lar description, consisting of a plunger attached to the main pumping engine, connected by a length of tube with a water pressure engine in another shaft, has been at work for the last ten years

PRACTICAL MECHANISM.

BY JOSHUA ROSE.

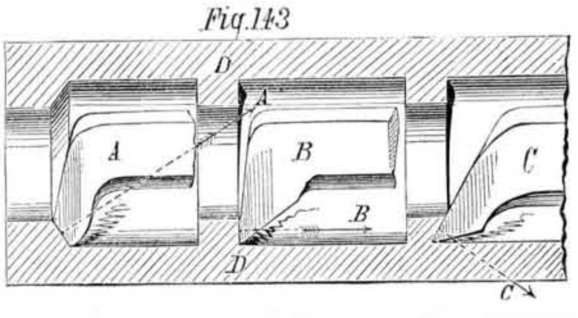
NUMBER XXXIII.

BORING TOOLS FOR LATHE WORK.

Boring tools for use on lathe work require to be shaped with greater exactitude than any other lathe tools, for the reason that they are slighter in body in proportion to the duty required of them than any other; and as a rule, the cutting edges standing further out from the tool post or clamp, the body of the tool is more subject to spring from the strain of the cut. It is obvious that, if the hole to be bored out is a long one, the cutting edge of the tool will become dull at the end of the hole as compared to what it was at the commencement (a remark which, of course, applies to all tools); but in tools, stout in proportion to the duty required of them, and held close in to the tool post, the effect of the slight wear of the cutting edge, due to a finishing cut, is not practically appreciable. In the case of a boring tool, however, the distance of the cutting edge from the tool post renders the slightest variation in the cutting capability of the tool sufficient to affect the work, as may be experienced by boring out a hole half of its length, and then merely exerting a pressure on the body of the tool, as near the entrance of the hole as possible, with the fingers, when the size of the last half of the hole will be found to have varied according to the direction in which the pressure was placed. As a result of this extreme sensitiveness to spring, the tool is apt to spring away from the cut as the boring proceeds, thus leaving the hole smaller at the back than at the front end. To remedy this defect, several very fine finishing cuts may be taken; but a better plan is to so shape the tool that its spring will be in a direction the least liable to affect the size of the bore of the work.

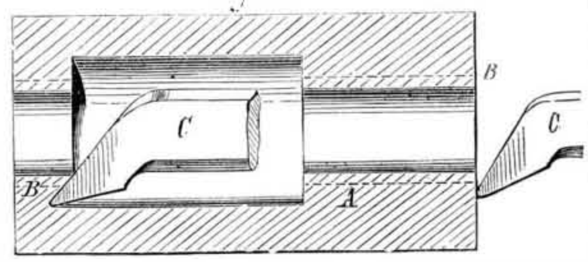
The pressure on the cutting edge of a tool acts in two directions, the one vertical, the other lateral. The downward pressure remains at all times the same; the lateral pressure varies according to the direction of the plane of the cutting edge of the tool to the line or direction in which the tool travels: the general direction of the pressure being at a right angle to the general direction of the plane of the cutting edge. For example, the lateral pressure, and hence the spring of the various tools, shown in Fig. 143, will be in each case in the direction denoted by the dotted lines. D is a section of a piece of metal requiring the three inside

Fig. 143



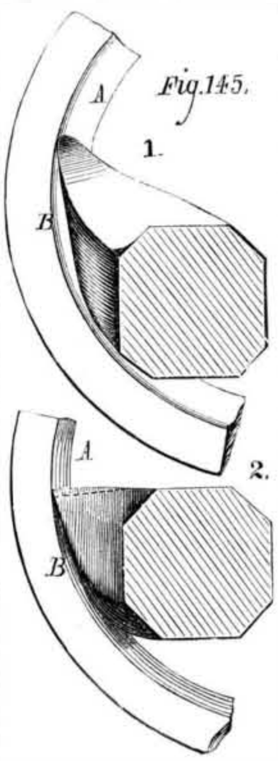
collars to be cut out; A, B, and C are variously shaped boring tools, from which it will be seen that A would leave the cut in proportion as it suffered from spring, which would increase as the tool edge became dull, and that the cut forms a wedge, tending to force the tool towards the center of the work. B would neither spring into nor away from the cut, but would simply require more power to feed it as the edge became dulled; while C would have a tendency to run into the cut in proportion as it springs; and as the tool edge became dull, it would force the tool point deeper and deeper into the cut until something gave way. Now, in addition to this consideration of spring, we have the relative keenness of the tools, it being obvious at a glance that (independent of any top rake or lip) C is the keenest, and A the least keen tool; and since wrought iron requires the keenest, cast iron a medium, and brass the least keen tool, it follows that we may accept, as a rule, C for wrought iron, B for cast iron, and A for brass work. To this rule there are, however, variations to be made to suit exceptional cases, such for instance as when a hole terminates in solid metal and has a flat bottom, in which case the tool, B (slightly modified towards the form of tool, C), must be employed. Or suppose a hole in cast iron to be, as is often the case, very hard at and near the surface of the metal. Tool, A, would commence cutting the hard surface and, becoming dull, would spring away from the cut in spite of all that could be done to prevent it; while tool, B, would commence to cut both the hard and the soft metal together, the cutting edge wearing rapidly away where it came into contact with the hard surface of the metal; and these conditions would, in both cases, continue during the whole operation of boring, rendering it difficult and tardy. But if the tool, C, were employed, the point of the tool would commence cutting the soft part of the metal first, and would undermine the hard surface, and (from the pressure) break it instead of cutting it away, as shown in Fig. 144, in which A represents a piece of metal to be bored, the bore being hard to the depth of the dotted lines, B. C is the tool shown as it would commence to cut, and also as it would operate while in full operation. After the hard surface is removed, tool B, in Fig. 143, may be employed to finish the boring, the point being ground a little more rounded. The objection to tool, C, in Fig. 143, for employment upon cast iron or brass, is that, in consequence of its excessive keenness, it is liable to jar or chatter. Tool, B, in Fig. 143, may be given top rake and employed to cut out a square corner, or it may, if not ground too keen, be used upon brass; but it is liable, in such case, to jar or chatter, unless the top face is ground away. Here, then, we come to the consideration of top rake, that is, the shape of the top face of the tool, our previous remarks hav-

Fig. 144.



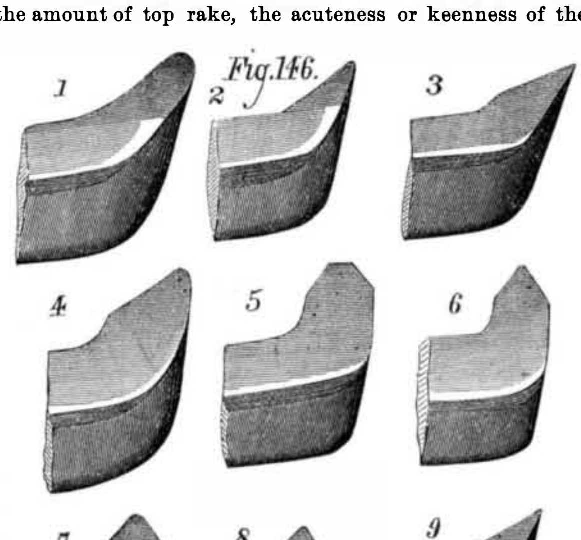
ing had no reference to that part of the subject. The application of top rake or lip to a boring tool lessens the strain due to severing the metal; by presenting a keener cutting edge, it lessens the tendency to lateral spring, and increases that to vertical spring, and is beneficial in all cases in which it can be employed. Upon wrought iron and steel it is indispensable; upon cast it may be employed to a limited degree; and upon brass it is inadmissible by reason of its causing the tool to either jar or chatter. In Fig. 145, B represents a section of the work, No. 1 represents a boring tool with top rake, for wrought iron, and No. 2 a tool without top rake, for brass work, which may be also used for cast iron when the tool stands a long way out from the tool post or clamp, under which circumstances it is liable to jar or chatter. A tool for use on wrought iron should have the same amount of top rake, no matter how far it stands out from the tool post; whereas one for use on cast iron or brass requires to be the less keen the further it stands out from the tool post. To take a very smooth cut on brass work, the top face of the tool, shown at 2 in Fig. 146, must be ground off, as denoted by the dotted line.

Fig. 145.



We have now to consider the most desirable shape for the corner of the cutting edge. A positively sharp corner, unless for a special purpose, is very undesirable, because the extreme point soon wears away, leaving the cutting qualification of the tool almost destroyed, and because it leaves the work rough, and can only be employed with a very fine feed. It may be accepted as a general rule that, for roughing cuts, the corner should be sufficiently rounded to give strength to the tool point; while, in finishing cuts, the point may be made as round as possible without causing the tool to jar or chatter. Now, since the tendency of the tool to jar or chatter depends upon four points, namely, the distance it stands out from the tool post, the amount of top rake, the acuteness or keenness of the

Fig. 146.



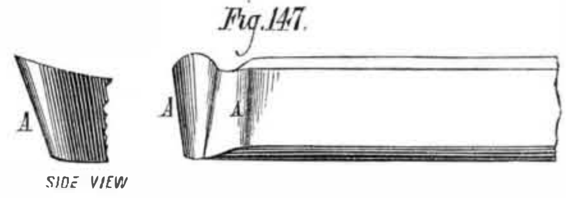
general outline of the tool, and the shape of the cutting corner, it will readily be perceived that considerable judgment is required to determine the most desirable form for any particular conditions, and that it is only by understanding the principles governing the conditions that a tool to suit them may be at once formed. In Fig. 146 will be found the various forms of boring tools for ordinary use. No. 1 is for use when the conditions admit of a heavy cut on wrought iron. No. 2 is for use on wrought iron when the tool stands so far from the tool post as to be necessarily subject to spring. No. 3 is to cut out a square corner at the bottom of a hole in wrought iron. No. 4 is for taking out a heavy cut in cast iron. No. 5 is for taking out a finishing cut in cast iron when the tool is proportionally stout, and hence not liable to spring or chatter: the point being flat, the cutting being performed by the front corner, and the back part being adjusted to merely scrape. No. 6 is for use on cast iron under conditions in which the tool is liable to jar or spring. No. 7 is for taking out heavy cuts in brass when the conditions are favorable. No. 8 is for brass work, either roughing out or finishing, when the tool stands far out from the tool post, or is slight in proportion to its duty. No. 9 is for taking out a sharp corner in brass work. No. 10 is an end view of No. 7, and No. 11 an end view of Nos. 8 and 9. The tools for wrought iron will answer equally well for steel or for copper.

An inspection of all these tools will disclose that the tool point is more rounded for favorable conditions, that is, when the body of the tool is stout, and the cutting edge is not held far out from the tool post; that, to prevent jarring, the point of the tool is made less round, which is done to reduce the cutting surface of the tool edge (since it is apparent that, with a given depth of cut, the round pointed tool will present the most cutting edge to the cut); and that, to further prevent jarring or chattering, the leading part of the cutting edge is ground at an angle; while, as another precaution against that evil, the general form of the tool is varied from that of tool, C, in Fig. 143, towards that of tool, A, in the same figure; while for brass work, no top rake or lip is employed, but the tool is beveled off to suit those cases in which it is liable to excessive spring. It is obvious that the feed may be coarser for a round-nosed than for a more acute tool, and that, the rounder the nose, the smoother the cut (with the same rate of feed) will be.

All boring tools for heavy duty may be hardened right out, that is, not tempered at all, while those slight in form at the cutting edges should be tempered to a straw color.

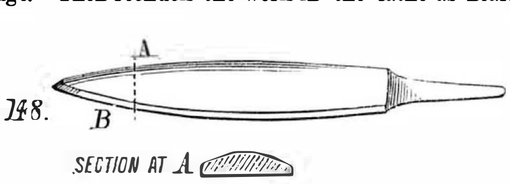
The side faces of the tool marked A, in both views of Fig. 147, may be beveled just sufficiently to well clear the feed of

Fig. 147.



the cut when used on wrought and cast iron, and ground further back, that is, with more angle, for use on brass, especially if there is a tendency to jar or chatter. The straighter, however, these side faces can be kept, the better the cutting edges are supported by the metal behind them, and the longer they will stand without regrinding. When boring light brass work, it is well to hold a brush near the entrance of the hole, to prevent the turnings from flying about the shop; while cutting tools for outside brass work may have a split leather washer forced over the body near the cutting end for the same purpose. After a piece of brass or cast iron work has been bored and taken out of the lathe, and is found on trial to fit a little too tight, it may, if it is difficult to chuck it true again, be eased by a half round scraper, as follows: Take an old half round smooth file and grind the edges at an angle, as shown in Fig. 148, B forming the cutting edge. Then rechuck the work in the lathe as nearly

Fig. 148.



true as possible, and revolve the work at such a speed that the scraper will cut at about 380 feet per minute; then apply the scraper by hand in the position shown in Fig. 149, A A representing the work revolving in the direction denoted by the arrow, and B the scraper shown in section. If the flat face and the beveled edge of the scraper is ground true and even, and care is taken in using it to take out the metal only where required, this tool will perform excellent duty and cut very smoothly. It may be also used to advantage to ease out by hand the narrow places of a hole that is oval, or the small end of one that is taper and requires to be made parallel. The smoothness of its work is much improved by smoothing its edge upon an oilstone. Here it may be well to state that the application of an oilstone to the cutting edges of a boring tool increases its tendency to chatter; if, therefore, a hole requires to be made unusually smooth, the tool must be given less top rake and may then be oilstoned. In many cases a tool may be prevented from chattering by holding it with the fingers as near the entrance of the hole as possible.

Fig. 149