PRACTICAL MECHANISM.

NUMBER V.

BY JOSHUA ROSE.

CASE HARDENING IRON.

Iron may be case-hardened, that is, the surface converted into steel and hardened, as follows: First, by the common prussiate of potash process, which is as follows; Crush the potash to a powder, being careful that there are no lumps left in it, then heat the iron as hot as possible without causing it to scale; and with a piece of rod iron, spoon shaped at the end, apply the prussiate of potash to the surface of the iron, rub it with the spoon end of the rod until it fuses and runs all over the article, which must then be placed in the fire again and slightly reheated, and then plunged into water, observing the rules given for immersing steel so as not to warp the article.

Another method is to place the pieces to be hardened in an iron box, made airtight by having all its seams covered well with fire clay, filling the box in with bone dust closely packed around the articles, or (what is better) with leather and hoofs cut into pieces about an inch in size, adding thin layers of salt in the proportion of about 4 lbs. salt to 20 lbs. of leather and 15 lbs. of hoofs. In packing the articles in the box, be careful to so place them that when the hoofs, leather, etc , are burned away, and the pieces of iron in the box receive the weight of those above them, they will not be likely to bend from the pressure. When the articles are packed and the box ready to be closed with the lid, pour into it one gallon of urine to the above quantities of leather, etc.; then fasten down the lid and seal the seams outside well with clay. The box is then placed in a furnace and allowed to remain there for about 12 hours, when the articles are taken out and quickly immersed in water, care being taken to put them in the water endways to avoid warping them.

Articles to be case-hardened in the above manner should have pieces of sheet iron fitted in them in all parts where they are required to fit well and are difficult to bend when cold. Suppose, for instance. it is a quadrant for a link motion: fit into the slot where the die works a piece of sheet iron (say ½ thick) at each end of the slot, and two other pieces at equidistant places in the slot, leaving on the pieces a projection to prevent them from falling through the slot. In packing the quadrant in the box, place it so that the sheet iron pieces will have their projections uppermost; then, in taking the quadrant out of the box, handle it carefully, and the pieces of iron will remain where they were placed and prevent the quadrant from warping in cooling or while in the box (from the pressure of the pieces of work placed above it).

It is obvious, from what has been already said, that the heavier pieces of work should be placed in the bottom of the box.

CUTTING SPEED AND FEED.

The term "cutting speed," as applied to machine tools, means the number of feet of cutting performed by the tool edge, in a given time, or (what is the same thing) the number of feet the shaving, cut by the tool in a given time, would measure if extended in a straight line. The term "feed," as applied to a machine tool, means the thickness of the cut or shaving taken by the tool.

Planing machines being constructed so that their tables run at a given and unchangeable speed, their cutting speed is fixed; and the operator has only, therefore, to consider the question of the amount of feed to be given to the tool at a cut, which may be placed at a maximum by keeping the tool as stout as possible in proportion to its work, making it as hard as its strength will allow, and fastening it so that its cutting edge will be as close to the tool post as circumstances will permit. In all cases. however, cast iron may be cut in a planer with a coarser feed than is possible with wrought iron. Milling machines should have their cutters revolve so that the cutting speed of the largest diameter of the cutter does not exceed 18 feet per minute, at which speed the cut taken may be made (without injury to the cutter) as deep as the machine will drive.

It is only when we treat of lathe work that the questions of feed and speed assume their real importance, for there is no part of the turner's art in which so great a variation of practice exists or is possible, no part of his art so intricate and deceptive, and none requiring so much judgment, perception, and watchfulness, not only because the nature of the work to be performed may render peculiar conditions of speed and feed necessary, but also because a tool may appear, to the unpracticed or even to the experienced eye, to be doing excellent duty, when it is really falling far short of the duty it is capable of performing. For all work which is so slight as to be very liable to spring from the force of the cut, for work to perform which a tool slight in body must be used, and in cases where the tool has to take out a sweep or round a corner which has a break in it, a light or fine feed must be employed; and it is therefore advisable to let the cutting speed be as fast as the tool will stand; but under all ordinary circumstances, a maximum of tool feed rather than of lathe speed will perform the greatest quantity of work in a given time. A keen tool, used with a quick speed and fine feed, will cut off a thin shaving with a rapidity very pleasing to the eye, but equally as deceptive to the judgment; for under such a high rate of cutting speed, the tool will not stand either a deep cut or a coarse feed; and the increase in the depth of cut and in the feed of the tool, obtainable by the employment of a slower lathe speed, more than compensate for the reduction of lathe speed necessary to their attainment, as the following remarks will disclose.

Wrought iron, of about two inches in diameter, is not uncommonly turned with a tool feed of one inch of tool travel to 40 revolutions of the lathe. With a tool feed so fine as this, it is possible, on work of this size, to employ a cutting speed as high as 27 feet per minute, providing the depth of the cut does not exceed one eighth of an inch, reducing the diameter of the work to 1¾ inches. The length of shaft or rod turned under such circumstances will be $1\frac{9}{32}$ inches per minute, since the lathe speed (necessary to give the tool a cutting speed of 27 feet per minute) would require to be about 51 revolutions per minute; and as each revolution of the lathe moved the tool forward $\frac{1}{40}$ of an inch, the duty performed is $\frac{51}{40}$ of an inch, or $1\frac{9}{32}$ inches of shaft turned per minute, as before stated. If, however, we turn the same rod or shaft of two inch iron, with a lathe speed of 36 revolutions per minute, and a tool travel of one inch to 24 revolutions of the lathe, the amount of duty performed will be $\frac{36}{24}$ inches, or 1½ inches of shaft turned per minute. Here, then, we have a gain of about 17 per cent in favor of the employment of the slow speed and quick feed Nor is this all, for we have reduced the cutting speed to 19 feet, instead of 27 feet per minute, and the tool will, in consequence, stand the cut much longer and cut cleaner.

Pursuing our investigations still further, we find from actual test that, cutting at the rate of 27 feet per minute, the tool will not stand a cut deeper than one eighth of an inch; whereas under the cutting speed of 19 feet per minute, it will take a cut of one quarter of an inch in depth, thus considerably more than doubling the duty performed by the tool, in consequence of the decreased cutting speed and increased feed or tool travel.

Lathe work of about three quarters of an inch in diameter may, if there is no break in the cut, be turned at a cutting speed of as much as 36 feet per minute, the feed being one inch of tool travel to about 25 revolutions of the lathe. The revolutions per minute of the lathe, necessary to give such a rate of cutting speed, will be about 183; the duty performed will therefore $\frac{183}{25}$, or $7\frac{5}{16}$ inches of three quarter inch iron turned per minute. A feed of one inch of tool travel to 25 revolutions of the lathe is greater than is generally employed upon work of so small a diameter as three quarter inch, but is not too great for the generality of work of such a size; for the tool will stand either a roughing or smoothing cut at that speed, unless in the exceptional case of the work being so long as to cause it to spring away from the tool, under which circumstances the feed may be reduced to one inch of tool travel to 30 or 40 revolutions of the lathe, according to the length and depth of the cut.

It will be observed that the cutting speed given, for work of three quarter inch diameter, is nearly double that given as the most advantageous for work of two inches diameter, while the feed or tool travel is nearly the same in both cases; the reason of this is that the tool can be ground much keener for the smaller sized than it could for the larger sized work, and, furthermore, because the metal, being cut off the smaller work, is not so well supported by the metal behind it as is the metal being cut off the larger work, and, in consequence, places less strain upon the tool point, as illustrated in Figs. 26 and 27.

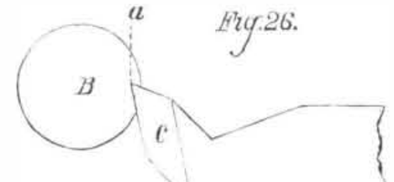
Fig. 26.

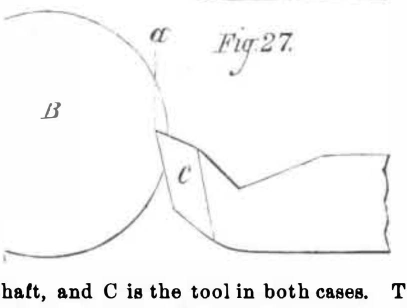
Fig. 27.

B is a shaft, and C is the tool in both cases. The dotted line, *a*, in Fig. 26, does not, it will be observed, pass through so much of the metal of the shaft, B, as does the dotted line, *a*, of the shaft, B, in Fig. 27. The metal in contact with the point of the tool in Fig. 26, is not, therefore, so well supported by the metal behind it as is the metal in contact with the point of the tool in Fig. 27, the result being that the tool, taking a cut on the smaller shaft equal in depth to that taken by the tool on the larger one, may have a higher rate of cutting speed without sustaining any more force from the cut, the difference in the resistance of the metal to the tools being equalized by the increased speed of the smaller shaft.

These conditions are reversed in the case of boring, the metal, being cut in a small hole being better supported by the metal behind it than is the case in a larger hole or bore.

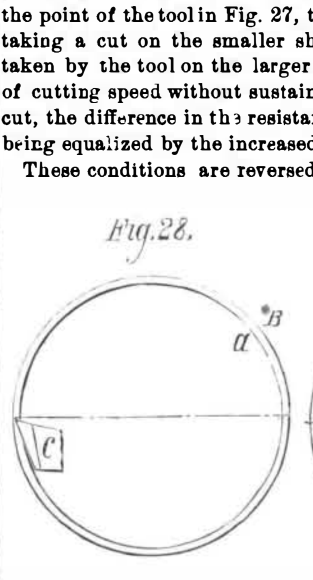
Fig. 28.

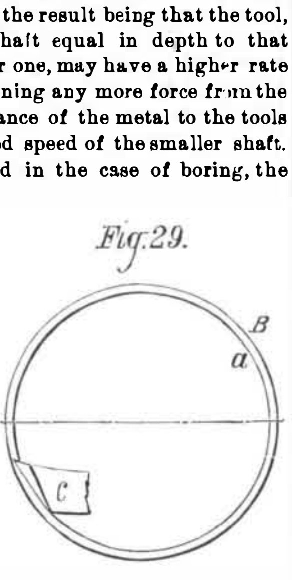
Fig. 29.

This is overcome by placing the cutting edge of the tool below the center of the work, as shown in Figs. 28 and 29, the circular lines, *a* and B, representing the cut, C being the tool in both cases. But in a large bore, the effect is not so seriously encountered, because of the nearer approach of the circle to the straight line, as shown in Fig. 30. The circular lines, *a* and B, represent the cut, and C is the tool.

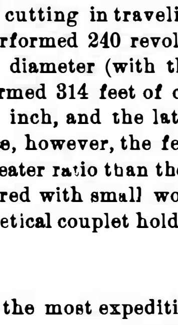
Fig. 30.

On heavy work it is specially desirable to have the tool stand a long time without being taken out to grind, for the following reasons: 1. It takes longer to stop and start the lathe, and to take out and replace the tool. 2. It takes longer to readjust the tool to its cut. 3. It takes more time to put the feed motion into gear again. 4. The feed motion is very slow to travel the tool up and into its cut, and to take up its play or lost motion. 5. Lastly, the tool should take a great many more feet of cut, at one grinding, than is the case with a tool for small work.

A tool used on work 5 inches diameter (the lathe making 20 revolutions to feed the tool one inch) would perform 314 feet of cutting in traveling a foot, the lathe having, of course, performed 240 revolutions; while one used on work 10 feet in diameter (with the same ratio of speed) will have performed 314 feet of cutting when the tool has traveled half an inch, and the lathe made 10 revolutions only. In practice, however, the feed for larger work is increased in a far greater ratio than the cutting speed is diminished, as compared with small work; but in all cases the old axiom and poetical couplet holds good:

> "A quick feed
> and slow speed,"

as the most expeditious for cutting off a quantity of metal, and, in the case of cast iron, for finishing it also.

A positive or constant rate of cutting speed for large work cannot be given, because the hardness of the metal, the liability of the work to spring in consequence of its shape, the distance of the point of the tool from the tool post, and other causes already explained, may render a deviation necessary, but the following are the approximate speeds and feeds:

Wrought iron of about 12 inches diameter: Heavy roughing cuts, 18 feet of cut per minute; and feed, 27 revolutions of lathe per inch of tool travel. Finishing cuts, 20 feet per minute. Feed, 80 revolutions per inch of tool travel.

Cast iron of about 12 inches diameter: Heavy roughing cuts, 25 feet per minute. Feed, 22 revolutions per inch of tool travel. Finishing cuts, 25 feet per minute. Feed, 8 revolutions per inch of tool travel.

Cast iron, 10 feet diameter: Roughing cuts, 15 feet per minute. Feed, 20 revolutions per inch of tool travel Finishing cuts, 19 feet per minute. Feed, 4 revolutions per inch of tool travel.

But these data in no wise apply to tools held far out from the tool post, nor to cutting tools used in a boring bar, concerning which latter too much depends upon the relative size of the bar to the hole to be bored, and upon the solidity of the lathe or machine driving the bar, to permit of any data being given.

Brass of small diameter may be turned at a cutting speed of 420 feet per minute, with a feed of 25 revolutions of the lathe per inch of tool travel, and work of 18 inches diameter at a cutting speed of 150 feet per minute, with a feed of 36 revolutions of the lathe to an inch of tool travel. The discrepancy in the feet of cut per minute arises from the causes explained in Figs. 26 and 27.

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Telegraphic Crows.

At a recent session of the Asiatic Society, Mr. L. Schwendler showed a crow's nest, made of pieces of telegraph wire, twisted together in a most ingenious and knowing manner. He said that lately such nests had been frequently found, and that the crows often selected telegraph posts, between which and the telegraph wires they built those wire nests, causing what are known as "earth" and "contact," and interfering with communication. Crows, however, were by no means the only animals interfering, by their domestic arrangements, with overland telegraphy. Wasps build their mud nests in the porcelain insulators, causing, in rain and dew, leakage from the wire to the ground. Birds of prey frequently dropped dead fish and other offal upon the wires, causing contact. These were all frequent sources of temporary interference with telegraphic communication upon overland lines, and they, combined with many other facts not necessary to mention, seemed to show that it would be a very great advantage to use subterranean telegraphs instead of overland lines.

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PASIGRAPHY.—Pasigraphy is the name of a new system of writing by numbers, which, it is asserted, may be used universally, and thus obviate the difficulty of communication between nations of different languages. Dr. Anton Bachmaier, of Munich, is the inventor. A conference of gentlemen of various nationalities was held in London, not long ago, to promote the undertaking, and the result is said to have been of an encouraging character.

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THE ST LOUIS BRIDGE has a total length of 4,462 feet, as follows: From Third street to the building line on the levee, 930 feet; thence to building line in East St. Louis, 2,107 feet; thence to commencement of the eastern approach on the dyke, 1,425 feet. This approach is 2,000 feet in length.

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