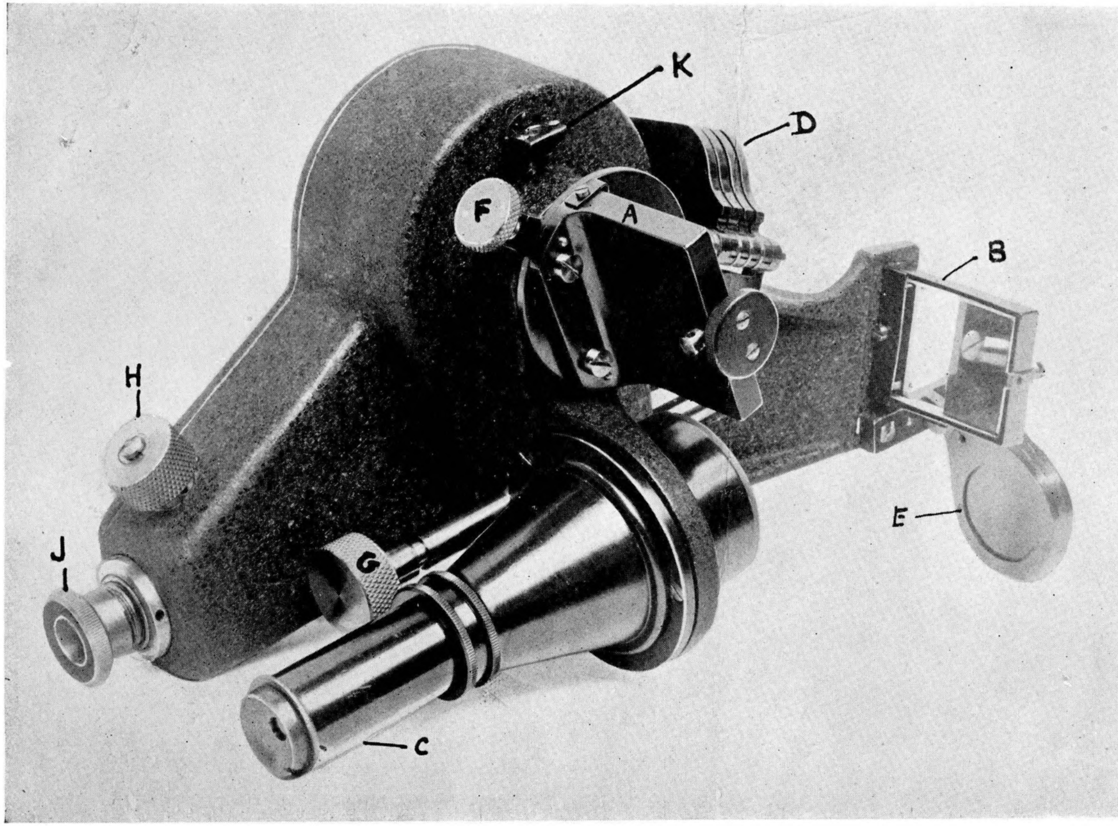

Fig. 1

A NEW FORM OF SEXTANT.

The general principle of the sextant has undergone little or no change since it was invented in the early years of the eighteenth century, nor have the details of construction altered much during the past 120 years or so. While the simplicity of the mode of action of the instrument sufficiently accounts for the absence of change in its general principle, it cannot be said that the almost total absence of development in its detail design is to be explained by an early perfection of form. At sea, where it finds its chief employment for the determination of latitude and longitude, it is not an easy instrument to handle without considerable practice, while the open exposure of its scales and all its working parts to the full influence of the sun and weather introduces a considerable risk of error and damage. Moreover, once the instrument has been made, the user has to place reliance upon the accuracy with which the manufacturer has divided the scales and centred the axis about which the vernier arm turns. No means are provided, as in other instruments fitted with a divided circle, for eliminating the effect of these two sources of error by taking the mean of opposite readings. The best that can be done is to furnish each instrument with a table of errors based on measurements of its accuracy by the National Physical Laboratory or other authority. In this connection, it may be noted that, to fulfil the requirement that the error in the reading shall not exceed 40 seconds of arc necessitates that the axis of a 7in. sextant should be correctly centralized to within one-thousandth of an inch. It is doubtful whether the original decentralisation error remains constant. There are, in fact, grounds for believing that the unequal exposure of the different parts of the instrument to the sun adds to the error each time the sextant is used in the tropics.

The new form of sextant illustrated (fig. 1) has recently been patented and placed on the market by C. F. CASELLA and C°., Ltd., 49, Parliament Street, London, S.W.I.

Messrs. CASELLA's new sextant is, by comparison with the ordinary form, small and light. Externally, it consists of a cadmium-plated casing, carrying the index mirror *A*, the horizon mirror *B*, the telescope *C* and the tinted glasses *D E*. These parts operate in precisely the same way as the corresponding parts of the ordinary type. With the exception of three control knobs *F G H*, a magnifying eyepiece *J* and an illuminating prism *K*, all the rest of the gear is contained inside the casing. There is no handle, the casing itself being sufficiently small to permit of its being readily held by one hand. The internal scales illuminated by light received through the prism *K* are read through the eyepiece *J*. They are read by the left eye, while simultaneously the right eye is observing the sun through the telescope *C*. In the ordinary sextant simultaneous observation and reading are not possible. It will be noticed, too, that whereas the ordinary sextant is held in the right hand, the new design is held in the left, leaving the right hand free to operate the control knobs.

The index mirror is mounted on an external circular plate, which is carried at the end of an internal sleeve *L* (fig. 2), to the other end of which is

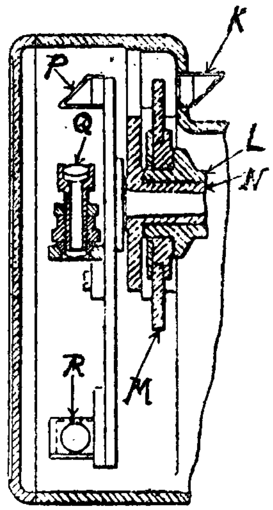

fig. 2

fixed an annulus *M* of glass engraved in degrees and half degrees. The sleeve *L* is carried by a hollow spindle *N* projecting from a spider plate fixed across the casing. Light entering the prism *K* is reflected through the scale on the glass annulus into the prism *P*. Thence it is reflected downwards through an object glass *Q* into another prism *R*, which turns it into the eyepiece *J*. The prism *P* and *R* and the object glass *Q* are mounted on a plate, which is provided with a spindle fitting within the bore of the hollow spindle *N*.

The knob *F* (fig. 3) screws into a ring surrounding the mirror and annulus sleeve *L*. If this knob is unscrewed the mirror and annulus can be rotated by means of the milled button fixed to the edge of the mirror frame until the image of the sun is brought down roughly onto the horizon. Fine adjustment is then secured by screwing up the knob *F* in order to lock its ring to the sleeve *L*. The ring referred to has a tail piece *S*, whereon the adjusting screw *G*, aided by a spring-pressed plunger on the other side, exercises delicate control. Both during the rough adjustment and during the fine adjustment by means of the screw *G*, the optical system *P Q R* remains stationary. Its spindle, although coaxial with the mirror and annulus sleeve *L*,

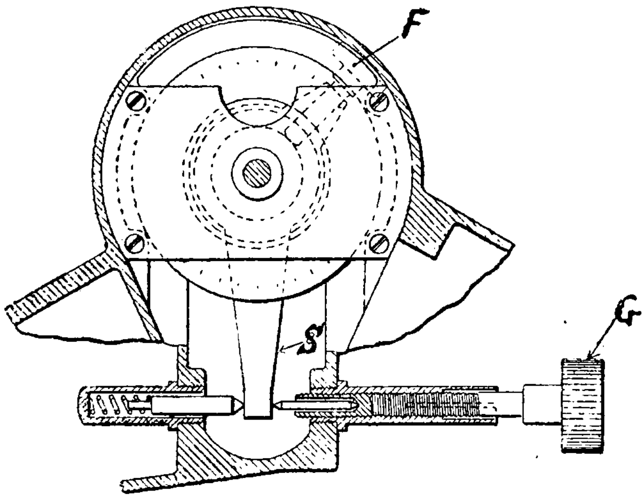

fig. 3

is shielded throughout its length by the fixed hollow spindle *N*, and therefore does not receive any fractional drag when the mirror, the sleeve *L* and the glass annulus are turned either from the knob on the mirror frame or through the agency of the fine adjusting screw *G* and the clamping screw *F*.

The eyepiece *J* is provided with two horizontal hair lines. The image seen through it (fig. 4) is a vertical projection of the small portion of the

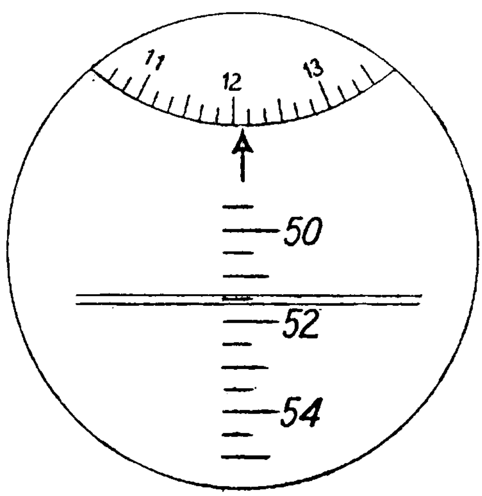

fig 4

$51^\circ 30' + 12' 08'' = 51^\circ 42' 08''$

glass annular scale that has stopped within the view of the prism *P*. The portion seen covers a range of 5 or 6 deg. In general, a degree or a half-degree mark will not fall exactly between the hair lines. Means must therefore be provided to permit the excess of the deficit to be read by a micrometer attachment. This micrometer attachment is controlled by the knob *R*, (fig. 5). The spindle of this knob bears against the end of a lever *T* which is hinged at its other end to the casing. A nut with a knife-edge raised round its edge bears against a tail piece *U* attached rigidly to the plate carrying the optical system *P Q R*. Contact between the tail piece and the nut is maintained by means of a spring extending from the plate of the optical system to a point on the casing. The adjustment of the position of the nut on the lever *T* is a makers' adjustment. The user is not required to adjust it.

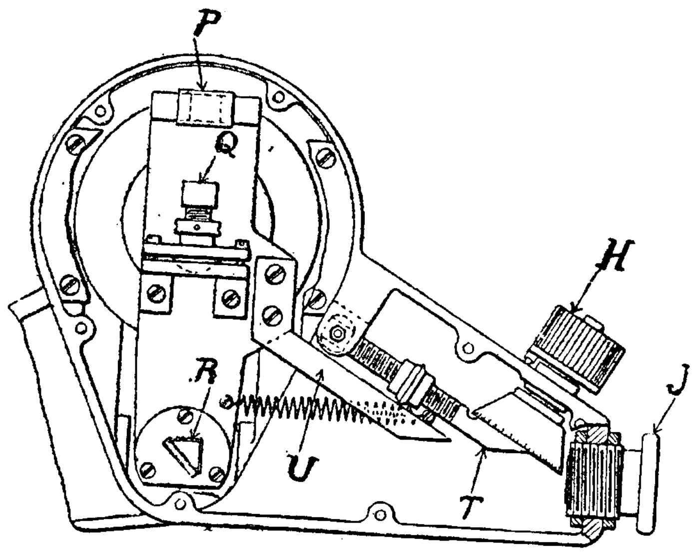

Fig. 5

According as to whether the knob *H* is turned to screw its spindle down or up, so will the movement given to the lever *T* and tail piece *U* tilt the optical system clockwise or anti-clockwise. The effect of such tilting is to bring the prism *P* opposite a slightly different portion of the glass annular scale. As seen through the eyepiece *J*, the glass scale image appears to move up or down, but in reality it is the optical system, and not the mirror and annulus system, which is moving.

The movement of the knob *H* is continued until a degree or a half degree division appears to divide the space between the hair lines. The reading sought is then the number of this degree or half degree division plus — or minus — a quantity which is proportional to the amount the knob has been turned. The magnitude of the addition — or subtraction — is obtained from the graduated edge of a celluloid or other transparent conical skirt surrounding and rotating with the screw of the knob *H*. A small portion of the edge of this skirt comes within the illuminated field of vision through the eyepiece *J*, and appears as a graduated arc at the top of the disc. The graduations are in minutes and tenths of minutes, and are read against the arrow point fixed in the field of vision. Although the celluloid skirt rotates with the screw of the knob *H*, the details of its attachment are such that it does not move parallel with the screw axis as the knob is turned. The edge of its image, as seen through the eyepiece, does not descend or rise as the screw is turned, but remains as shown. just touching the point of the arrow.

The chief advantages of this new form of sextant are its lightness and general handiness, the full protection which it affords to the scales and the fact that it permits observation and reading to be made simultaneously. The angle to be determined is as in the ordinary type of instrument, twice the angle turned through by the index mirror, but the optical magnification of the scale is such as to overcome the difficulty caused by the compression of the scale of the ordinary sextant. If it is desired to take mean readings for the purpose mentioned, a relatively simple modification of the design can be adopted. In this design the prism *P* is replaced by two prisms situated to view the ends of the horizontal diameter of the annular scale. Coincident with the centre line of the glass annulus there is a third prism which reflects the images received from the first and second downwards into the object glass *Q*. By these means the eyepiece *J* receives the images of two short sections of the scale glass instead of one. These sections are diametrically opposite each other on the scale, and by taking the mean of their readings the effect of decentralisation of the axis is eliminated.