

REVERSIBLE LEVEL

constructed by COOKE, TROUGHTON & SIMMS, LTD.

The Reversible Level S 113, constructed by the firm COOKE, TROUGHTON & SIMMS, LTD., Buckingham Works, York, is constructed so that the telescope may be set level for each sight by the manipulation of a highly sensitive setting screw, this method being now recognised by acknowledged authorities as more accurate and rapid than attempting to set the axis truly vertical and relying on the accuracy of the relation between this and the line of collimation.

All observations are made from one stance but the special feature of this level is that its adjustment can be readily checked by the user without anything more than turning the telescope through 180° about the axis of collimation, and taking observations in the two positions. Further, this instrument, even if out of adjustment, gives "true level" as the mean of these two readings.

The characteristics of this level depend on the ability of a reversible spirit level to determine a mechanical axis (and the coincident axis of collimation) in a horizontal plane.

The spirit level, which has both upper and lower surfaces visible, is attached to the side of the telescope, and is so constructed that, when in either position of the telescope (see figure 2, *A* and *B*) the bubble occupies a similar position in relation to index marks, the instrument is in adjustment, *i.e.*, when the telescope is truly level the bubble is in the central position.

For this to be possible the effective surface of the spirit level, which is most simply described as being barrel-shaped, should be circular at all cross-sections throughout its length, and symmetrical in longitudinal section about its axis. Then with this axis of symmetry horizontal, the bubble will occupy the same section of the tube however the spirit level may be rotated on its own axis or about another but parallel axis.

The spirit level is read by a prism device and magnifier, which is the most precise method yet devised and in combination with the above renders this level an extremely accurate and convenient levelling instrument.

In practice this instrument is used with the spirit level on the left side of the telescope. For testing the accuracy of the instrument the two observations made are:—

(i) With spirit level on left, Fig. 2 *A*.

(ii) With spirit level on right, Fig. 2 *B*.

and normally these will agree, but if not, then their mean gives the "true level" and it will be obvious that, by adjusting the spirit level with the telescope directed to this mean, the adjustment of the instrument will be corrected. Fig. 2 *C* shows the level in proper adjustment.

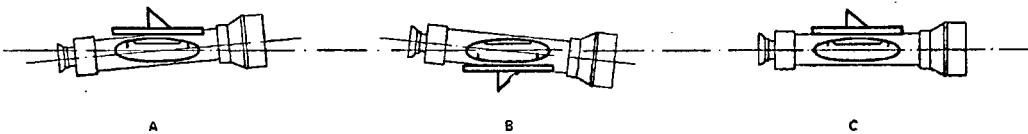


FIG. 2

From the simplicity of the above method of check it will be apparent that this level possesses a distinct advantage over other types of reversible levels.

SPECIFICATION.

Telescope. — Internal focussing, 1.65 ins. aperture and 11.0 ins. equivalent focal length. Glass diaphragm with stadia 1:100 (Fig. 3 and 4) in interchangeable cell which

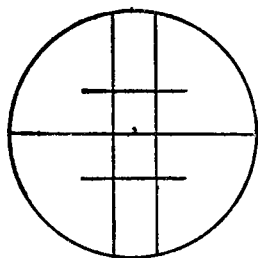


FIG. 3

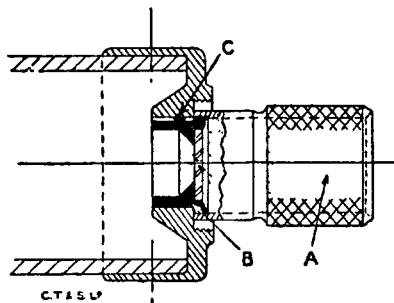


FIG. 4

allows the diaphragm to be withdrawn, cleaned and replaced, without fear of disturbing the collimation of the telescope. Screw-focussing inverting eyepiece, power 30, with exceptionally large ($1^{\circ}25'$) and flat field of view, dustguard and ebonite eyeshield. Peep sights are provided. Rayshade to object-glass provided with cross sighting slits and scale giving angles up to 20° elevation and depression at right angles to the line of sight. This telescope will resolve 0.01 ft. at 1100 ft. with normal eyesight and average lighting conditions.

Spirit levels. — Long spirit level, value 12-15 secs. to 0.1 in., mounted on the side of the telescope, in which position disturbances caused by the supports being at different temperatures are eliminated. The bubble is viewed from eye-end of telescope by an optical device by means of which coincidence of the reflected images of half the ends of the bubble in the spirit level indicates that the telescope is truly horizontal. Hermetically-sealed circular spirit level is also fitted for preliminary levelling.

Tribrach & Body — Three footscrews with dustcovers; trivet stage permanently attached. Connection to head of tripod by standard large diameter screw-head. Clamp and slow motion in azimuth. The telescope (which carries the main spirit level) is held in a cross-head bearing, which can be tilted in a vertical plane about a substantial horizontal axis by means of a patented fine-setting differential screw having an effective pitch of $1/500$ inch. Thus the spirit level can be set horizontal with extraordinary ease and precision.

Differential screw. — A micrometer scale and counter is fitted to the fine-setting screw for gradient measurements and for obtaining distance of staff by subtense method. Ten complete turns of the screw and micrometer drum tilt the line of sight through a vertical interval of one foot on a staff 100 ft. distant, or 1 in 100; thus one complete turn gives $1/10$ th ft. at a similar distance, or 1 in 1000. The drum is graduated into 50 divisions, and a movement of one division tilts the line of sight through approximately 4 secs. of arc.

Note the simplicity of the formulae:—

$$(A) \text{ gradient} = \frac{\text{micro. reading}}{1,000} \quad (B) \text{ distance} = \frac{10,000}{\text{micro. reading}} \text{ when base on staff is 10 ft.}$$

Metric units may be substituted for English measurements.

Referring to figure 5 :

V is the fixed scale for counting the number of complete revolutions made by the drum. (Note that the reference line is carefully calibrated for each instrument).

H is the scale for recording fractions of a revolution. Thus the reading is :

$$\begin{aligned} & 1 \text{ rev. on scale } V \\ & 23/100 \text{ rev. on scale } H \\ & = 1.23 \text{ below zero.} \end{aligned}$$

EXTRAS.

S 218: *Magnetic compass* (C in fig. 1). — Circular type for attachment to the side of the level body. Compass ring 2.25 ins. dia. graduated in $\frac{1}{2}$ degrees and read by

means of a magnifier from the eye-end of the instrument. When not in use, it is held in the instrument box by the same screws used to clamp it to the instrument. Weight 0.25 lbs.

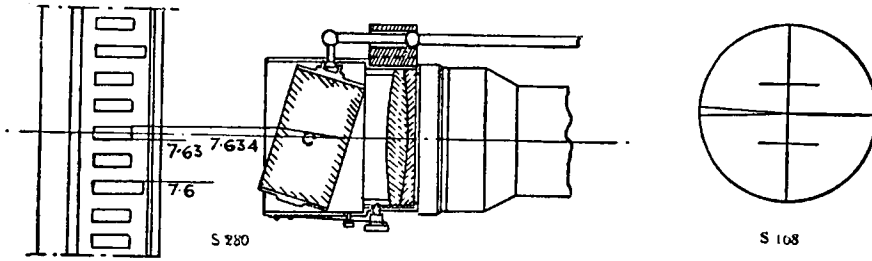


FIG. 6

S 280 : Micrometer Reading Attachment. (Fig. 6) — This attachment is used for measuring the interval between the diaphragm lines and previous 0.01 ft. division on the staff. The device consists of a parallel plate of glass which may be tilted and so displaces the incoming rays of light. This displacement is controlled by a micrometer screw calibrated to read to 0.001 ft. and gives directly the amount of the interval.

