

Machine Construction & Drawing.

(From Collin's Elementary Science Series.)

(Continued from page 253.)

circumference into 16 equal parts, and the distance AA' into 8 equal parts. Through the points I, II, III, &c., draw the cam shown in dotted lines, as for fig. 162; if the roller were a point, or the *knife edge* of a sliding bar, this would be the required cam; but the roller has a diameter of 2", therefore, from the points A', I, II, III, &c., as centres with a radius of 1", describe arcs of circles inside the dotted cam; a curve touching these arcs will be the outer edge of the required cam.

91. The following are the dimensions of its several parts:—Thickness of rim *c* 1"; width of rim *h* 3"; diameter of shaft *a* 3"; key *g* $\frac{7}{8}$ " $\times$ $\frac{1}{2}$ ", 6" long; diameter of boss *b* $5\frac{1}{2}$ ", and $4\frac{1}{2}$ " through; the arms *f* are $\frac{3}{4}$ " thick, and 2" wide at the narrowest part, increasing to $2\frac{1}{4}$ " for the longest arm; the others are in the same proportion; inside the rim and outside the boss is a feather *d* $\frac{3}{4}$ " wide and $\frac{3}{4}$ " thick; on each arm there are two feathers *e* $\frac{3}{4}$ " thick and $\frac{3}{4}$ " deep, increasing to $\frac{7}{8}$ " in the longest arm. The inside of the rim *c* and the feather *d* are curves parallel to the outside of the rim.

Fig. 164 is a front-elevation, fig. 165 is an end-elevation, and fig. 166 is a sectional end-elevation, made by the plane SP, fig. 164.

92. During one half revolution of the cam, as the radii increase from CD to CL, the roller is moved outwards from A to A'; but in the return half revolution the radii decrease from CL to CD, it is therefore necessary to apply some means of keeping the roller in contact with the cam, which may be accomplished by means of a spring or a weight, or by using another roller B, and connecting the two with a link, so that to produce the return of the roller A the cam acts upon the roller B, and thus brings back A, together with the slide attached to it.

93. **Inking-in a Drawing.**—It is usual to put drawings of machinery in ink, whether *working* or *finished* drawings, since by constant use the blacklead lines would remain only for a very short time. Indian ink is the kind of ink used; it may be obtained either in the solid or liquid state: the former will be the best for the general student to obtain it in. Sticks of a good quality can be had for one shilling and upwards; cheaper qualities are not to be recommended. Having prepared the ink for use by rubbing it in a clean slab with a little water, and having satisfied yourself that it is of the required shade, by trying it with your drawing-pen on the margin of the drawing, commence to ink-in. But, before doing so, the following general hints will be of service to the student:—Clean off with india-rubber all surplus blacklead, leaving the lines just visible, as the lead is liable to get between the nibs of the pen, and so cause the lines to be irregular. When you have supplied the pen with ink, before using it try it on the margin of your drawing, so as to get the line of the required thickness. Never put away your pens with ink in, but clean them with a piece of wash-leather or linen rag; it will also be necessary to clean between the nibs occasionally while using the pens.

94. The following order should be observed in inking-in:—First ink-in all circles, portions of circles, and curved lines, to which straight lines are to be joined, keeping both the nibs and the needle point of the bow-pen as nearly perpendicular to the drawing board as possible;

if the nibs are inclined too much to the surface of the paper the circular lines will be irregular in thickness, and if the needle point is inclined too much the hole will be enlarged, which is objectionable. The pen for drawing straight lines, or curved lines by means of moulds or curves, should be held nearly perpendicular, being inclined a little towards the right and outwards, so that the point of the pen may be seen. The lines are to be drawn from left to right, as in penciling. Particular care should be taken in joining a curve and a straight line; the best way is to commence the straight line from the curved one, and not try to join the former to the latter. If the lines of the drawing, both full and dotted, are correctly shown in pencil, it is immaterial whether the full lines are put in first and then the dotted ones, or otherwise; but if this is not the case, then begin by inking-in the lines which are *furthest from the plane upon which the view of the object is projected*, as such lines will be in full; the *outline** of the object will also be in full, the remaining lines must be determined by the ordinary principles of projection.

95. The beginner should be extremely careful in inking-in his drawings, so as to avoid having to use the knife, or any other means, for scraping out or erasing a wrong line; it will therefore be advisable for him to pencil-in all lines as they are to be inked-in.

After considerable practice he may deviate a little from this order; but, as a rule, the less it is deviated from the better, as the dotted lines should be distinguished from full lines; not necessarily by dots of equal length, but just sufficient to show the difference.

96. **Shade or Dark Lines.**—In the examples given up to Plate XXIII., except in Plate II., we have considered the drawings to be plain outline drawings, having all the lines, which form the boundaries of the surfaces represented in each figure, of the same thickness; we will now explain the use of *shade* or *dark lines*.

The figures in Plates XII. to XXIII. may be taken as types of those termed *working drawings*, that is, drawings from which the object is to be constructed; in such drawings all the lines are to be of the same thickness. For *finished drawings*, which are usually made to a small scale ($\frac{1}{2}$ and under) and used for the purpose of reference, &c., shade lines are often employed, whose chief use is to convey to the mind a better idea of the form of the several parts of the object, and to give what is considered by many to be, a better finish to the drawing; however, their use is a matter of taste. In Plate II. shade lines are employed. Figs. 190 to 192, Plate XXVI., represent, as a finished shade-lined drawing, the pedestal shown in Plate XXIV.

97. For the purpose of shade-lining drawings, the light is assumed as coming from the left-hand and from behind the observer towards the object, and at such an angle that the projections of each ray† are inclined to the horizontal and vertical planes at an angle of 45°.

Figs. 167a, 167b, Plate XXIII., are the plan and elevation of an object made up of plane surfaces, having a square hole through it. The lines *ab* represent the direction of the rays of light; those lines upon which the light falls directly are fine lines, the remainder are made thicker, and are termed *shade* or *dark lines*. We may say generally, for elevations, the shade lines are put on the *right-hand* and *bottom edges* of projecting surfaces; where two surfaces

* By the term *outline* we mean the boundary lines of the object, outside of which there are no lines.

† The rays are considered to be parallel.