by means of which the torch is suspended from the car, was made from ¾-in. round iron threaded to fit the reducing tee. This hook should be about 1 in. longer than the torch. The wick should be about 11 or 12 in. long. Oil is introduced by unscrewing the pipe cap on the top of the reservoir. A torch built in this manner is almost indestructible and will stay lighted even in a strong air current.

Holder for Danger Signs

Although safety experts attach much importance to the disk-shaped danger signs of different colors now used by many industrial concerns, it is found in practice that there is not always a suitable place to hang or takc them up at a point where danger exists. The workmen are therefore exposed to hazard because it is too much trouble to provide a means by which the admonition may be displayed.



A Convenient Danger Sign

The illustration shows a danger-sign holder that can be moved about for temporary use or fastened to the floor. It is made so that it can be used anywhere and is so constructed that the sign can be set to point directly toward the danger to be avoided.

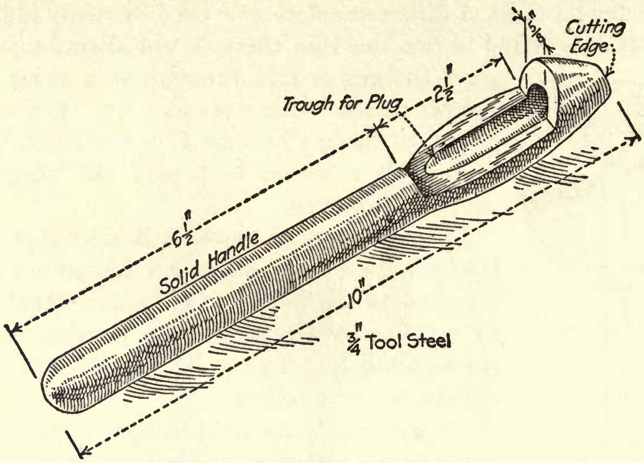
It consists of a cast-iron base having an adjustable rod about ½ in. diameter, held in place with a binding-screw in the base. The top of the rod is sawed down a short distance through the center so as to provide a place for the sign, which turns in a small pin, as shown. The binding-collar and screw near the top hold the sign securely in place, after the arrowhead is set to point at the danger to be avoided.

The use of these holders will prevent many accidents. Several of these signposts should be made and placed where they will be accessible at all times.

Spad-Plug Tool

With the use of this device for making spad plugs, the tiresome job of whittling plugs is avoided, there is no litter, and much time is saved, as several hundred plugs can be made in a few minutes.

Where sandstone or sandstone-and-slate roof is encountered in the mines it is necessary to use a hand drill or jumper to place holes for station and sight spads. This necessitates a plug being driven in the hole to retain the spad. The device is used in making these plugs. It is formed by flattening a piece of tool steel at one end and rolling it into a circle the exact size of the plug desired. A slot is cut to allow the plugs to pass out as they are made. The cutting edge is sharpened on an emery wheel, and the tool is then tempered. Poplar wood is best to use in making these plugs, as it swells on

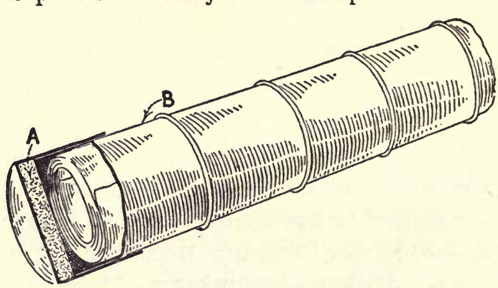


Simple Tool for Making Spad Plugs

becoming moist and remains firm when once set. The wood is sawed to the desired length across the grain. The illustration shows a tool for making plugs ⅝ in. in diameter, which is a convenient size, but one of any diameter can be made by increasing the diameter of the cutting circle.

Improved Blueprint Tube

If the cover of the cylindrical container for blueprints does not fit tightly, the prints are subject to dampness and the attendant

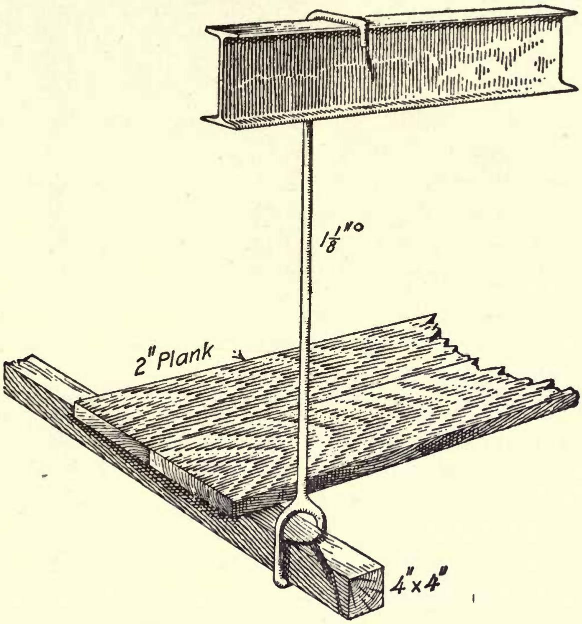


A Tight Blueprint Tube

deterioration. The following arrangement will remove this fault: A felt disk *A* about ¾ in. thick was turned down to the right size and then shellacked to the inside of the cover. The tube *B*, when the cover is put on, now hits the felt, making a good joint. With the use of the felt disk no trouble will be experienced in keeping the blueprints in good condition.

Staging Hangers for Riveters on Structural Work

Slinging a staging for riveters on structural ironwork is too often done with ropes, which for this purpose are both unsatisfactory and unsafe. A cheap and convenient hanger, shown in the



Staging for Structural Ironworkers

accompanying sketch, is made of $1\frac{1}{8}$-in. round iron, with a large eye at the lower end and a hook at the upper end to hook over the I-beams or other structural members. Through the eye is inserted a 4x4 timber on top of which 2-in. planks are laid. The cost of these hangers is small, they are light and can be handled easily, and they are not liable to destruction. Ropes, of course, require no initial preparation, and may be used in a slipshod manner, but they have none of the solidarity of the iron hanger. And once the iron hanger is made, it may be found much more convenient than rope, irrespective of its other excellent qualities.

Reflector for Underground Surveys

A useful and easily constructed reflector to be used in making underground mine surveys can be made as follows: Take a piece of any good strong wire and bend it in the form of a circle with a handle attached, and cover it with a piece of tracing cloth, as shown in the accompanying drawing. When held back of a plumb bob and string with a lamp behind it, this device will greatly diffuse the glare of the light and give the transitman a perfect shadow for a sight. The tracing cloth can be removed and replaced when burnt or otherwise injured. This reflector is superior to the ordinary tin reflector, in so far as no light is necessary for the instrumentman while taking a sight, and it is cheaper and gives better results. The size of the reflector will be governed by the individual case in which it is to be used. However, it has been discovered in actual practice that a reflector 6 in. in diameter with an 8-in. handle is both convenient and satisfactory. Other diameters and handle lengths might, however, be made with equal ease and be more advantageous.

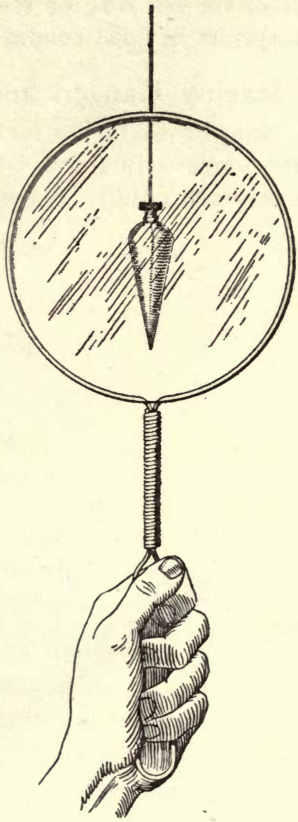


Fig. 1. The Reflector in Use

Another form of reflector, shown in the second illustration, can easily be made in the blacksmith or carpenter shop. The objections to the previous device are that it takes considerable time to fasten the tracing cloth to the frame and that, for instance, when sights are to be given from "cart-wheels" or other points in the roof not marked by a spad from which the plumb bob line may be hung, three hands would be required—one for the device, one for the bob line, and one for the lamp.

A tin frame is made to hold a half sheet of ordinary letter head or extension sheet paper, the upper edge of the frame being left open for its insertion. Four wire standards are soldered or riveted to the frame, then carried back to a common point, and finally twisted into a handle, a loop being left at the common point for hooking in

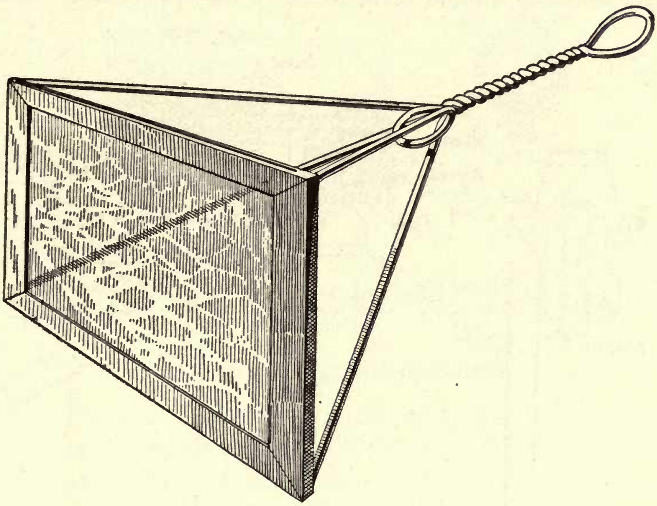


Fig. 2. Another Form of Reflector

the carbide lamp. This loop should be far enough from the frame to prevent burning the paper.

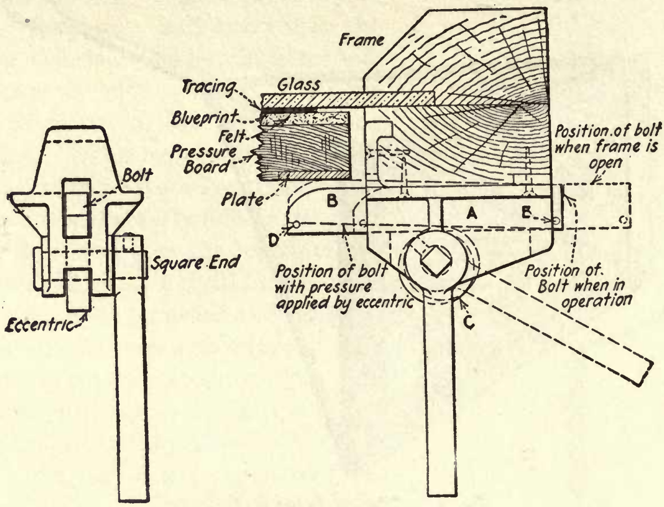
This arrangement throws the full rays of the lamp against the paper. Letter paper is cheaper than tracing cloth and serves the purpose well. The frame or handle may be turned so as to have the long side vertical, but this is not necessary, for when it is held horizontal a sufficient view of the bob line can be secured.

Clamp for Blueprint Frame

Where the electric blueprinting machine has not been introduced, and where the old-style sun frame still exists, the clamp here illustrated will be found very useful. There are many devices used for clamping the pressure board down on the back of the frame so as to give the necessary close contact between the tracing and the glass. The door-bolt generally used, however, is a most unsatisfactory means of securing this contact.

The clamp is composed of a brass bracket *A*, which is fastened by screws to the side of the frame. It has a sliding piece *B*, which can be moved in and out by hand like a "bolt" and is so designated in the illustration.

Underneath this bolt is an eccentric disk *C*, which is fastened to a pin and has a hand lever fitted in its square end. When the



Details of Blueprint Clamp

bolt is shot into place, the lever is pulled over to the right, as shown by the dotted lines, and the eccentric disk forces the bolt up in the direction of the pressure board, thereby pressing the tracing against the glass of the frame. There are pegs, *D* and *E*, to limit the movement of the bolt. In actual use, of course, the whole appliance is reversed and so remains till the clamping is complete.

Repairing Pipe Leaks

The following pipe repairs are reported to have been made successfully: A 4-in. cast-iron pipe broke apart under a building foundation. To allow the water to be turned on again as soon as possible, the clamp *A*, 6 in. wide and $\frac{1}{4}$ in. thick (Figs. 1 and 2), was used, with sheet-rubber packing wrapped around the pipe, and two pieces of sheet copper *D* and D_1 6 in. wide, where the edges of the clamp came together. This job lasted for many years. Another 6-in. cast-iron water pipe had a 15-in. crack (Fig. 3.) A piece of $\frac{1}{4}$-in. iron 4 in. wide formed to the shape of the pipe, with sheet rubber placed under it, was clamped over the break (Fig. 4).

A 3-in. steam pipe leaked at the flanges because the threaded ends were badly corroded. A copper sleeve and a 5-in. pipe 8 in. long were slipped over the opening after the flanges were removed

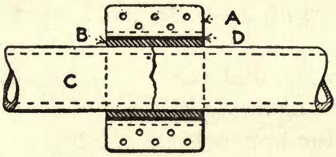


FIG. 1.

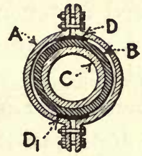


FIG. 2

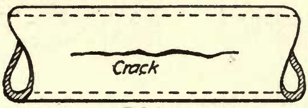


FIG. 3.

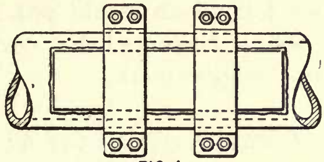


FIG. 4

Methods of Clamping Broken Pipes

(Fig. 5). The space between the outside of the 3-in. pipe and the inside of the 5-in. pipe was then filled with Smooth-On, iron and elastic cement mixed. Heat from a blow torch was then applied for half an hour, and in two hours steam was turned on.

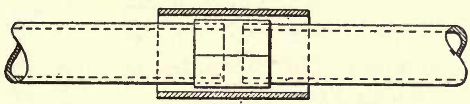


FIG. 5.

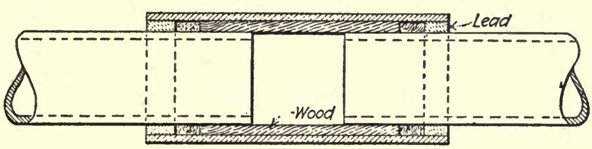


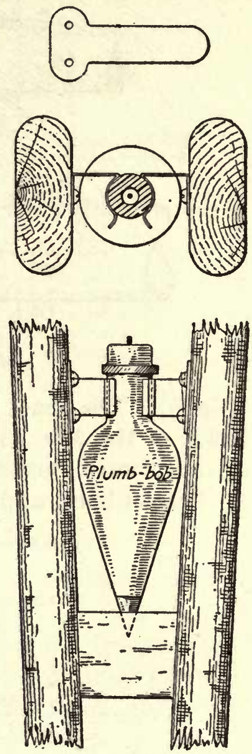
FIG. 6

Joining Pipe Ends With Sleeves

In extending a cast-iron water main it was found that what should have been the connecting length was a foot short and there was no more pipe of the same size on hand. Instead of sending to the city for a pipe and sleeve, one of the men went into the workshop and in a few minutes turned out a wooden sleeve 16 in. long to fit over the pipe. Next a 20-in. piece of larger pipe was cut and placed over the pipe ends and the wooden sleeve (Fig. 6). The joint was then run with lead in the usual way.

Plumb-Bob Holder for Transit Leg

In making the plumb-bob holder illustrated, cut two pieces of thin spring brass as shown in the accompanying sketch. Bend as shown, and fasten in the split leg with ⅜-in. round-head brass screws. Cut from the same material an oval plate, and tack it on the block below with brass brads before boring the 3/16-in. hole for bob point. A very light grip will hold the bob, even up to a jolt which would put the instrument out of business. No parts project. And no "trigger work."



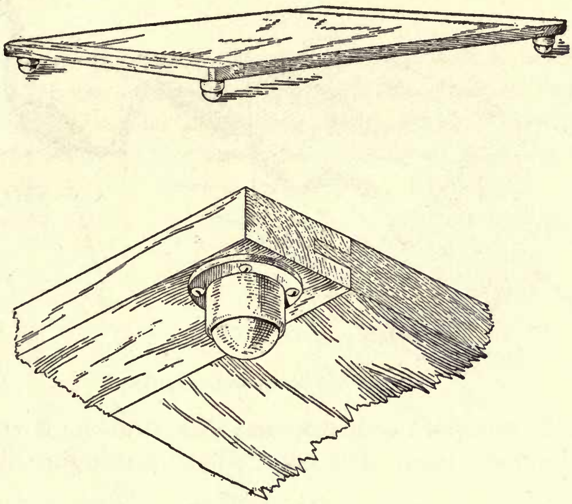
A Brass Spring Plumb-Bob Holder for Transit Leg

Cloth Backing for Maps

In order to satisfactorily and easily put cloth on the backs of paper maps, drawings, etc., so as to strengthen them for field or office use, the cloth should be soaked in water and stretched as tightly as possible over a smooth board or table top, using thumb-tacks or carpet tacks to hold it in position. The map or drawing to be mounted should also be soaked and a coat of paste applied to the back of it as well as to the stretched cloth, care being taken to rub the paste well into the meshes of the cloth. Pressure should then be applied by means of a roller, to obtain close contact between the cloth and the paper and to get rid of any excess paste. It should be allowed to stand thus until dry. The paste used is of the common wall-paper sort, which, if it should happen to get on the surface of the map, could be easily rubbed off without any harm. Care must be taken in soaking the print that the ink used does not run or smear, and also, in applying the pressure, that the surface does not rub off. Unbleached muslin makes a strong backing cloth, and since it is of close weave, it will support the map if additional work is to be done on it. Much time is spent in getting up maps and drawings, and a little care in backing them up with cloth and in subsequent usage would hardly be amiss.

Ball-Bearing Drawing Board

In making freehand drawings the board must be turned and shifted frequently to accommodate the hand to different curves and lines. Every time the change in position is effected the fingers



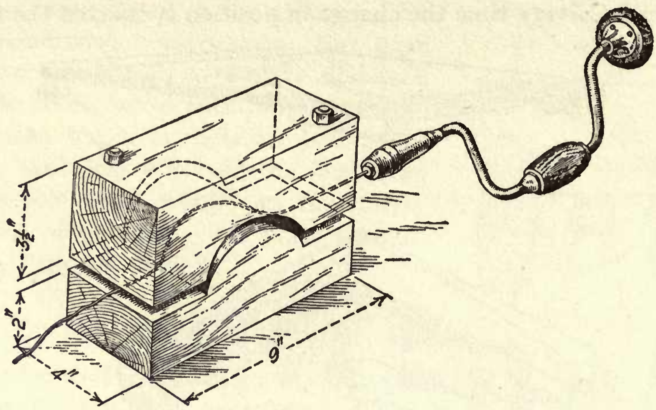
Two Views of Drawing Board, Showing How the Casters Are Fitted On

must be deftly inserted between the board and the table. Provide your board with four ball casters, as sketched, to facilitate this turning and shifting. The casters are a standard article readily bought anywhere. This board has been found valuable in freehand work.

Handy Wire Straightener

To many the straightening of an old, kinked wire is no easy job, but to those who become familiar with the straightener described the problem will be comparatively simple.

To make this straightener first procure two blocks of hard wood, each about 3½x4x9 in. Cut the two ends of one piece down from 3½ in. to 2 in. in thickness for a distance of 2½ in. from either end. This will leave a rectangular projection in the center of the piece. Round the two ends of this projection off as shown in the accompanying illustration. From the other block, and on a 4x9-in. face, cut out a concave depression to fit over the curved surface of the other block. Then, placing the two blocks together, bore two holes, one in either end and in opposite corners, as shown in the diagram. By means of two bolts clamp the two blocks onto the wire to be straightened, near one end. Fastening a brace or similar grip-

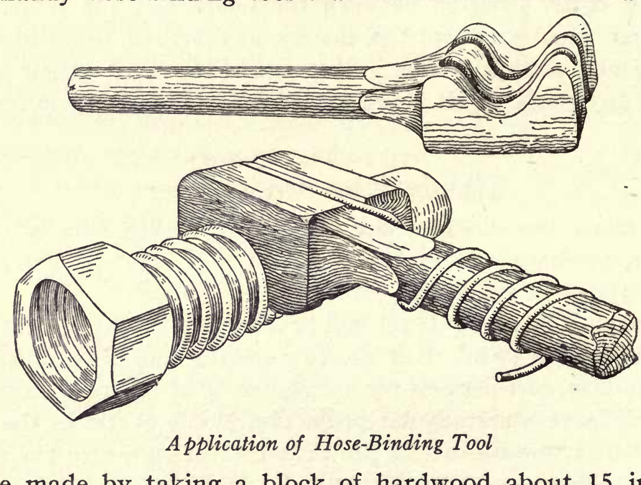


Wire Straightener in Operation

ping tool to the short end, turn the wire, drawing it through the block at the same time. The result will be a straight wire.

Hose-Binding Tool

A handy hose-binding tool that will make a substantial repair

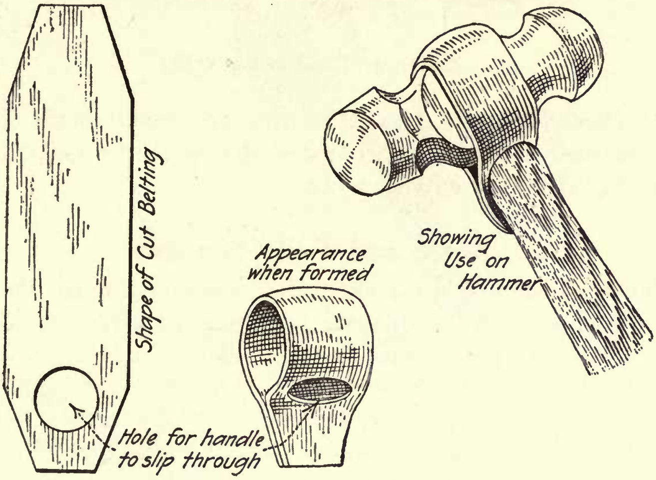


Application of Hose-Binding Tool

can be made by taking a block of hardwood about 15 in. long and $2\frac{1}{2}$ in. square and shaping it as shown in the illustration. Grooves can be cut or turned in the handle for wire ways if necessary. This handle will keep the wire taut through the process of winding. It is especially useful to steam fitters and engineers when inserting nozzles or nipples of steam apparatus in rubber hose to hold them tight.

Soft Hammer

An ordinary engineer's hammer can be made to serve in place of a mallet for use on wood or other soft materials by using a piece of leather or belting in the manner shown in the drawing. A hole is cut in the leather large enough to be slipped over the end of the



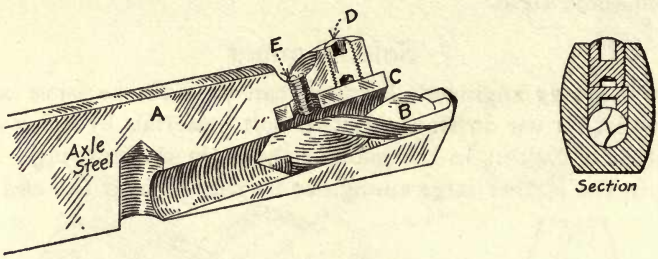
Engineer's Hammer With Leather Cushioning

handle and the leather is then slipped to the head of the hammer, flapped over it, and nailed onto the handle, or the two ends are wrapped to the handle with several turns of fine wire. The hammer is used sidewise on wood, which brings the leather belting into play and softens the blow. In this way the user has in compact and convenient form a hammer ready for various uses, and the leather will wear for a long time.

Broken Drills as Turning Tools

Here is an economical little device that cuts down tool-steel expense. It is a tool holder made of a size best suited to the use to which it is to be put. The drill holder, or rather tool holder, is illustrated at *A*. *B* is a drill, which is properly ground for turning;

C, a clamp that holds the drill in place; *D*, a setscrew for tightening the clamp; and *E* is a small screw that prevents the clamp from getting lost when the device is not in use.

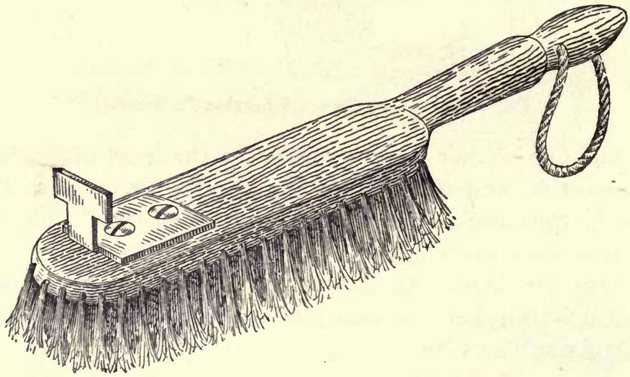


Holder for Using Broken Drills

This contrivance works well, as drills are usually made of a good grade of steel, and it reduces tool-steel expense by making use of the broken drills for cutting tools.

Brush and T-Slot Scraper

The device shown in the illustration consists of a machine T-slot scraper and a brush. Chips can readily be removed from blocked and crowded slots with the scraper, which is made of cold-rolled

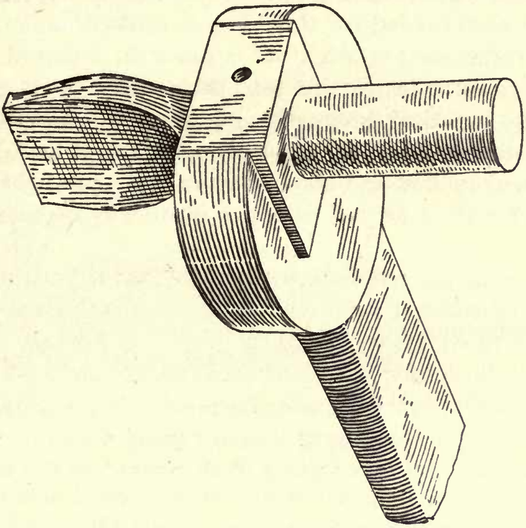


Combination Brush and T-Slot Scraper

steel and screwed onto the back end of the brush. Then when the chips are freed, the brush is brought into play to remove them. It is evident that time is saved by using such a contrivance instead of two separate articles.

Screw-Driver for Heavy Work

When forcing home large screws in dies where cap-screws cannot be used, it is necessary to have leverage on the screw-driver in



A Screw-Driver for Heavy Work

order that the screws may be driven tightly. One of the best methods of obtaining this leverage is to shrink-fit and pin a square nut on the shank of the screw-driver, as shown, and apply a wrench.

Keeping Cement Fresh

It is sometimes thought that only one thing is necessary for the safe and effective storage of cement—a tight roof. Water-tight storage is not enough, however, it being necessary to observe the following rules:

1. Cement will retain its strength for an indefinite period when stored in air-tight containers.

2. Cement will be injured less by storing in paper sacks than in cloth sacks, everything else being equal.

3. Cement in any kind of commercial packages will be injured least while in storage if the packages are piled as closely together as possible. In other words, the outside surface of the pile of sacks should be reduced as much as possible.

4. Piles of cement sacks should be covered with a tarpaulin to

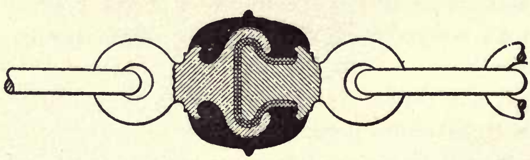
prevent as far as possible the circulation of air through the pile. Note the word "tarpaulin"; an ordinary canvas cover is not a tarpaulin, but a paulin. Five parts coal tar, one part gasoline and one part good japan drier make a water-tight black coating for canvas such as is needed for this kind of work.

Surface condensation often takes place on a stored sack of cement. The moisture is carried into the cement to its great injury as well as the practical destruction of the sack. The deterioration of the sack may not be evidenced at once; but it may be returned to the mill and refilled and sent to some other job, where it bursts and is paid for by a person who was in no way responsible for its condition.

There is a saying among cement men that if you turn your cement—that is, move it from one pile to another—once a month, it will not be injured by an indefinite period of storage. This is not the case; pile it closely and cover it as nearly air-tight as possible and you will have very little caked cement. If the cement is caked it is better to let it alone until you are ready to use it rather than to break the cake, thus presenting fresh cement to the action of the air.

Strain Insulator for the Mule

In many coal mines electric power is used for haulage and cutting, but mules for gathering to the locomotives. Where these animals are thus employed, they frequently get shocked, and even killed, through the mine cars getting off the track and against the live wires. This is especially the case in mines operating in low and medium thick coal measures.

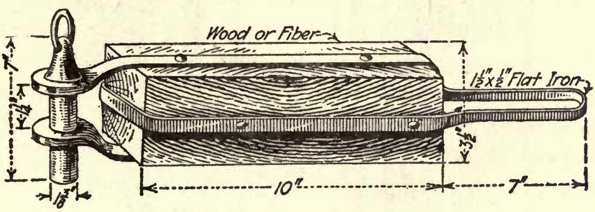


Cross-Section of Strain Insulator Welded into Chain

To eliminate this hazard a ball or conical strain insulator can be welded into the trail chain at or near the spreader ring. The strain insulator effectually prevents current passing along the trail chain to the mule from the drawbar of a car that may have come in contact with the feeder or trolley wire. Care must be taken when welding the links holding the strain insulator in place to make them long on each side of the insulator and to protect the insulator by wet burlap, asbestos or some other material which will not allow the composition of which the insulator is composed to be injured by the heat of welding.

Insulated Car Hitching

As a safety precaution it is well to install the insulated wagon hitching shown in the accompanying illustration between the electric locomotive and the cars when transporting miners to and from



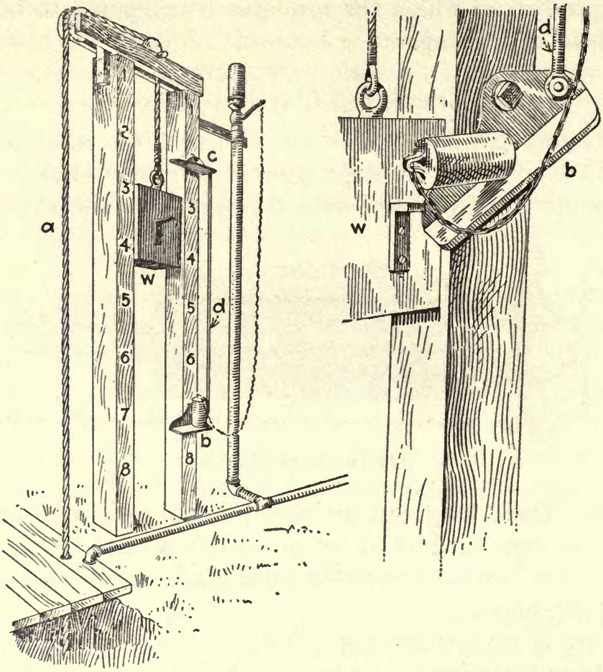
The Insulated Hitching

the mine. These hitchings are about 18 in. long over all. They consist of a dry, hard wood, or preferably a fiber block, which is strapped upon two sides with the same grade of iron that is used in ordinary hitchings.

The use of such a hitching effectually prevents the locomotive current from traveling back along the trip of cars and thus finding its way to the rail. With the ordinary arrangement of cars and locomotive, it is not at all uncommon for the current to find its way back along the trip and thus to the rail, particularly if the rail is heavily sanded. A severe explosion of powder which occurred at Fayette City in January, 1916, is believed by many to have been caused by such a stray current. As this hitching is placed immediately behind the locomotive and the wood or fiber forms an effective insulator, it is impossible for the iron of the cars to become energized.

Sump-Pit Alarm Whistle

The alarm device shown in the illustration was used on a 48x32-in. x 10-ft. stroke pump at a sump 300 ft. below the surface. On the float wire *a* a beer keg filled with tallow was used, and a weight *w* was made to balance the keg. When the water rises to the 7-ft. mark, the arm on the weight upsets the pocket *b* and dumps out a small weight that is attached to the whistle valve by a light chain; when the water falls to the 2-ft. mark, the arm on the weight *w* upsets *c*, which is connected to *b* with a reach rod, and the small

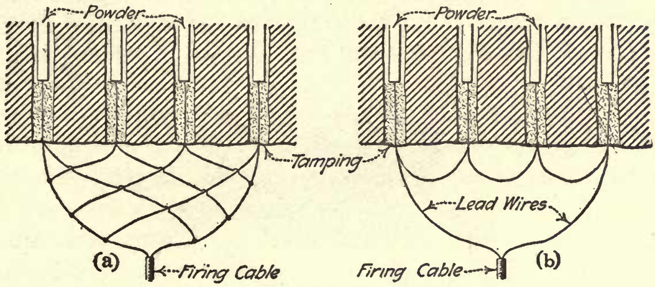


Combined Indicator and Alarm

weight is again released and the whistle blows. Of course the whistle continues blowing until the engineer closes the valve and hangs the weight on a hook provided for the purpose.

Connecting Up Shots

There are two methods of connecting a number of shots to be fired by electricity. The shots may be connected in parallel, as illustrated on the left at *a* in the accompanying figure, or they may be connected in series, as illustrated on the right at *b*. It is perhaps safer to connect the shots in parallel, because each shot is then fired independently and simultaneously, with the same strength of current. This method offers less risk of misfire than when the shots are connected in series, as the current in the latter case must pass from one hole to the other through the entire series. This may result at times in exploding only the first and last holes of the series. Greater caution is needed, not only in connecting up the shots for firing, but in allowing more time before going back to work

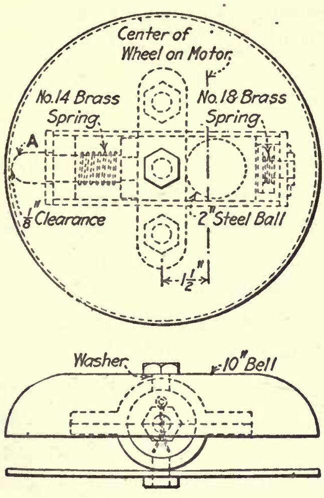


Two Methods of Connecting Up Shots

after the blasts are fired. That will give the smoke and the sulphur fumes a chance to clear away and the miner can see better what he is doing and avoid any danger that he might not otherwise discover.

Automatic Locomotive Gong

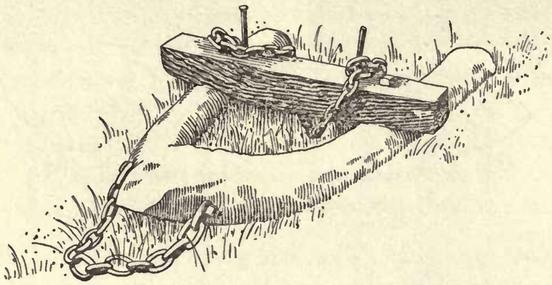
The motor bell shown in the illustration has proved to be satisfactory in the mines of the Republic Iron and Steel Co., at Gilbert, Minn. It is simple and does not depend on any outside power for its operation. This bell is attached to the wheel of an underground electric locomotive. The revolution of the wheel causes the bell to ring. When the cylinder points downward, the steel ball falls on the plunger *A* and causes it to strike the gong. As the bell turns upward, the ball recoils on its spring, and is ready for the next turn. The rate of travel can easily be determined by the sound of the bell, as its frequency and tone depend directly on the speed of the motor. In this way it acts as a safety device. Automatic bells of this type, being such a distinct yet simple improvement, should be installed on all the locomotives which are used underground.



Automatic Locomotive Gong

Hauling Shoe

The device illustrated below, patterned after the farmer's "stone boat," is very convenient for hauling rail, pipe, mine timbers or other material. The shoe was made of a forked locust trunk, peeled, and the large end cut down to allow the passage of



Shoe for Hauling Pipe or Timbers

a 12x$\frac{5}{8}$-in. bolt. A piece of 4x4-in. oak lumber, about 2$\frac{1}{2}$ ft. long, was fastened to the fork by means of $\frac{1}{2}$-in. drift bolts, to which were attached two $\frac{5}{8}$-in. iron rods, about 8 in. long, which served as attachments for the chain. Its cost is insignificant. The amount of pipe handled, or of props and other mine timbers hauled out, may be tripled by its use.

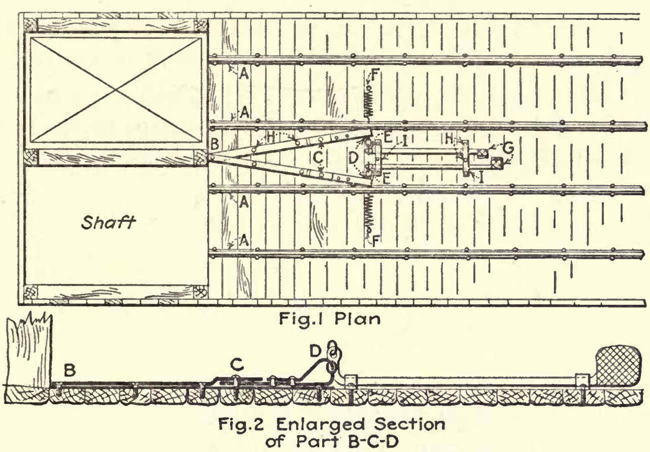
Useful Safety Catch

The drawing on the next page illustrates a safety catch which is used to prevent cars from running into the shaft sump. It is simple in construction and easy to manipulate. Fig. 1 is a plan of the arrangement. The parts *B-D* are made of iron 1 in. thick and about 1$\frac{1}{2}$ in. wide. The end *B* is placed against the center upright of the shaft, the other end *D* resting beside the track rail *A* and extending above it about 6 in. When not being held off the rail by the cager putting his foot on the lever *G* to allow cars to pass onto the cage, the catch is always held in position ready for action by means of a spring, similar in arrangement to spring latches or switches, the spring being fastened in the middle of the track at the point *F*.

The catch, or chock, end of this arrangement catches the outer edge of the car wheel, and thus if the force is sufficient (as in the case of a runaway) throws the car from the track. The car wheels generally extend over the outer edge of the steel rails as much as 2 in., which is sufficient to allow the catch to rest just beside the rail and engage the protruding part of the wheel.

The levers *E* and *G* are made of a piece of round iron, $1\frac{1}{2}$ in. in diameter. The end *E* is about 4 in. long and is maintained in a vertical position by a chain link connecting it with catch *D*. The other end of lever *G* is about 6 in. long and makes an angle with the floor of about 45 deg., pointing away from the track on which it operates the safety catch, or chock.

The distance from *E* to *G* is about 4 ft.; thus when the car is resting against the catch and the cager gets in position to place the car on the cage, he puts his foot on the lever *G* and presses it to the floor. This turns the bar and the lever *E* sufficiently to withdraw the catch from in front of the wheel. The lever *G* acts as a foothold until the rear wheels of the car are past the catch. The floor at this point is made of plank about 4 in. thick and 10 to 12 in. wide



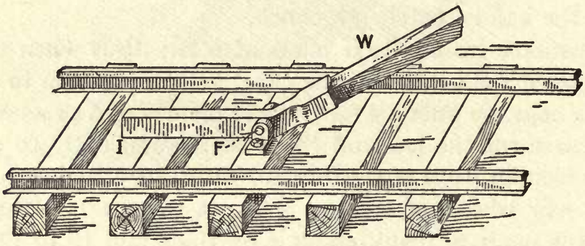
Figs. 1 *and* 2. *Details of the Safety Catch*

laid side by side. The catch pivots on the bolt *C* about 18 in. from the chock *D*.

This safety catch is simple, practical and quite inexpensive. It can be installed by any experienced mine engineer or superintendent and will fill the bill satisfactorily if the conditions call for any such arrangement.

Safety Stop in Mine Slope

On a slope where the haulage is accomplished by means of an endless-rope system the mine cars are gripped to the rope when coming out of and going into the mine. If the rope should break, the loaded cars would run backward down the slope into the workings, with probably disastrous consequences. To insure against such an accident safety devices are installed at short intervals in the center of the track for the entire length of the slope.



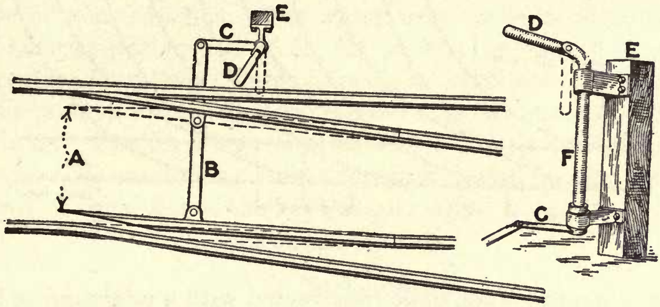
Simple Car Stop for Mine Slope

One of these safety stops is shown in the accompanying illustration. The arm *I* is made of iron, while the arm *W* is of wood. These arms are fulcrumed at *F*, this fulcrum being bolted securely to the track on the floor of the slope. The arm *W* is so attached that ordinarily it is high enough above the floor to be struck by the mine cars as they pass up the slope. As a loaded car moving up the slope strikes the arm *W*, the arm, pivoting on *F*, moves downward, allowing the car to pass over it, the iron arm *I* at the same time rising slightly into the air. When the car has passed over and the downward pressure on the arm *W* is thereby relieved, the iron arm *I*, because of its weight, falls to the floor of the slope, elevating *W* to its initial position.

If the rope to which the loaded cars are gripped should break, the car in going backward down the slope would come in contact with the arm *W* and be brought to a standstill. These devices are placed at short intervals so that a car cannot acquire enough momentum either to throw itself from the track or to break the arm *W*.

Semiautomatic Switch

A new type of mine switch which is semiautomatic in operation, as may be seen in the accompanying illustration, consists of the switch points *A*, joined by the bridle bar *B*, which are operated by the lever *D*, actuated through the vertical standard *F* from the lever *C*. The standard *F* is secured by brackets to the post *E*, which is placed against the rib, the length of the bridle bar *B* being made sufficient to accommodate this arrangement.



Layout of Semiautomatic Switch

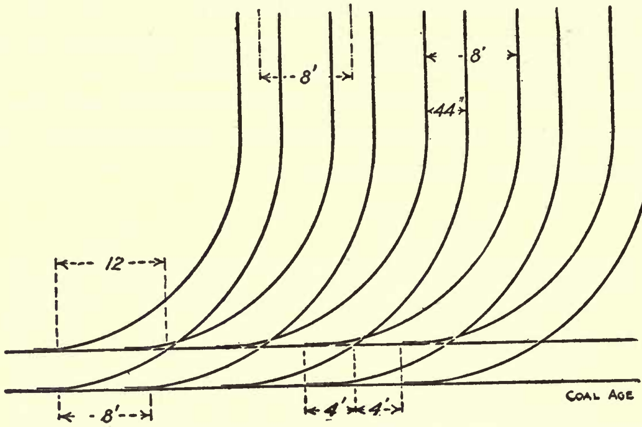
As will readily be perceived, it is only necessary to throw this switch by hand when the trip is approaching the point of the switch. When traveling in the other direction, or toward the left in the illustration, the locomotive will automatically throw the points in either direction, so that it is unnecessary for the triprider to throw the switch by hand. The hand lever *D*, which is usually made of about 1-in. round iron, is hinged so that when not in use it folds down alongside of the standard *F*. This hand lever is usually made about 12 in. long.

There are many places in the mine where such a switch as this would be extremely convenient, and its simplicity is such that it may be readily made by any mine blacksmith.

Economical Switch Arrangement

The accompanying illustration shows how a number of switches may be laid to secure a maximum economy of space. In the figure it will be noted that five complete switches, with a track gage of 44 in., and each having a lead of 12 ft., take up a total distance of only 48 ft., where ordinarily 72 ft. would be required.

The arrangement as here shown has been used for the purpose of running locomotives into the motor barn. It was possible for



Plan Showing Switches

this building, therefore, to be constructed with a minimum of length and breadth.

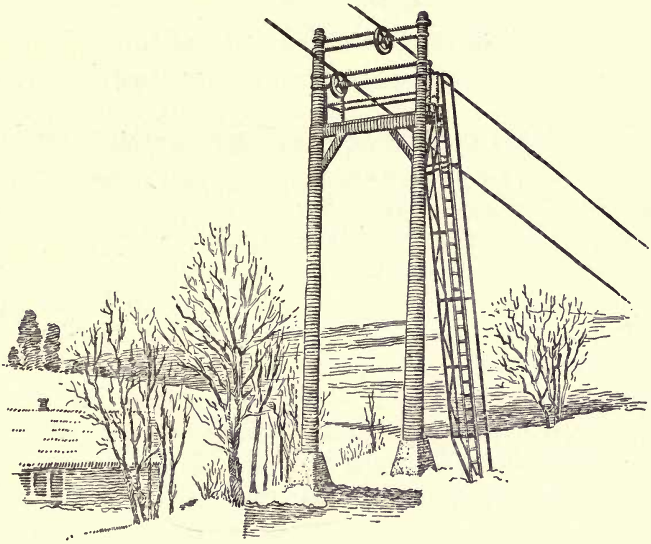
Concrete Cable-Idler Stands

At the Isabella mine, Palmer, Mich., the Cascade Mining Co. has three concrete idler stands. The largest is on a solid-rock bluff 80 ft. from the steel idler on the shafthouse. The span between the two poles of the stand was made great enough so that by adding a third it will serve the ropes on the cage hoist. A play of 3 in. was allowed between the side of the post and the idler hub at its outer position in fixing the location of the stand.

On the center line eight anchor-bolt holes were located $1\frac{1}{2}$ and 3 ft. respectively on each side of the post. On lines at 45 deg. and 90 deg. to the first line, 16 more holes were similarly located. A jackhamer was used to drill the holes 8 in. deep. Anchor bolts made of $\frac{1}{2}$-in. round with $1\frac{1}{4}$-in. eye and an 8-in. shank were next cemented into the holes facing centers.

Forms were built to the full height of the stand. Reinforcing rods were welded full length and the bottoms given approximately the correct bend before being placed in position. The corner rods were $\frac{7}{8}$ in. square and were carried to the top of the posts. The side rods were of 1-in. square ribbed steel, ending just below the horizontal crossbrace. Horizontal ties 1x$\frac{1}{8}$ in., made to fit inside the rods, were spaced 5 ft. apart. Starting with intervals of 20 in. from the top of the beveled pier, the rods were wired horizontally, ending with intervals of 10 in. at the top. Four $\frac{1}{4}$-in. square iron rods and three horizontal ties of $\frac{1}{8}$x1 in., 4 in. square, were used as reinforcement in the 8x8-in. horizontal brace. Eight inches back from the ends the four horizontal rods were bent down and securely bound to the vertical rods in the posts.

The base forms were made of 2-in. hemlock, the pier and pole forms of 1-in. hemlock. The latter were made in three sections. The bottom section was 12 ft., the middle section 10 ft. and the top section 8$\frac{1}{2}$ ft. long. Three sides of the forms were nailed together on the ground and then placed around the rods and the fourth side nailed on. The form was lined in with a transit and spragged securely. The reinforcing rods were first bound to the horizontal crosstie at the collar of the beveled pier only.

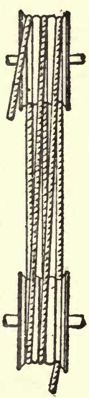


As soon as the base forms were finished, the rock footing was washed clean and the rods spragged into position, using a transit to line up the bottom ring. The base was then poured, short lengths of rail, pieces of old cable, etc., serving as reinforcement. The forms for the beveled piers were immediately centered and filled. The mixing was all done by machine, the mixture in the base and beveled forms being 3-2-1. The same mixture was used in the poles, except that the pebbles were limited to a maximum of $\frac{3}{4}$ in.

The rods were wired in the two days during which the base was setting. The lower section of the pole forms was then centered, spragged and filled. The rods cleared the inside of the forms by $1\frac{1}{4}$ in., so it was necessary to watch them closely in tamping to keep them centered. The middle section was added after allowing a few days for the setting of the bottom section. The top forms were spragged to the lower sections of the opposite form already placed and filled. The top section was handled in the same way. The holes for the bolts were left by inserting a 1-in. iron pipe in the forms just the length of the inside dimensions of the form. The brace form was set into the sides of the top forms and filled at the same time. The forms were left on for several days, and then the whole stand was allowed to set for two weeks, after which the steel work was added.

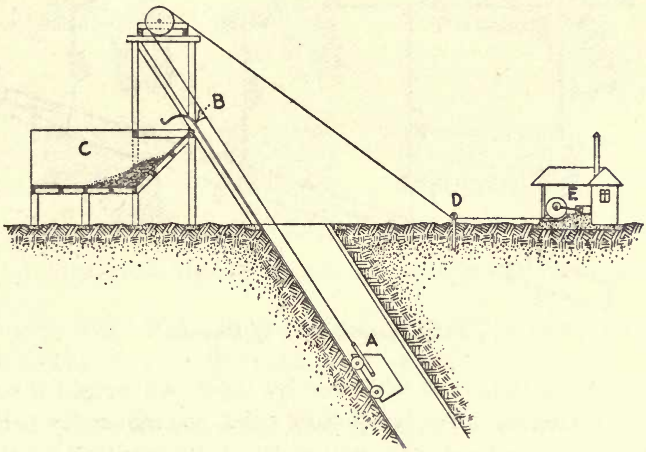
Endless-Rope Winding Drum

The use of a single drum in endless-rope haulage always develops a fleeting of the rope—that is to say, the rope travels from one side of the drum to the other or tends to climb on itself. This fleeting of the rope can be overcome properly only by the use of two drums placed tandem to each other, either in line with the rope or one above the other, as illustrated in the accompanying figure. The rope winds on the upper drum in the first groove, and, passing over the second drum, winds off the corresponding groove on that drum. From there it passes to the second groove on the first drum and then to the corresponding groove on the second drum, following the same order until it finally passes off the last groove on the second drum, as illustrated in the figure. It is not necessary to have more than two coils or grooves on each drum, except where there is a possibility of the rope slipping on the drum, when the number of turns on each drum should be increased. The labor cost was $356.15. Material, consisting of 2,936 lb. reinforcing steel (1 in., $\frac{7}{8}$ in., $\frac{3}{4}$ in. and $\frac{1}{2}$ in.), $\frac{5}{16}$ in. 3-strand galvanized steel wire, sand, and 95 sacks of cement, cost $132.72. The total cost was $488.87.



Headframe for Inclined Shaft

A mine reopened in Virginia was entered by an old inclined shaft dipping at an angle of 55 deg. It was deemed necessary on account of the situation of the mill and waste pile to put the hoisting plant



Headframe with Hoist on Opposite Side of Shaft

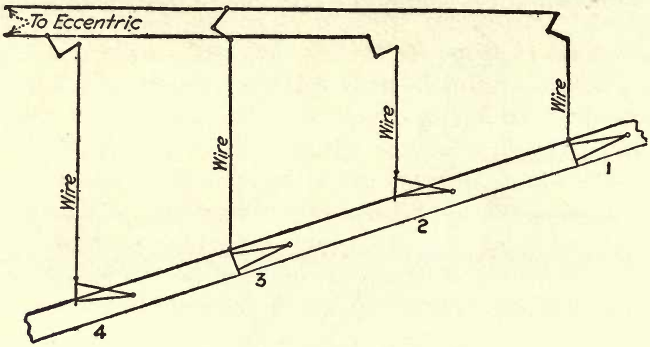
on the hanging-wall side of the shaft rather than in the usual position on the foot wall.

A headframe was built of native timber, as shown in the accompanying illustration. Its diagonal legs rested on the shaft collar set, which was a monolithic concrete block, while the posts were set on concrete piers set in the foot wall. The legs were given the same slope as the shaft and carried the track. The skip *A*, which was a wooden affair built on the property, ran up to the point *B*, where it dumped into an ore bin *C*, which was made an integral part of the headframe. An idler *D* kept the hoisting cable down so that it entered the drum of the hoisting engine *E* horizontally. The headframe was successful in operation.

Retarder for Steep Chutes

The accompanying diagram shows a retarder that may be used successfully in steep chutes. Sometimes the space in a breaker is so distributed that it is necessary to put in chutes with steep slopes. In such cases the coal moves too rapidly and is badly broken. The best plan, of course, is to have the chutes at just the right angle to let the coal slide slowly, but the next best thing is to retard the coal if it moves too rapidly.

The device illustrated consists of a number of hinged gates set



Diagrammatic View of Retarder

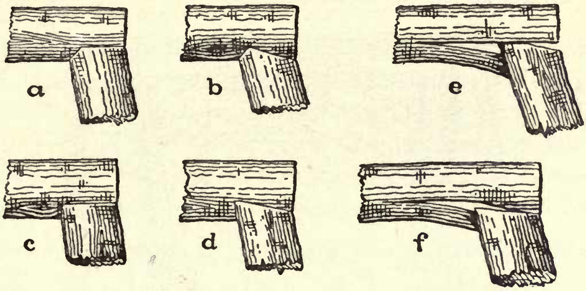
in the chute so that they will close by their own weight if released. They are raised by wires or by rods which are moved by bellcranks operated by eccentrics, the motion being transmitted to the bellcranks by wires or rods.

The gates are so moved that alternate ones are closed or open at the same time. Thus, in the illustration, No. 1 and No. 3 are closed while No. 2 and No. 4 are open. The coal will collect above No. 1 and No. 3, and when they are raised, it will slide down until stopped by No. 2 and No. 4, which will then be closed. In this way the coal slides only a few feet at a time and does not acquire such high velocity as to be broken.

Notching Mine Timbers

All timbers forming part of a timber frame should be notched. In the accompanying figure are shown two methods (*a* and *b*) in quite common use for notching mine timbers when timbering airways and haulage roads. The method shown at *a* presents a horizontal bearing surface for the top of the leg, while that at *b* is inclined. In both of these methods, the notch is cut at an angle to the axis of the collar, which is correct. The method shown at *a*, however, is preferable, as the bearing surface is at right angles to the direction of the roof pressure.

At *c* and *d* are shown the incorrect methods of making the two notches just described. The notch at *c* is cut at right angles to the axis of the collar instead of being cut at an angle, as shown at *a*. The notch at *d* is cut forward in the collar so that it is nearly parallel



Proper and Improper Methods of Notching Mine Timbers

to the axis of the leg. Both of these methods present more or less of a tendency to split the collar, as shown at *e* and *f*.

Double-Acting, Self-Closing Trapdoors

A mine trapdoor which can be opened in either direction by a mule and which at the same time is capable of resisting the force of the air-current may be constructed as illustrated in Fig. 1.

This door is made similarly to any other mine door, except that it is hung so as to swing clear within the door frame, which is constructed of heavy timbers set solid in the entry. Also, the post on which the door is hung is given an inclination inward, or toward the center of the entry, of from 1 to $1\frac{1}{2}$ in. per ft. of height, according to the strength of the air current. By this means the door is given a certain fall, which causes it to close by reason of its own weight.

The space around the edges of the door is as indicated in the figure—closed with a canvas flap, which prevents leakage of air past the door when it is closed; or a canvas cushion can be made to fit around the edge of the door by packing the canvas with straw after nailing one edge of the strip on one side of the door, the other edge being then drawn over and nailed to the opposite side. At the bottom of the door only the canvas flap is used. The hinges are ordinary strap hinges. The bolt hooks to which the door is hung are set in the center of the post. Care must be taken that sufficient headroom is given on each side of the door to enable it to swing free, as the door rises when opened, but the thickness of the collar above the door usually provides sufficient room to overcome this difficulty.

In Fig. 2, a plan for a door designed for the same purpose, the door is set in a substantial frame made of square timber.

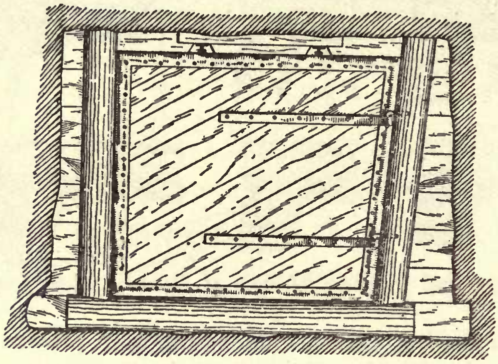


Fig. 1. A Self-Closing, Double-Acting Door

The upper hinge is an ordinary heavy strap hinge fitted to a strong bolt set in the center of the face of the post. The lower hinge is formed by two straps of iron securely bolted one on each side of the door. Each of these straps is forked at the end, as shown in the plan in the figure. The forked end of each strap fits over a staple driven in the face of the post. These two staples are about 5 in. apart. It is readily seen that by means of this arrangement the open door will have a considerable fall, which will enable it to close readily when released. The two pronged hinges at the bottom of the door form a base of 5 in. that gives sufficient stability to the door to enable it to resist the pressure of the air current which is almost constantly acting to force it open.

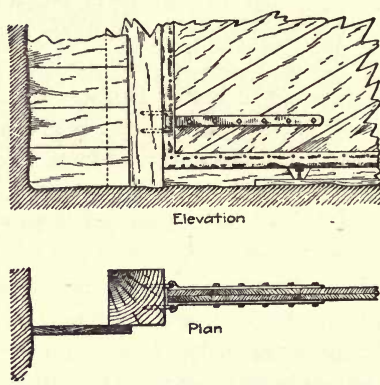


Fig. 2. Lower Section of Swing Door

Instead of being hung on hinges the door in Fig. 3 is swung on two bolts made of $1\frac{1}{2}$ in. round iron. These bolts are secured to the upper and lower edges of the door, a short distance from its rear edge, so that there is a partial counterbalance of air pressure acting on the smaller end of the door. Where the air pressure is not great this partial counterbalance is sufficient to keep the door closed, but where the air pressure is considerable a weight should be attached to a short chain or cable, which in turn should be fastened to the upper rear end of the door.

When this plan is adopted it is necessary to make a frame having two horizontal pulleys placed side by side and operating in connection with a vertical pulley between them, as shown in the figure. This arrangement is necessary to the proper operation of the weight, whichever way the door is made to swing. The weight must exert a force great enough to overcome the unbalanced force of the

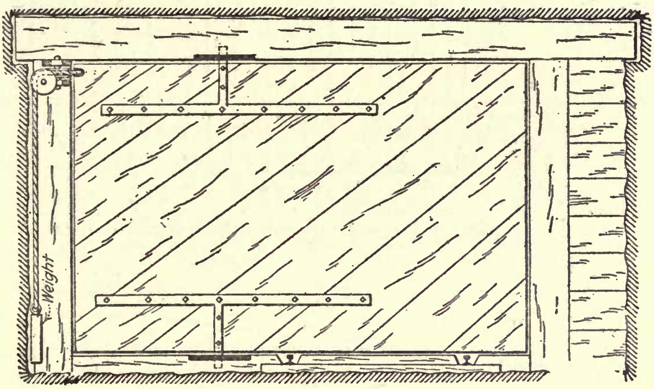


Fig. 3. Balanced, Double-Acting Mine Trapdoor

air pressure on the longer end of the door. The collar is set in hitches cut in the coal in both ribs.

Any ordinary mine door, of course, can be made to swing both ways if hung properly with the old-fashioned gate or barn-door hinge. It can be made to close automatically by fastening a rope to the top corner of the door farthest from the hinges and passing the rope through a series of pulleys similar to that shown in Fig. 3. It might be well to add a second vertical pulley, however, set at right angles to the first vertical pulley and parallel to the rib. To the end of the rope is secured a heavy sliding weight adjusted to run up and down an inclined way, which is constructed along the rib.

As the swing of an 8-ft. door is about 12 ft., the slideway should be at least 13 ft. long to enable the weight to rest wholly on the slide when the door is closed. The slideway should be set as steep as possible.

Inasmuch as a double door is much easier for a mule to push open, the following sketch may be of more interest than the foregoing plans. The two half-doors, as shown in the figure, are each hung on a $1\frac{1}{4}$-in. vertical iron rod by means of heavy strap hinges.

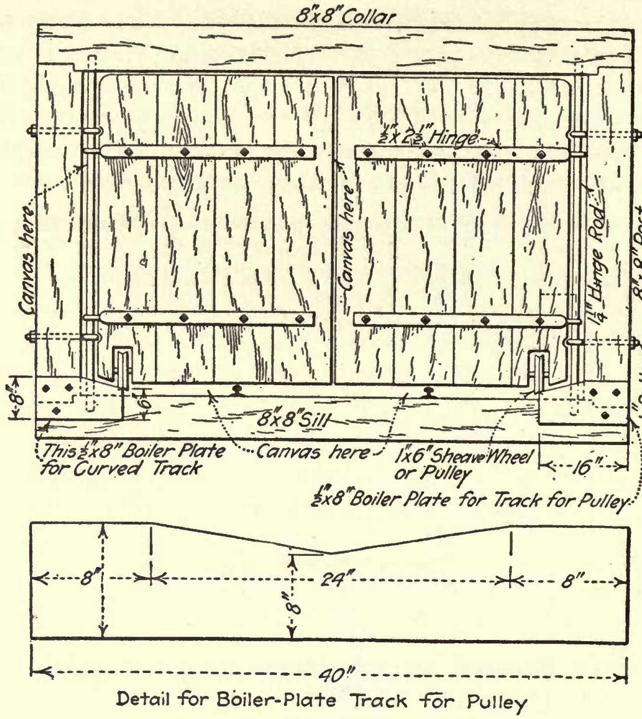


Fig. 4. Self-Closing Double Doors

The vertical rods are supported in a substantial timber frame set in the entry. This frame consists of an 8x8-in. collar, a sill of the same size and two side posts.

The figure practically explains itself, but it is well to observe that the weight of each door rests on a small 1x6-in. sheave or roller secured in the lower edge of the door. The track for this roller is a piece of $\frac{1}{2}$-in. boiler plate set on edge and bent into a semicircle. The upper edge of the plate is cut to a slight curve so as to form two inclined planes on which the roller travels. The plate is dapped into the sill and securely bolted to the post in such a manner that it forms a circular track around the hinge-rod as a center. The effect of this arrangement is to cause the door to rise slightly on the rod when swung in either direction. The door closes of its own weight. It is necessary to trim both edges of the collar so that it will not interfere with the rising of the door as it is opened. Also, the strap hinges supporting the door must fit nicely on the iron rods, and the latter must be straight, so that the doors will swing freely to and fro.

Check Doors

For ventilating falls or long rooms the general practice has been to hang a curtain of one or more thicknesses of brattice cloth across the entry to deflect part of the air current into the place where air is needed. In order to facilitate the passage of trips, curtains were cut into strips from 3 to 4 ft. wide, with a consequent loss of efficiency in turning the air current into the place to be ventilated. Moreover, the curtains were quickly torn by passing cars, so that their life was short, frequently less than a day.

A more satisfactory method of deflecting a portion of the ventilating current is to be found in the use of check doors, which, while more costly to build and to hang than brattice-cloth curtains, are also more effective in operation and capable of rendering longer

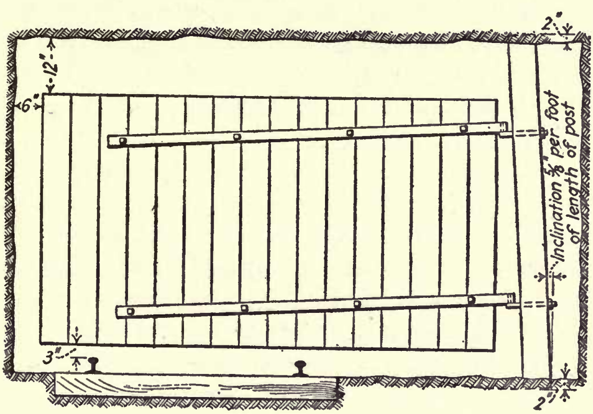


Fig. 1. General Arrangement of Check Door

service. The cost of a new door may be saved if an ordinary ventilating door that has become worn and leaky at the edges is used as a check door.

The general arrangement of a check door is shown in Fig. 1.

For supporting the door, a 6x8-in. post may be used. In the roof a rectangular hole the size of the cross-section of the post must be cut about 2 in. deep. A trench the width of the post must be dug in the bottom of the entry, so that the post may be first slipped into

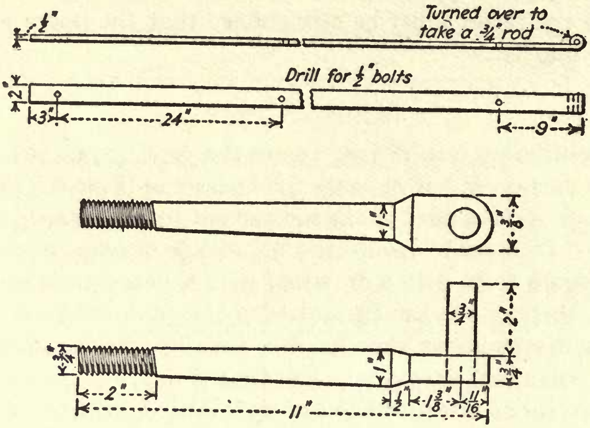


Fig. 2. Details of Check-Door Hinge

the hole in the roof and then slid along the trench to its final position. When in place, the post must be plumb in the direction of the entry while inclined from the vertical across it about $\frac{5}{8}$ in. to each foot of length of post, in order that the door may be self-closing.

The door is built of two thicknesses of 1-in. ship-lap, on one side the boards being vertical, on the other horizontal. By using 8-d. nails and bending them over when through the wood, the boards are strongly and tightly joined together. The height and width of the door depend upon the size of the airway. It is best to have the height of the door at least 15 in. less than the height of the entry and the width at least 2 ft. less than the entry's width. When hanging the door, a clearance of 3 in. must be left above the rail to allow for any possible sag; and at the top the clearance must be about 12 in., so that the door will not hit the roof when swung full open.

The straps for hanging the door from the hooks, and the hooks for attaching the door to the post are shown in Fig. 2. The length of straps depends somewhat upon the length of the door, good practice being to make them about 1 ft. less than the length of the door. The straps, of which there must be two for each door, are made of wrought iron, 2 in. wide and $\frac{1}{2}$ in. thick, and are drilled at intervals of 24 in. for $\frac{1}{2}$-in. bolts. It is important to have the bolts of just the right length for fastening the nut after passing through door and strap, for if they are longer, passing cars will catch them, resulting in derailment of cars, weakening of the door, or in wrenching the door from its fastenings. At the hinge end of the door the strap is bent into a circle to allow the entrance of the $\frac{3}{4}$-in. bolt of the hook.

Hooks are made of 1-in. square wrought iron beaten down at one end to a thickness of $\frac{3}{4}$ in., and drawn out at the other end into cylindrical form to the diameter of a $\frac{3}{4}$-in. bolt, and then threaded. If a steam hammer is not available it is somewhat cheaper merely to draw the material down for a short distance and then weld a $\frac{3}{4}$-in. bolt to it. At the heavier end the piece is punched or drilled for a $\frac{3}{4}$-in. rod, a $2\frac{3}{4}$-in. length of which is then welded into the hole. When the hooks are driven into the holes drilled through the post for them, it is only necessary to attach a nut to the upper hook.

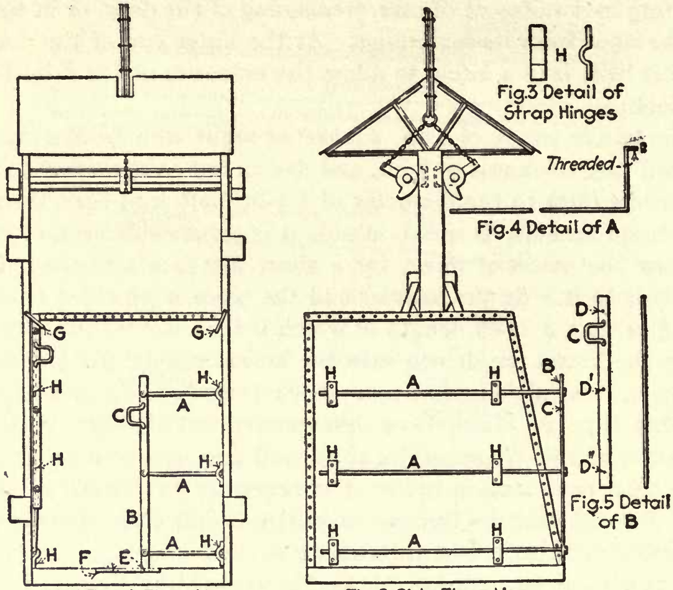
This type of check door has proved satisfactory in service. It lasts a reasonable length of time, and may frequently be used in more than one location before it is necessary to discard it. Moreover, since it may be bumped open by a trip coming from either direction, no time is lost in opening it. As it swings closed of its own weight, it is unnecessary for the trip rider to close it.

Safety Cage Gates

The folding safety gate shown in the accompanying sketch consists of few parts and is of extremely simple design. Besides accomplishing the purpose of a cage gate, it has the added advantage of folding back against the sides of the cage when supplies and materials are being loaded.

The cages in actual use from which the sketch was made are of the standard all-steel design, and while employed to some extent for raising ore in cars, they are used principally for the transportation of men and supplies required in the mine. The cages have a single deck just large enough for one steel mine car of the usual 20-in. gage, end-dumping type. The back and two sides of the cages are covered by steel plates bolted to the frame and extended above the cage floor to a height of $4\frac{1}{2}$ ft.

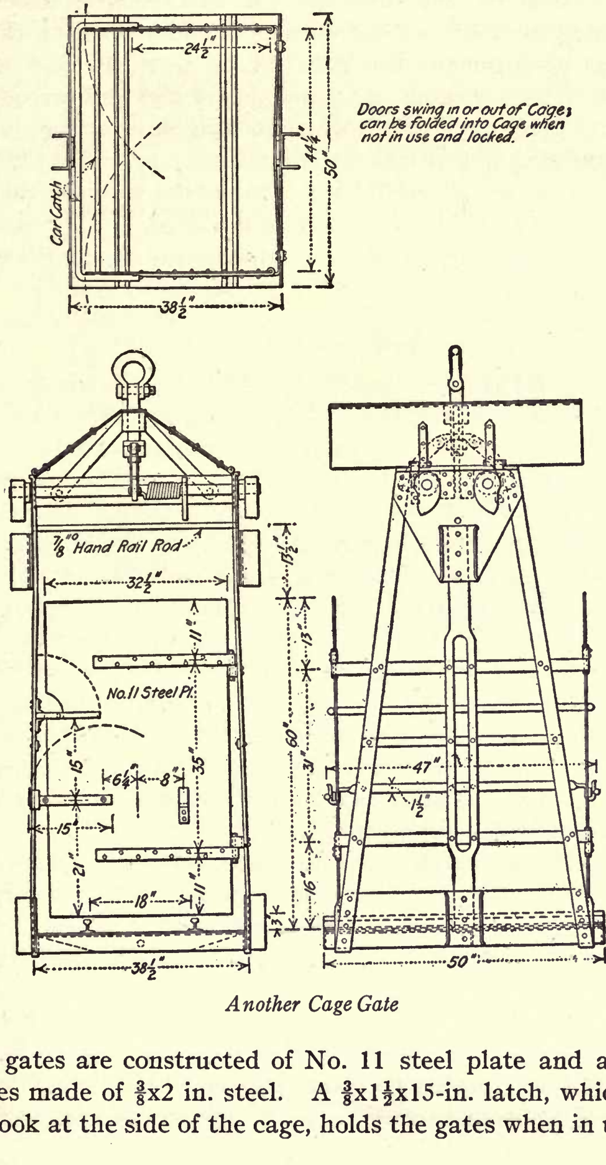
Each half of the safety gate is bolted by iron straps, detailed in Fig. 3, to the steel siding of the cage. The bent bars *A*, of which there are three for each side of the gate, are made of $\frac{3}{4}$- or 1-in. round stock 4 in. less in length than the side length of the cage plus one-half the front width. Each bar is bent at right-angles at a distance from one end equal to 4 in. less than half the width of the



Folding Safety Gate for Cages

cage, and again at a distance of 2 in. from the same end, so that the bar has the form shown in Fig. 4. The short right-angle bend is threaded to receive a nut. The other member making up the rest of half the gate, detailed in Fig. 5, is a straight bar of steel *B* $\frac{3}{8}$x2 in., 4 or 4$\frac{1}{2}$ ft. long, with a handle *C* riveted or bolted to it at a convenient height, and with three holes *D* for the side bars, which are bolted in as shown in the illustration. Fig. 1 shows one side of the gate folded back against the side of the cage, and the other side let down into position, the lower end of the bar *B* dropping into a rectangular slot *E* in the floor of the cage, a small steel plate *F*, suitably slotted, being attached to the wooden floor of the cage to act as a catch or guide for the bar *B*. When folded back the gate is held by keep *G*.

The safety cage gates shown in the second drawing were designed, to be installed on two light cages in use at Leadville, Colo., in order to comply with a state law that became effective Apr. 13, 1915, requiring all mine cages to be equipped with gates. Although they are not of the folding type, they may readily be swung out of the way when cars are to be hoisted.



Another Cage Gate

The gates are constructed of No. 11 steel plate and are hung on hinges made of $\frac{3}{8}$x2 in. steel. A $\frac{3}{8}$x1$\frac{1}{2}$x15-in. latch, which drops into a hook at the side of the cage, holds the gates when in use from swinging in or out of the cage. The car catch may also be lowered when the latch is in place, thus giving additional security in holding the gates from swinging out.

When the cage is to be used for hoisting cars the gates can be folded one over the other, into the cage, and locked in that position by engaging the latch on one gate in the door hook on the other. With this arrangement the gates in no way interfere with the operation of the car catch or the hoisting of cars and can quickly be swung into place and latched when hoisting or lowering men.

For lowering timber into the mine these doors were found to be safe, and saved considerable time as compared with the old method of using ropes to hold the timber in the cage. Gates or doors of this type may readily be added to almost any cage with very few alterations.

End-Gate Lifters

The accompanying illustration (Fig. 1) represents a device for automatically lifting the end gates of mine cars while passing over crossover dumps. A loaded car in approaching the dump comes in contact with the horizontal lever *A*, which turns upon the vertical pivot *B*. Motion is thus transmitted through the adjustable rod *C* to the horizontal lever *D*, which turns on the vertical pivot *E*. This lever at its inner end carries a stirrup *F*, which engages the hook on the car end gate. As the car is dumped, this stirrup lifts the end gate, the arm revolving slightly during the process.

Upon the car and dump righting themselves after the former is emptied, the counterweight *H*, acting through the cable *G*, returns the lever *D* to its normal position. Another car approaching the dump and striking the lever *A* revolves the lever *D*, carrying the stirrup *F* to such a position as to clear the empty car as it is bumped off the dump by the loaded one.

A simple arrangement in connection with a Phillips crossover dump for automatically lifting the end gate of a mine car while dumping is shown in Fig. 2. The necessary equipment consists of three short 2-in. pipes, two 15-ft. lengths of 1-in. pipe, three pipe straps, separating pipes and bolts, and four pieces of strap iron $\frac{1}{4}$x1 in. about 5 ft. long.

The loaded car in moving toward the dump strikes the arm *B* and in raising it moves the arm *A* away from the stirrup on the end gate of the empty car by means of the two 1-in. pipes connecting

A and *B*. The arm *B* drags over the top of the loaded car, holding *A* out of the way until the loaded car bumps the empty off the dump. Then before the loaded car reaches the horns of the dump these arms drop back to their vertical positions, and *A* is ready to catch the stirrup of the loaded car when it is dumped. These arms extend about 8 or 10 in. below the top of the car. While the sketch does

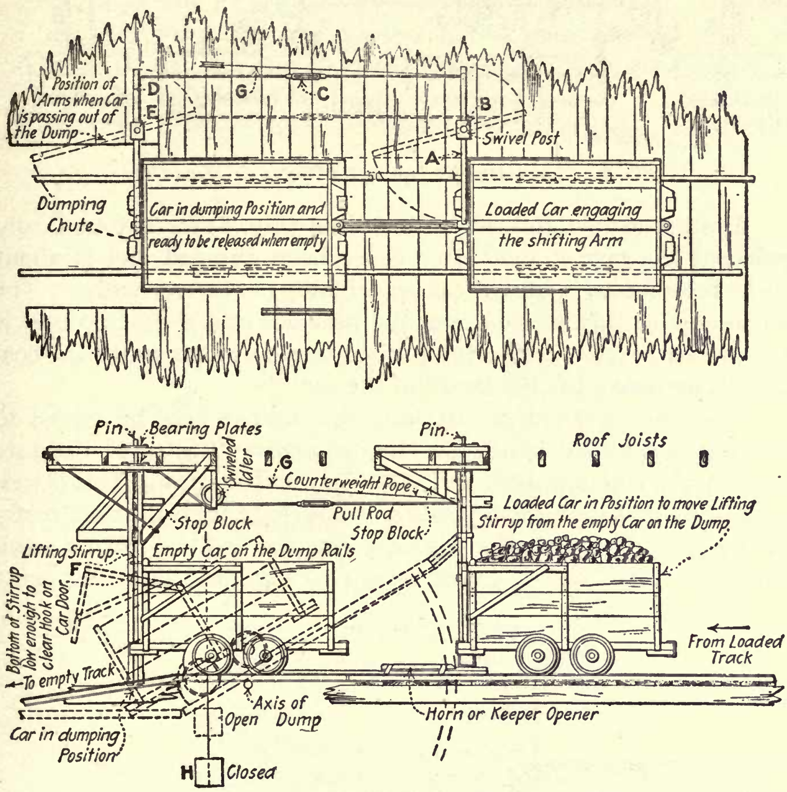


Fig. 1. *Plan and Side View of the Door Lifter*

not show it, the arm *A* is about 5 in. behind the front of the car to assure catching the stirrup of the end gate when the car is ready to dump.

The material in this apparatus is all comparatively light, so that only the one rod *B* is necessary to extend below the top of the car, thus avoiding dragging over the loaded car. The distance between the arms at the dump will, naturally, vary according to the length of the cars. Care should be taken to avoid placing the arms too close together, so that the loaded car will not get too close to the dumping point before the front is in position to catch the stirrup of the end gate.

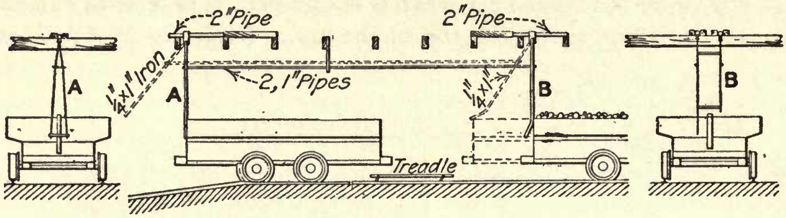


Fig. 2. Apparatus for Lifting End Gates on Mine Cars

Another simple method is illustrated (Fig. 3) for automatically releasing the gate of a car after it has been dumped and is about to be replaced by a loaded car on a Phillips crossover dump. The advantage of this method over the previous one is that no coal is scraped off in front of the dump when used at mines where the coal is built up above the top board of the car.

The exact method of installing this release may be varied to suit the material at hand. In the installation illustrated the gate hook is of a common type and is made of 2x$\frac{1}{2}$-in. iron. This is suspended so that its normal position is not quite vertical when ready to engage the hook on the mine-car gate and is fitted with a small weight to facilitate its quick return to engaging position, being

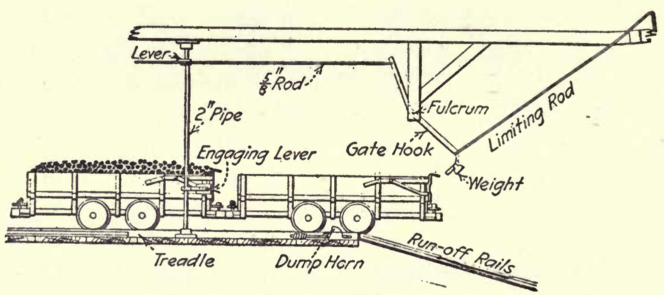


Fig. 3. Details of End-Gate Lifter

limited in this movement to the proper position by the limiting rod, which is $\frac{1}{2}$ in. in diameter, bent into a hook which passes over a timber. The vertical axle, to which are connected the arm which the cars strike and the lever which swings the hook back by its pull on the ⅝-in. connecting-rod, is a 2-in. pipe set in end plates. Both levers are 2x½-in. iron, bent to fit the pipe and fastened to it by through bolting.

The position of the vertical axle must be such that the "engaging" lever is struck by the front end of the car as soon as the treadle rail is depressed and the horns spread to release the empty car. The length of the levers will depend on local conditions. Although it might appear that the connecting-rod pulling at an angle would give trouble, the operation has been found to be smooth and quick and can be worked by hand.

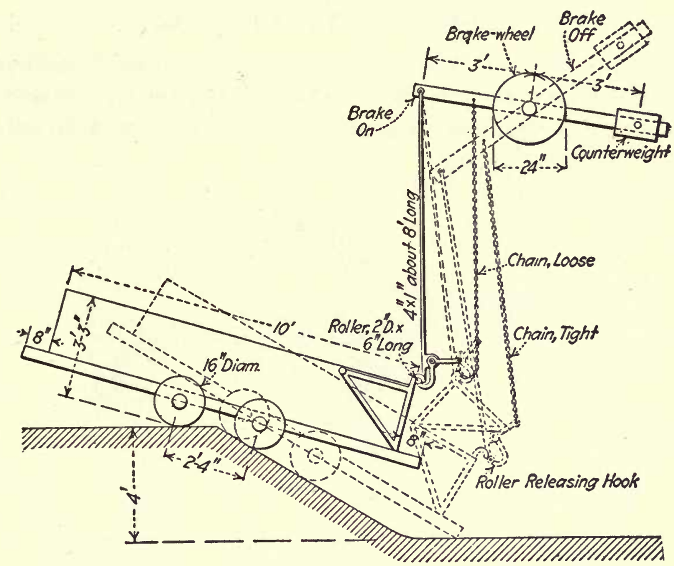


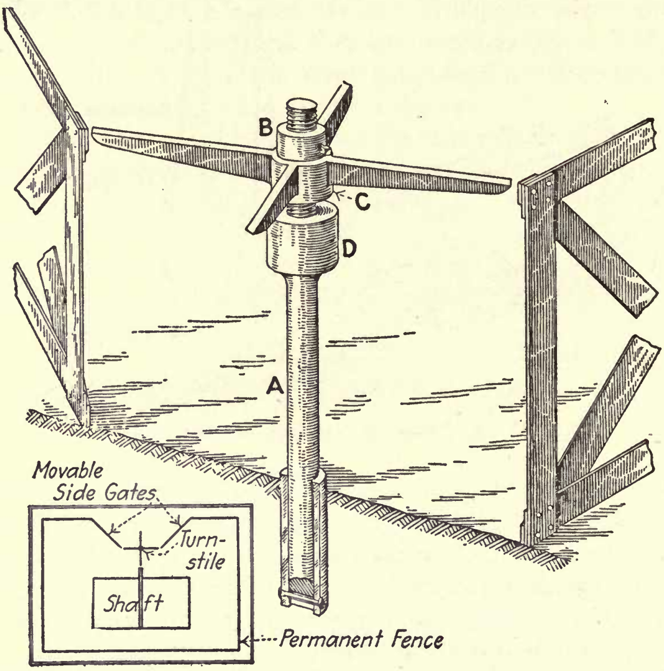
Fig. 4. Details of Simple End-Gate Lifter

The necessity for reconciling a Jeffrey-Griffiths dump and a car with a lifting end-gate was responsible for the device in Fig. 4. It would have been easier, of course, to open the gate and then let it fall, as some mines are doing, but there would also have been a consequent repair bill due to the shock of the falling gate. The sketch shows how this was avoided.

The arm to which the opening device is attached is held in position by a brake band on the brake wheel. Normally the brake is tight, but it can be released by a lever in easy reach of the dump operator. As the car starts to dump, the hook on the car gate is caught by the roller and holds the gate stationary while the car completes the dumping movement. The forward movement of the car is taken care of by the swing of the hanger about its supporting pin at the end of the arm. When the car is empty, the brake is released, and the weight of the door revolves the arm and lowers the gate. Just before it closes, the trip chain withdraws the roller from the hook and releases the gate. The brake is still held off, and the counterweight returns the device to its original position, ready for the next car, while at the same time the empty is run off the dump.

Shaft Gate for Limiting Load

The purpose of the shaft gate illustrated is to limit the number of men getting on the cage at one time. The post *A*, which may be a piece of old shafting, is slotted at the bottom and threaded at



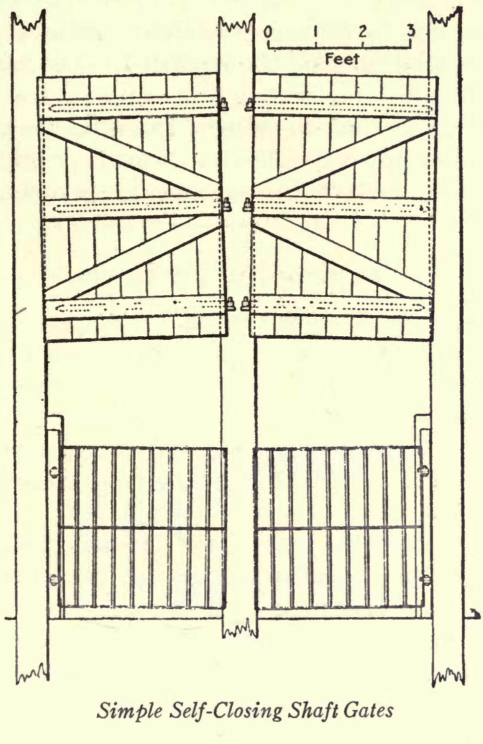
Details of a Safe and Practical Shaft Gate

the top. The four-armed turnstile *C* screws up and down on this post. Its motion is limited by the collar *B*, which can be fixed in any position by the setscrews. If only ten men can be carried in the cage, the stile should have a play of but $2\frac{1}{2}$ turns. Then an eleventh man, being unable to pass the stile without turning it back, would know the cage was already carrying to capacity.

When the shaft is being used for coal or supplies, the gate is lifted out of the socket and set aside. The side gates, being light enough for one man to handle easily, are lifted out of the way when not in use. This arrangement prevents men from crowding onto the cages in larger numbers than is safe or allowable by law.

Self-Closing Shaft Gates

A simple but efficient shaft gate is shown in the illustration. The gate is merely swung off center so that it closes by gravity with-

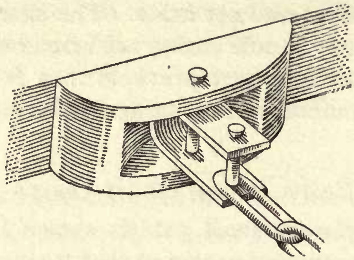


Simple Self-Closing Shaft Gates

out undue jar. The wooden upper gate is used to protect anyone standing at the shaft from falling matter.

A Handy Clevis

A device that has proved useful in mine haulage consists of a flat clevis that extends out from the locomotive bumper and saves the use of long coupling links. Often, when a locomotive goes in



A Clevis that Replaces Long Coupling Links

and out of the rooms over curves of short radius, the cars are derailed unless a long coupling is employed. The clevis shown is made of flat iron 4x½ in., with a 1-in. hole for the coupling pin. This clevis allows the link to swing sidewise, and when carried on the locomotive permits a coupling to be made at either end of the car. It is especially useful where couplings are permanently fastened to one end.

Coupling-Pin Fasteners

The cars on which the device in Fig. 1 was successfully employed were coupled together with a single flat link about 12 in. long made from a steel bar 1 in. square. The drawbars of the cars were made from two pieces of iron or steel riveted together, the bottom being a plate ¼-in. thick and 8 in. wide, and the top piece a bar 4 in. wide and ½ in. thick riveted lengthwise to the middle of the bottom plate.

Both the plate and the bar were of the same length when fixed in place, and extended about a foot beyond the end of the car bed or box. Where the upper bar of steel passed through the end of the car box, it was given an offset upward of about 2 in., leaving a space of about 2 in. between the plate and the bar for the coupling link, which was 1 in. thick. A coupling pin entered the hole in the end of the upper bar, passed through the coupling link and through a hole in the lower plate, as may be seen in the sketch. The bottom of the car was made of 4-in. planks which extended about a foot beyond the end of the car box and acted as bumpers. The ends of the bumpers were shod with plates of $\frac{1}{4}$-in. iron which passed around the top, end and bottom of the bumpers and were held in place by bolts passing through the plates and ends of the plank bumpers. The drawbars were about 2 in. shorter on each end than the bumpers and were bolted fast to the 4-in. planks that form the car bottom, and also to the car axle. The coupling pins were fastened to the cars by light chains so they would not get lost.

An angle, or claw-shaped piece, made from 1x$\frac{1}{4}$-in. iron bar was riveted to the coupling pin near its top end in such a manner that it would swing freely up and down. The coupling pin extended about 6 in. above the top of the drawbar and was prevented from passing any farther through the drawbar by a collar welded to the pin. The claw-shaped piece fastened to the coupling pin was of such a length that when the pin was in position in the drawbar, the claw extended over the end of the upper bar of the car drawbar, but not to the lower plate of the drawbar. It was placed inside the link.

If the coupling pin attempted to rise, the claw engaged the top bar of the drawbar and prevented the pin from jumping out of its position. When it was desired to uncouple the cars, it was only necessary to catch hold of the claw, raise it from between the bar

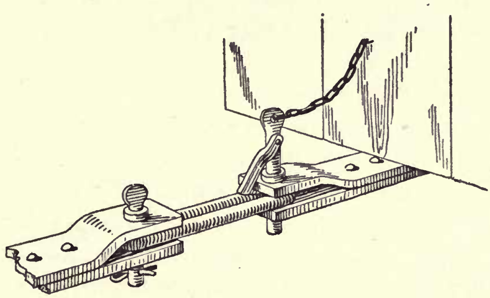


Fig. 1. Device Used Between Cars

and plate and pull out the coupling pin. The claw was fastened to the side of the coupling pin, but it was given an offset near its middle so that the claw proper would line up with the center of the coupling pin and fall between the sides of the link, giving it the same position as if it was fastened to the center of the pin. The other end of the coupling link was permanently fastened to the drawbar by means of a coupling pin having a cotter passing through its lower end to prevent the pin from jumping out of place.

A safety catch on the haulage-rope coupling pin is shown in Fig. 2. The haulage rope, by means of a babbitted socket, is fastened to a short length of chain, 4 to 6 ft. long. The chain is provided with a swivel, and on its end a clevis, which is fastened by means of a pin

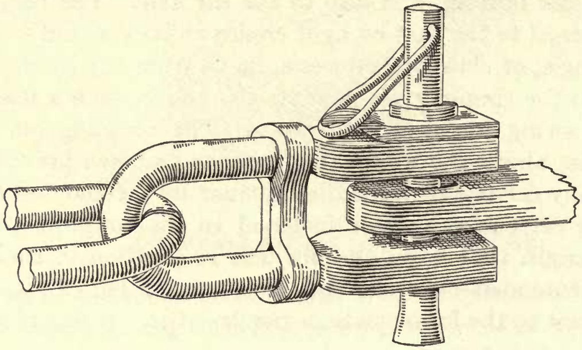


Fig. 2. Pin Holders Used at End of Haulage Rope

to the foremost drawbar of the trip. This drawbar, of course, has a hole in the end through which the pin passes. The sides, or bars, of the clevis are held a uniform distance apart by shrinking a hot link entirely around them near their middle and hammering it closed between the bars. This forms a solid connection between the two sides.

The lower end of the coupling pin, which passes through the end of the clevis, is made in the shape of a truncated cone and of a larger diameter than the rest of the pin. The hole in the lower bar, or side of the clevis, is made large enough to permit this enlarged end of the coupling pin to pass freely. The hole in the upper bar of the clevis is made smaller and cone-shaped, so that when the coupling pin is withdrawn its lower end fits this hole snugly but will not pass through it. The lower end of the coupling pin should then be flush with the lower side of the upper bar of the clevis, allowing the cars to be uncoupled readily, but preventing the clevis and pin from becoming separated.

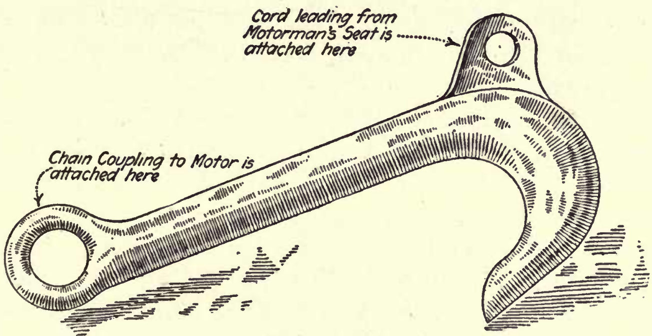
The coupling pin extends about 6 in. above the top of the clevis. A ring which passes through a hole in the top end of the pin is bent at right angles to the pin on both sides, so that it cannot slide through the hole in the pin, but only swing up and down. The upper portion of the ring is enlarged into a circle large enough to reach to the upper bar of the clevis when the coupling pin is in position. A bar or plate of steel (preferably spring steel) is welded to the top bar of the clevis having a claw-shaped projection on its end. Sufficient space is left between this claw projection and the top of the clevis to accommodate the ring.

When the coupling pin is in position, this ring should lie on top of the clevis under the claw projection. When tension is put on the haulage rope, the clevis moves forward a trifle, there being some lost motion between it and the coupling pin. This motion pulls the ring still tighter under the claw projection and entirely prevents the coupling pin from rising out of place.

Coupling Hook for Locomotives

The novel coupling hook illustrated below is used in disconnecting a train of mine cars from the electric haulage locomotive when the train is connected to the end of the locomotive opposite to that at which the motorman's seat is situated.

The operation is simple and is accomplished by the motorman pulling a cord that is attached to the hook at the offset eye. This causes the hook to turn in the connecting-chain link and to be disengaged from it. In some cases it is necessary to have a man on

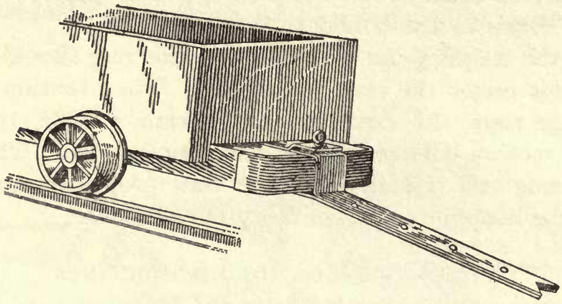


Coupling Hook for Mine-Haulage Motors

the train to do this work, and the uncoupling is often done while the train is in motion. Needless to say, this is a dangerous practice and one in which the men are not supposed to indulge. The use of this hook makes it unnecessary for a man to get his hands and arms between the locomotive and the cars when he uncouples them, and in some places it will save the labor of one man on the train.

A Good "Dog"

"Drags" or "dogs" are employed at many mines for derailers on the rear ends. Some patterns turn sidewise and slide back in front of the cars, while others break the drawbar off or bend it so that it



The "Dog" Attached to Car

can not be coupled again. Much relief will be experienced in the adoption of the design shown in the accompanying illustration, which needs no explanation.

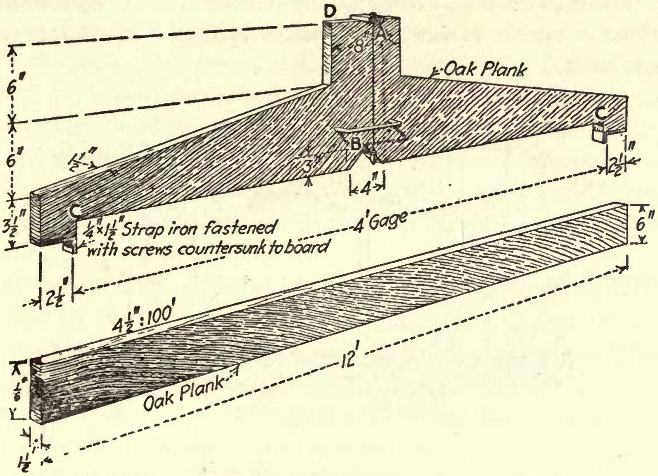
Gage and Level Boards for Track Laying

In laying track in the gangway or heading which he is driving, the miner will undoubtedly find the gage and level devices shown in Figs. 1 and 2 superior in many ways to those he is now using.

The gage board shown in Fig. 1 is used in laying track. Before the second rail is spiked to the ties the miner should try his board on both rails to make sure that the gage fits properly over the rails at the offsets *CC*. These offsets are reinforced with strap iron so that constant wear at these points will not alter the gage.

From *A* to *B* a straight line is marked in the exact center of the board and at right angles to the line *CC*. A cord with a plumb-bob attached is suspended from *A* so that the plumb will swing freely in front of the notch cut at *B*. Where curves in the mine roads occur it is desirous to elevate the outside rail, and if the gage board is placed on the rails and a combination spirit level on which can be read the elevation per foot is placed on the plane surface at *D*, the miner can readily raise his rail to the desired height. These combination rules and spirit levels are commonly used for all kinds of work in and around the mines and can be obtained at almost any hardware store.

The level board used by the miner for carrying his grade is shown in Fig. 2. The large end of the board is placed on the track with the small end pointing in the direction of the grade. The road is then raised or lowered until the bubble in the spirit level, on top of the board, comes to rest in the center of the rule.



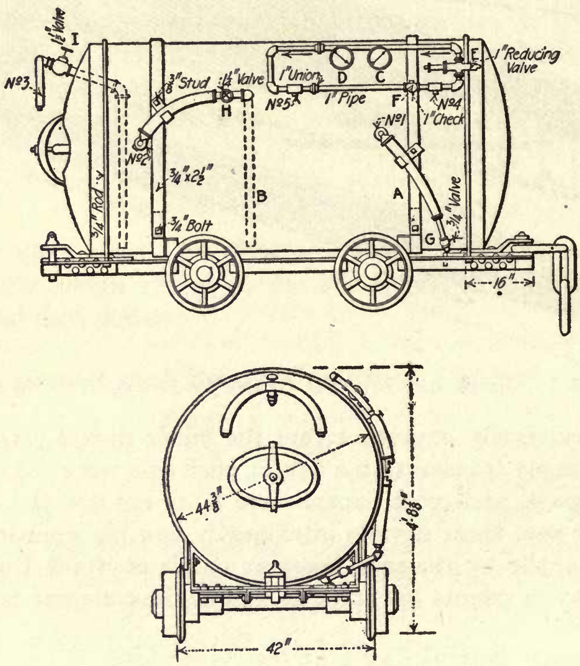
Figs. 1 and 2. Simple and Practical Devices for Laying Track in Coal Mines

It is extremely important that the miner should carry a good road, for many transportation delays, such as a wet road caused by poor drainage, and much expense and labor are avoided by it. If the miner uses these devices intelligently and his work is checked up occasionally by the mine foreman or his assistant there is no reason why he cannot lay track as well as the company tracklayer.

Sprinkling Car for Mine Use

The ordinary type of sprinkling car used in mines is a wooden tank mounted on trucks, the tank having a large hole in one end at the bottom. Before filling the tank, a wooden plug is driven into this hole; and when the car reaches the piece of road to be sprinkled, the plug is removed. None of the dust except that between the rails is reached by the water, and that part is thoroughly soaked. This dust is usually not very harmful, for it is pretty well mixed with shale dust. The dangerous dust, of course, is on the ribs and timbers; and to reach this the sprinkler described in the following paragraphs was devised.

The device consists of a two-compartment steel tank mounted on trucks to run on track of any gage. The tank, as shown in the accompanying drawing, is equipped with two valves *H* and *G*, and two short lengths of hose, each having a quick-connection coupling numbered 1 and 2. The tank is also equipped with a valve *I* at the rear to which is attached the pipe connection 3. These connections are drilled in such a manner as to make a spray when water is forced through them.



Side and Rear Elevation of Sprinkler

Where the valves *H* and *I* are connected to the tank, a pipe connection on the inside runs close to the bottom of the tank. Two pressure gages *C* and *D* are connected to the tank, one in each compartment. The tank is also equipped with a pressure-reducing valve *E* and a check valve *F*, which are connected to the tank by means of pipe and pipe connections 4 and 5. These connections are located on opposite sides of the partition that divides the tank into the two air- and water-tight compartments *A* and *B*. Compartment *B* is equipped with a manhead to make it accessible for cleaning out and repair purposes.

The operation of the sprinkling tank car is as follows: Hose 1 is connected to a compressed-air supply line, and the valve on the supply line and the valve *G* are opened, admitting compressed air into compartment *A*. When the pressure in compartment *A* rises above the limit set by the reducing valve *E*, compressed air begins to flow through pipe connection 4, reducing valve *E* and pipe connection 5 into compartment *B*. When the pressure in compartment *B* reaches the limit set by the pressure-reducing valve *E*, the valve in the supply line and the valve *C* are closed, and the quick connection 1 is uncoupled. The limit set by the pressure-reducing valve may be anything desired, from zero up to the maximum pressure available in the supply line.

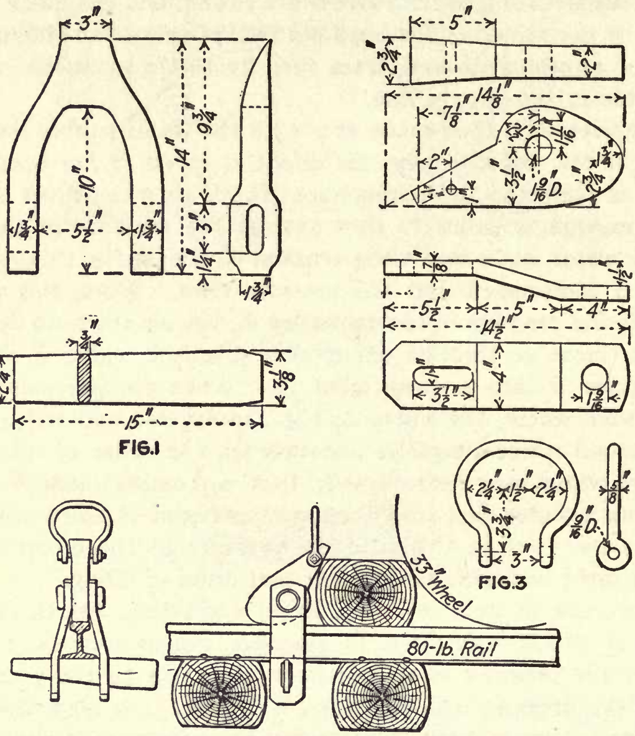
Connection is then made at 2 with the water-supply line. The valve in the water-supply line and the valve *H* are opened and water is admitted to compartment *B*. This water must be under great enough pressure to flow against the pressure in the tank. As the water flows into compartment *B* the air in this compartment is compressed and the pressure rises. When this pressure exceeds the pressure in compartment *A*, the air starts to flow from compartment *B* through connection 4, check valve *F* and pipe connection 5 into compartment *A*. When compartment *B* has filled with water, the valve in the supply line and valve *H* are closed, and connection 2 is uncoupled. The order of filling with air and water may be reversed; that is, compartment *B* may be filled with water first and then compartment *A* filled with compressed air; but in this case the pressure of the compressed-air supply must be higher than in the first order of filling.

The tank is now ready to begin sprinkling. Both compartments *A* and *B* have the same pressure, but as soon as valve *I* is opened the pressure in compartment *B* drops to the pressure at which the pressure-reducing valve *E* is set. The air continues to pass from compartment *A* through the pressure-reducing valve *E* into compartment *B*, maintaining a constant pressure over the water in compartment *B* until the water in that compartment is forced out through sprinkler connection 3. The sprinkler 3 is so made and connected that the spray of water may be directed against the roof and sides of an entry, or in any other direction. Any water getting over into the air compartment *A* when filling compartment *B* with water may be blown out through connection 1 by opening valve *G*.

The sprinkler may also be used for fire-fighting, or any other purpose where water may be needed, by connecting the desired length of hose to connection 2 and opening the valve *H*.

Rail Clamp for Steam Shovel

Fig. 1 shows the ordinary rail clamp used in many of the openpit mines on the Mesabi Range, to block the wheels of steam-shovel trucks. A tie is ordinarily used for a block and is placed between



Details of Rail Clamp Used to Hold Steam Shovel

the clamp and the wheels. These clamps fit loosely over the section rail and are tightened by driving steel wedges between the clamp and the ball of the rail. The improved clamp shown in Figs. 2 and 3 has been in use for several years in one of the Hibbing district openpits and has proved entirely satisfactory. The important feature of this clamp is the cam which rests on the ball of the rail and is tightened by the pressure of the block against it, doing away with the wedges used on the ordinary type. The handle on the top of the cam offers a safe and easy means of handling the clamp.

Automatic Car Rerail

An effective device for rerailing mine cars can be made by bending into a curve both ends of two full-length rails similar to those used for mine track. The bent part should be from 4 to 6 ft. long, depending on the gage of the track. Spike each of these rails fast to ties, as closely as possible to the track rails, on the inside of the track.

The bent ends of these two rails should touch each other in the middle of the track. They should be laid side by side, one next each track rail. The space between the two guard rails is filled with heavy planking laid flush with the top of the rails. Heavy planking is also spiked fast outside the track rails. It is laid snug against the track rails and should be flush with their tops on the side next to the rail. Its outer edge should be higher, and slope toward the rail.

With heavy loaded cars, planks may not be strong enough and the use of heavier timbers may be necessary. These timbers may be covered with plates of $\frac{1}{8}$-in. iron or steel, although it is not absolutely necessary to do so. The slope of the outside planks toward the track rails tends to slide the car-wheels in the direction of the track rails.

The curve on the end of the guard rails catches against the flanges of the derailed wheels and presses them toward the track rails. The straight length of the guard rail holds the derailed wheel on that side, which is now running on its flange, against the track rail. The space between the guard rail and track rail is filled in sufficiently to permit the car-wheel to run on its flange, raising its tread above the rail top.

An 8- or 10-ft. length of plank is spiked fast, parallel to the track rail and outside of it, on top of the other planking. This is placed so close to the rail that the car-wheels will just clear it when they are on the track. This plank should be thicker than the depth of the wheel flanges and tapered off at both ends, so that the wheels can run up onto it easily. It should be covered with $\frac{1}{8}$-in. steel plate and should be at least a foot wide. It is placed halfway from the ends of the guard rails, one of them being placed on each side of the track, outside the track rail. The guard rails between the track rails and the steel-plate-covered planking on the outside of the track, sloping toward the rail, draw the car-wheels against the rails.

The car-wheel on the outside of the track then climbs this raised plank, elevating the car-wheel and flange above the rail. The slope of this elevated planking and the pull of the guard rail on the opposite side carry the flange of the wheel over the rail and onto the track. If the plate iron is kept wet or oiled with car grease, the wheels slide easier upon it.

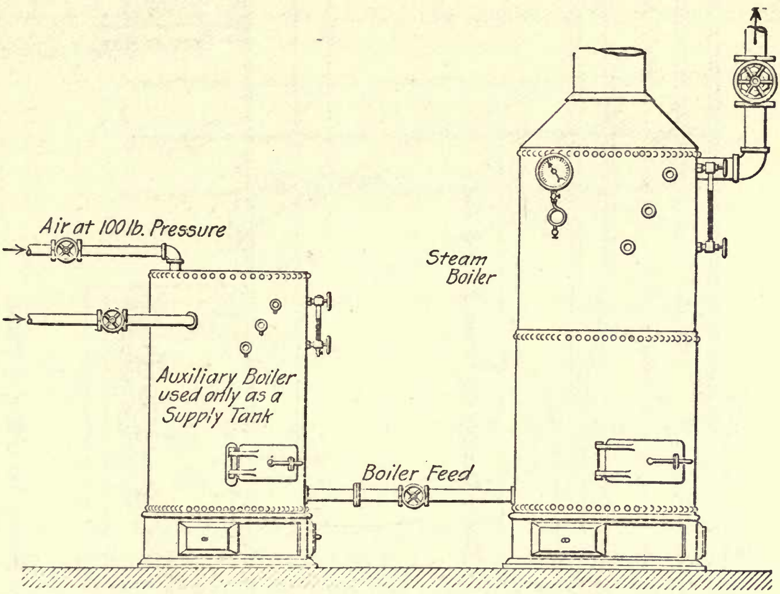
The rerail has been used most successfully at a tipple at the end of a long rope haulage. The cars bumping against each other on coming from the kickback at the tipple, and making up a trip of empties, or the rope starting out with an empty trip, sometimes derails the cars. This rerail is placed a few feet ahead of where the end of the trip is when starting, and never fails to replace the derailed cars on the track. The cars on the rails follow the track without interference from the rerailing device. Each side and end of this device is a duplicate of the other, so that it does not matter on which side the car is derailed or which way the trip is traveling.

Boiler Feeding

In order to avoid occasional injector troubles, where high-pressure air is available, a small vertical boiler may be set beside the steam boiler and the water piped to it. The air line is connected to its top, and another pipe led from its bottom to the steam boiler. Each pipe line must, of course, be supplied with a valve.

The operation of the device is as follows: The small boiler being filled with water, the valve in the water-supply line is closed, as are also the try-cocks, which have been opened to allow the air displaced by the incoming water to escape. The boiler water line valve is then opened, also the air-line valve that admits air under pressure, and forces the water into the steam boiler, which was under a lower steam pressure.

If water from a shaft is suitable for boiler feeding it can be run into a small boiler like the one described, but set above the water line in the steam boilers. A steam line from them may be connected in place of the air line, thus saving injector or boiler-feed pump troubles. There would be nothing to prevent the use of a feed-water heater in addition. Even in a permanent plant this



Arrangement of Auxiliary Boiler and Piping

method might in some cases be better than injectors or boiler-feed pumps. The valves could be grouped conveniently, and by using two tanks one could be filling while the other was emptying.

Disappearing Barney

The advantages of the unique arrangement of the barney illustrated are that the barney not only disappears into its pit, but that it runs on the full-gage track on the plane and that the empty cars run into their place in front of it without interfering with the rope.

The operation of the barney on the full-gage track of the plane and the narrow-gage track of the pit is accomplished by automatically changing the gage of its wheels. Each of the four wheels is mounted on a separate floating axle, which is carried by a long square bronze box. The two front boxes as well as the two rear ones are set close together. The boxes slide in and out in bearings. Fully extended, they are held in position, by a catch which,

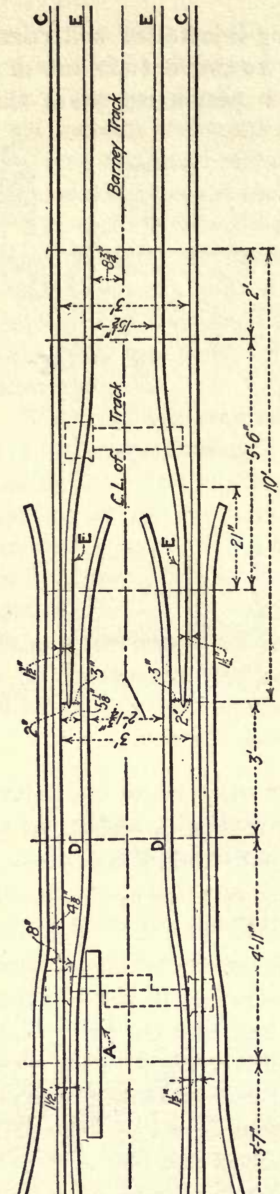


Fig. 1. Track Arrangement at Foot of Plane, Showing Operation of Guide Rails

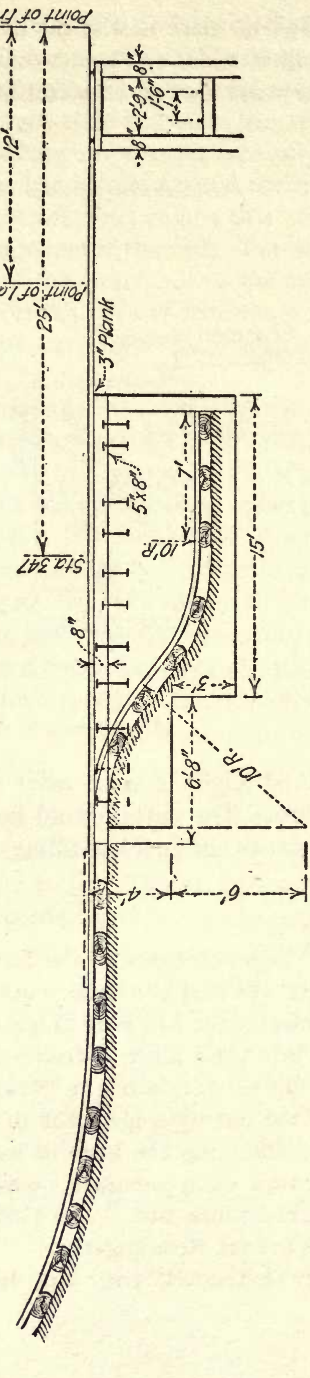


Fig. 2. Cross-Section of Barney Pit at Foot of Plane

when the trip approaches the pit at the bottom of the plane, is released by a trigger which is raised by passing over the block *A* (see plan, Fig. 1.) The wheels have a tread of about 8 in. or wide enough to rest on the rails *C* when the insides of the flanges are in contact with *D*.

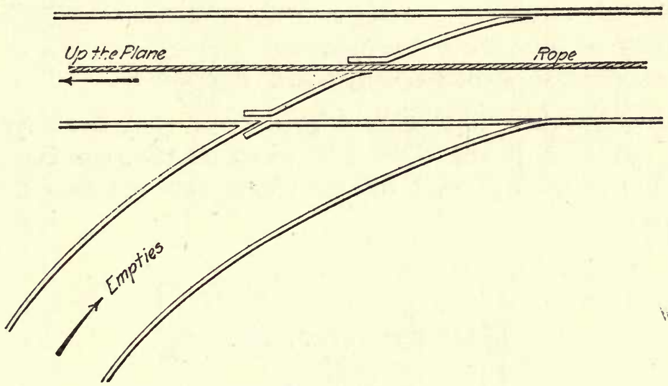


Fig. 3. Juncture of Empty and Plane Tracks

When the barney approaches the pit, the catch holding the axles is first released by the block *A*. Then the outside ends of the wheels come into contact with the converging raised rails *B*, which force the wheels together. The rails *B* are of the ordinary variety, but laid on their sides. As the wheels come together the tread still rests on the rails *C*, and the wheels cannot accidentally be thrown too close together to rest on these rails, because the flanges would be caught by the rails *D*.

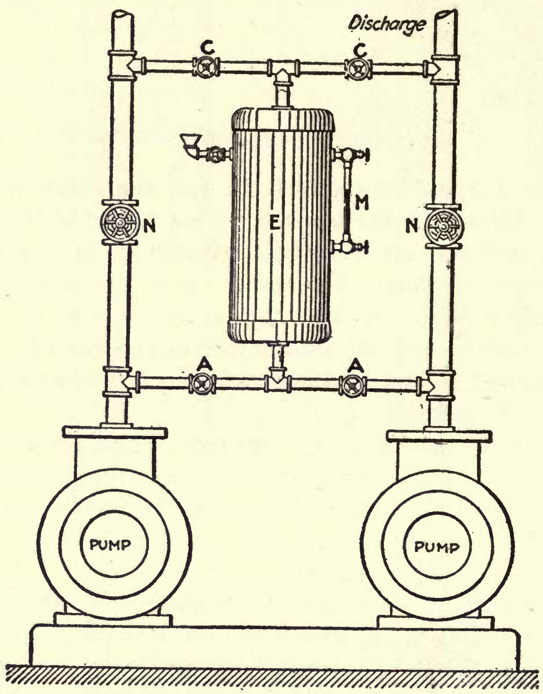
The wheels are now close enough together to allow the flanges to run inside the rails *E* which go down into the pit. These rails converge sufficiently to clear the treads of the wheels from the rails *C* on which the cars are running and on which they pass over the barney, which is now in the pit.

When the barney comes out of the pit to push the empties up the plane, the treads of the wheels run on the rails *E* until they are pushed out onto *C* by the pressure of *D* against the flanges. They are locked in this position until released by passing over the block *A* on the next down trip. Fig. 2 is a vertical section through the pit.

The track arrangement necessary to get the empties onto the track in front of the barney without disturbing the rope is shown in Fig. 3. Generally the rope falls into the slot, but if it does not it is easily pushed in by the man tending the bottom of the plane. The few words required for the description of this part of the plane should not lead to underestimation of its importance, for it adds greatly to the ease of operation of the plane to run the cars onto the track in front of the barney without taking them over the pit.

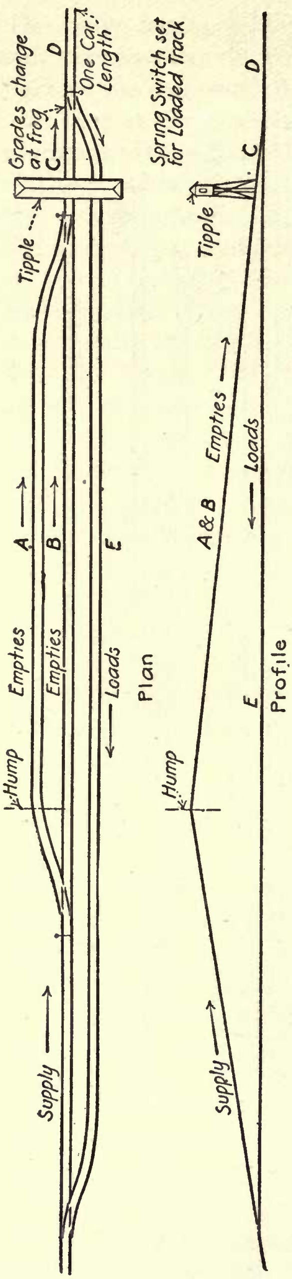
Boiler-Compound Feeder

The illustration represents a good form of boiler-compound feeder, where *E* is the body and where *M* the glass gage. Its merit lies in the fact that the compound does not pass through the pump.



Compound Feeder Connected to Two Pumps

The feeder can be readily regulated or cut out by valves *N*, *C* and *A* while the pumps are in operation.



Plan for Tipple Tracks

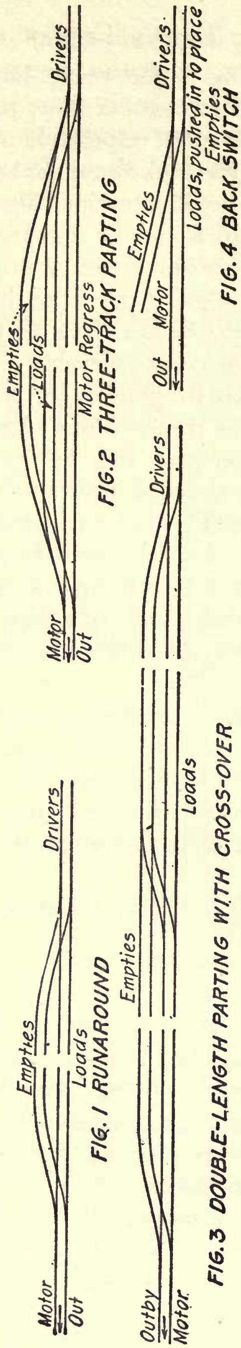
Owing to the tipple being located near the head of a stream or other physical obstacle, it is often impossible to obtain room for a tail track above the tipple. The accompanying illustration shows an arrangement which can be adapted to any case where such circumstances exist.

The general plan of operation in the scheme shown in the sketch is to place the empty railroad cars on tracks *A* and *B*. These cars are dropped one at a time downgrade to the tipple, where they are loaded and afterward run by gravity down the grade *C* about 100 ft. In going down track *C*, the cars attain a sufficient momentum or speed to carry them up the grade *D* through a spring switch. Here they come to a stop and run back by gravity down the loaded track *E*.

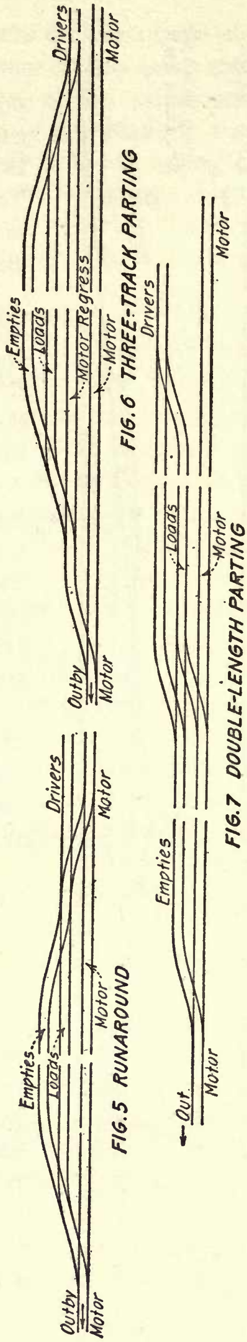
The railroad locomotive pushes the empties up the supply track and over the knuckle onto tracks *A* and *B*. The locomotive then returns and goes onto track *E*, where it picks up the loaded cars.

Motor Haulage and Side Tracks

A mistake frequently made in examining mining costs is the failure to look at the question of haulage in its proper integral parts. The main haulage is one distinct part and the gathering of the coal another. Each should be handled in the most economical manner irrespective of the other. On a properly arranged main or express haulage there is little difference in the transportation cost for a thousand feet or for a mile.



Figs. 1 to 4. Four Fundamental Side-Track Arrangements



Figs. 5 to 7. Adaptations of Standard Partings to Intra-Terminal Work

The latter haulage is equipped with heavy motors and good track and operates heavy trips, while the former worries along with a light motor and usually poorly surfaced track.

There is, however, a vast difference in the economy of mule-gathering as compared with short and long hauls. As the mine workings advance there are constantly changing conditions, and the corresponding readjustment of the haulage to the end that all the integral parts of the system may work at their most economic speed and so that the most frequent delays should affect the fewest possible men. It is a condition far from economical when an hour's delay under the tipple stops the entire mine, motor and drivers for the same period. With properly arranged side-tracks, a reasonable surplus of power and empty mine cars and track accommodations for them, there should be no trouble in operating for a reasonable length of time, holding the loads on the side-tracks and tipple tracks until the dumping again starts. The tipple and main haulage should accordingly be sufficient to recover in a short time from the congestion caused by the delay. In other words, in order to keep the greater expense, the gatherers, working steadily, the main haulage and tipple must be equipped with a surplus capacity.

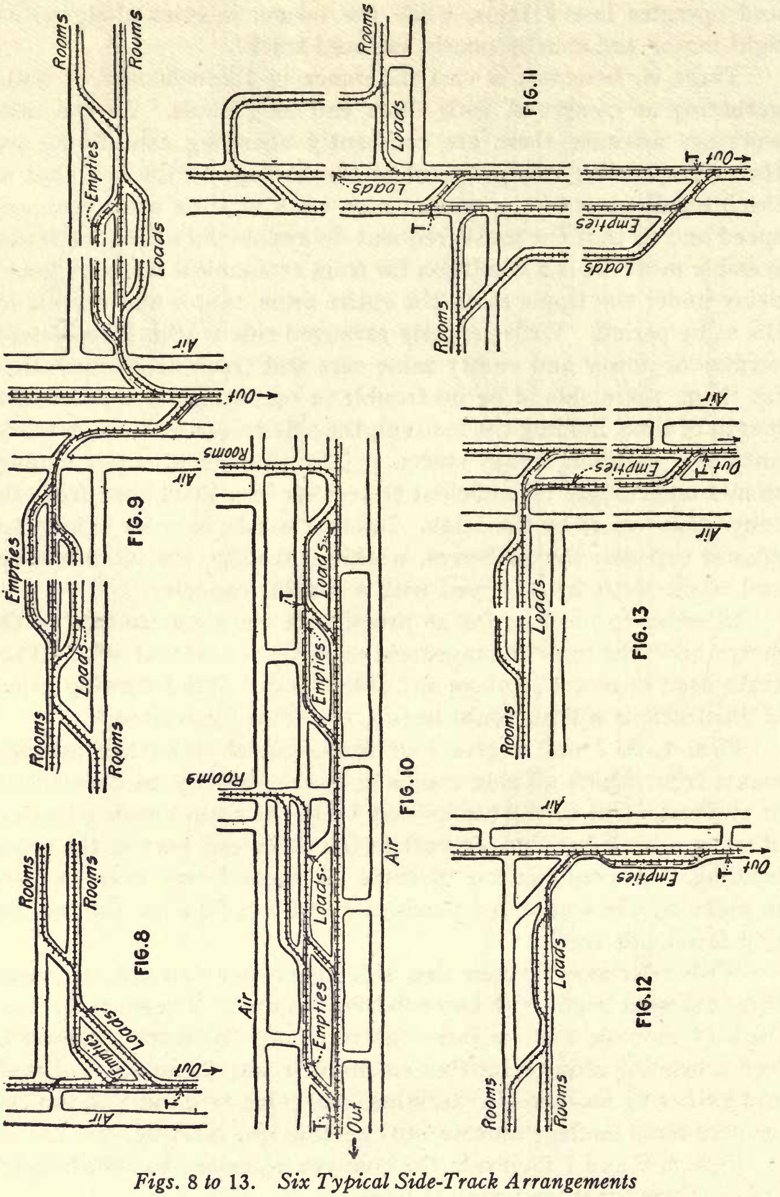
In order to meet as far as practicable the requirements of the motor haul, the mine management must be conversant with all the kinks used in motor haulage and side tracks. The following group of illustrations will no doubt be of great value for reference.

Figs. 1, 2, 3 and 4 give four fundamental side-track arrangements from which all side tracks or terminals may be constructed or evolved. One of the tracks may be in the main heading and another in a back heading, or part in the main and part in the cross-heading. A combination of some of these forms may be used to make up the completed partings, but these four are the foundation of all side tracks.

With reference to their use, side tracks may be classed under three different heads with two subdivisions each. These are, 1, junctions of animals and motors—(a) terminal, (b) intra-terminal to feed a heading along a continuous motor road; 2, junction of main and gathering motors—(a) terminal, (b) intra-terminal; 3, for two or more main haulage motors—(a) passing, (b) meeting.

Figs. 5, 6 and 7 illustrate the changes necessary to adapt standard partings for intra-terminal work.

We may consider first the simplest form of motor haulage;



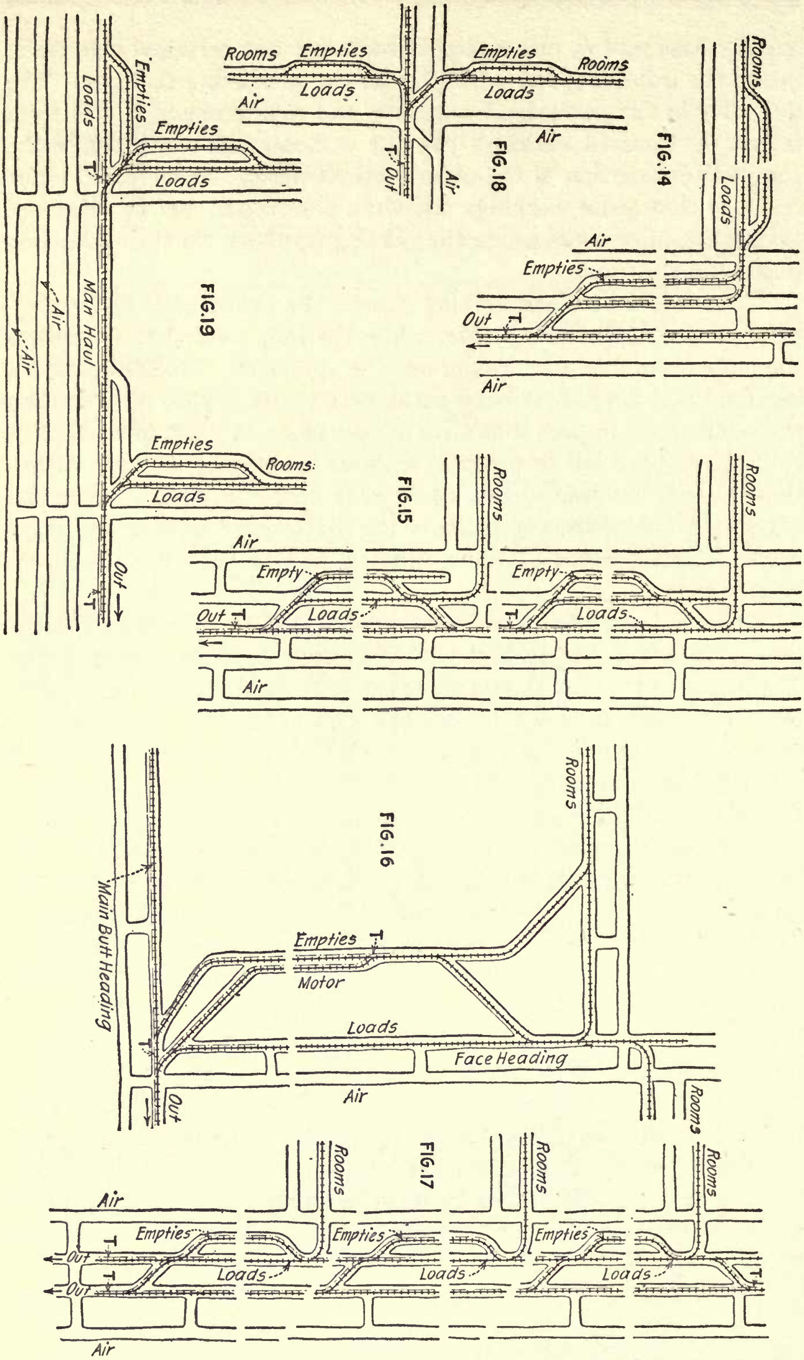
Figs. 8 *to* 13. *Six Typical Side-Track Arrangements* namely, one motor, one straight track and one terminal side track inside the mine, beyond which lie all the producing sections. The difficulty in the permanent adoption and maintenance of this form is that the forward workings call for a closer side track before the complete exhaustion of the older sections permit an advance. The result is that some workings are often abandoned before they are exhausted, in order to move the parting up closer to the advancing portion of the mine.

These older sections, having passed the prime of their production, are expensive to operate, while the long animal haul renders the more favorable section expensive in operation. Had this original terminal side track first been constructed with a view of extending the motor road to pass it as soon as necessary in such form that it could have been left in position without interfering with the extension beyond, the rear section could have been completely exhausted without delaying the extension of the motor road until the forward driver's haul became extreme and the cost of gathering rose prohibitively.

The chief point to be borne in mind is that the motor haul is the means by which the animal gathering may be done economically. The design of the haul should embrace every section of the mine within a reasonable distance or driver's haul from the point of production. Although this may require additional motor power, it is nevertheless provident. It is not simply a single track with a single terminal placed at such a point as to "strike a happy medium" in accommodating all the workings. It is a series of branches with terminal and intra-terminal partings, each placed so as to give the greatest efficiency in the gathering of the coal from each and every heading or section of the mine until these sections are exhausted.

A side track that serves the purpose of a terminal for the motor haul and at the same time supplies that particular heading at its head when the motor haul is extended to feed the advancing workings without change or alteration is an impossibility. This change, however, from a terminal to an intra-terminal side track should be, for the sake of economy, as small as possible and made with the least possible expense. It is an important point in laying out the motor haulage and its side tracks to have in mind constantly the questions, Where will the next parting be? and, Have provisions been made to pass on beyond this in the most economical way?

When local conditions will permit, it is better to have the com-



Figs. 14 *to* 19. *Six Somewhat Complicated Side-Track Layouts* plete terminal side track located on the main or face headings and its parallels. This location is more easily converted from a terminal to an intra-terminal parting. The transformation, however, is often blocked by insufficient pillar thickness or by the necessity of maintaining the air course. The disadvantage of this location is the increased distance given the mules in coming out from the butt-headings onto the main; but this can be compensated by shortening the butt-headings.

If the plans contemplate placing the individual intra-terminal side tracks on the room heading, the extension of the motor haul involves, first, moving the terminal side track forward, and, second, the building of a side track in the room headings. The terminal side track that is located just outside of the first butt-heading should serve the purpose with little change for the first butt alone, when the terminal is later installed at the second or third butt-heading.

Lack of forethought in these matters has often caused the extension of the motor road to be such an expensive proposition that changes were delayed until more than the cost of moving side tracks was wasted in excessive animal haulage. The economy of animal haulage is contingent upon its confinement to moderate distances. It is unlike the gathering motor in this respect, and to maintain its economy the straight or main haulage must be continually advancing in steps of a few hundred feet.

Figs. 8 to 19 inclusive give illustrations of terminal and intra-terminal side tracks. Their adaptability to any set of local conditions must be determined for each particular mine. Under certain grades the simple runaround is by far the most satisfactory and most conveniently operated side track, both for motors and drivers. Under other conditions it is an abominable nuisance.

On the other hand, if conditions are such that the empties can be pushed into the empty track, the parting may be simplified. It is evident that where the grades are against the loads on the main headings it may be prohibitive for the mules to bring the loads out of the room heading; in fact, the empties may drift into the room headings by gravity, saving the time necessary for the motor to pull them in and establishing this as the most favorable location for the parting.

At times locating the side track as desired by the management is prevented by the air course. Where there are not sufficient grades to assist the motor on the partings, and where the main headings are producing room headings on both sides, it seems advisable that there should be five parallel face headings, the center being the main haul, the next to the right or left utilized for the side tracks, and the extremes for the air return. Four headings are sufficient if room headings are broken on one side only.

In advancing terminal workings it is frequently unnecessary to make a parting at every butt-heading. Assuming these butt-headings to be 300 or 400 ft. apart, there is no difficulty in working the first half of the second butt from a terminal side track at the first butt. In the meantime the first butt has reached its limit with the room cut through to the second butt, near the center of the block. To bring the coal from the upper half of the second butt through this room to the first butt, and thence to the side track, will not give an excessive haul. This will permit the lower half of the second butt to be pillared out completely. The removal of the coal from the lower half of the first butt may be delayed, but it is coal close to the side track, economical to mine and a good asset to have in reserve for the future.

Generally speaking, it is better to sacrifice motor convenience to the aid of the driver. A few energetic motormen are more easily watched and controlled than 20 or 30 drivers scattered throughout the entire mine workings. Furthermore, the more side tracks there are conveniently located for the driver, the fewer drivers are coming into one side track, and better service from these men is the result.

There should be ample equipment of mine cars and generous length of side tracks, with provisions at each for surplus empties. Many plants are so designed that the motor cannot get away from the tipple if loads from the previous trip are standing nor can it feed the inside partings if empties remain there. There is no economy in operating under such conditions, and there is no reason why these conditions cannot be rectified.

When motors are badly pushed for time and there is danger of increasing the number of side tracks to such an extent that the error of reducing the capacity of the motors is pending, the side tracks may be concentrated by bringing (for instance) coal from the first and second butt-headings to the first parting, and the third- and fourth-heading coal to the fourth-heading side track, either through standing rooms or along one of the face headings parallel with the main. It is not good mining to operate and maintain a side track for a heading which for any possible reason does not produce sufficient coal to keep one driver busy. This driver's haul had better be lengthened and the side tracks reduced.

There are four considerations which determine the length or capacity of side tracks. These are (1) the daily capacity of the workings fed by the parting; (2) the number of trips the motor makes daily; (3) whether or not there is ample mine-car equipment, and (4) the number of loads the motor can haul in a trip.

Granting the desired number of mine cars, the most important consideration is the tonnage or length of the trip the motor can handle. It should therefore not be required to feed a particular parting or associated group of partings until this length of trip has been gathered. Instead of the motor making the rounds of all the partings in turn, it should feed the heavy producing sections frequently, while the declining sections should be treated only as the full trip is gathered.

Practically the same general remarks pertain to the junction of main and gathering motors, with this general modification: The economy of gathering motors is not vitally dependent upon a short haul. The installation of the gathering motor greatly lessens the expense of advancing the side tracks to keep pace with the mine workings. There is, however, an economic distance beyond which the gathering motors should not be run. This distance varies with local conditions, grades and capacities of the motors. When this maximum is reached, there develops the necessity for breaking the haul into main haulage and gathering-motor haulage and the question of proficient side-track arrangement must be met.

Whereas animal haulage must unavoidably fill the side tracks by numerous small trips of loads, the gathering motor may arrange to enter only when it has gathered the full capacity of the straight-haul terminal. Ordinarily the tonnage of the straight-haul motor will be greater than that of the gathering motor, which will involve the straight-haul motor in turn collecting the trip from several gathering-motor terminals.

The question of side tracks resolves itself, therefore, into whether it is necessary for the gathering motor to make several returns to the terminal in order to gather the required trip for the straight-haul motor and whether several gathering motors are coming into the same parting. To provide for the most complicated case where the loads will not drift into the parting by gravity, where they must be pulled in and where several landings must be made before the return of the straight-haul motor, the siding must be triple length, with two crossovers. It may not be advantageous for the gathering motor to clear the main parting of empties, but the usual room for surplus empties must be provided.

The grades on the heading may be so steep that they determine whether the gathering is commenced from the first or last room. The usual practice is to install a runaround at the mouth of the room heading in order to let the motor take its position in the rear (going in) of the empty trip.

The illustrations portraying the animal side track show the principal methods of arrangements with numerous modifications. Where the actual conditions and the duty required of the gathering motor are known, these will, with slight changes, serve the purpose. In fact, the requirements of the terminals for animal haulage are more numerous than for gathering motors, as the motors have more power and can shift and push loads under conditions that would be prohibitory for a mule. On account of the greater distance covered by the gathering motor, the intra-terminal side track is rarely used.

The next step in the question of motor haulage is met when the distance or tonnage gets beyond the capacity of one straight-haul motor. The installation of the second motor brings us to a decision on the following four points: (1) Whether or not to lay double track on the entire main haul used by two or more motors in common; (2) Whether or not to arrange for the motors to meet at intermediate points, thus splitting the distance into several parts; (3) To provide intermediate passing points; or (4) Whether or not the mine can be divided into sections, so that each motor shall work a different part and, by a system of signals or the word of a trapper, keep them from colliding on that part of the track used in common.

There is no question concerning the advantage of the double track—it is the surest way to eliminate accidents. Its disadvantage is its expense. Hence the majority of single-track mines. The meeting of the two motors practically answers the same purpose, with little loss of time during normal running, provided the meeting place is located at such a point that the inside motor or motors can work the side track on nearly even time with the outside motor. Under this system there are fewer empty mine cars and loads on the main haul and outside. In deciding between meeting and passing at some intermediate point there is little choice, except in the number of mine cars required by each system.

For two motors only, the kind of side track is a simple question when only meeting or passing is required. But as the haulage enlarges and two or more inside motors are necessary, with various times requisite for their trips, the meeting place becomes more complicated and provision must be made for all the motors to work independently of one another. A clear and distinct understanding of just what the side track is required to accomplish is the principal part of its design.

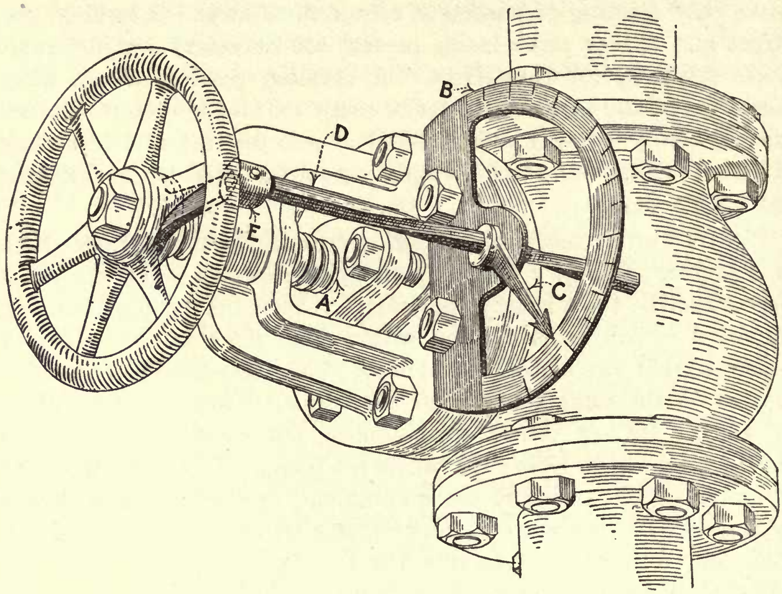
As for two or more motors using part of the main single track in common, without a distinct passing or meeting point, the practice cannot be too strongly condemned. Without adequate electric signals it is dangerous. Even with signals it cannot be operated without great loss of time in waiting. The same applies to several motors on the same terminal at the tipple. There must be delay in waiting for the others or in finding out where they are, and always doubt as to where the others are going. This is too frequent at many mines to require much comment, except that it is always good policy to keep more than one motor off one track, and if more than one is needed to handle the tonnage, break the haul into parts, allowing one motor only to land on the tipple.

Valve Indicator

Engineers often feel the need for an indicator or telltale to show the exact position of a throttle or other valve, particularly where it is not readily accessible for trial. An ingenious device for this purpose is shown in the illustration, which is applicable to any type where the stem travels with the valve. Such a contrivance is used on the throttle valves of the large reciprocating units at the Pratt Street power house of the United Railways and Electric Co., of Baltimore, Md.

The construction and operation are shown in the illustration: *A* is the valve spindle, and *B* a graduated quadrant fastened rigidly to the body of the valve. The pointer *C* is fastened to the quadrant, but is free to revolve over its face. The center of pointer *C* is pierced by a square rod *D*. The rod *D*, through a clamp *E*, is made to follow the movement of the valve stem in and out as the valve is operated, and the part of *D* that engages the pointer *C* is twisted so that from the open to the closed position of the valve the pointer *C* will travel 180 deg. over the quadrant.

This indicator is simple to make, all the parts being forged by



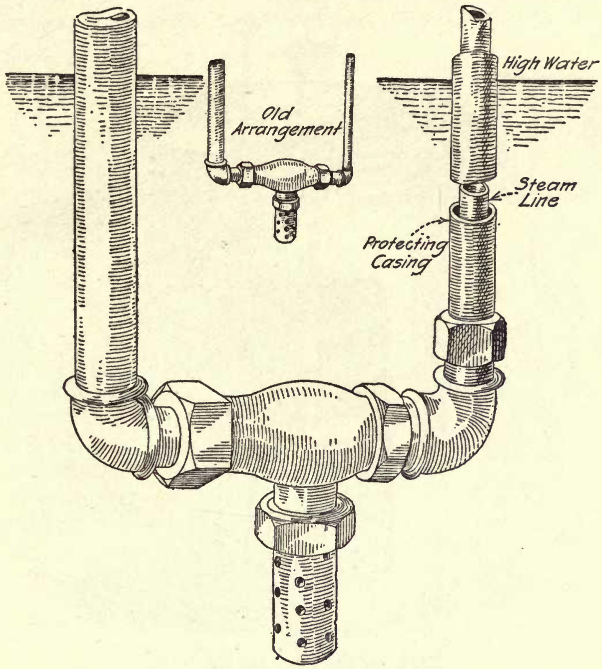
Indicator to Show Position of Valve

hand and requiring little machine work. It should be useful on main steam and other inaccessible valves where a positive indication of the position of the valve is desired from a distance.

Protecting Submerged Steam Pipe

At a certain mine plant where fuel was cheap an ejector was used to elevate the water to the main supply tank. During the dry or summer season very little difficulty was experienced, but during the winter, with its constant heavy rains or thaws, the water in the creek rose so that the steam line to the ejector was submerged about 3½ ft. With the temperature about zero, the steam pressure was lowered so that the ejector would not throw enough water to supply the demand, and on several occasions temporary shutdowns resulted.

There were railroad tracks situated between the tank and the ejector, and the piping was underground, so that repiping would have been expensive. A casing was placed around the steam pipe by using a larger pipe and making a water-tight joint at the bottom, forming a sleeve so that the water could not come in contact with



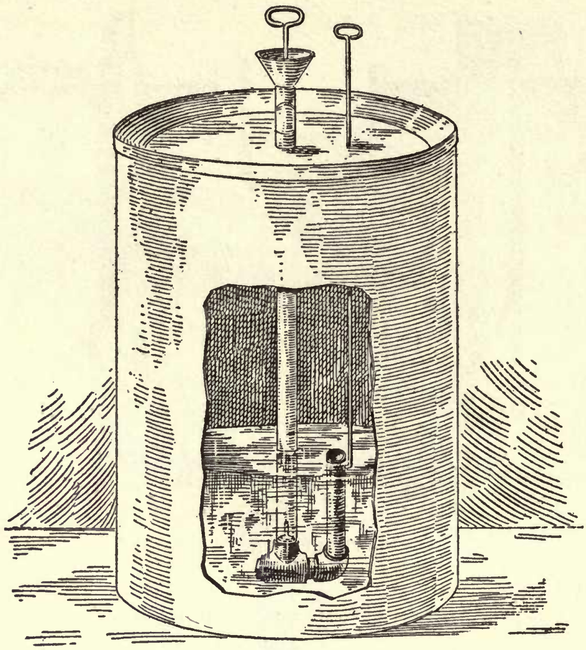
Steam Pipe Protected from Cold Water

the steam line, as shown in the illustration. This saved considerable steam, and no more shutdowns occurred due to the device failing to throw sufficient water.

Oil-Level Indicator

Frequently the supply of oil in the storage tanks becomes too low to tide over the demand for it while the purchasing department is having a new supply delivered. The oil-level indicator illustrated will give sufficient warning of the approaching exhaustion of the supply.

Attach loosely to the suction of the oil pumps in each tank a pipe, as shown in the illustration, turning vertically about 14 in. After the tank has been filled, the end of the suction pipe is turned upward so that, instead of taking oil from the bottom, it takes oil from a higher level. When the oil reaches this level, the suction fails and the attendants are warned that it is time to send

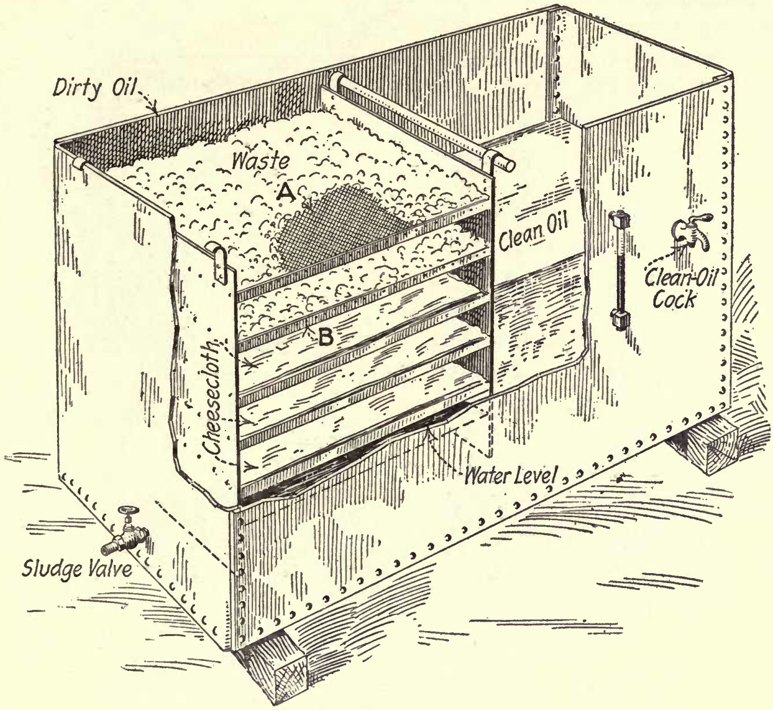


High-Level Pump Suction Pipe

in their requisition for more oil. To take care of requirements in the interval, it is only necessary to turn down the vertical pipe so that it will draw the oil from the lowest level in the tank.

Home-Made Oil Filter

An old 54x40x18-in. steel tank that had been used as a boiler-compound tank was utilized in making this oil filter. From the local junkyard were secured several strips of steel about $\frac{3}{4}$ in. wide by $\frac{3}{16}$ in. thick, and two pieces of 18-gage iron $17\frac{7}{8}$ in. wide by about 22 in. long. The narrow strips were bent to form five rectangles $17\frac{1}{2}$x27 in., and were then covered with heavy screen, as at *A*, and spaced equally in one end of the filter. They were riveted to sheet-iron pieces, to which hooks were riveted at the top. A rod was run through the tank to hold one side of the basket, and the other side was hooked to the wall of the tank. A gage-glass and a clean-oil cock were fitted in the positions shown. An old 1-in. pipe connection and valve placed in the bottom at one end of the tank served as a sludge and drain valve. These are all shown clearly in the illustration, and with a little care, should prove to be easy to construct.



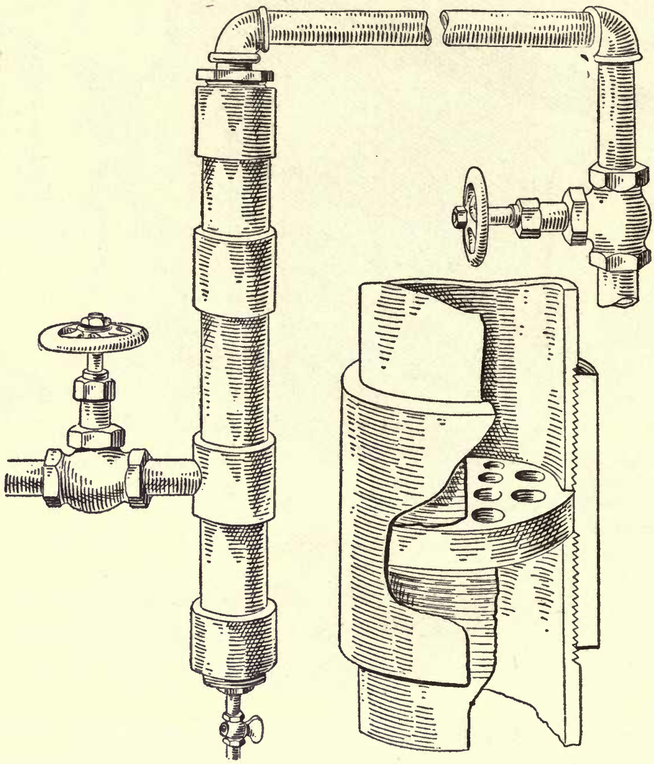
Details of the Filter

The action of the filter is as follows: The two upper shelves of the basket are filled with waste about 3 in. deep. The three lower shelves are covered with five or six layers of cheesecloth. The tank is then filled with water up to the point indicated, and the filter is ready for use as soon as the basket is placed in position on its four hangers.

The dirty oil is poured into the top of the basket, and passes down through the two trays of waste, the three trays of cheesecloth and thence into the water, and rises in the clean-oil chamber, from which it is drawn off through the clean-oil cock.

Easily Constructed Separator

Much trouble was experienced in regulating the speed of a 14x7x14 direct-acting steam pump used for boiler-feed purposes, on account of the condensate cutting away the valve disks and seat of the throttle valve; a separator was made as shown in the illustration.



Separator in Steam Line to Feed Pump

The result was not an exceptionally finished piece of work and altogether free from crudities, but it served its purpose in doing away with the valve trouble. The separator was made from old fittings, the baffle being a disk held between the nipple ends and having 12 holes $\frac{3}{16}$ in. in diameter drilled through it. It took two men only about two hours to put the separator into service.

Facing Up Pump Valve Seats

In truing up the valve seats of pumps, when no grinding outfit is at hand, the following method has proved of great value. Anneal a flat file and cut a piece *A* long enough to cover fully the seat of the valve to be ground. Drill and tap a hole *B* in the center for a $\frac{3}{8}$-in. bolt, then reheat and temper it. Cut the head off a $\frac{3}{8}$-in. bolt *C*, 4 to 6 in. long. Run the bolt down through piece *A* and extend it through $\frac{1}{4}$ to $\frac{3}{8}$ in. to form a guide to steady the grinder when in use. A locknut set up tight holds the cutter fast to the stem, which is squared at the opposite end. By placing it in a brace or in a breast drill a nice job can quickly be done.

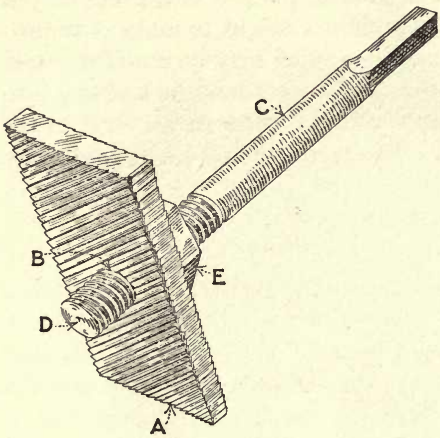


Fig. 1 Tool for Truing Up Brass Valve Seats

A tool made as follows will probably give more satisfactory results, inasmuch as it has a larger bearing surface. The pieces of old file are cast into the

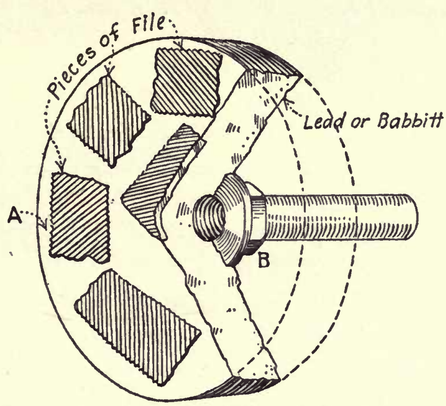


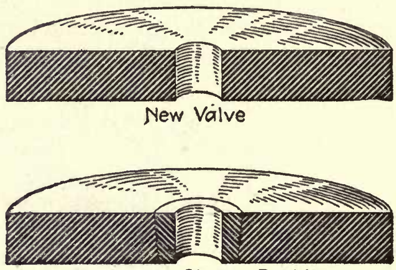
Fig. 2. Another Tool with Larger Bearing Surface

babbitt-metal body so that the flutes in the file scrape the valve seat crosswise. Care should be taken that these pieces are not located with the flutes as at *A*; they will groove the seat and it will be difficult to do a good job. The position of the files should be similar to that in drawfiling.

This tool is made by placing files on some plain metal surface, surrounding them with a ring or mold, and pouring the babbitt into the mold. On top and in the center place a nut, preferably a washer nut, as indicated at *B*, of sufficient height to allow it to project above the mold, so that a socket wrench may be used for rotating the tool. Or, if desired, a threaded driver may be screwed into the nut and the valve-seat facer rotated with an air drill or an ordinary carpenter's bit brace. The metal should be backed away from the files slightly.

Rubber Pump Valves

Rubber pump valves for ordinary mine pumps often become a source of considerable trouble. Not infrequently the hole through the rubber disk becomes enlarged because of the wear of this part upon the valve stem. To obviate this difficulty a rubber bushing may be inserted in the stem hole. A valve with a large hole is punched so that the succeeding hole is considerably larger. A bushing or center piece may then be punched from an old valve, but care should be taken to cut it a little larger than the hole it is to fit. After both parts are treated with rubber cement, the bushing is forced into place. A hole is then punched in the center of the blank valve thus formed. When this central hole has again worn too large, the plug may be removed and a new one substituted. By this means valve stems that have worn even considerably may be kept in service, as it is an easy matter to fit the hole in the valve to the valve stem. Thus, if the original size of the valve stem was $\frac{3}{4}$ in. in diameter, but had become worn down to, say, $\frac{5}{8}$ in., it would be an easy matter to punch the hole in the valve to $\frac{5}{8}$ in.

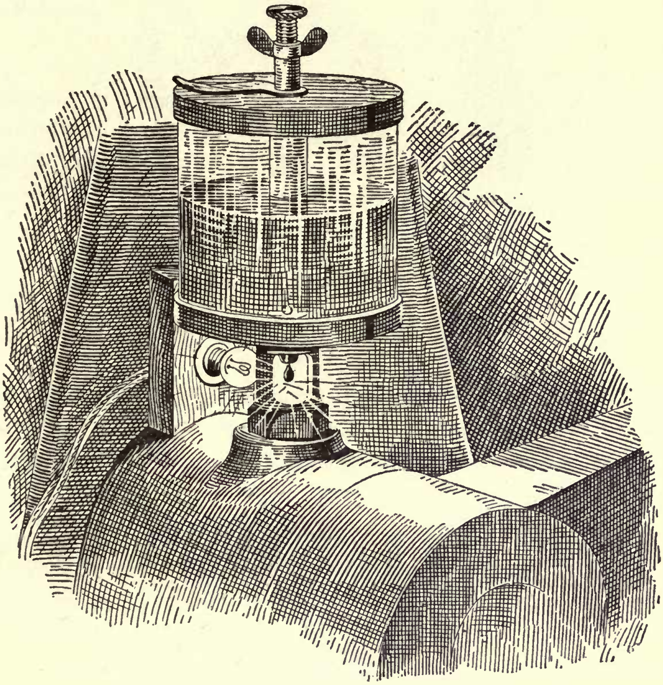


View of Valve With and Without Bushing

This method of repairing old valves has been tried for several months and has been found to work with considerable satisfaction.

Illuminating a Sight Feed

Where lubricators are situated in dark places a miniature electric lamp placed back of the sight glass will facilitate seeing the drop of oil.

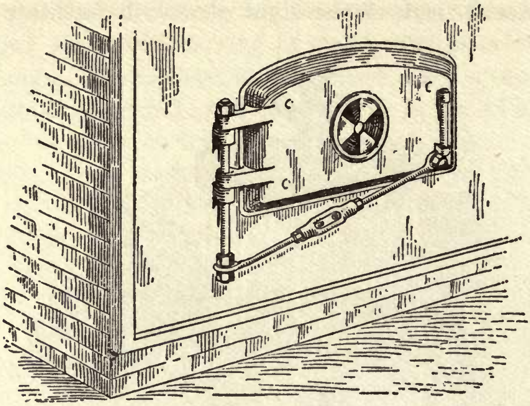


Miniature Electric Lamp at Oiler

If but one light is used, a battery is best for furnishing the current, but if several oilers are closely grouped the lights can best be connected in series to a regular circuit through a switch, so that the current can be turned on or off at will.

Old Fire-Doors

In repairing old fire-doors according to the method shown in the illustration the door is first blocked into position, and the holes in the hinges are reamed out to about 1 in. diameter with a ratchet and extension drill (an ordinary drill welded to a long shank). A new hinge pin is used which not only passes through both hinges, but extends about 9 in. below the bottom hinge. To the lower end of this pin a turnbuckle rod is fastened by two nuts, its other end being bolted to the front end of the door, just below the handle. This makes a substantial device. There is no warping from

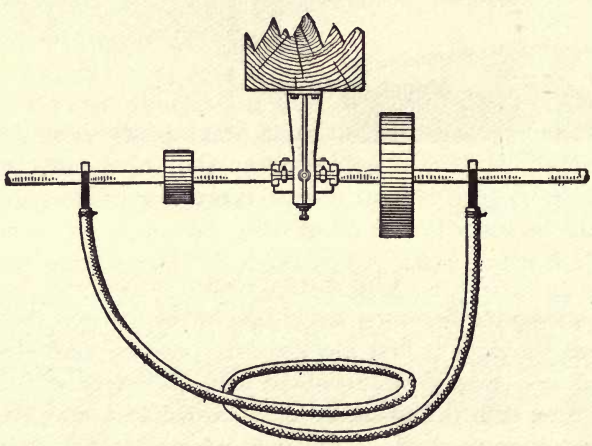


Door Supported from Below

the heat, and the turnbuckle corrects any sagging of the door. The job has, moreover, a neat appearance, and it is only necessary to proportion the parts to the weight of the door to get complete satisfaction.

Simple Shafting Level

To level shafting or to ascertain the relative levels of two points some distance apart which cannot conveniently be reached with a

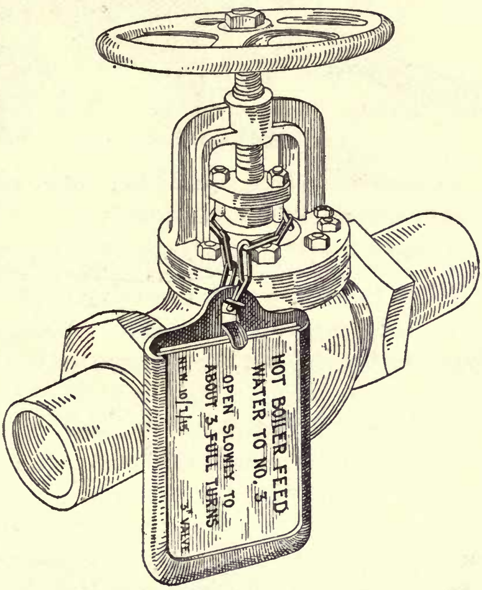


Hose Containing Water Used for Leveling

straight-edge, it is common practice among millwrights and builders to take a common garden or other hose, insert a glass tube in each end, and fill the apparatus with water almost to the tops of the tubes, as shown in the illustration. From the height of the water in the two tubes the inequality of level between any two points can be ascertained.

Identification Tag for Valves

Frequent changes of help cause much confusion and result in many mistakes in operating valves, so that the purchase of aluminum tags with protected white writing spaces may prove to be a considerable economy. These can be attached by light chains to

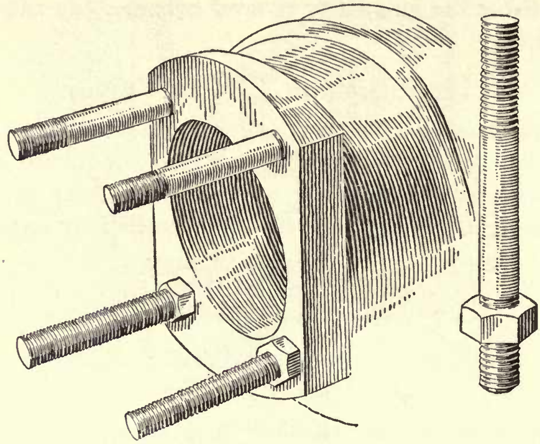


Identification Tag Attached to Valve

the bodies of the valves throughout the plant, with an inscription on the tag as to the service of the valve, its size, make, date installed and any special instructions thought necessary.

Locknut on Gland Stud

Boiler feed pumps are liable to prove troublesome due to their gland studs breaking off where they screw into the pump body. This annoyance may be avoided by threading the whole length of the stud and screwing a locknut up against the pump to act as a support and to keep the stud solidly in place. It is a great improvement over the original design. For long studs or such as cannot be threaded their entire length, the thread may be cut enough longer

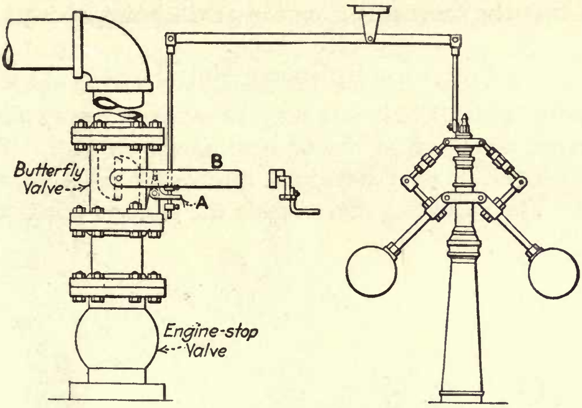


Application of Locknut

than the threaded hole to receive the nut also, in which case the nut is backed on first, then the stud is screwed into the casting snugly and finally the nut is tightened as before. A long stud such as described is shown to the right of the illustration.

Home-Made Engine Stop

Details are here given for making a home-made engine stop entirely from scrap material, except the butterfly valve. The device consists of a butterfly valve placed directly above the engine throttle. The disk of the butterfly valve is arranged to be moved by a heavy lever *B* keyed to its stem in such a way that its weight is sufficient to close the valve. The closing lever is supported in a horizontal position, which corresponds to the open position of the valve, by a projection on the side of the lever which catches on the top of a forked bell-crank lever *A*. This little lever *A* is pivoted, as shown, to a small forged bracket fastened to the valve body by one of the flange bolts. A rod is attached to the top of the governor and extended upward to connect with a horizontal lever pivoted to a point on the ceiling. The other end of the lever is connected to the forks of the bell-crank lever *A* by means of a rod. This rod is provided with two collars which enable it to be set to trip the bell-crank and release the valve-closing lever whenever the governor reaches either the top or the bottom of its travel. Thus the device either serves



A Home-Made Engine Stop

to stop the engine upon the failure of the driving belt, so that the governor would stop revolving and fall to the extreme bottom of its travel, or acts in the event of an increase in speed sufficient to send the governor to the extreme top of its range.

Belt-Cutting

The following kink eliminates the necessity of "cutting the belt square" before lacing and insures even running. A straight-edge or steel square is not needed for joining narrow belts.

The sketches show the method plainly: Fig. 1, how the belt is

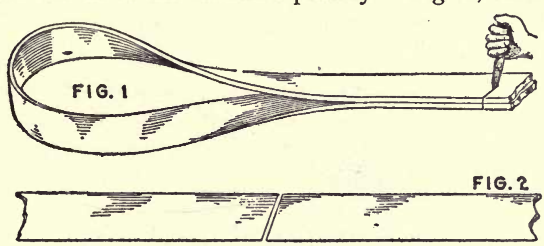


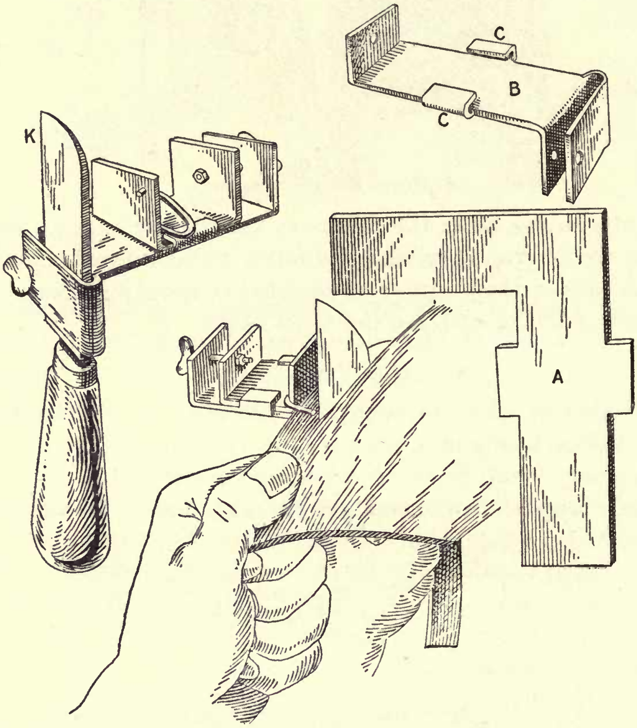
Fig. 1. *How the Belt Is Folded. Fig.* 2. *How It Matches*

laid for cutting; Fig. 2, how the ends match. Match the two ends, one on top of the other as shown, with both smooth sides either up or down and the sides perfectly even. Then cut both together along a straight line. If cut square, at 45 deg. or any other angle, the joint will be a perfect fit.

In case of double or triple belts, where both sides are smooth, place the "outside" of the belt either up or down. The belt must be twisted so that the same side is on top at the point of cutting.

Gage for Splitting Belt Lace

A gage for splitting belt lace may be made of heavy sheet brass or iron shaped as shown at *A* and bent as shown at *B*. The short extension *C* is turned over to form a groove for the slide, as shown assembled. The adjusting screw holds the slide in position for the

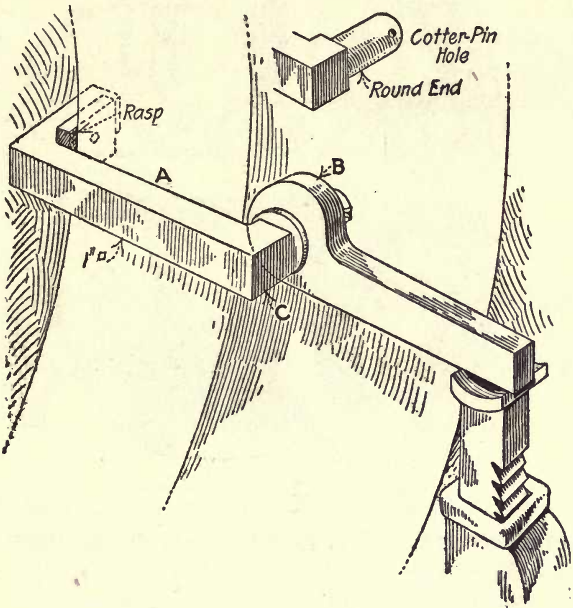


Gage to Cut Belt Lace to Uniform Width

width of lace required. A small spring wire bent and fastened to the slide, with the end extending over the lace, will keep the lace level on the gage. This little contrivance is placed on the blade of an ordinary jack-knife *K* and clamped. The whole thing is only $1\frac{1}{4}$ in. long and $\frac{1}{2}$ in. wide. It is easily made and serves the purpose as well as an expensive gage, which is seldom provided.

Engine-Turning Jack

The home-made device described here for turning an engine off center will not mar the wheel. It consists of a piece of 1-in. square steel, made like *A*, and a piece of $\frac{3}{4}$-in. flat iron made like *B*. This piece is fitted on the rounded end *C* of the clamp, with a washer on

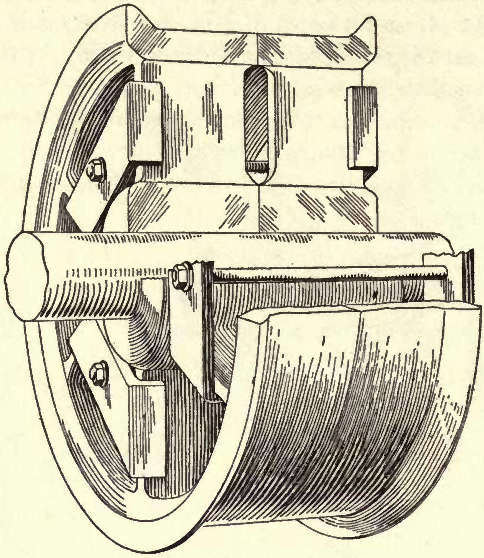


Rig for Turning a Flywheel

each side and a cotter pin through the end of the round piece. On the square end of the arm *A* a 2-in. piece of an old rasp is riveted so as to bite the inside of the rim. A lifting jack is used on the outer end of the piece *B*. There is no slip to this rig, as the heavier the lift the tighter its hold.

Old Mine-Car Wheels

Two discarded mine-car wheels placed face to face on a shaft make a good roller for carrying the cable of an inclined hoist. There are usually several old car wheels on the scrap heap. To make of these a cable roller is a simple two-hour task for the mine blacksmith. The job is a particularly easy one, provided the wheels were loose on the car axle. With most car wheels the hub protrudes beyond the outer rim. Knock this hub off with a sledge and chisel. Two wheels having been prepared in this manner, they are placed face to face and clamped together with U-clamps and driven on the shaft. Any shaft with a diameter smaller than that of the bearing

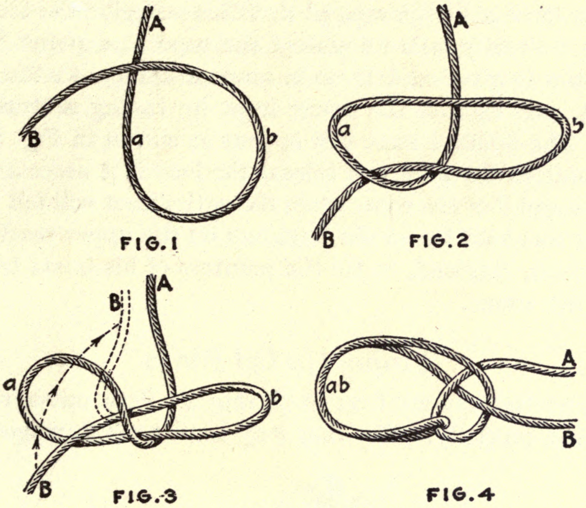


Car Wheels Clamped Together

hole in the wheels will suffice, as the wheels can be shimmed to fit. This is true also if the bearing within the wheels has been badly worn. The flanges prevent the cable from slipping off, and the chilled bearing surface of the wheels wears well under the cable. Rejected car axles can be used as shafts for the rollers, provided the ends are not worn so seriously as to give a poor bearing in the boxes.

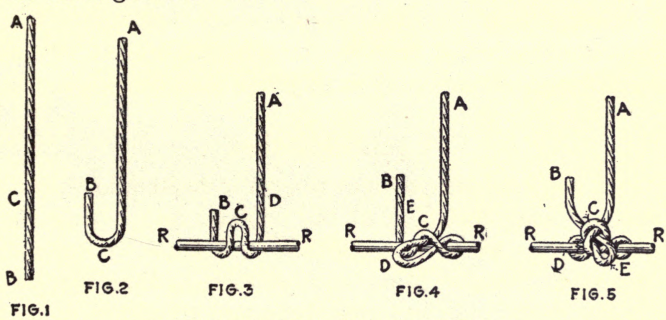
Useful Hitches

In tying the knot take a bight wherever desired, as shown in Fig. 1. Then, catching the bight at the points *a* and *b*, turn the bight over in a direction away from the tier, so that the knot assumes the shape shown in Fig. 2. Make another turn in the same direction; Fig. 3 is the result. In practice these two turns are made in one operation, Fig. 3 being merely a 360-deg. turn of the bight in Fig. 1. Then place the line *B* beside the line *A* and bring the loops *a* and *b* together back of the lines *A* and *B*. A hook or other fastening may then be placed in the resulting double loop and a strain taken on the line *A*. The finished knot is shown in Fig. 4. Care must be taken to have the line *B* beside the line *A*, or the knot will not hold. When the strain is taken off and the hook removed the knot falls apart. Its principal use is on a fall line, or any line to which power



A New Hitch

is applied, in case a temporary pull is desired at any point other than that at which power is usually applied. It may be used also in many other cases which will be obvious after familiarity with the knot has been gained.



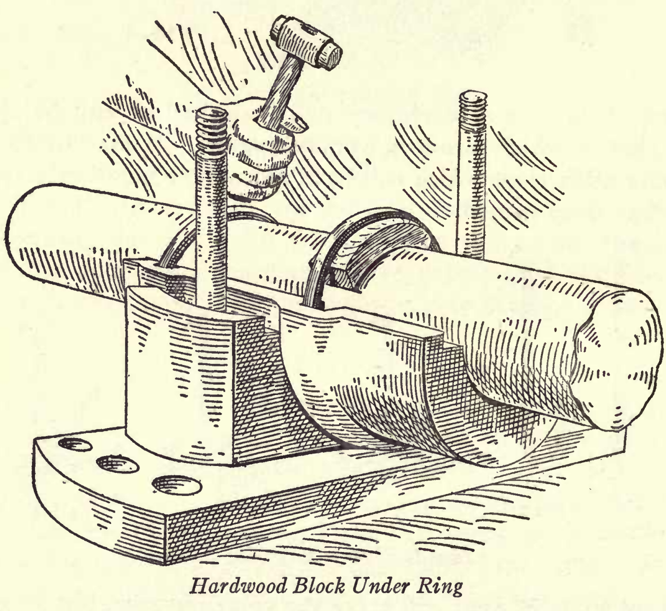
How to Make a Releasing Hitch

Another hitch that will serve the same purpose, but permit the load to be released with greater ease, provided it is a rod or bar that cannot be slipped out of a knot, is shown in the second illustration. *AB* represents the rope to which a load is to be attached, say at a point *C*, Fig. 1. Make a loop at *C*, as shown in Fig. 2, and wrap the double end around the load *RR*, as shown in Fig. 3. Then, doubling the rope at *D*, slip it through the loop *C* and tighten by pulling on the end of the rope at *B*, which will give the knot shown in Fig. 4. Finally, after doubling the rope at a point *E*, pass it through the loops *C* and *D*, in a manner similar to the previous operation, and tighten the entire knot by taking a strain on the rope *A*. The finished knot will appear as shown in Fig. 5.

To unfasten the knot and release the load it is necessary simply to pull the end *B* of the rope, when the entire knot will fall to pieces. This knot was used by an old boatman on the upper reaches of the river Thames, England, to tie the painters of his boats to the iron rings in the wharf.

Truing Up Oil Rings

It is sometimes found that an oil ring is a little out of round and fails to turn properly. The ring may have been damaged slightly



Hardwood Block Under Ring

in assembling the machine or jammed or struck subsequently. In some machines the oil rings can be easily removed, but in others, particularly in the intermediate bearing of a three-bearing machine, considerable work is required. A simple method is here suggested for truing a ring in place. By calipering one of the true oil rings, the correct inside diameter is obtained, and calipering the shaft at the bearing gives its diameter. Then by sawing out a hardwood form to fit the curvature of each and using as shown, the ring may be tapped with a copper hammer and revolved slowly and made true in a short time.

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