27. In cases where the fixed collars would prevent the fixing of wheels, pulleys, &c., a *loose collar d* is used. The loose collar is shown in figs. 65 and 66. Fig. 66 is partly in section showing the screw *f*, which fixes the collar to the shaft. Figs. 63, 64, are drawn to a scale of $\frac{1}{8}$. Figs. 65, 66, to a scale of $\frac{1}{4}$.

28. **Bearings.**—By the term bearings is to be understood the *surfaces of contact* between the shaft, or other moving piece, and its support; the form of the bearings depends upon the kind of motion given to the moving piece. The motion of shafting is generally one of *rotation*,* the bearings are therefore surfaces of revolution, as circular cylinders, cones, &c. In figs. 63, 64, the bearings are cylindrical.

If the motion of the shaft or other moving piece is one of straight translation (motion in a straight line), as, for example, the piston-rod and the slide-block of a steam engine, the bearings have a circular, square, triangular, or other straight-lined cross-section, and are perfectly straight in the direction of motion.

A kind of motion made up of the two former is termed *helical* or *screw motion*, the bearings of which must have helical surfaces.

The supporting pieces for the three kinds of motion named are, for rotating pieces, *journals, bushes,* and *pivots;* for straight translation, *slides;* and for screws, *nuts.*

29. **Journals** are sometimes formed in the frame of the machine, and generally consist of movable pieces, termed *steps*, made of brass or other alloy. In cases where it is inconvenient or impracticable to adopt this form, *pedestals* or *plummer-blocks* are employed, to which the steps are attached, as illustrated in the drawings of a pedestal, Plate XXIV., figs. 177 to 179.†

30. **Bushes** usually consist of a hollow cylinder of metal, cast-iron, steel, or brass, in which the shaft rotates; they are generally fixed in the frame of the machine. Two common forms of bushes are shown in figs. 67, 68, 69, the drawing of which should present no difficulty to the student. In figs. 67, 68, the bush consists of a plain hollow cylinder *b*, fitting accurately the hole in the frame, and fixed to the latter by means of a screw *s*; *a* is the shaft, *cc* the frame. Half the elevation in fig. 68 is in section. The bush shown in fig. 69, half of which is in section, has a collar *d* on one end, with a screw or screws passing through it, and fixing the bush to the frame; the same letters of reference are used for this example as for the former. Where the wear is considerable it is not advisable to use bushes, unless they can be turned round a little, as they wear, or be replaced readily, as they soon get out of truth; the common plan is to use movable steps, which admit of adjustment to compensate for wear. See drawing of pedestal, Plate XXIV., figs. 177 to 179.†

31. **Slides.**—In figs. 70, 71, is represented a common form of slide; *a* is the fixed surface or *bed*, *b* the sliding piece, *c* is a *strip*, a piece of metal fixed to the sliding piece by the screws *d*, which is acted upon with screws *e*, so as to compensate for wear of the surfaces. Slides are of very common use; among others we may mention the *slide-bars* of steam-engines, the *slide-rests* of lathes, the *cross-slides* of planing machines, &c. Fig. 70 is an elevation showing part of the sliding piece and bed; the latter is in section, as also is the portion of the former, which shows the strip and screws. Fig. 71 is a plan. The figures are drawn to a scale of $\frac{1}{8}$.

* The term *rotation* is employed to denote the act of turning about an axis.

† These plates will appear in future numbers.

32. **Nuts.**—On Plate VII. is shown the bearing surface of a screw; fig. 87 is an elevation of the screw; fig. 89 a sectional elevation of the bearing or nut, taken through the line SP in fig. 88; fig. 90 shows a section of the screw and nut in contact. The drawing of the screw and nut will be explained later on.

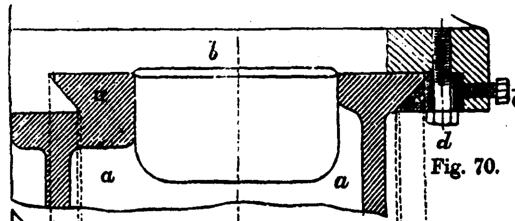

Fig. 70.

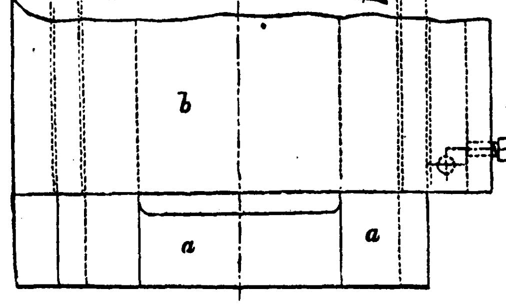

Fig. 71.

33. **Couplings.**—Shafting is usually made in lengths, whose length varies according to circumstances, for convenience in erecting and mounting, and to allow of disconnecting portions of it. These lengths are connected by couplings. We may divide couplings into two classes; first, those used for shafts, which require disconnecting only at long intervals; and, secondly, where they are being disconnected constantly.

The *box butt, box half-lap,* and *face-plate* are the chief kinds used in the first class. In the second class there is a great variety, including *clutches* with from two teeth upwards, *friction cones*, &c. Plate V. shows two forms o. the first class, viz., the butt and the half-lap box couplings.

Fig. 72, 73, 74, are views of the butt box coupling; figs. 74 is a plan; fig. 73 an elevation, showing in section the box and portion of the shaft ends, *a* and *b*; fig. 72 is an end-elevation. The two shafts are *swelled out* at the ends so as not to reduce the strength of the shaft by the key-ways, and also that the box may pass over any collars that may be on the shaft. The ends of the shafts and the box are firmly connected by the key *d*. It is usual to place couplings near to the bearings, as shown in the figures; the bearing is on the shaft *a*, and is marked *e*; *c* is the box.

The half-lap box coupling is represented in figs. 75, 76, 77, which are respectively end-elevation, front-elevation, and plan. The front-elevation is in section, showing the half-lap of the shafts and the connecting key. This coupling was introduced by Mr. Fairbairn.* The following are the proportions given by him:—

Area of coupling - - - -	= 2 × area of the shaft.
Or, in other words, diameter of coupling - - - -	= 1·4142 × area of shaft.
Length of lap - - - - -	= diameter of shaft.
Length of box - - - - -	= 2 × diameter of shaft.
To which may be added outside diameter of box - - -	= 2¼ × diameter of shaft.

(*To be continued.*)