PRACTICAL MECHANISM.

BY JOSHUA ROSE.

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PATTERN MAKING.—BEVEL WHEELS.

"He who can make a good bevel wheel is a good pattern maker." That was once the saying; but the system that divides a trade into specialties is now growing to be the general custom, and it has robbed the expression of half its truth, for there are many good pattern makers who have been engaged all their lives in specialties remote from bevel wheel making. We give the saying, however, merely to show the importance that has always been attached to work of this kind, not undeservedly. A pair of bevel wheel patterns, fresh from the workman's hand, especially if of mahogany and nicely varnished, excite general admiration. It is a job easy enough to do; but you must know the way: that way is what I shall endeavor to elucidate.

Fig. 205.

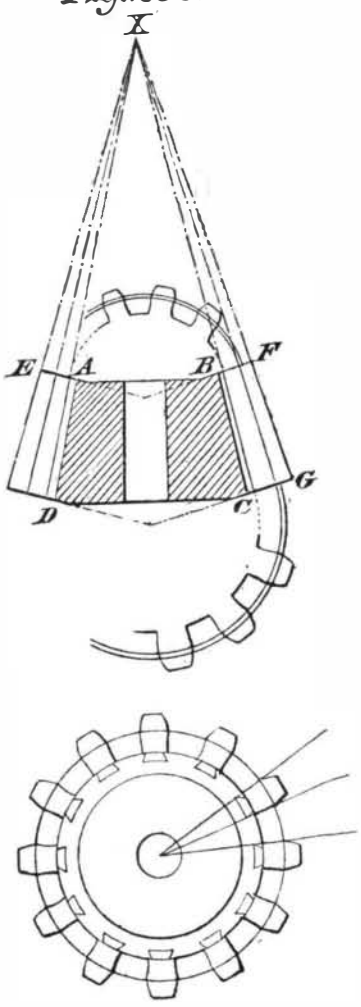


Fig. 205 is a sectional elevation and plan of a bevel pinion; the construction of the body does not differ materially from that of a spur. We may commence building up, if the pinion is of such size to require building, from the small side, A B, for the reason that it is desirable and convenient to turn the part, where the teeth are to be, last, when the building is completed; or if it is a solid piece, we begin by turning off to the line, D C, then reverse on the chuck and turn A B, making a slight recess for the core pivot, set a bevel to the angle, A B C, on the drawing, and turn the circumference to it and at the same time to the required diameter, making it perfectly true and straight for the reception of the teeth. Very little, if any, sandpapering is to be done on this part; it destroys the evenness of the surface. With a fine tracing point, and while the lathe is in motion, mark a line near to D C on the circumference, or, properly speaking, the face. Upon this line the pitching or dividing is made to determine the position of the teeth; divide this line into as many parts as it is desired to have teeth. It often happens in performing this division that, having passed the compasses around the piece, we do not fall exactly into the starting point, but yet are so near that we cannot shift the compasses, even if they are furnished with a slow-motion screw, without making the error greater. The usual way of overcoming this difficulty is to give the compass points a few slight rubs upon the oilstone inside or out, according as we wish either to enlarge or diminish the distance between them.

When a pair of bevel gears are geared together, all the teeth on each wheel incline towards a single point; this point is where the axial lines of the shafts would meet if produced. In order to give this direction to the teeth of a bevel wheel or pinion, we must set them square; but to an article of the shape we have produced, an ordinary square cannot be applied in this case, and the workman calls to his aid one of the simplest problems in practical geometry, namely, to erect a perpendicular to a given line. This is illustrated in Fig. 206, where the whole outline is supposed to represent the turned body of the pinion. A B is the line passing around it, of which we have previously spoken. In it take any point, C; it may be one of the points already made in pitching off. With C as a center, and at any distance convenient, mark D and E; with D and E as centers, and at any suitable distance, mark the arcs which intersect at the point, F. Join F C; it is the perpendicular line required. As it would be too troublesome to go through this operation for

Fig. 206.

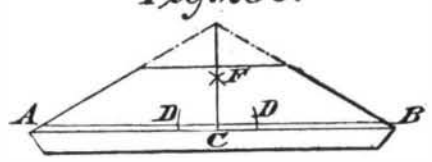
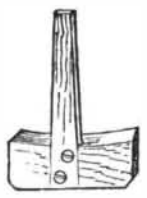


Fig. 207.

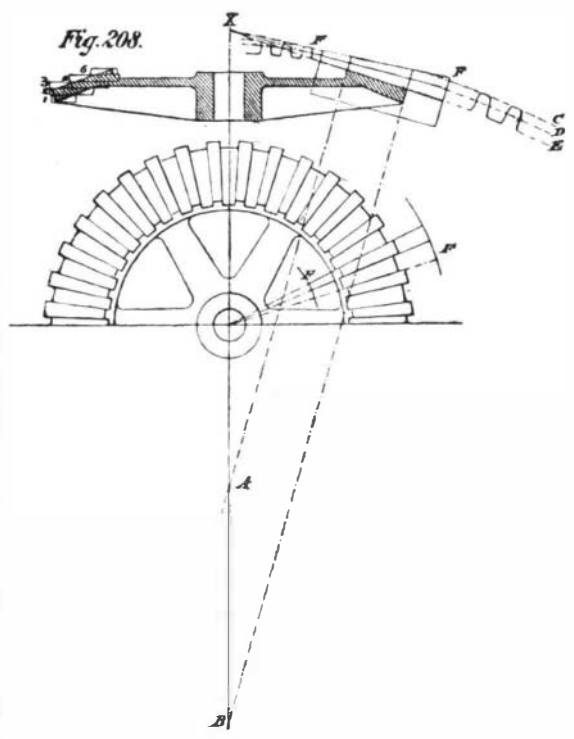


every tooth on the wheel or pinion, a square has to be made, such as shown in Fig. 207; the back is generally a piece of pine gauged to fit the edge of the rim or face; a hard wood blade is screwed to it, so that, when the back is applied to the rim, the blade may be made to coincide with the perpendicular line, F C; all the rest of the perpendiculars required at the points of division are traced by this square. Another method even more simple is to plane a piece of thin wood to lie upon the hand-rest of the lathe, so as at the same time to coincide with the perpendicular drawn by the aid of the compasses; it is then correct for tracing the others. This arrangement is shown in Fig. 209.

If we intend simply to glue and brad the teeth, we proceed to make blocks, a little larger every way than the teeth require to be, hollowing out one side to fit the cone of the body of the pinion. These blocks are glued on to the lines; and when the work is set, it is returned, this time setting the bevel to the angle, E F G. A pitch line must be traced on each side; redivide and draw in the outline of the teeth on the larger side; then, by the methods already described for making perpendiculars, transfer the points of the teeth to the small side; then complete the outline, following out the same principle adopted in tracing the large side: that is to say, taking corresponding centers and distances proportionate to the diminished size of the small side of the cone, as shown in Fig. 205, where the large and small ends of three teeth are set out.

When the subject of spur pinions was under consideration, I deferred making any remarks upon the attachment of teeth by dovetails until bevel gear should be treated on; let us now consider the advantages and disadvantages, if any, of this mode of fixing the teeth. We have long ago mentioned the property which wood has of altering its size according to the dryness or humidity of the atmosphere, which

Fig. 208.

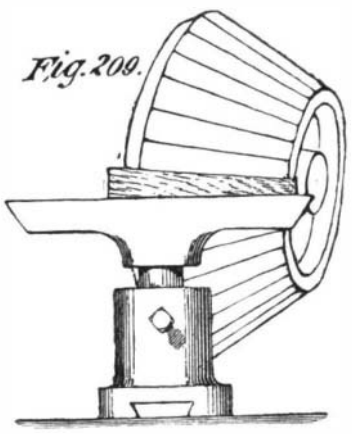


alteration, though considerable across the grain, is very slight in the direction of its length. Hence, when teeth are glued to a body, the grain of which crosses that of the teeth, there will be a movement between the two when the pattern is subjected to a change in dampness or dryness; the dovetail allows freedom for any movement from these causes, retaining the tooth in its position under all circumstances. Should the mould happen to break down in the act of withdrawing the pattern, it may be restored to a considerable extent by knocking out a few teeth, placing them in the damaged impressions left by the pattern, and bedding up the sand around them. It sometimes happens that the teeth of a bevel wheel or pinion will be too much undercut to leave the mould without damaging it; this method will admit of the teeth being withdrawn in detail, after which the pattern can be lifted without difficulty. To counterbalance these advantages must be mentioned the extra cost inseparable from this method of fixing the teeth. This, however, is really a small matter when dealing with pinions; and therefore bevel pinions usually have their teeth attached by dovetails, excepting those of small size. If it is decided to use dovetails, we proceed as follows: The body of the pinion has been turned and divided, and the perpendiculars all finely drawn in. Cut out of thin wood a piece of the size which the dovetails are intended to be, which is such that a small margin of tooth may be left on each side; set the piece on the rim, at a distance from a perpendicular equal to the margin allowed; set it by the square shown in Fig. 207, as the dovetail must have such a taper that its sides may both tend towards the point, X, before alluded to, namely, the intersection of the axes of the shafts. This will be the case if, when one side of the dovetail template has been set square, the other is square also. By this template, lines for all the dovetails are scribed on the face; the depth is laid off on the drawing by lines tending toward X; and from this the depth of each end of the recess may be gauged on the pattern. No curvature is given to the bottom of this; it is pared out flat with the chisel; the dovetails are now fitted, and left projecting above the face; they are driven moderately tight; the projecting parts are then turned off level with the rim.

We have now to go through the same process as before described for making and attaching teeth. When the glue is well set, each should be knocked out, numbered, and the dovetail bradded. Fig. 208 is a section and half plan of a bevel wheel; in the latter the shape of the teeth is not shown, but merely their thickness at the pitch line; in the sectional view, a few teeth are laid out in profile upon arcs struck from the centers, A and B, which are the points of intersection of perpendiculars from the ends of the teeth (at the pitch line) and the center line. In the section on one side is shown a series of rectangles numbered from 1 to 5; these represent the segments of which the rim is composed. It is true that they might be made more nearly to approximate to the shape of the rim by sawing them to a bevel, but a machine suitable for this is not in every shop; and when it is considered that the segments themselves are usually not more than $\frac{5}{8}$ inch in thickness, it will be seen that the additional complication counterbalances the saving in lumber and time in turning. If, however, the wheel is very large, or where thick segments are employed, we may advantageously saw the segments to a bevel. The method described for turning the bevel pinion is exactly suitable for the wheel; the arms will be checked together, but need not be built into the rim, unless we desire an exceptionally strong pattern; the obliquity of the rim enables us to get a good purchase, by means of screws through the end of each arm into it. Care must be taken to have the ends of the arms each to bear properly on the rim; otherwise the rim will be thrown out of true in screwing.

It will be remembered that, in treating upon the spur wheel, we had, in forming the box for shaping the teeth, simply to draw out on each end the natural size of the tooth, that is, if we except a slight diminution towards one end for draught; but the conical form of a bevel wheel gives a little extra trouble. In Fig. 208 the tooth proper is of the length of the face of the wheel, as seen in section. Now all lines

Fig. 209.



bounding the teeth must converge to the point, X; so if we take F F to represent the length of the box, we must strike out upon the large end an enlarged, and upon the small end a diminished, tooth; then by planing to these lines we shall have formed such a box that any piece shaped in the gap formed in it will be of the proper size and shape for a tooth. It would confuse our engraving too much were we to attempt to show the enlarged and diminished tooth on the ends of the box; but the principle is easily understood, as we have but to follow out whatever method has been adopted on the drawing for producing the tooth curves. It will be necessary to recur to this subject again when treating specially upon the methods of tracing out the curves suitable for teeth.

SINCE the first of the year New York has exported over 70,000,000 gallons of petroleum against 25,000,000 by all other ports. Last year the city had only about half the trade.