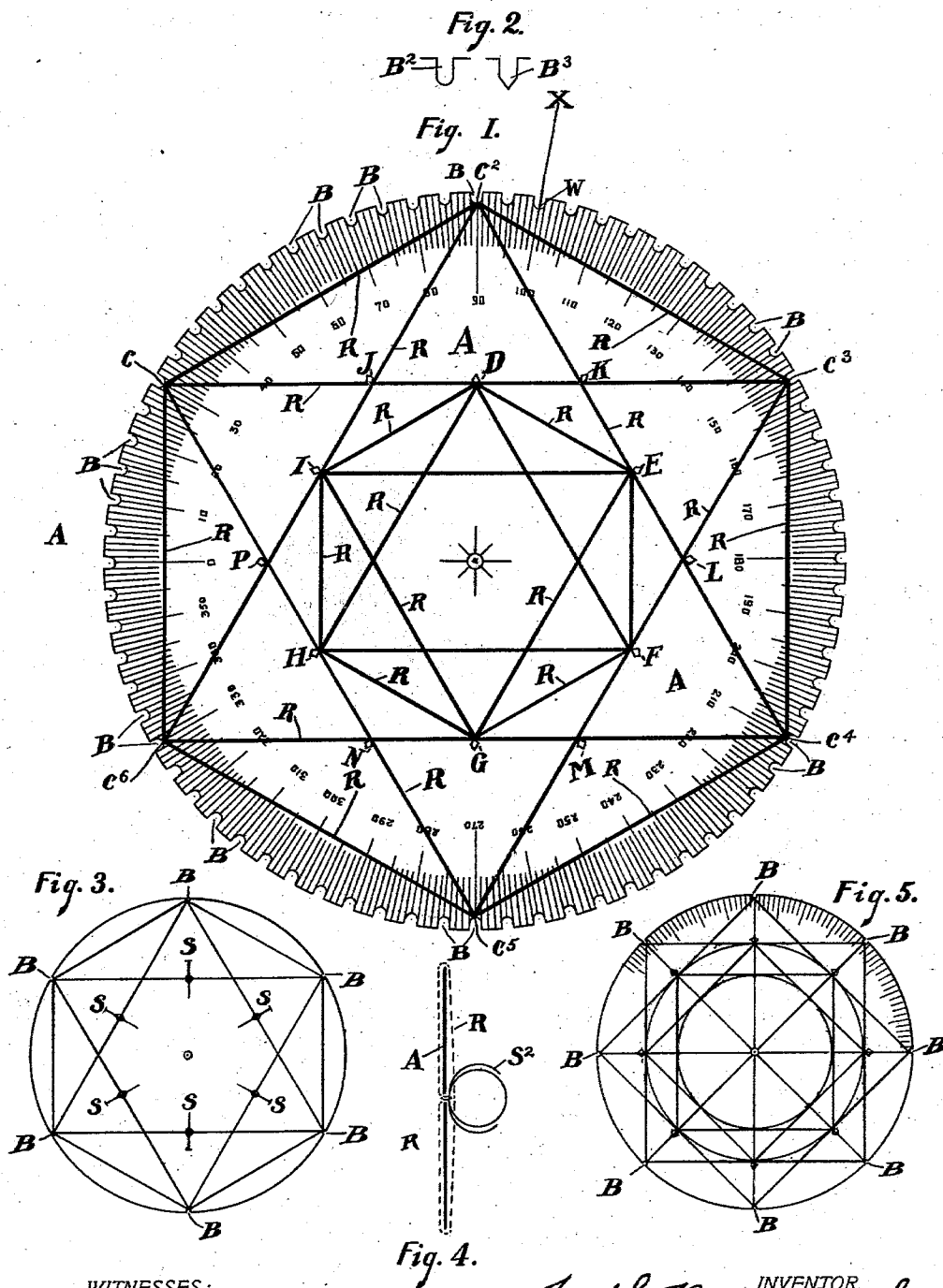


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J. H. RENSHAW.
PROTRACTOR AND ITS ACCOMPANIMENTS.
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NO MODEL.



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PROTRACTOR AND ITS ACCOMPANIMENTS.

SPECIFICATION forming part of Letters Patent No. 757,568, dated April 19, 1904.

Application filed February 17, 1902. Serial No. 94,529. (No model.)

To all whom it may concern:

Be it known that I, JOSEPH HOWARD RENSHAW, a citizen of the United States, and a resident of the city of Cincinnati, in the county of Hamilton and State of Ohio, have invented certain new and useful Improvements in Protractors and Their Accompaniments, of which the following is a specification.

My protractor is generally useful. It was, however, primarily invented to assist those classes of mechanics, of draftsmen, of students, including school children, who cannot execute protractors or intricate geometric figures with drawing instruments or who have not the time or the facilities for so doing.

The protractor is peculiarly well adapted for use as a pocket or field piece (instrument) for students, &c., and for stone-cutters, carpenters, and for those of other trades whose work involves or requires the setting off of angles relative to the material to be operated upon.

As a class-room appliance my protractor gives a maximum of perfect geometric and arithmetical figures without any of the disadvantages or the disagreeable features of existing methods.

My protractor does not require professional accuracy to execute, but can be accurately manipulated by the most clumsy mechanic or student. It affords an accurate means of protracting and at the same time as a chart gives facilities for planning or experimenting. It is admirably adapted for teaching concrete geometry, mensuration, and geography.

In the accompanying drawings, making a part of this specification, and in which similar letters of reference indicate corresponding parts, Figure 1 represents a side elevation of a protractor illustrating my invention. Fig. 2 illustrates two of the preferred kinds of notches which are present at the peripheral edge of the protractor-disk. Fig. 3 illustrates one means of securing the elastic band or bands to the protractor-disk. Fig. 4 illustrates another means of securing the elastic band or bands to the protractor-disk. Fig. 5 illustrates certain modes of placing upon

the protractor an additional circle or circles, polygon or polygons.

I will now proceed to describe my invention in detail. A indicates a protractor-disk. This consists of a thin circular piece of material whose general surface is preferably white. This disk is graduated at and near its peripheral edge to represent the degrees of a circle. The peripheral or outer edge is provided with notches B, whose radial center line is coincident with a radius of the circle described by the protractor. I provide rubber or other elastic bands R. In the drawings, Fig. 1, I have illustrated the use of these bands. Thus C C² indicate an elastic band engaging two of the notches, one-half of the band being seen and one-half of the band being at the rear of the protractor-disk. So, also, C² C³, C³ C⁴, C⁴ C⁵, C⁵ C⁶, C⁶ C⁷, C⁷ C⁸, C⁸ C⁹, C⁹ C¹⁰ represent elastic bands engaging the notches, one-half of the band being at the rear. These bands indicate chords of the circle of the protractor-disk.

Any band may be altered to and made to engage at either end or both ends a notch or notches other than what it now engages, thus forming a different chord from that it now makes. This may be done at the will of the one using the protractor.

D E F G H I respectively indicate holes made in the protractor and illustrating how such holes can be made for use. In the present illustrative instance the holes are in the lines of the chords indicated by the bands aforementioned. These holes bisect or trisect the chords of regular inscribed polygons or represent the vertices of the angles of regular polygons concentric with center of the circle of the protractor-disk. I D, D E, E F, F G, G H, H I, I E, E G, G I, H D, D F, F H represent rubber bands or elastics used as lines to connect the said series of holes bisecting the chords of the hexagon D E F G H I.

Among the various modes of using the elastic bands to represent lines as mentioned in the last paragraph the preferred ones are shown—namely, by a pin S or by a split ring S², located at the rear of the protractor-disk.

In using the pin S the looped end of the rubber band is passed through the desired hole in the protractor-disk and the pin passed and set within the loop and against the disk, substantially as shown in Fig. 3. The band will when elastic draw upon the pin sufficiently to hold it in place against the rear of the protractor-disk.

In using the split ring the looped end of the rubber band is passed through the desired hole in the protractor-disk and the split ring caught into the looped end, substantially as shown in Fig. 4.

Any series of holes are to be made and used, as desired; but to be of value in connection with the advantages offered by my invention these holes should be so placed as to bisect or trisect or regularly intersect the chords bounding an inscribed polygon or else constitute the vertices of the angles of any regular polygon concentric with the protractor-disk.

In order to extend the scope and utility of my invention, it should be borne in mind, relative to the graduations shown on the protractor-disk, there may be substituted instead of degrees, which are a common multiple of all fractional denominators up to twelve, except seven and eleven, any graduation, such as inches, hundredths of decimals, metric divisions, &c.

Any suitable material may be used for making the protractor-disk. Among such material may be mentioned sheet metal, wood, pulp substance, &c. A desirable material is aluminium or the latter mixed with a stiffening alloy, because the same is not only light, but can be written upon by the one using the protractor-disk, and the writing or characters so written or marked thereon can be afterward easily erased. Very desirable materials are transparent or semitransparent materials, which cannot only be written or marked upon and the writing or marks be erased when desired, but the material can be seen through, thereby conferring upon the protractor a valuable feature of advantage, in that it (the protractor) can be placed on the drawing or work, and the angles can be read through the transparent or semitransparent disk on or against the matter underneath the disk. Among such desirable materials I would mention celluloid, also a manufactured substance recently brought to attention, known as "amber." This is a valuable requisite of the protractor-disk for mechanics or students studying geometry and requiring the angles and lines lettered or numbered or otherwise marked.

Further detailed explanation relative to certain features of my invention will now be given.

The peripheral notches B B, &c., are of two-fold purpose. They afford a new means of obtaining accuracy in transferring an angle from the protractor to the drawing, in that they not only permit the protracted line, as

W X, to touch the circumference, but also to extend within it to the depth of the notch, which is considerable. If the line is not drawn true, it can more readily be detected by its distance from the degree-marks on its immediate right and left than from the graduation which was prolonged, the prolongation seldom having the same width as the graduation-line, especially in the case of a sketched line.

The notches B hold the bands, as A B, B C, &c., Fig. 1, from slipping off the disk. The preferred form of notches are illustrated in Fig. 2 and are as follows: The notch shown at B² has parallel sides terminating in a U-shaped end, and the notch B³ has parallel sides terminating in a V-shaped end. The notches bring the band or bands into the exact position needed to be assumed. The elasticity of the band automatically brings the band into the bottom or V-shaped portion of the notch. The introduction of the band into the bottom of the V-shaped part of the notch accomplishes more accurate work than instruments.

The notches may be placed at any of the degree-marks as desired; certainly not all, but preferably at each fifth degree, beginning at zero.

C C², C² C³, &c., represented by the broad dark lines on Fig. 1, represent the elastic bands, and they in turn represent lines, with notches at every fifth degree, and elastic bands. The outlines of any regular or irregular polygon, together with their diagonals, can be readily constructed, and the chord taken with its arc can be measured. The circumference being graduated, the measure of any of the angles of the inscribed polygon can be found by counting the number of degrees in the arc included between the sides of the angle, knowing that an angle with its vertex lying in the circumference of a circle is measured by one-half of the arc included between its sides. Thus the elastic bands and notched protractor become a potent factor in constructive and demonstrative concrete geometry, arithmetic, geography, physics, &c.

The center of the protractor-disk being provided with a circular hole concentric with the disk, this hole permits of elastic bands passing through it. They can be fastened by a pin, as in Fig. 3, or can be fastened by an open or split ring, as shown in Fig. 4, without breaking or in any wise injuring them—i. e., the bands. The center hole adds a radial element to the chart, giving with a band an adjustable angle at the center, which the graduations in the circumference measure.

The center hole may be graduated to give greater exactness in locating the center or vertex of the figure concentric with the protractor when it is desired to protract.

The pin or ring acts (in connection with a given hole) as a pivot, giving the band a wide range of angular motion around the circum-

ference. The bands placed as diameters and pivoted by the ring at the center hole permits the diameter to be broken in two radii, which are movable around the disk. This is
 5 extremely valuable in teaching the angle, an angle being the amount of divergence of two straight lines having a point in common and is measured by the arc of a circle having its center common to the two lines.

10 To permit of more complicated geometric figures and problems than can be constructed by the use of radii diameters and chords, holes have been placed in the protractor in such a relation to each other and the chart that they,
 15 with bands, will give regular figures within in regular inscribed figures, the requisite for their use being that they either bisect, as in Fig. 1, the holes at D, E, F, G, H, and I or trisect, as in Fig. 1, the holes at J K L M N
 20 P, the chord bounding a regular inscribed polygon or form the vertices of the angles of a regular irregular polygon having its center concentric with the center of the protractor.

The perforations of the disk may be made
 25 diamond shape, the diagonals of which shall lie in the line of a radius and a chord, respectively, giving accuracy to the position of the bands, also accuracy in protracting.

As indicated in Fig. 5, there may be more
 30 than one circle placed upon the protractor when it is deemed necessary and the graduations read by connecting the center and the peripheral graduations when the circles are concentric.

35 The protractor may be used to advantage by placing a sheet of paper on it, using the rubber bands to hold it (the paper) in place, and the design plotted or protracted upon the paper.

40 This invention is not only distinctively new in its features, but remarkably so in this fact that thousands of geometric, arithmetical, and geographical problems and principles can be easily proven with the use of one chart and
 45 only nine elastic bands. When the problems become intricate, the angles and lines can be designated by letters or other characters and erased when the construction is taken from the protractor. It especially appeals to pre-
 50 ceptors teaching fractions and incidental number, because the pupils of these classes cannot draw to any degree of accuracy. Mechanics whose hands are too rough for pencil-work have here a tool of unlimited possibilities.
 55 As an introduction to concrete geometry it is superior to paper cutting or folding.

My invention is completely advantageously useful when used in connection with an elastic band or bands, elastic cord or cords, of proper
 60 length; but it is partly useful in a modified and inferior degree when a non-elastic band or bands, cord or cords, of proper length are employed.

The protractor may be made in the shape
 65 of a sector or segment, giving the invention a

wider range of application, especially in proportion.

What I claim as new and of my invention, and desire to secure by Letters Patent, is—

1. A circular protractor-sheet provided
 70 with notches on its edge, and an elastic band or bands, adapted for use in connection with such notches and in application thereto, substantially as and for the purposes specified.

2. A circular protractor-sheet provided
 75 with notches on its edge, and adapted to receive a band or bands, for mathematical purposes, substantially as and for the purposes specified.

3. A circular protractor-sheet, having marginal graduations, and provided with notches,
 80 and a band or bands, adapted to enter such notches for mathematical purposes, substantially as and for the purposes specified.

4. A circular protractor-sheet having marginal graduations, and provided with notches
 85 adapted to receive an elastic band or bands, the elastic band or bands, cord or cords, in combination therewith, substantially as and for the purposes specified.

5. A circular protractor having marginal graduations and provided with notches on its
 90 edge, and having one or more perforations in the sheet, and a band, or bands, adapted to enter said notches, and means for holding the band in the desired perforation or perfora-
 95 tions, substantially as and for the purposes specified.

6. A circular protractor-sheet, provided with notches on its edge, and having one or
 100 more perforations in the sheet, and a band or bands, adapted to enter said notches, and means for holding such band in each of such perforations, substantially as and for the purposes specified.

7. A circular protractor-sheet provided with notches on its edge and having one or
 105 more perforations in the sheet, and an elastic band or bands, adapted to enter said notches, and means for holding such band at or in each of such perforations, substantially as and for the purposes specified.

8. A circular protractor-sheet provided with notches on its edge, marginal graduations, and a central perforation marginally
 115 graduated, and a band or bands, and means for holding such band in such perforation, substantially as and for the purposes specified.

9. A circular protractor-sheet provided with notches on its edge, marginal graduations, and a central perforation marginally gradu-
 120 ated, and an elastic band or bands, and means for holding such band in such perforation, substantially as and for the purposes specified.

10. A circular protractor-sheet provided with marginal graduations, and notches at its
 125 edges, and one or more perforations at desired places in it, the perforations being of a diamond shape, the diagonals of the latter being in the line of and perpendicular to the radius
 130

of the circle of the protractor, one or more bands, and means for holding the said band in each of such perforations, substantially as and for the purposes specified.

5 11. A circular protractor-sheet provided with marginal graduations, and notches at its edges, and one or more perforations at desired places in it, the perforations being of a diamond shape, the diagonals of the latter being
10 in the line of and perpendicular to the radius of the circle of the protractor, one or more elastic bands, and means for holding the said band in each of such perforations, substantially as and for the purposes specified.

15 12. A circular protractor-sheet having notches at its edge, and one or more perforations in it as desired, and a split ring, and one or more bands adapted to enter any one of said notches, and be held by said ring in connection
20 with one of said perforations, substantially as and for the purposes specified.

13. A circular protractor-sheet having marginal graduations, and notches at its edge, and composed of a substance transparent enough
25 to see marks on a substance below it, and one or more bands, adapted to be used in connection with such notches, substantially as and for the purposes specified.

14. A circular protractor-sheet having marginal graduations, and notches at its edge, and composed of a substance transparent enough
30 to see marks on a substance below it, and one or more elastic bands, adapted to be used in connection with such notches, substantially as and for the purposes specified.

15. A circular protractor having marginal graduations and notches on its edge, and composed of a material, which latter readily receives marks and allows them to be readily
40 erased, and a band or bands, adapted to be received in the notch or notches, substantially as and for the purposes specified.

16. As a new article of manufacture, a cir-

cular protractor composed of a transparent material, adapted to receive marks and permitting them to be readily erased, and having
45 notches on its edge, and marginal graduations, one or more bands, for use with such notches, substantially as and for the purposes specified.

17. As a new article of manufacture, a circular protractor composed of a transparent
50 material, adapted to receive marks and permitting them to be readily erased, and having notches in its edge, and marginal graduations, one or more bands, for use with such notches,
55 and one or more perforations at suitable places, and means for holding a band, at each of such perforations, substantially as and for the purposes specified.

18. A circular protractor having graduations, and one or more perforations, and one or more bands, and means for holding the band at each of such perforations, substantially as and for the purposes specified.

19. As a new article of manufacture, a circular protractor composed of a material, adapted to receive marks and permitting them to be readily erased, and having notches in its edge,
65 and marginal graduations, one or more bands, for use with such notches, and one or more perforations at suitable places, and means for holding a band, at each of such perforations,
70 substantially as and for the purposes specified.

20. A protractor duly laid off with marginal graduations, and provided with notches located on opposite edges, and an elastic band adapted to be connected to the notches and strained between the same, the notches being
75 located relatively to the graduations, and adapted to locate the elastic band relatively to the latter, substantially as and for the purposes
80 specified.

JOSEPH HOWARD RENSHAW.

Attest:

E. STARBUCK SMITH,
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