ANGLES from SINE SET-UPS

WORKSHOP HINTS and TIPS

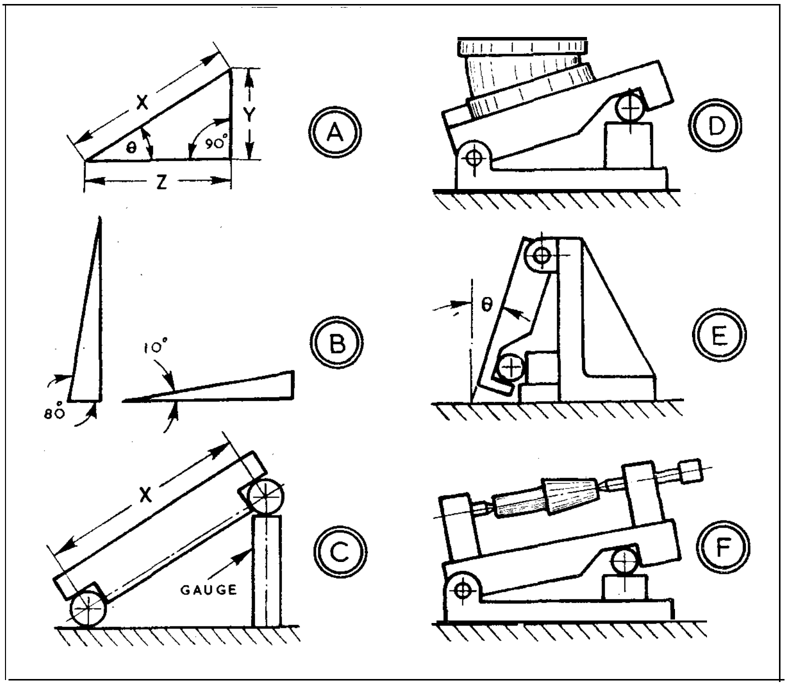
By GEOMETER

FOR many purposes, angles on components or gauges may be set out with protractors or dividing heads, or by employing marking-off principles, but these methods fall considerably short of precision standards. The equipment may be inaccurate, and there is the chance of error in its use-in the reading of a protractor, for example, even a vernier type.

The possibility of error where angles have to be precise calls, therefore, for the use of methods and equipment based on the change in proportion with angle of the elementary right-angled triangle, which enables an angle to be settled from simple linear measurement.

Proportions of triangles are contained in tables of trigonometrical functions under sines, cosines and tangents; but only sines are required in this case, and all equipment whether a sine bar, sine plate or sine centres functions on that principle.

The elementary right-angled triangle is as at ***A.*** It has a sloping side or hypotenuse length X, a vertical height Y, and a horizontal or base length Z. The angle between the vertical and the base is always 90 deg. (as it is a right-angled triangle), and the angle 0 varies between zero degrees and 90 deg. As it does so, the triangle changes from a flat position, as at B, right (0 shown at 10 deg.), into a vertical attitude, left (0 shown at 80 deg.).



Throughout the change, length X remains fixed, and the proportions of the vertical Y and the base Z vary according to angle. The sine is obtained by dividing X into Y. At an angle of 90 deg. (beyond ***B,*** left, which is 80 deg.), X and Y are the same; and as X= 1, 1 into 1 = 1. So sine 90 deg. is 1.

At an angle of zero degrees (beyond ***B,*** right, which is 10 deg.), the vertical Y has disappeared, and 1 into 0 = 0. Thus, sine zero degrees = 0. Between 0 and 90 deg., the sine table contains a series of decimal fractions; and finding the required angle in degrees, taking the decimal fraction, and multiplying it by length X, provides height Y, which is the simple linear measurement required.

The sine bar, as at C, is a straight piece of tool steel provided with a step at each end to keep a pair of accurate rollers a fixed distance apart, X. This distance is often 5 in. or 10 in., mostly for convenience in multiplying the fraction taken from the sine tables to obtain height Y, though, actually, length X can be any dimension. Having obtained height Y, a gauge of that length or several slip gauges can be used to prop up the sine bar as shown-and the slope or angle required is obtained to great accuracy.

The sine bar is normally used on a surface plate against the face of an angleplate to which it can be held by toolmaker's clamps when set to angle. An object such as a flat plate gauge can be placed on top and the angle verified by dial indicator mounted on a surface gauge.

Various adaptations overcome some of the obvious limitations of this basic arrangement; and one such is the sine plate, as at ***D. This*** has a flat base and a hinged plate to obtain the angle by placing a gauge under a roller; or there may be a projecting dowel each side, so two gauges of the same height are required. Any broad-based component can then be stood on the plate for checking the top by dial indicator, as before.

As a sine bar is brought up to the larger angles, it becomes difficult to set and use; and where these angles are frequently encountered, the arrangement as at ***E*** may be devised. Here the bar is hinged at the top, and the angle taken from the vertical.

Sine centres, as at ***F,*** are a development of the sine plate, so that centred parts like taper gauges can be set up for checking angle. El