USE OF

Toolmaker's buttons

By GEOMETER

THOUGH it would, perhaps,. be difficult to establish Just when toolmaker's buttons came into common use, a substantial claim could be made for their influence in raising the standards of precision on which manufacturing processes now depend. Before the jig-borer appeared, they were the sole means by which systems of holes could be laid out precisely-or at least to an accuracy limited only by that of the measuring equipment. Consequently, a great deal might be different from what it is now, had toolmaker's buttons never been known-although, obviously, they are the sort of things any number of reflective machinists might have invented.

Using two buttons held by screws to the face of work or a jig, they can be spaced, measuring over them by micrometer, and firmly fixed. Then in a set-up on a lathe, a button is trued by indicator, removed, and the hole opened out to size by drilling and boring. The second hole is produced in the same way, and so the spacing of the two is that at which the buttons were set.

Number no problem

Any reasonable number of buttons can be set by measurement of pairs, checking either overall or between them, with no real difficulties occurring so long as the centre dimensions for each pair are known. That is not always the case, however; and sometimes preliminary calculations are necessary.

The most obvious and frequent example involving calculation is as at *A,* where there are holes on a pitch circle at angle Θ. The radius is *R,* with centre hole S, and holes *T* and U on the pitch circle. Using a button at S, or a plug in a hole previously machined, the setting of a button for either hole *T* or U can be done by overall or between measurement, on the basis of radius *R*. But to space all three holes precisely, it is necessary to know dimension V, a straight line between centres of holes *T* and U, which can be arrived at through trigonometry.

If angle Θ is divided by two and a line run out, it joins at the mid-position the straight one between *T* and U, and two equal right-angled triangles are formed-one shown with close hatching. Looking up the angle $\Theta/2$ in sine tables, a decimal fraction is obtained, and this is multplied by *R* and 2 which gives dimension V.

The same result follows more directly if the diameter of the pitch circle is given and not its radius. That is, there is no need to halve a pitch circle in order to work with the radius. If *R* is run across the circle to *W,* and this point joined to *U, a* larger triangle is formed which is similar to the smaller one, and right-angled on the theorem that "the angle in a semi-circle is a right-angle." So referring again to the sine of $\Theta/2$, and multiplying the fraction by the diameter, V is arrived at directly. There are other methods of obtaining angular spacings, but this one takes care of any value of Θ less than 90 deg.

On a straight line

Locating a number of buttons on a straight line is another practical problem for which the solution is as at B, using a straight-edge X clamped to the work so the buttons can be brought to it. On a similar principle, having located one button from an edge, the inward setting of another can be achieved through a block Y, for a single measurement Z to set the second button.

Checking of buttons on a straight line and in relation to an edge can be done on a surface plate, with the work set up and " clocked " true on an angleplate, as at C. A test over all buttons shows if there is any variation in height.

A plate carrying a button suitably set from its edge can be used in setting an angleplate, as at *D;* while a plate with button can be mounted on the face of a component, as at *E*, for locating a sunken hole. Again, as at *F,* a plate may carry a button and be clamped to the faceplate for a component to be located on it.