

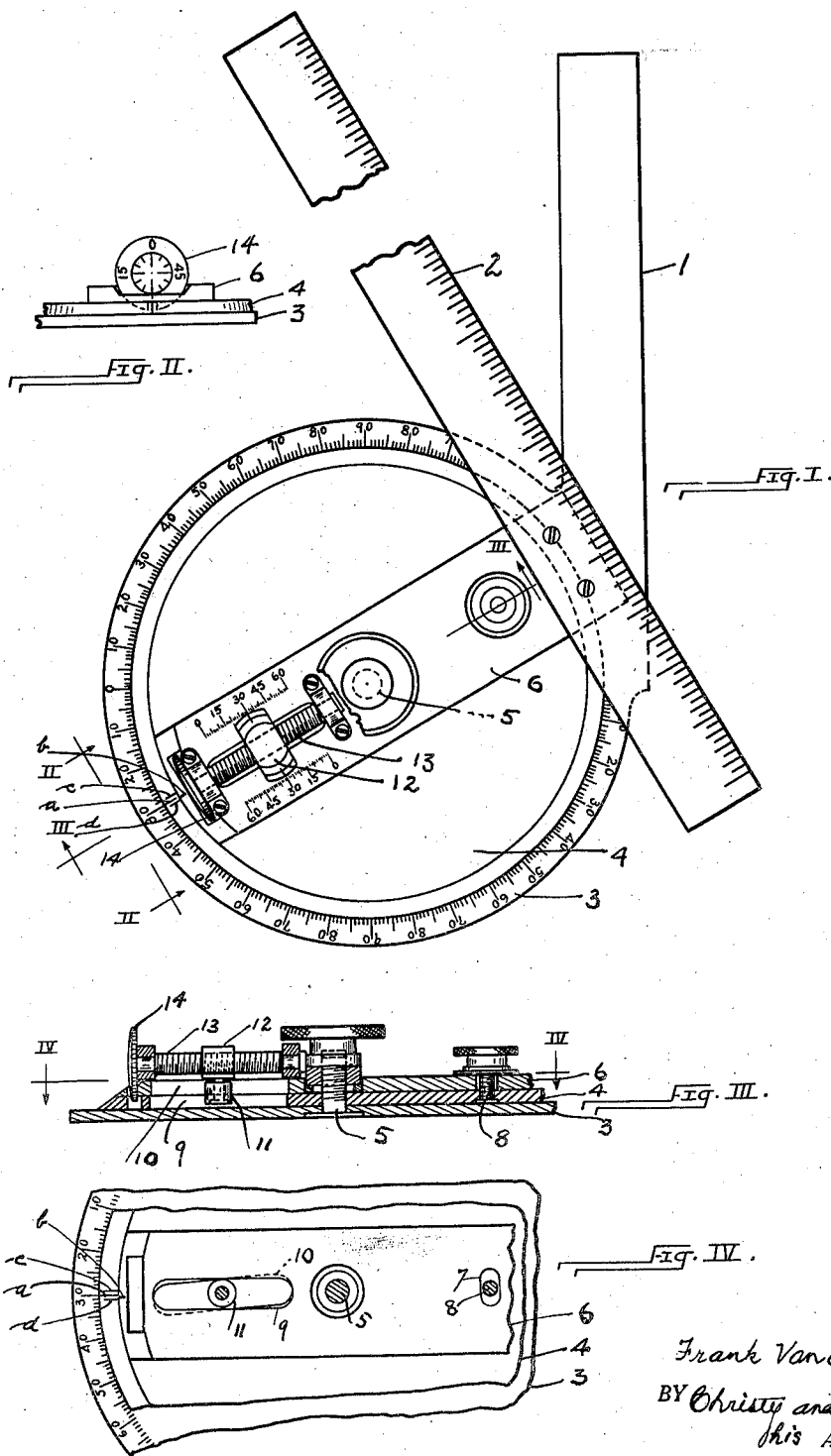
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INSTRUMENT OF PRECISION

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## INSTRUMENT OF PRECISION

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2 Claims. (Cl. 33—75)

This invention relates to instruments of precision and consists in means for effecting and for measuring minute adjustment of two relatively rotatable plates. Of wide and general applicability, it finds immediate utility in the construction of protractors, and in that application it will here be shown and described.

In the accompanying drawing Fig. I is a view in plan of a protractor that embodies the invention; Fig. II is a fragmentary view in elevation, and in Fig. I the field of view and the direction that afford the showing of Fig. II are indicated at II—II; Fig. III is a fragmentary view in section, on the plane indicated at III—III, Fig. I; and Fig. IV is a fragmentary view in plan and to larger scale.

The protractor includes, as is usual, two straight edges, 1 and 2, severally mounted on disks 3 and 4. The two disks are concentrically pivoted for relative rotation, and a clamping screw 5 is provided for securing the two disks in any position of angular displacement to which they may be brought. The underlying disk 3 is larger than the overlying disk 4 by a sufficient margin; and the margin of the underlying disk is graduated as shown, to form a scale. The overlying disk 4 is bevel-edged, and bears at its edge a radially extending index line, *a*. The structure and the graduation of the margin of disk 3 and the positioning of the index line *a* are such and so correlated that the index line upon disk 4 by its position along the circumferentially extending scale upon the margin of disk 3 affords measure of the angularity at which the two straight edges 1 and 2 stand related. In the position shown in Fig. I, for example, the reading, 30, tells that the straight edges are inclined to one another at an angle of 30°.

It is usual in these instruments to graduate the margin of the disk 3 to degrees, as the disk here is shown to be graduated, but not more minutely; and, in order to measure with greater precision the infinitely variable angle at which the straight edges may stand, it is usual to form upon the beveled edge of disk 4 a vernier scale. In the instrument of this invention a vernier is not employed, but instead a refinement of structure is provided, in consequence of which the angularity of the straight edges may readily be measured in minutes and even in seconds.

The overlying disk 4 is elaborated in structure. It consists of two concentrically mounted and relatively rotatable parts: the disk 4 of the familiar instrument, with its index line *a*, and an incomplete disk or plate 6 superposed on plate

4. This plate 6 carries immediately the straight edge 2. The margin of plate 6 is, throughout a sufficient interval, shaped to the arc of a circle of smaller radius than that of disk 4, and this arc-shaped margin of plate 6 is beveled and bears a radially extending index line *b*. It is advantageous also to provide upon the edge of disk 4, in addition to the index line *a*, the radial lines *c* and *d*, spaced laterally upon the two sides of line *a* at intervals that indicate a range of swing of one degree each way of plate 6 upon disk 4. Through a slot 7 in plate 6 remote from the centre extends a clamping screw 8 by which the plate 6 is normally clamped to and integrated with the disk 4. So long as the screw is tight, the instrument is serviceable as an ordinary protractor. It is only when the screw is loosened that the disk 4 and plate 6 are released for relative rotation and for the operation of parts in which my invention particularly lies.

The disk 4 and the plate 6 are slotted with elongate, parallel-walled slots 9 and 10. The slots are of equal length and in the assembly are approximately coincident in position, and they are approximately radial in their extent. The departure from precisely coincident position is indicated in Fig. IV. Their axes extend at a slight angle one to the other. A cylindrical block 11 of a diameter equal to slot width extends into each slot. Because of the angularity in the placement of the slots a shifting of the block 11 in radial direction with respect to the centre of relative turning of disk and plate effects angular displacement of plate 6 relatively to disk 4. The slots are so arranged and proportioned that within the range of movement of block 11 the displacement of the plate 6 may amount to as much as one degree.

Means are provided for a gradual and controlled shifting of block 11 along the slots. Such means are found in a nut 12 that travels upon a threaded shaft 13. The shaft 13 is rotatably mounted in radial position in bearings carried by plate 6 and is provided with a milled head 14 which it may be turned manually. The nut 12 carries pivotally the block 11. As the shaft is turned the block is shifted. Upon the adjacent surface of plate 6 two graduated scales are laid (Fig. I), and upon the outspread foot of the sliding nut 12 an index line for each scale is laid. While a single scale and index line will suffice, two scales simplify operation in some cases—the calibrations on one scale reading upward in right-to-left direction and the calibrations on the other reading in opposite direction. Each scale

is conveniently formed of sixty graduations; and the proportions and organization are such that the line and scale afford index in minutes of the swing of plate 6 upon the disk 4.

5 The threaded connection between nut 12 and shaft 13 may be so proportioned that with each rotation of the shaft plate 6 is shifted one minute. The flat face of head 14 of the shaft may be scaled peripherally with sixty graduations 10 (Fig. II), and, cooperating with this scale, index line *b* upon plate 6 may then additionally afford reading of seconds in the range of shift of plate 6 upon disk 4.

The use is that of a protractor of ordinary 15 structure, with this refinement. Let it be supposed that the angle is to be measured at which two lines lie upon a drawing. Screw 8 is initially tight, with line *b* coincident with line *a*, the line upon nut 12 coincident with zero of the scale 20 upon plate 6, and zero of the scale upon head 14 coincident with line *b*. Screw 5 is initially loose. Straight edge 1 is laid on the drawing in coincidence with one of the lines, and disk 4 is turned until straight edge 2 comes to coincidence with 25 the other. Screw 5 then is tightened. Conceivably line *a* upon disk 4 may then be found to be coincident with a graduation line in the scale upon the margin of disk 3, and in such case no further mensuration is needed—the angle 30 is of so many degrees value. If, however, as ordinarily will be the case, the line *a* is found in intermediate position between two graduations of the scale, screw 5 is made tight, screw 8 loosened, and shaft 13 turned. The shaft is turned 35 until the line *b* comes to coincidence with the next lower line upon the scale of disk 3 than the point at which line *a* has come to rest. The readings of the scales upon the plate 6 and upon the head 14 will then give the minutes and seconds 40 by which the angle under mensuration exceeds the number of degrees now indicated by line *b* with respect to the scale upon disk 3.

Manifestly, by opposite shifting of the nut 12 upon the shaft 13 (assuming the initial setting 45 to be such as to permit opposite shifting) the interval may be measured in minutes and seconds, by which the line *a* in its position falls short of the next higher degree mark.

By the means described the straight edges 1

and 2 may be set in any required relative positions of angularity, within the capacity indicated.

The invention is manifestly applicable to instruments of precision generally in the making 5 of measured angular adjustment.

I claim as my invention:

1. In a protractor that includes two straight edges and two disks coaxially mounted and relatively rotatable, a refinement of structure adapted to afford more accurate mensuration, such refinement consisting in a plate mounted for rotation 10 on the common axis of the two disks, the said plate carrying integrally one of the two straight edges, means for alternately securing the plate for integral rotation with or releasing 15 it for independent rotation with respect to the immediately adjacent disk, the more remote disk being the one that carries the other straight edge, the said plate and the disk immediately adjacent 20 to it being slotted with parallel-sided slots that extend in general radial direction with respect to the axis of turning but having in the assembly mutual obliquity of position, and a block engaging at once the parallel sides of both slots 25 and movable while so engaged longitudinally of both slots and radially with respect to the axis of turning.

2. In a protractor that includes two straight edges and two disks co-axially mounted and relatively rotatable, a refinement of structure 30 adapted to afford more accurate mensuration, such refinement consisting in a plate mounted for rotation on the common axis of the two disks, the said plate carrying integrally one of the two straight edges, means for alternately securing 35 the plate for integral rotation with and releasing it for independent rotation with respect to one of the two disks first named, the second of the two disks first named being the one that carries the other straight edge, the said plate and the 40 first of the two disks first named being slotted with parallel-sided slots that extend in general radial direction with respect to the axis of turning but having in the assembly mutual obliquity of position, and a block engaging at once the 45 parallel sides of both slots and movable longitudinally of the so engaged slots and radially with respect to the axis of turning.

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