Setting up with a star diagonal

By **GEOMETER**

A RIGHT-ANGLE microscope made from a star diagonal can be used in the chuck of a lathe to give optical precision for two important settings. The first is to true the axis of the tailstock to that of the spindle after the tailstock has been set over for taper turning. The second is to centre cross lines on work on the vertical slide, a necessary preliminary to machining with revolving tools.

These extra settings represent a new departure for a microscope on the amateur's lathe. They bring the instrument into the class which includes jig borer microscopes and optical centre finders for centre lathes and drilling machines.

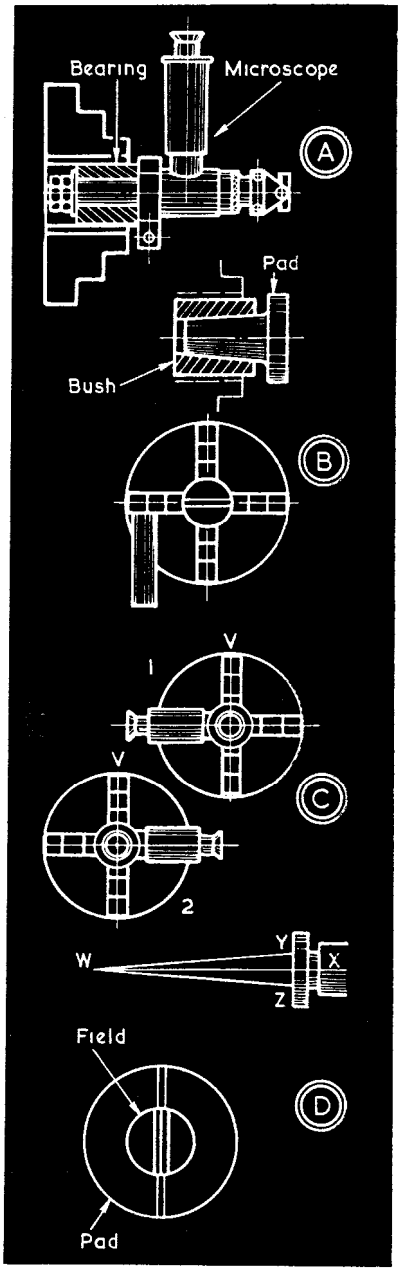
The principle of operation has been used in industry for several years. It was introduced by Watts for optical plumbing in theodolites and was patented by them. They then used it for their Watts Microptic Centre Locator, an instrument which was smaller than a jig borer microscope, and suitable for use on drilling machines, milling machines and centre lathes.

It is obvious that the microscope is a useful if not indispensable tool for a modem workshop. By using it, a turner learns the principles and tricks of the latest practice. Construction is not difficult for anyone with experience of general turning.

To mount the microscope in the chuck, a parallel spindle is fitted to the star diagonal in the same way as the taper shank for fitting to the tailstock. The same clamp can be used. The parallel spindle is in a bearing which is gripped in the three-jaw or four-jaw chuck. The end of the spindle has a thread for two nuts which are locked when they have been adjusted to a firm friction grip. The fit of the spindle in the bearing and the adjustment of the nuts must give a firm mounting without any trace of shake. Diagram A shows the set-up.

The microscope is focused on two lines on a flat (pad) centre in the tailstock. These lines are scribed with a pointed tool so that they precisely straddle the axis of the pad. The tailstock is clamped to the bed, and the barrel is advanced until the lines are clearly seen. Then the barrel is clamped and the microscope adjusted.

To avoid inaccuracy, the lines are scribed on the pad by the method illustrated at diagram B. The pad is turned from mild steel with a taper for the tailstock barrel. Then it is mounted in a bush in the four-jaw chuck. This bush should be bored in the chuck to take the pad. The scribing tool is set just above (or below) centre height, and a stop is used to two opposite jaws of the chuck. By this method, the lines must lie equally each side of the axis.



To adjust the microscope, we first turn it to position CI. The optical axis, as seen from V, must then coincide with the lathe axis. This gives a line of sight from W to X. To counteract wobble in the chuck mounting, we turn the chuck while making observation in the microscope. The field as seen by the scribed lines moves between extreme positions Y and Z, which are 180 deg. apart. From one or the other, the chuck is turned 90 deg. and the position V is marked with chalk.

The line in the microscope ocular should lie between the two scribed lines on the pad, as at D. This setting can be obtained from the optical micrometer. Then the microscope is turned over to position Cz; the setting should be the same. If it is not, we adjust the tailstock to half the error, and also adjust the optical micrometer. Then a recheck is made from the first position CI. With a few adjustments, spot-on accuracy is obtained.

For work on the vertical slide, you use the microscope in this way for the vertical line of the crossed pair, but bring the line precisely to the one in the ocular. For the horizontal line, the microscope is set vertically, and the chuck is turned **90** deg. so that V is at the side. Then you bring the horizontal line precisely to the one in the ocular.

The spindle for mounting the microscope can be 1/2 in. dia. and the bearing I in. dia. X **1** 1/4 in. long. A thread not coarser than 26 t.p.i. should be used for the spindle locknuts. ❑