are in contact, if the upper one does not project beyond the lower one the shade line is not used, as shown in the bottom line of fig. 167*b*; the object is supposed to be resting on a horizontal plane. In the case of sections and hollows, the shade lines are on the *left*, as shown in fig. 168*b*. Figs. 167*a* and 168*a* show how shade lines are employed for plans; fig. 168*a* is a sectional plan.

98. For cylindrical objects there is a little difference in the use of shade lines. Figs. 169*a*, 169*b*, represent in front and end-elevation a portion of a shaft; fig. 169*a* is *shaded*; along the line *ab* the *light* is most intense, gradually decreasing towards *gh* and *cd*; along *cd* the *shade* is greatest, and gradually decreases towards *ab*, *ef*; if now we put a shade line for *ef*, the effect which the shading produces is destroyed; for this reason shade lines are not employed for cylindrical objects,* except for the ends and projecting parts, as *fh*, fig. 169*a*, and *ab*, *cd*, and *ef*, fig. 171*b*.

The circular ends are represented as shown in figs. 169*b*, 170*a*, and 171*a*, the circular line increasing in thickness from the points *a*, *k*, to *c*, fig. 169*b*, where it is thickest. In hollow cylindrical objects the inside and outside are shade-lined, as shown in fig. 170*a*, and sections of the same have shade lines, as shown in fig. 170*b*.

Fig. 170*a* is an end-elevation, and fig. 170*b* a front sectional elevation. It is important to notice the difference in the use of shade lines for *plans* and *elevations*; if we consider fig. 170*a* to be a plan, and fig. 170*b* an elevation, then the shade lines as shown would not be correct.

Figs. 171*b*, 171*a*, represent in front and end-elevation a shaft having a neck and collars, upon which are shown the usual shade lines. The angles formed by the collars and the shaft are filled-up, as shown, with a curved surface, and the outside edges of the collars are rounded; these curved surfaces are not shade-lined, for a similar reason as that given for fig. 169*a*.

99. Conical objects are treated in a manner similar to that of cylindrical objects, as shown in figs. 172*a*, 172*b*, which are respectively plan and elevation of a portion of a right cone. The elevation, fig. 172*b*, is assumed to be raised above the surface AB, that is to say, its lower surface *cd* is not in contact with another surface, therefore the line *cd* will be a shade line. If the lower surface of the cone rested upon a surface larger than its own, the line *cd* would not be a shade line. The plan, fig. 172*a*, has a shade line, as in the case of the circular ends of cylinders, for its bottom surface *cd*, but not for its top surface *ef*; if the bottom surface were in contact with a surface larger than its own, the circular shade line would not be used.

Figs. 173*a*, 173*b*, represent in plan and sectional elevation a portion of a hollow cone, upon which are shown the shade lines for the position of the object indicated by the figures. If the bottom surface were in contact with a surface larger than its own, the line *cd*, fig. 173*b*, and the outer circle in fig. 173*a*, would not be shade-lined. The two right-hand edges of the section, fig. 173*b*, are shade lines, as would be the case if the object were a hollow cylinder.

Figs. 174*a*, 174*b*, represent in plan and elevation a portion of a bolt with a hexagonal head, the part next to the head being cylindrical. The object is resting upon a plane, as shown in fig. 174*b*; the bottom and two right-hand edges of the head are shade lines. The circle in fig. 174*a* is shade-lined, as in the previous examples, and three sides of the hexagon are shade lines.

Figs. 175*a*, 175*b*, represent the same object in front and end-elevation; fig. 175*a* shows two faces of the head, and fig. 175*b* shows the under side of the head and the end of the cylindrical part of the bolt. The object in these figures is assumed not to be resting upon a surface; if, however, it did, then the bottom line in each figure would be a fine line, unless the surface upon which it rested was smaller than the surface of the object.

If the view, plan, or elevation, of an object is inclined at the same angle and in the same direction as the projections of the rays of light, as in fig. 176, the lines of the view which are parallel to these projections are fine lines. Fig. 176 represents the elevation of the bolt shown in fig. 174*b*, the centre line *ab* of which is inclined at 45°, and slopes from left to right, having the same inclination and direction as the rays of light; the lines *cd*, *ef*, &c., which are parallel to *ab*, are fine lines. The lines *df* and *gh*, which are at right angles to *ab*, are shade lines. If we consider fig. 176 to be a plan, the lines *df* and *gh* would be fine lines; and *ek*, *lh*, shade lines. In the examples of shade lines which have been given, we have considered each of the straight lines in the views of an object to be of the same thickness; and also the thickest part of each circle to be of the same thickness. Sometimes there is a difference in the thickness of the shade lines of a drawing, which is governed by the distance and inclination of each line from the assumed source of light.

By a proper use of shade lines one view of the drawing of an object will convey a much better idea of the form of the object represented, than if they were not used; cylindrical forms can be distinguished from other forms by the omission of the shade line in the former; and projecting surfaces can be distinguished from other surfaces, and also from recesses, by the position of the shade line. Where dotted lines are used in shade-lined drawings, they should be all of the same thickness.

100. Working and Finished Drawings.—We will now give examples of the two chief kinds of drawings used, taking a *Pedestal* or *Plummer-Block* as the object for representation. In Plate XXIV. is shown an ordinary *working drawing* of the whole pedestal (figs. 180 to 183 are added for another purpose, as will be explained shortly); the dimensions are not given, as the parts are shown in detail in Plate XXV. The cast-iron and brass portions are shown in Plate XXV. in detail with all the dimensions added and also the radii of the arcs of circles: this may be taken as a type of drawings such as should be supplied to the *Pattern* or *Model Maker*, along with Plate XXIV., which shows the arrangement of the whole as put together. The wrought-iron work is also drawn in detail for the *Smith*. In Plate XXVI. is shown the pedestal as a *finished* shade-lined drawing.

101. Pedestal or Plummer-Block.—In Plates XXIV. to XXVI. are shown in elevations and plans, a pedestal as defined in Art. 29, page 29. Fig. 177, Plate XXIV., is a front-elevation, the right-hand half being in section, as made by a vertical plane S_1P_1, fig. 178. Fig. 178 is a plan, a portion of which is in section, as made by a horizontal plane $S_{11}P_{11}$, fig. 177; and fig. 179 is an end-elevation.

A is the *body* of the pedestal which supports the *steps* B; attached to A is the *sole-plate* or *base-plate* C, by which the pedestal is connected by bolts E to the frame of the machine, either directly, or by means of an intermediate bracket; D is the *cover* or *cap* connected to the body by the bolts F, the object of which is to keep the top step in contact with the shaft; on the top of the cap is an *oil-cup*

(Continued on page 284.)

* However, if we consider the use of shade lines to be a matter of taste, and therefore liable to difference of opinion, we may state that in many cases they are used for cylindrical objects.