PRACTICAL MECHANISM.

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NEW SERIES—No. XXVII.

PATTERN MAKING.—GEAR WHEELS.

We now approach a class of work in which the fullest amount of care and attention on the part of the pattern maker, for the attainment of accuracy, is exceedingly desirable. Patterns for wheel work, clumsily constructed, may be positively worthless, or may at least give rise to great loss of time in the fitting shop, in correcting the defects in the castings taken from them. It is not our purpose to enter into the various methods of arriving at the proper form or curvature that is to be given to the teeth, as that is a subject quite extensive and a study in itself. What more particularly concerns us is the general construction of the patterns from designs furnished.

Gear wheels are of two kinds, spur and bevel, the former for transmitting motion when the shafts are parallel, and the latter to be used when the shafts are inclined to each other. When the teeth of a bevel wheel are inclined at an angle of 45° with the axis, that wheel is called a miter. Skew bevels are wheels suitable for shafts that are inclined to each other and are not in the same plane. Pinion is a distinctive term, applied to the smaller of a pair of gear wheels when there is a great disparity between them; or it may mean generally a small gear wheel.

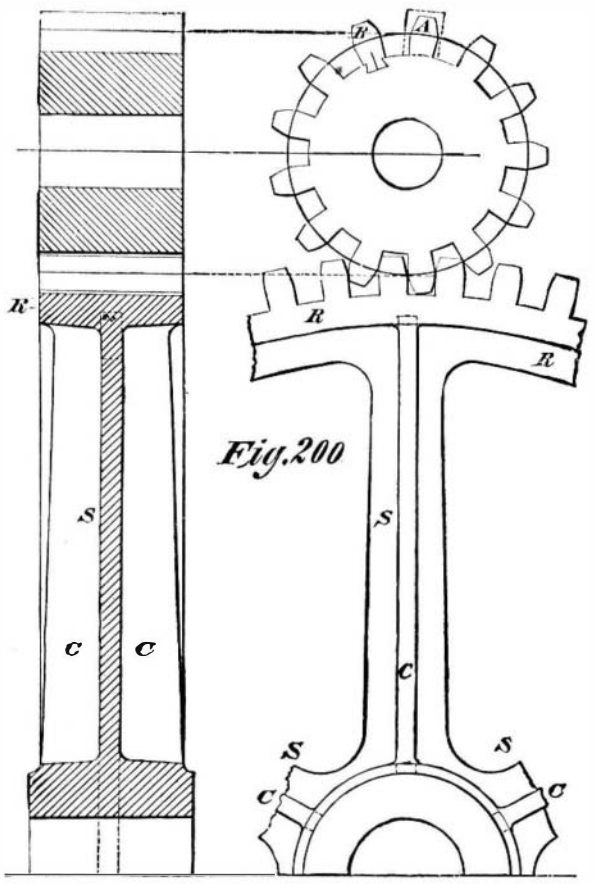


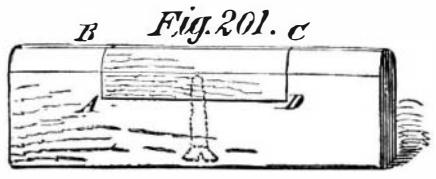
Fig. 200

Fig. 200 is a plan and section of the pattern of a spur wheel and pinion, such as is usually supplied to workmen. The plan exhibits the form of the teeth and pitch, with the size and number of arms. The sectional view shows the breadth of face, depth of hub, and ribs on the arms. In the construction of gear wheel and pinion patterns, the particular method to be adopted, as also the material to be used, will depend upon size and the service expected to be got out of the patterns. Mahogany, dry and straight grained, is an excellent material for wheel patterns; but for large work it is too costly. In some cases the teeth are worked in mahogany, and fixed to a pine body; in the majority of cases, however, pine is the only material used. The pinion may be carved out of one piece, or it may have the teeth attached to a hub; and if the latter, then the teeth may be held by dovetails, or they may be simply glued or nailed. If the pinion is so deep in proportion to its diameter as to be strong enough, and not more than 5 or 6 inches diameter over all, it may be cut from the solid; in this case, the grain of the wood must lie in the direction of the teeth. For turning the piece, we must use a chuck or face plate smaller than the pinion is at the bottom of the spaces, so as to be able to trace circles on both sides by the motion of the lathe; if such a face plate is not at our disposal, we may bore a hole in the piece to be turned, and fit to it an arbor of hard wood. Having turned the pattern, trace upon it very fine circles to indicate the pitch line, the line for the roots of the teeth, and (if required) circles for the centers used in tracing certain peculiar forms of teeth. All these circles are to be traced on both sides of the pattern, and draft is to be allowed by making the circle for the roots of the teeth a little smaller on one side than on the other, and also by turning the piece slightly taper. The pinion is now to be pitched out, on one side, very accurately; this is sometimes a matter of no small difficulty, for, having passed round with the compasses a few times, the points are liable to slide into previous impressions, giving rise to error. For this reason the pattern maker does not allow the points of his compasses to fall where he intends the center of the teeth to be, until he has obtained the correct division, which is known by the compass point, after having made the tour of the circle, falling exactly into the starting point. He now proceeds to lay down the centers of the teeth, and to delineate their size and form; then, by squaring across the face, the points of the teeth are transferred to the other side; the teeth are then outlined on that side and the intervening spaces cut away exactly to the lines.

For a large-sized pinion, the usual method is to build up a hub or body with quadrants breaking joint at each course or layer; the body is then turned, and the circumference pitched off to the required number of teeth. Blocks of hard or soft wood, planed nearly to the size of the teeth and hollowed on the side that goes next the body, are to be glued on and set to the lines made on the surface of the body when it was pitched off (see tooth marked A, Fig. 200). When the glue has properly set, the whole is replaced in the lathe, and turned off, the same as for a solid pinion; the lining-in will also be a repetition of the process above explained. Another method is to fix the teeth on dovetails, as at B, Fig. 200; but as this is very seldom adopted for spur pinions, it will be more in place to describe it when dealing with bevel gear.

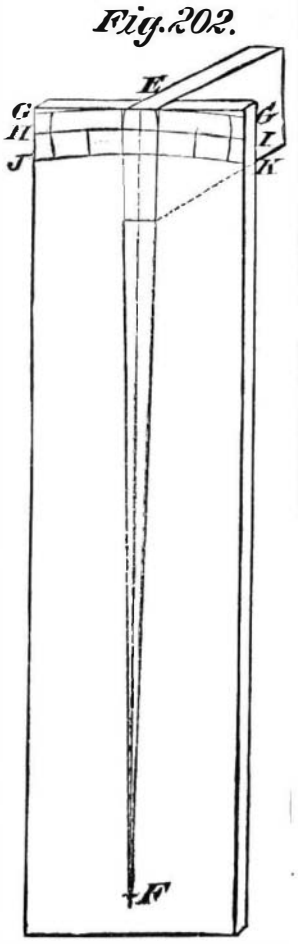
We now proceed to the construction of the wheel, which in our illustration has six spokes or arms, marked S; the rim, R, must of course be built up in segments; and when we have reached to the height of the top of the flat arms, we should turn the inside to the finished size, and cut in the arms, as shown in Fig. 200, the rest of the building can then be proceeded with. To avoid here useless repetition as to the details observed in building or in preparing the arms, the reader is referred to the SCIENTIFIC AMERICAN of January 20, 1877. Having turned the body of the wheel both inside and out, we proceed to attach, on each side of the arms, a hub, so as to form the whole hub as in Fig. 200; the ribs, C, are then fitted, and lastly we complete the body by filleting the corners. For the teeth there is but one method that is usually adopted, and that is to form them in a box as follows: Plane a piece of hard wood, as in Fig. 201, some five or six

Fig. 201.



inches longer than the teeth, and about three inches wider; the thickness is not to be less than that of the tooth at its thickest part. The ends of this piece must also be planed; from the edge, B C, gauge the line, A D, the required depth of tooth. Lay off, about in the center of the piece, the distance, B C, equal to breadth of face of the wheel, and make two saw cuts, B A and C D. Let this piece be now let into a piece of planed board, Fig. 202, which is an inch or so longer than the radius of the wheel at the tops of the teeth. This piece is to fit tightly into the mortise, which is made equally on each side of a center line on the board. Take now in a trammel the radius of the wheel at the top of the teeth, and mark off, from the outer edge of the hard wood box, the distance, E F, on the center line of the board. The point, F, represents the center of the wheel. Take the radius of the wheel at the pitch line, and also at the roots and points of the teeth; and with these distances describe the arcs, E G, H I, J K, and such other arcs as may be necessary, on which to take the centers for describing the correct form of the tooth. Complete the delineation of three teeth, or at least the center one, which will be upon the hard wood box; reverse now this box, and draw the outline of the tooth upon the other end of it; remove the piece from the mortise, and plane off to the shape of the tooth as drawn; remove the portion, B A D C, and the box is ready for shaping teeth in. Such teeth during the process are held by the screw shown.

Fig. 202.



Select for the teeth lumber very straight in the grain, and rip off a number of strips about two or two and a half feet long, of a width and thickness, when planed, slightly fuller than the required teeth, and hollow one edge to fit the curvature of the rim of the wheel. Saw the strips into pieces a trifle longer than the teeth, and plane the ends so that, when finished, the length of the pieces is exactly equal to the breadth of the rim; this latter process is most rapidly performed by placing some eight or ten side by side in a frame, and, if necessary, tightening them by a wedge and nipping in the vise (see Fig. 203). The frame must be equal in width to the length it is required to make the pieces, and care must be taken not to diminish this width, as is sometimes done. In planing a number of teeth, it perhaps is as well to blacklead the frame where it is apt to be planed; this will at least

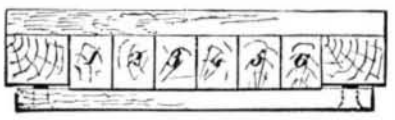
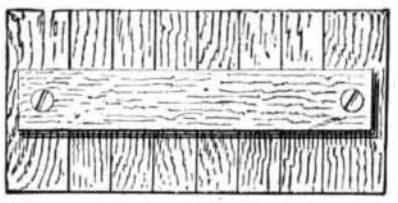
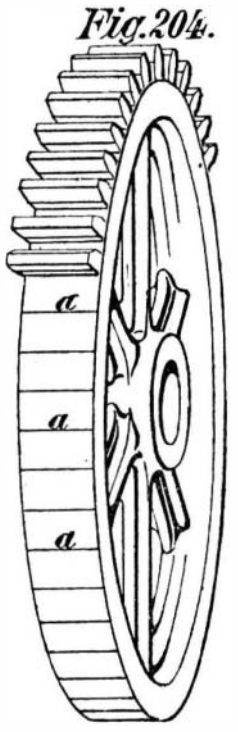


Fig. 203.



show when damage has been done. The blocks are now severally shaped to the proper contour in the box, Fig. 201, particular attention being paid not to shave away the box in shaping the teeth; for this reason it is well to have an extra plane, very finely set, to finish with. The rim of the wheel having been divided according to the number of teeth required, and lines squared across its face, at *a*, Fig. 204, the finished teeth are glued on exactly to the lines. Only a few spots of glue should be applied, so that little or none may exude and hide the line that we pose the teeth by; when the glue has perfectly set, the teeth should be additionally secured by nails. If the above processes are followed up with proper care, the teeth will all be found evenly set around the wheel; nevertheless, it is only right to verify their position with a pair of callipers while the glue is yet soft.

Fig. 204.



Very large wheels, or even those of moderate size when difficulties of transportation are anticipated, are made by bolting together a number of sections. A section usually consists of an arm and two equal portions of the rim, one on each side of it, so as to have a joint midway between each pair of arms. However, this may be one thing that must be observed, namely, to have the joints always in the center of spaces; therefore it is sometimes necessary to employ unequal segments or sections, in which case the pattern is made to the longer segment; and when these are cast, the flange is moved to suit the shorter one, and the superfluous teeth are stopped off in the sand. This saves cutting the pattern, which remains good for other wheels when required. The extremities of the arms, which are to be screwed to the hub, are provided with flanges for this purpose, the hub being flattened to accommodate them. A great deal of nicety is required in constructing wheels on this principle, as the spaces between the teeth at the joints must be neither wider nor narrower than at other parts.

Killed by Lightning.

Recently, during a severe lightning and thunder storm, at Newberne, N. C., three young persons, Isaac Richardson, aged 20, Eliza Collins, 20, and Laura Williams, 19, were struck by a heavy discharge of electricity, and instantly killed. Richardson was escorting the two girls, arm in arm, from church to their homes; and as they neared Queen street, a gentleman, who was but a few feet behind, saw them fall as the flash struck them. The coroner found the lifeless bodies lying side by side, with arms still locked. At the time of the accideut they were walking under a steel-handled umbrella, which was found lying upon the ground near the bodies (the cover partially burned), and which, undoubtedly, was what attracted the electric discharge.

Strange Electric Phenomena.

The city was interested, last evening, by the appearance on C street of a strange phenomenon. At first it had the appearance of sparks of fire coming up through the pools of water beside the street. These sparks seemed to explode on reaching the surface, in many instances producing reports loud enough to be heard across the street, and being accompanied by a little cloud of smoke, and emitting a decidedly sulphurous smell. It was noticed that the phenomena occurred only on one side, under the telegraph wires. The sparks seemed to be caused by drops of water falling from the wires of the telegraph, which exploded when striking the pools of water. This solution was seemingly confirmed by the fact that when the wires became dry the phenomena ceased. It still remains to be explained, however, why, under the circumstances, such results should follow the falling of the water drops from the wires.—*Virginia City Enterprise.*