MODERN MACHINE SHOP METHODS. No. 3.

BY W. L. CHENEY.

Jig Making.

It generally happens that the man who makes a jig is also the designer of it, because he is necessarily a skilled man, and knows what is wanted better than a draughtsman; besides, no two jigs are just alike. Therefore, a very good way to make one jig might be a very poor way to make some other jig. The object of a jig (in most cases) is to enable an unskilled man to drill, or drill and ream, one or more holes some exact distance from a certain point, or from each other, and these exact distances must either be originated, or transferred from a model piece. The foundation of accuracy in locating holes in jigs, is a center indicator, or "wriggler," as it is sometimes called, which consists of a long arm, free to move in all directions by means of a universal joint attached to a shank to go in a tool post, something like fig. 8.

Suppose it was necessary to make a jig to drill two holes, the centers of which should be exactly one inch apart. One way to locate the centers would be to make two sleeves like fig. 9 exactly one inch in diameter, and a short center-punch that fills the hole. The punch should be ground

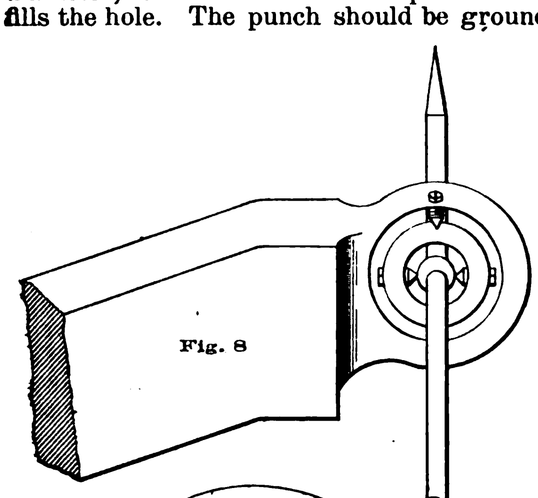

Fig. 8

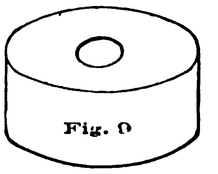

Fig. 9

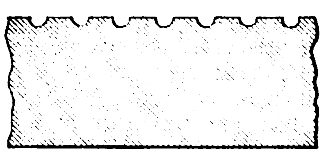

Fig. 10

true after being hardened. Clamp the sleeves firmly on the surface of the jig, so that they touch each other, and mark the centers with the punch. Remove the sleeves, and hold the job against the face-plate of a lathe, which should be squared up every time it is used for a job of this kind. Put the center-indicator in the tool post, and run the carriage up till the point of the short end of the indicator arm is firmly in the center made by the punch, and rap the work until no movement can be detected at the other end of the arm when the lathe is running; then fasten the work firmly, and, after drilling a hole a little smaller than necessary to take the size bushing wanted, bore it out to size. Then move the work on the face-plate, and make the other hole the same way. Any two sleeves may be used to locate the centers of holes at greater distances than they would if touching each other, by clamping them so that the outsides will caliper the distance wanted, plus one half the diameter of each sleeve. For example: the centers of two sleeves, each one inch in diameter, will be two inches apart when the outside of the sleeves caliper 3 inches.

Micrometer calipers are now made so nearly perfect that they are largely used for measurements of two inches and under. They are moderate in price, and have the advantage over vernier calipers that they can be more easily set, and with less liability of mistakes. There is never any question about a micrometer being exactly on the line, but I never saw two men who could set a vernier exactly alike. It is a good thing to have a wooden handle to clamp on to a micrometer to keep the heat of the hand from expanding the metal.

Some of the best mechanics claim that no measurements, either by micrometer or vernier, much over one inch, can be relied upon, because these tools will "come and go" with every variation of temperature, which variation is in proportion to the length.

The method of locating holes given above, is open to the objection that unless great care and skill are taken, the position of the sleeves may be changed while the hammer is being used to mark the centers. Another way would be to locate the work on the face-plate by the hole in the sleeve.

To do this, a center-indicator, in which the arm has only vertical motion, must be used. The short end of the arm is bent upward enough to bear against the upper side of the hole in the sleeve, and should be rounded and smooth enough to ride nicely against the upper edge of the hole, where it will be held by the weight of the long end of the arm. The work may thus be trued and fastened, the sleeve removed, and the hole drilled and bored as before.

There are plenty of good ways to locate centers, and the one selected must be governed by circumstances; but, if the job is very particular, the use of the center-indicator and boring the holes out in a lathe, seems to be about the best to make a sure thing of it.

When holes are to be transferred from a model piece, it may sometimes be done by counterboring in a drill press, the holes first having been drilled a little under size, after locating the centers as near as can be conveniently done by ordinary measurements. Of course the end of the counterbore must be a nice fit to the hole in the model piece, and the cutting part the size wanted for the bushing. The objection to this way is that a counterbore does not make a nice, straight hole, in which to drive the bushing, and if the hole is reamed after counterboring, the location may be changed. Therefore, if a perfect job is wanted, the best way after the under-sized holes have been drilled, is to true the work on a face-plate by the holes in the model piece, letting the end of the indicator arm stick through the hole in the jig, and into the hole in the model piece, after which the hole in the jig can be finished for the bushing by boring as before.

If a jig is to be used on an upright drill, it should have small hardened steel legs, so that it can stand firmly on the table, in spite of the chips which will constantly accumulate.

After being hardened and put in place, the ends of the legs should be nicely ground off, or, if no grinding machine is available, they should be trued by lapping. A cast-iron plate, planed as flat as possible, and full of small grooves, is a good thing to use. The surplus emery gets down into the grooves, and, when a little more cut is wanted, a little benzine on the plate will wash up enough emery to take hold nicely. The benzine seems to make the emery take hold better. Some prefer corundum for this kind of work.

The full size section shown in fig. 10 is about right for a lap of this kind, and is a very useful thing to have around a shop.

Of course a jig must be made to hold the work without springing, and the same principle applies to this as to holding work on a planer table, and if many pieces are to be done in the jig, it is very important that they should be easily put in place and removed.

It is generally acknowledged that it pays to put a little finish on a jig and make a neat job of it, because the man who uses it naturally takes more care of it than if it was a rough-looking affair. In fact, a man who can do a nice, close job on a jig, can't help finishing it up in style, any more than a swell drug clerk can help doing up five cents' worth of flaxseed in a neat parcel, and tieing it with a red string.

(To be continued.)

THE HANDREN & ROBINS ERIE BASIN DRY DOCKS.

It has been frequently asserted that the dry dock facilities in New York are quite inadequate to the commerce visiting the port, but those who have made such statements are not well informed. This city contains a dry dock plant not equalled, at all events not surpassed, by any in the world, for it will take any ship now afloat, or likely to be afloat for many years to come, excepting only the '*Great Eastern.*'

These docks are now occupied and known as the Handren & Robins Erie Basin Dry Docks, at South Brooklyn, N. Y. We recently passed a morning in looking them over, and they well repaid the time spent. There are two docks, Number One being 510 feet long, with 22 feet of water over the sill, and Number Two 600 feet long, with 27 feet of water over the sill. These are situated in easy reach of New York bay, away from other shipping, and where the largest steamers can be handled as easily as if they were in midocean. Attached are shipyard, plate and angle iron furnace, machine, and blacksmith shops, boiler shops, plate bending roll and plate planing machines, which will handle the largest, heaviest, and widest plates rolled. The bending rolls will take in 16′ wide by $1\frac{1}{2}$ thick, and the garboard bender will handle any sheet which goes in a ship. The company have some of the largest punches and shears in the country, capable of punching a hole $1\frac{1}{2}$ inches diameter in $1\frac{1}{2}$ inch iron; besides these, there are a multitude of small tools, lathes, planers, etc., by which all repairs of any character can be made, either to hull or machinery.

Alongside the docks and at convenient intervals, are powerful steam derricks, capable of lifting any weight they may be called upon to handle; stern frames, heavy propellers, shafting, boilers, etc., can be quickly got in or out of place. There are also a full line of electric lights all about the dock, so that night and day are the same, so far as work is concerned. The electric lights can be carried under a ship's bottom, or to any point needed upon emergency.

At the time of our visit the steamer '*Canton,*' of the P. R. R. Co., was in dock, having her bottom scraped and painted, and we went below to examine the condition of the dock itself. It was as dry and comfortable as a machine shop, and afforded facilities for full inspection of every foot of the bottom of any vessel. The '*Wisconsin,*' which recently went ashore on Long Island, was also in hand, having a new stern frame put in, as was also the '*Leerdam,*' which needed the same attention. The '*Lornty,*' the immense four-masted English iron clipper which was so long at the bottom of New York harbor, and finally raised, was towed to these docks, and now lies at anchor, so well repaired that one who did not know the circumstances would think her a new vessel.

The fullest facilities are at hand for prompt and thorough overhauling of any steamer that may meet with disaster, and we are glad to be able to advise all interested of these facts. The refitting and occupation of these docks by Handren & Robins have cost very considerable sums, but the charges for work done are those usually made for such service. Considering the facilities, they are actually lower, for the gain in time by modern rapid methods, heavy tools, and steam derricks, greatly lessens the cost of work.

A bill to provide for the inspection of steam boilers over 10 h.p. has been introduced into the New Jersey legislature.

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THE STRONG HIGH-SPEED EXPRESS LOCOMOTIVE.

Our engravings represent a radical departure in locomotives in every essential point, and these changes have been well thought out. The Strong engine is not so much a new theory as it is a new thesis in locomotive practice, and between these two words there is a wide difference in the result, provided only that the thesis is correct. In the case of this engine the work done speaks for itself, as we shall show later.

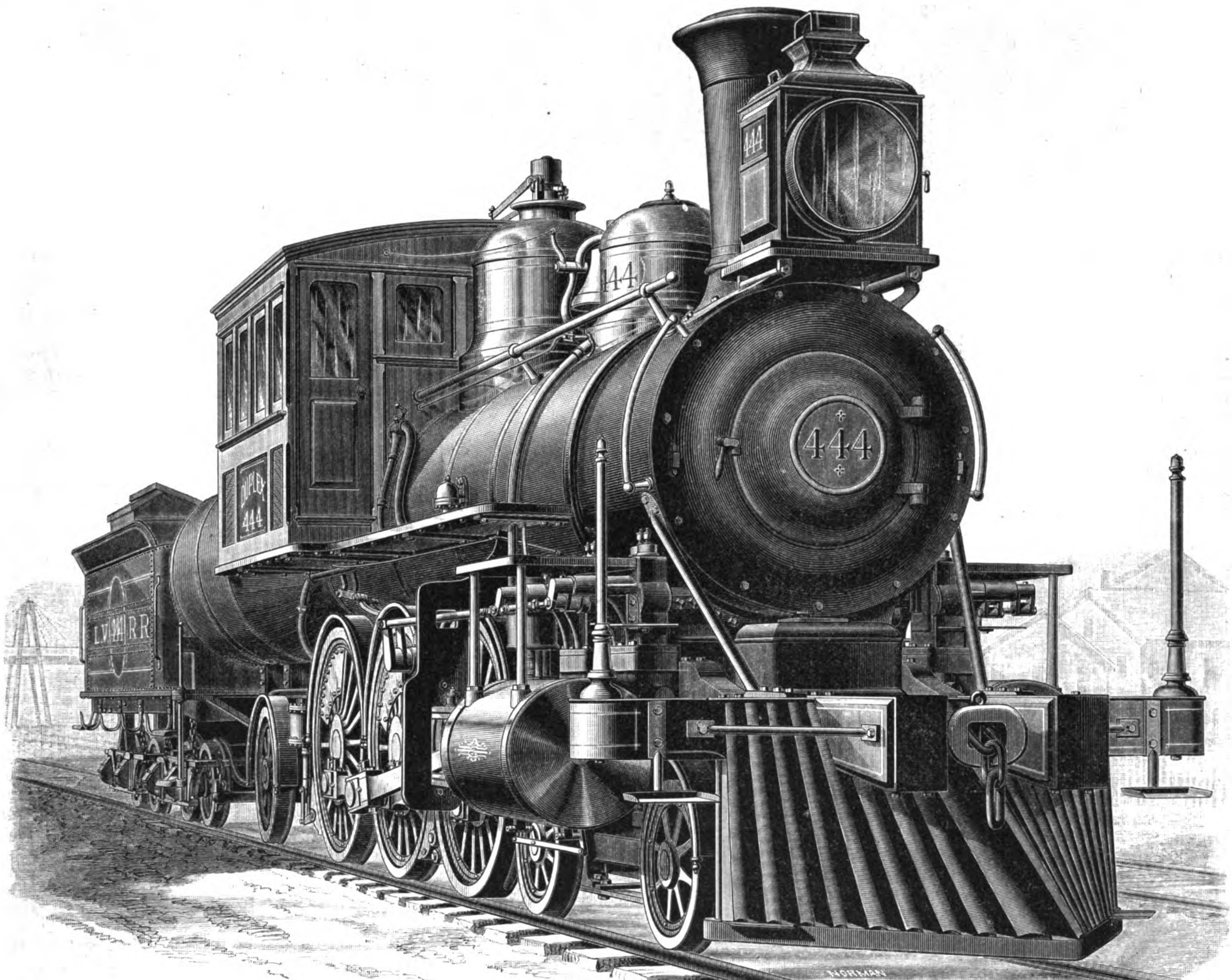
This engine was constructed at the Lehigh Valley R. R. Co.'s shops in Wilkesbarre, Pa., and weighs, ready for service, 137,000 lbs., 90,000 of which are on the drivers; these are six-coupled 62" diameter. The total wheel base is 30' 3', but the rigid wheel base is only 5' 7", enabling her to traverse curves 200' radius. The cylinders are 20"×24", and the steam pressure is 160 lbs. per sq. inch. These are briefly the dimensions; the argument of the designer, Geo. M. Strong, M. E., is succinctly this: High speed on railways is the desideratum and demand of the day, and to achieve it power must be had. From inherent mechanical defects in the standard locomotive in use to-day it is lacking, and this is the cause of the present low averages—40 miles an hour—on railways. As a corollory, if the mechanical difficulties are removed, an improvement in speed would be secured. The chief mechanical difficulties at present are low mean pressures at high speed, too high back pressures, and a difficulty in maintaining high initial pressures on the boiler through faulty design of the present one in use. These are the features which are radically changed in the Strong locomotive as

naces—two in number—are corrugated and welded, except where shown; they communicate with the tube sheet as usual, and discharge into the ordinary smoke-box and stack. The grate area is 62 square feet, with a total heating surface of 1848 square feet, an extraordinary and unusual amount. The fuel used is the finest buckwheat, or pea coal and screenings, with all the culm in it, and the combustion (as shown by the small amount burned) is excellent. This is attained by the duplex furnace system; for these, being fired alternately, pass all their products of combustion into one chamber before reaching the tubes, so that the gases arising from a "green" fire are ignited by the incandescent fire. The longitudinal seams of the shell are all welded, the circular ones being the only ones riveted. Such a boiler is capable of sustaining almost any practical working pressure safely, but it is intended not to exceed 175 pounds.

With the space at our command we cannot review the Strong locomotive as fully as it deserves, and must glance briefly at the valve gear, which is a marked feature of the engine, and shall use the words of the designer in referring to it.

The valve-seats are plugs, fitting in holes bored in the passages from the saddle to the cylinder, the ordinary steam-chest being dispensed with. The valves are let into grooves milled or planed in the seats, so arranged that the valves are free to move up and down in the seats. There are ten (10) ports in each seat on a 19×24 inch, or a 20×24 inch cylinder, each port being $4\frac{5}{8}$ inches, giving a total port length of $46\frac{1}{4}$ inches in each valve. ... course ...

of piston travel, thus getting 6 expansions. The exhaust does not close until $8\frac{1}{2}$ inches from the end of the return-stroke, avoiding excessive compression. The link-motion is not good for very fast, and heavy work. It can neither get the steam in, nor out, properly. In losing at both ends, it exhausts at too high a pressure, and does not allow an initial pressure near that of the boiler. These objections are overcome by the valve-gear shown, which is of the radial type. The motion for all the valves on one side of the engine is obtained from a single eccentric, one motion of the lever attached to the eccentric moving the valves the amount of their lap and lead, and another motion produces the opening in addition to the lead. There are two levers worked from the same eccentric strap; one being bolted rigidly to it, while the other has a pin forged on the end of it. This pin has a bearing in a bushed hole in the strap itself. Both these levers have a fulcrum pin at a certain distance from their ends, connected with one end of a link, whose other end is hung by means of a pin from a block, capable of being moved along a sector or arc. The path of the pin when moved along this arc, is radial to the fulcrum pin already mentioned. Thus the position of this block on its sector, which is regulated through the medium of a reach rod, by the lever in the cab, determines the inclination of the travel of the fulcrum pin. When the block stands in the center of the sector as shown on the drawing, there is no inclination to the travel of the pin and ... moved only the amount ...



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