PRACTICAL MECHANISM.

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HAND TURNING.

Turning work in the lathe with a tool held or guided by hand, or, as it is commonly termed, hand turning, is at once one of the most delicate and instructive branches of the machinist's art, imparting a knowledge of the nature and quantity of the resistance of metals to being cut, of the qualifications of various forms of cutting tools, and of the changes made in those qualifications consequent upon the relative position or angle of the cutting edge of the tool to the work; and this knowledge is to be obtained in no other way than by the practice of hand turning.

It is the work of an instant only to vary the relative hight and angle of a hand tool to the work, converting it from a roughing to a finishing tool or even to a scraper, which operations are difficult and sometimes impracticable, if not impossible, of accomplishment with a tool held in a slide rest.

The experience gained from the use of slide rest tools is imparted mainly through the medium of the eyesight, whereas in the case of a hand tool the sense of feeling becomes an active agent in imparting, at one and the same time, a knowledge of the nature of the work and the tool: so much so, indeed, that an excess in any of the requisite qualifications of a hand tool may be readily perceived from the sense of feeling, irrespective of any assistance from the eye; and in this fact lies the chief value of the experience gained by learning to turn by hand.

For instance, there is no method known to practice whereby to ascertain how much power it requires to force a slide rest tool into its cut, or to prevent its ripping in; so that a wide variation in the tendency of such a tool to perform its allotted duty easily and without an unnecessary expenditure of power, may exist without becoming manifest to any save the experienced workman; whereas the amount of power required to keep the cutting edge of a hard tool to its work, to hold it steadily, or to prevent it from ripping, is communicated instantly to the understanding through the medium of the sense of feeling. Nor is this all, for even the sense of smell becomes a valuable assistant to the hand turner. Several metals, especially wrought iron, steel, and brass, emit (when cut at a high speed) a peculiar smell, which becomes stronger with the increase in the speed at which they are cut and the comparative dullness of the edge of the tool employed to cut them, more especially when the cutting edge of the tool is supplied with oil during the operation of cutting. The reason that this sense of smell becomes more appreciable during the operation of hand than during that of slide rest turning is because the face of the operator is nearer to the work, and because hand turning is performed at a higher rate of cutting speed.

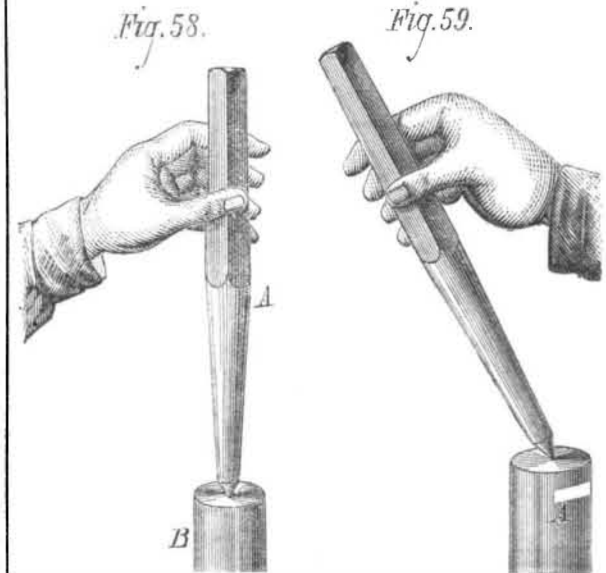
If a tool for use in a slide rest is too keen for its allotted duty, the only result under ordinary circumstances is that it will jar or chatter (that is, tremble, and cut numerous indentations in the work), or that it will lose its cutting edge unnecessarily quickly. But a hand tool possessing this defect will in many instances rip into the work, because the power, required to prevent the strain, placed by the cut upon the tool, from forcing the tool deeper into its cut than is intended, is too great to be sustained by the hand; and the tool, getting beyond the manipulator's control, rips into the work, cutting a gap or groove in it, and perhaps forcing it from between the centers of the lathe. If, on the other hand, a tool is of such a form that it requires a pressure to keep it to its duty, the amount of such pressure, when the tool is held at any relative hight and angle to the horizontal center line of the work, and the variation in that amount, due to the slightest alteration of the shape of the tool, are readily appreciated by sensitiveness of the hand; when they would be scarcely if at all perceived were the same tool, under like conditions, used in a slide rest.

These considerations, together with the great advantage in the relative rapidity with which the form and applied position of a hand tool may be varied, render hand turning far more instructive to a beginner than any other branch of the machinist's art. And since the subject is of equal importance to apprentices, to amateur turners, and to those who have learned their trade without having the opportunity to study this important branch of it, the subject will be treated in detail so as to be available to the merest tyro.

The first lesson will be to learn to turn a piece of plain iron, and the tools necessary for this operation are a bench vise, a file, a center punch, a hammer, a center drill, a graver, and of course a lathe, with the requisite hand rest and driver or dog. Having fastened the piece of iron to be turned in the vise, with the top face not more than an eighth of an inch higher than the jaws of the vise, so as to prevent the iron from jarring while it is being filed, file the end as nearly level and square with the body of the iron as possible. The next operation will be to centerpunch it by holding the pointed end of the centerpunch as near the center of the end face of the iron as the eye will direct; and while pressing the point of the punch sufficiently firm against the work to prevent the punch from slipping, strike the other end of the punch with a hammer, which will make a conical indentation in the end of the work, to receive the lathe center. This operation should be performed upon each end of the work so that it may be turned between the centers of the lathe. It is a common practice to center one end of the work only, and to fasten the other end in a chuck, thus making the chuck serve as a driver and obviating the necessity of centerpunching more than one end of the work. This method will, it is true, save a little time, but is objectionable for the following reasons: Chucks will run quite true while they are new, and indeed for some little time, but they do in time get out of true; and as a result, if the work requires to be reversed in the lathe so as to be turned from end to end, the part of the work turned during the second chucking will be eccentric to that part turned during the first chucking. If one end only of the work requires to be turned, and needs be true only of itself and irrespective of the part held in the chuck, the latter may be employed; this subject will, however, be treated hereafter.

The most desirable shape for the centerpunch, and the manner of holding it, are shown in Fig. 58, A being the

Fig. 58. Fig. 59.



punch, and B, the work. The work being provisionally centered, we must make those centers true, so that the work will true up without requiring to have too much metal cut off in the operation; to this end, we place the work between the centers of the lathe, and adjust the back center so that the work will revolve easily if the hand is drawn lightly across it, and yet it must not be so loose as to be able to shake at all. We then adjust the hand rest so that it will clear the work; and using it to steady the right hand, we hold a piece of chalk near to the work, revolving the latter by brushing the fingers of the left hand quickly and lightly across it; by then slowly advancing the chalk towards the work until the two touch, the chalk will mark the eccentric side of the work if it does not run true, and a ring around the same if it is true. If it be so much out of true as to require alteration, it must be placed in the vise again and the center drawn by striking the centerpunch while it is at an inclination, the point being in the direction of the chalk mark, as shown in Fig. 59, A being the chalk mark, and therefore the direction in which the center requires to go.

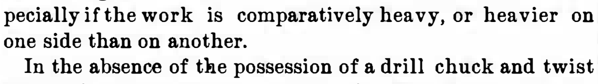
Having removed the center according to the judgment, the chalk mark should be effaced, and the work placed again in the lathe and tested as before, the whole operation being repeated until the work runs sufficiently true.

Our next performance must be to drill a small hole up the center of the work, using the centerpunch mark as the center wherein to insert the drill point. The object of this is to ease away the bottom of the center in the work, so that it will not press against and wear away the extreme point of the lathe centers, and to prevent the centers in the work from moving their position in consequence of the wear due to the friction caused by their revolving between the lathe centers, as they would do in the absence of the center drilling. For this purpose the universal chuck and a twist drill about a sixteenth of an inch in diameter are the most desirable tools, they being purchasable from any store keeping machinists' supplies. The chuck must be screwed on to the running spindle of the lathe; and the drill being fastened in the chuck, the work is placed so that the point of the drill is in one of the centers and the center of the back head of the lathe is in the other center. Then, by starting the lathe and holding the work still by the left hand while the right hand is gently screwing out the back lathe center, the work will be forced over the revolving drill, thus drilling the hole referred to. While the drilling is being performed, the drill should be freely supplied with oil to assist it in cutting and to prevent it from wearing away and becoming dull. It is very important, during this operation of center drilling, to relax, every few seconds, the hold upon the work sufficiently to permit it to make about a third of a revolution, which may be done while the other hand is supplying oil to the drill. The object and effect of this is to cause the center drilling to be true, which otherwise it would not be, especially if the work is comparatively heavy, or heavier on one side than on another.

In the absence of the possession of a drill chuck and twist drills, they may easily be made, the best forms being as follows:

Fig. 60 represents the drill chuck with one end of the drill

Fig. 60.



in its place, while Fig. 61 represents the drill separate. The cone, from A to B in Fig. 60, is the part which fits into the socket or hole in the lathe spindle; from the end, C, to the nearest side of the slot, D, is drilled a hole, the slot, D, being cut down to half the diameter of the hole; and its bottom face is left taper as shown, so that the taper, D, of the drill

Fig. 61.

(Fig. 61) will, when forced into its place, serve to lock the drill and prevent it from turning in the chuck.

The drills may then be formed of steel wire (Stubs' is the best for the purpose) by simply filing the flat taper, D (Fig. 61), on one end of the wire, and forging out the other end to a drill of the required size, care being taken to forge the drill end (as shown in Fig. 61) smaller at A than at the drilling end, B, from B to A being a gradual curve: which is called the clearance, and which serves, in consequence of the decreased diameter of A, to permit the cuttings of the drill to pass out of the hole while the drilling is being done. If the drill is not given sufficient clearance, the cuttings will become jammed in the hole, and, binding fast to the drill, will arrest its revolving motion, and cause it to twist and break off, leaving the cutting end of the drill fast in the hole; in which case, unless one end of the broken piece happens to protrude so that it can be extracted by a pair of pliers or a hand vise, and unless it can be jarred loose (as is sometimes the case) by striking it against a block of iron or wood, the work must be heated to a low red and permitted to cool of itself, so as to soften the point of the drill to allow it to be, by another drill, cut or drilled out.

Important Researches on Explosive Substances.

Roux and Sarrau have previously shown that two different kinds of explosions can be produced by dynamite, according as the substance is made simply to deflagrate (explosion of the second order), or to detonate by the percussion of fulminate of mercury (explosion of the first order), and that the force of the explosion produced by the same quantity is very different in the two cases. They now find that the majority of explosive substances, gunpowder included, possess the same remarkable property.

The reciprocal of the weight (due corrections made) of each substance, which when exploded in one and the other manner sufficed to rend similar cast iron shells, gave the relative explosive forces. Some results of the experiments are given in the following table, the explosive force of gunpowder ignited in the ordinary manner being taken for unity:

Name of substance	Explosive force	
	2nd Order.	1st Order.
Mercury fulminate	—	9·28
Gunpowder	1·00	4·34
Nitroglycerin	4·80	10·13
Pyroxyl (gun cotton)	3·00	6·46
Picric acid	2·04	5·50
Potassium picrate	1·82	5·31
Barium picrate	1·71	5·50
Strontium picrate	1·35	4·51
Lead picrate	1·55	5·94

Of the highest practical importance is the discovery of the detonative explosion of gunpowder induced by the detonation of nitroglycerin (itself set off by the fulminate of mercury): for the force of the explosion is more than forefold greater than that obtained by igniting gunpowder in the ordinary manner. (The increased force of gunpowder and gun cotton, when exploded by the agency of detonation, was fully demonstrated by Abel six years ago). The authors observe that the mass of the substance employed for exciting detonation must usually bear a certain proportion to that of the substance to be exploded, but in some cases the action is propagated throughout the latter when once up at any given point.—*Comptes Rendus, Journal of the Chemical Society.*

Self-Watering Locomotives.

The self-supplying water apparatus for locomotives is coming into very extensive use in this country. It consists of a water trough from 800 to 1,200 feet long, laid between the tracks of the railway. As the engine passes along at a velocity of, say, 20 miles an hour over the trough, the fireman, by means of a lever, lowers one end of a pipe into the trough, and the water is carried up into the tender. The water is prevented from freezing in winter by means of steam pipes. The use of this device, by saving time in stoppages, permits a more moderate average of speed, and so results in economy.

Chromo-lithographic Process.

In place of using a special stone for each color, necessitating as many separate impressions as there are colors, the entire subject is drawn upon a single stone, and a proof is taken on a thin sheet of copper. This sheet is then cut out carefully according to the desired contour of the colors, and upon each of the portions is fixed a solid block of color, previously prepared. The whole is combined into one form, and is printed on an ordinary lithographic press, all the colors at once, the moisture of the sheet being sufficient to take off and hold the colors as the sheet goes through the press.

KANGAROO LEATHER.—In Australia kangaroo skins are becoming an important article of traffic, and experts declare that they make the toughest and most pliable leather in the world. Boot uppers of this material are said to be both comfortable and durable. It also makes the best of morocco whips, gloves, etc. Of these skins some are exported in their raw state, and others after being manufactured. The kangaroo is widely distributed throughout the colonies, and great numbers are slaughtered, yearly, for their skins.