By GEOMETER

MICROSCOPE on the lathe-8

OPTICAL MICROMETER

When a hollow-barrelled tailstock is fitted with an objective lens and an ocular, an optical micrometer can be included to correct small differences in height between the axis of the spindle and the cross-wire in the ocular. It is an alternative to the eccentric bush which was shown in the last article.

Its function is the same. The difference is that the eccentric bush is entirely mechanical and well understood, whereas the optical micrometer is half-mechanical, half-optical, and unappreciated by most engineers. Yet it is a simple device which can be fitted to, or included in, many optical instruments.

The mechanical parts are a parallel transparent block, with the means-such as a lever or a toothed quadrant-to tilt it in the path of light rays or a line of sight. Glass is used in regular instruments. We can use clear plastic sheet for convenience.

The optical function is one which is fundamental to optics., We shall see first how it applies on the lathe, and then take some examples of instruments.

On a lathe it cannot be expected that the axes of spindle and tailstock will remain perfectly aligned in continued use. Guideways wear, and so do tailstock faces. A slight fall must occur. Moreover, we cannot be certain that the cross-wire in our ocular is across its centre. But we need this wire to be correctly centralised to set it to the lines scribed on the work.

In the example at A, the tailstock axis and cross-wire are beneath the spindle axis. We have the flat plastic forming the optical micrometer at O. The spindle axis is on line P. The tailstock axis and cross-wire are on line Q. These two lines must be brought together. so that we have, in effect, a straight line of sight.

As at diagram B, we tilt O so that we look along Q, up *R* through the plastic,. and along P. This is the refraction which always occurs when a ray passes obliquely from one transparent medium to another. Here the movement is from air to plastic, and from plastic to air.

For a given angle of tilt, the elevation (or depression) which is obtained like this is dependent on the thickness of the plastic or glass. If the micrometer shown at B were thicker, line *R* would be longer, and less tilt would be needed to bring *P* and Q into line. I use 1/8 in. plastic for a 1 in. microscope objective. For a small camera lens, it is better if the material is about 1/4in. thick.

In an optical instrument, a graduated quadrant is mounted with the micrometer on the spindle, as at C, where 0 is the micrometer, S a scale and T a fixed pointer. Then up or down displacement is known from the reading.

In the Ordnance Survey of Great Britain, optical micrometers of this type were widely used in precise levelling operations. Through the levels, staffs could be seen long distances away; with the micrometers, graduations could be brought into line. This was equivalent to raising or lowering the instruments bodily.

In the Watts Microptic Measuring Machine, which is accurate to 0.00005 in. over 4 in., there is a similar micrometer in the optical system.

On the lathe we have no need for a quadrant, as the piece of plastic can be tilted and the result seen through the ocular and objective lens. All we require is a suitable mounting. Diagrams D, *E* and *F* show an example.

The parts are two triangular plates U and V, clamped to the sides of a pair of blocks *W* and X, which are bored to grip on the microscope objective. A small camera lens requires a modified design which will be shown in my next article. The plastic disc is pressed into a holder Y. which can be machined from flat material; or it can be set in a ring Z which can be made from tubing and. fitted with countersunk screws. For this, the plastic is filed to clear the screw heads.

No dimensions are binding, and for materials there is the choice of brass, aluminium or duralumin. Plates can be 1/16in. to 1/8 in. thick, blocks 1/4 in. to 3/8 in., and the holder 3/16 in. to 1/4 in.