Machine Construction & Drawing.

(From *Collin's Elementary Science Series.*)

(*Continued from page 221.*)

should present no difficulty after working out the previous examples; however, as the curves *l'm'*, *m'o'*, are the projections of the intersections of two curved surfaces, and therefore somewhat different to the preceding example, we have worked them out in figs. 140, 141, Plate XIX., for the small end of the crank; those for the large end are obtained in a similar manner. The angle formed by the connection between the *web g* and the *boss e* is filled-up by a quadrant-shaped surface *mn*, *m'n'*; the circular surface *ml* cuts this surface; the curve *m'l'* is therefore the projection of the intersection of the two curved surfaces *ml*, *mn*; and similarly the curve *m'o'* is the projection of the intersection of *no*, *mn*, which connects the *web g* and the *feather f* with the boss. The web and the feather are also connected by a curved surface similar to *mn*, *m'n'*. The construction lines show how the curves *l'm'*, *m'o'*, are obtained; the method used is the same as that employed for the preceding figures, *lm* in fig. 140 corresponding to *a'b'* in fig. 136; the only difference is that *lm* is a curved surface, whereas *a'b'* is a plane surface.

80. The dimensions of the crank are as follow (see figs. 138, 139):—$a = 2'..6''$, $b = 12''$, $c = 5''$, $d = 7\frac{1}{2}''$, $e = 3\frac{1}{4}''$, $f = 4''$, $g = 6''$, $h = 12''$, $k = 9\frac{1}{2}''$, $pq = 1'..1''$, $rs = 1'..4\frac{1}{2}''$; where *a* stands for half the stroke, *b* the diameter of the crank-shaft, *c* the thickness of metal round the shaft, *d* the diameter of the crank-pin in the crank, *e* the thickness of metal round the pin, *f* the thickness of the feather, *g* the thickness of the web, *pq* and *rs* the width of the web at *pq* and *rs* respectively, *h* the depth at the shaft end, and *k* the depth at the pin end.

81. The Eccentric is employed to change rotary into reciprocating rectilinear motion, chiefly where the extent of the motion is small compared with that obtained from the crank; one special feature in the eccentric arrangement is, that it can be applied to shafts without necessarily being fixed at one end, or causing a break in the length of the shaft, as at *v*, *w*, fig. 134. In figs. 143 to 145, Plate XX., is shown an eccentric which consists of a circular plate A, termed the *sheave*, usually keyed to the shaft S. The centre of the sheave and that of the shaft are a certain distance BC apart, this is termed the *eccentricity*; twice the eccentricity BC (= BD) is termed the *throw*, and corresponds to the *stroke* of the crank. As the sheave is fixed to the shaft it turns with it; the motion is taken from the sheave by means of the *strap* E, which consists of a ring in halves fitting into a groove cut in the sheave, and connected by bolts F, F. The strap does not turn round with the sheave, but oscillates, having P for a centre; and at the same time it receives a motion in directions BD, DB; therefore the strap must not fit the sheave too tightly. At G are inserted pieces of metal or hard wood, by adjusting the thickness of which, compensation can be made for the wear between the surfaces of the sheave and the strap. Attached to the strap by means of bolts, or by a *cotter*, as in the figures, is a rod HK which transmits the motion to the piece to be operated upon, as the slide-valve of a steam-engine, as in the the example, where L is one end of the valve-rod.

82. The dimensions of the several parts of the figures shown in Plates XX. and XXI. are as follow:—The throw BD is $2\frac{1}{2}''$, the diameter of the shaft S is $3\frac{1}{2}''$, the key T is $\frac{3}{4}'' \times \frac{7}{16}''$, and it is let into the shaft $\frac{1}{8}''$. The sheave A is $7\frac{3}{4}''$ diameter outside, $7\frac{1}{4}''$ diameter at the bottom of the groove, and $2''$ wide; the width of the groove is $1\frac{1}{2}''$; the thickness of metal round the shaft is $\frac{13}{16}''$, at *g* it is $1''$ thick to allow for the key-way; the rim *e* is $\frac{1}{2}''$ thick, and the arm *f* is $\frac{3}{4}''$ wide. The strap E is $7\frac{1}{4}''$ diameter inside, and $8\frac{1}{4}''$ diameter outside; the width is $1\frac{1}{2}''$ *bare*;* each half is provided with *lugs* $\frac{5}{8}''$ thick, through which pass bolts F $\frac{3}{4}''$ diameter; the distance, centre to centre, of the bolts is $9\frac{1}{2}''$; at V on one half of the strap is a boss $1\frac{1}{2}''$ diameter to receive one end of the rod HK; U, U, are feathers $\frac{1}{2}''$ wide, whose object is to strengthen the connection between the boss and the strap; W is a collar on the boss V $1\frac{5}{8}''$ diameter and $\frac{3}{8}''$ wide; the distance from the outside of the collar to the centre B of the strap is $6''$. The cotter Q is $3''$ long, $\frac{3}{16}''$ thick, and $\frac{7}{8}''$ wide in the middle; the amount of *taper* in its length is $\frac{1}{2}''$ per foot; M is an oil-cup forming part of the strap, a section of which is given in fig. 146; R is a hole through which the oil passes; the cup is $1\frac{1}{2}''$ diameter outside, and $1\frac{1}{4}''$ diameter inside; the tube is $\frac{1}{2}''$ diameter, the hole $\frac{1}{4}''$ diameter; the distance from the top of the cup to the centre line is $4\frac{1}{8}''$; the cup is provided with a cover O, which is screwed into the cup; the diameter of the screwed part is $1''$, but the thread is finer than that given for $1''$ diameter in Table II., page 38. The edge of the cup-cover is generally *milled*, to allow of a better hold being taken when unscrewing it. The other dimensions may be taken from the figures. The eccentric-rod HK, is $2'.. 5\frac{1}{2}''$ from the centre P to the outside of the collar; the portion in the boss V is $1\frac{7}{8}''$ long and $\frac{7}{8}''$ diameter; the rod is $\frac{7}{8}''$ diameter at each end, and increases to $1\frac{1}{8}''$ in the middle; the end K of the rod is *forked*, and through it passes a pin X, connecting the valve-rod L to it; between the fork and the cylindrical portion K the cross-sections are rectangular and square; a portion of the latter has its edges chamfered, leaving the section an octagon, as shown in fig. 155. The dimensions of the forked end are marked on the drawings, figs. 153, 154. The pin X is prevented from leaving its position by means of a pin Y which passes through the former; between the pin and the fork is a washer $1''$ diameter and $\frac{1}{8}''$ thick; the pin Y may be either a piece of round *wire*, or of the form shown in fig. 156, which is termed a *split-pin*; the cross-section of the wire out of which it is made is a segment of a circle, nearly a semicircle; by opening out the halves of the pin at *a*, it is prevented from leaving the hole in which it is placed. The sheave is cast-iron, the strap is brass, and the rod, pin, washer, and cotter, are wrought-iron.

83. Fig. 142, Plate XX., represents in outline the eccentric arrangement; the centre line *a'y'* is the path of the valve-rod, which passes through the centre C of the shaft; BEDF is the path of the centre of the eccentric; BD is the throw; the positions *b*, *d*, of the rod end correspond to the positions B, D, of the eccentric; *bd* = BD. The sheave is shown in four positions, I, II, III, IV, whose centres are B, E, D, F, respectively; the variable motion obtained from this arrangement is similar to that obtained from the crank as shown in fig. 133, Plate XVIII.

* To allow the surfaces of the strap and the sheave to slide past each other, one of them must be made a little less than the other; the term *bare* is used to denote this difference, which cannot be shown in the drawing.