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18. Figs. 42, 43, represent the nut circumscribed by a

hemisphere of radius rin former figures; in the plan, fig. 42, are shown two section planes v_1s_1 , v. s., each containing a face of the nut, as visi in fig. 38. On the left of the centre line in Fig. 43. tig. 43 is shown onehalf of the face contained in the plane $v_1 s_1$, together with the portion of the sphere cut off by the same plane. On the right of the same figure the face contained in the plane v282 is shown; the remaining portion of the sphere cut by the plane is distinguished by sec-



tion lines, † as in the left hand portion of the figure; the construction lines will explain how to draw fig. 43.

19. The terms plan and elevation, as employed for figs. 35-43, and for all details or parts of machinery, are only intended to apply in the cases represented; where we two pieces by a bolt. In this example the piece a can consider the object as a whole; for instance, in a machine receive a small change of position in direction ad; the we may have nuts in various positions, plans, and eleva- bolt is prevented from turning by the pin or key c; e is a tions, in the same elevation of the machine; in that case washer. Fig. 49 is a sectional elevation made by a plane we speak of the plan or elevation of the machine as a passing through the centre line of fig. 50. We do not whole, and not with respect to its individual parts, show the bolt in section, as its shape is shown more clearly Therefore

We shall distinguish the cut surfaces or sections of objects fig. 49 a longitudinal-section. by diagonal lines, as in fig. 43,



20. Bolts.-Figs. 44, 45, and 46 are three views of an ordinary $1\frac{1}{2}$ " bolt with hexagonal head and nut drawn to a scale of $\frac{1}{4}$. Fig. 44 is a plan; fig. 45 a front-elevation; and fig. 46 an end-elevation, showing the screwed end of the bolt and the nut. The screwed part ab is not correctly represented in the figures, but is shown as is usual in small scale drawings; we shall consider the true form under the title of screws. The thickness of the head $T = \frac{7}{8}$ of the diameter D of the bolt. Bolts are used for the purpose of connecting two or more pieces of material, and are made of various forms. Figs. 47, 48 illustrate a common form, the head a is square, the portion b next to the head is also square, and fits into a square hole, which prevents its turning round while

the nut is being screwed on; the diagonal lines on a and b are used to denote its form (usually only shown in working drawings) when an end-view is not shown.



Fig. 49.

Fig. 50.

Fig. 51.

Therefore, when we speak of the plan or elevation of a by not doing so; this is the usual form adopted. Fig. 50 piece of a machine, we do not assert that that plan or ele is an end-elevation; fig. 51 an end-elevation with the The projection of a circle upon a plane, making an angle bolt in section, showing form of hole in α and pin c. the plane of the circle, is an ellipse. Such a section is sometimes termed a cross-section, and

(To be continued.)