C. SCHREIBER.

PROTRACTOR.

APPLICATION FILED NOV. 6, 1916.

1,318,607.

Patented Oct. 14, 1919.

2 SHEETS—SHEET 1.

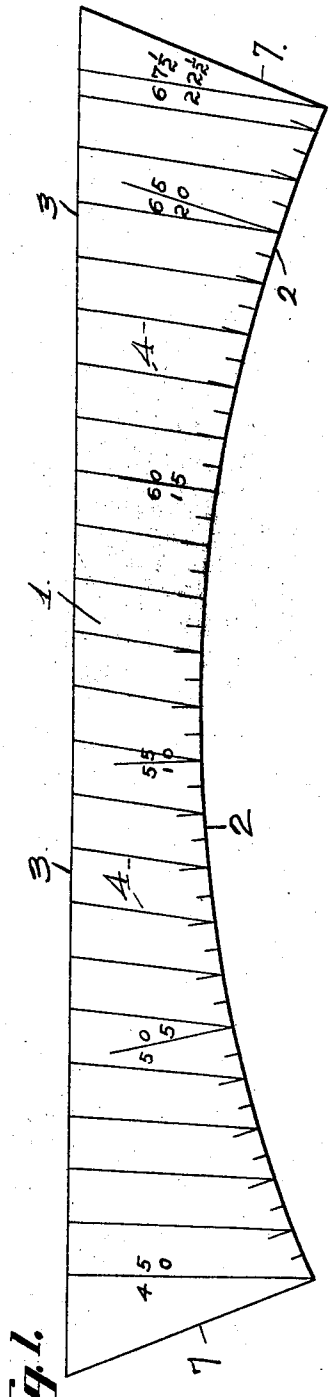


Fig. 1.

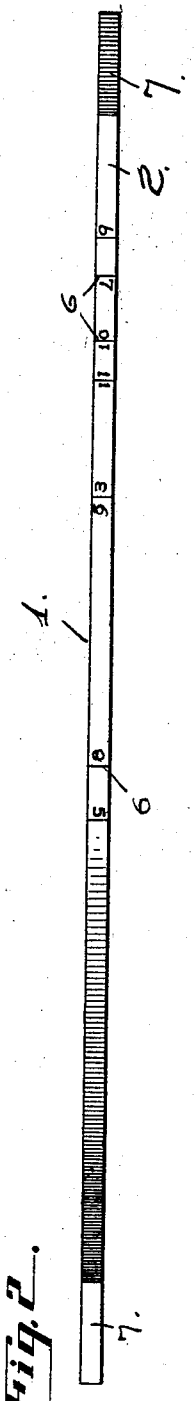


Fig. 2.

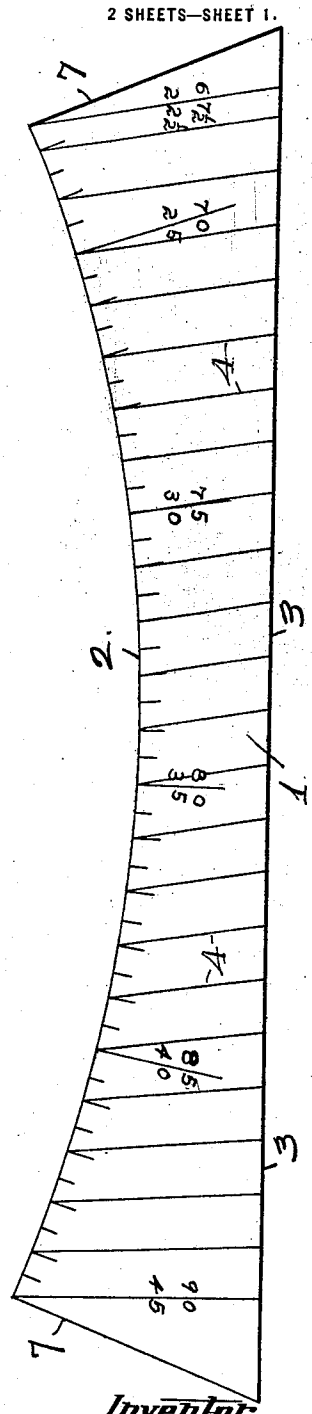


Fig. 3.

Inventor
Conrad Schreiber
By Arthur L. Slee.
His Atty.

C. SCHREIBER.

PROTRACTOR.

APPLICATION FILED NOV. 6, 1916.

1,318,607.

Patented Oct. 14, 1919.

2 SHEETS—SHEET 2.

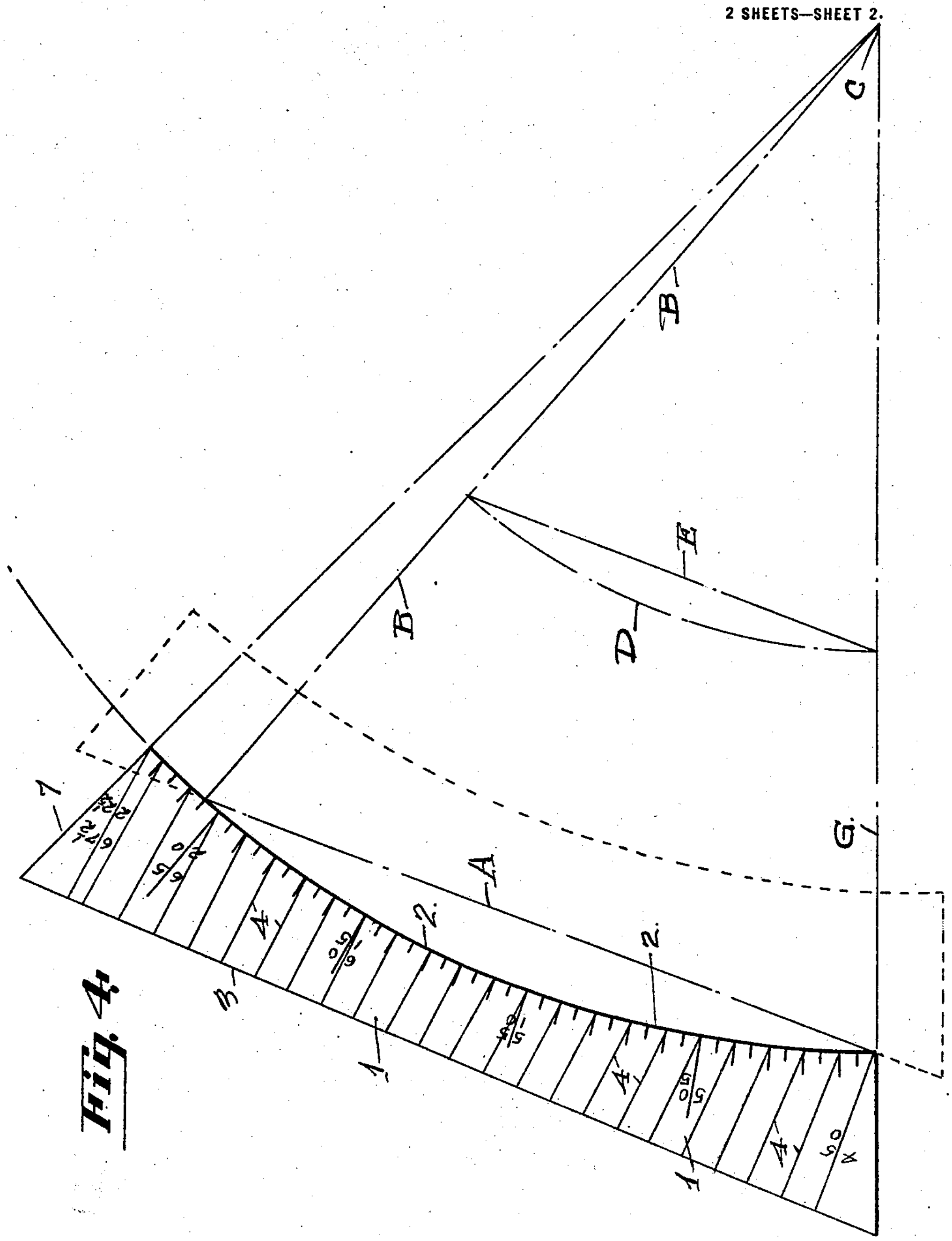


Fig. 4.

Inventor

Conrad Schreiber

By Arthur L. Slee

His Atty.

THE COLUMBIA PLANOGRAPH CO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

CONRAD SCHREIBER, OF SAN FRANCISCO, CALIFORNIA.

PROTRACTOR.

1,318,607. Specification of Letters Patent. Patented Oct. 14, 1919.

Application filed November 6, 1916. Serial No. 130,909.

To all whom it may concern:

Be it known that I, CONRAD SCHREIBER, a citizen of the United States, residing in the city and county of San Francisco and State of California, have invented a new and useful Improvement in Protractors, of which the following is a specification.

My invention relates to protractors for the use of carpenters, mill wrights, sheet metal workers and other artisans, whose work requires a knowledge of geometry and trigonometry, and wherein certain angles and lengths of curves must be determined, and the objects of my invention are—

First, to provide an improved protractor arranged to indicate in a straight line the length of an arc;

Second, to provide an improved protractor adapted to provide a means whereby a circle or any portion thereof may be laid out with reasonable accuracy;

Third, to provide an improved protractor arranged to determine the length of one side of several polygons capable of being inscribed within any circle.

I accomplish these several objects by means of the preferred form of an arc of the device disclosed in the drawings forming a part of the present specification wherein like characters of reference are used to designate similar parts throughout the said specification and drawings, and in which—

Figure 1 is a plan view of one side of the protractor.

Fig. 2 is a side elevation of Fig. 1.

Fig. 3 is a plan view of the reverse or opposite side of the protractor, and

Fig. 4 is a diagrammatic view disclosing one application of the device.

The design and operation of this device is based on the well known principle that when corresponding angles of several triangles are equal the corresponding sides of the said triangles are in direct proportion to each other.

Referring to the drawings the numeral 1 is used to designate a comparatively thin and flat protractor having an arcuate edge 2 and an opposite straight edge 3.

Both faces or sides of the protractor 1 are graduated radially from the arcuate edge 2 to indicate degrees, and other graduations 4 extend from the intersections of said degree graduations with the arcuate edge 2 across the faces or surfaces of the protractor 1 to the straight edges 3 thereof. The direction of the graduations 4 is such that a length between the end graduations on the straight edge 3 equal to the length of the arcuate edge 2 will be divided into the same number of parts as said arcuate edge 2.

Hence the length, in a straight line, of an arc of one or any number of degrees of the circle represented by the arcuate edge 2 may be instantly determined and measured off.

The actual dimension of each space between the graduations representing one degree is actually two degrees in length, the purpose of which will hereinafter be more fully set forth.

The face of the arcuate edge 2 is provided with certain graduations 6 which represent the chord of an arc, or one side of various polygons.

Graduations for producing an equilateral triangle, a three-sided polygon. as well as graduations for a square, or four-sided polygon, are not given as these may be easily determined in various other ways.

The ends 7 of the protractor 1 are arranged at an angle of $67\frac{1}{2}°$ to the straight side 3 and these ends extended or produced, would meet at the center of a circle of which the arcuate edge 2 is a part. Referring to Fig. 4 it will be observed that as the two ends 7 with the straight edge or side 3 form two angles of $67\frac{1}{2}°$ which will total 135° the angle at C will be 180° minus 135° or 45°.

Therefore, the sides 7 are at an angle of 45° relatively to each other instead of $22\frac{1}{2}°$ as indicated by the graduations 4, and eight of these protractors, or the same protractor turned over on its ends 8 times would complete a circle and if a line were drawn along the straight edge 3 at each turn an octagon would be described.

It will be noted in Fig. 2 that the numeral 6, as well as certain other numerals indicating the graduations 6, are inverted. The reason for this will be apparent when it is noted that one sixth is greater in length than one eighth of a circle. Therefore, to measure off the length of one side of a hexagon it would be necessary to lay the protractor as in Fig. 4 and then turn it upon its upper end 7 which would lay the protractor 1 on the adjacent eighth of the circle and turn the index 6 uppermost to indicate that end of one-sixth of a circle extending from the

base line G. One-fifth of a circle would be longer and is indicated farther on. The numeral or index 8 is also indicated midway between the ends of the arcuate edge 2 and from this it is apparent that an octagon may be laid out from two points, viz; the center as well as from the ends of the protractor 1.

In laying out the sides of a hollow octagonal column it is evident that boards of the proper width have longitudinal edges beveled to an angle of 22½° from the edges of the board. Therefore, I find from experiment that it is more convenient to designate the included arc on the arcuate sides 2 as being 22½° instead of 45° which is the actual degree. A further reason for indicating the degrees as twice the actual size is that in laying out longitudinal boards for hollow octagonal, hexagonal or other polygons, that the amount of material to be beveled off from the edge of the board is equivalent to a wedge including an angle of a degree indicated by the width of the board on the arcuate edge 2 of the protractor 1.

This is evident in laying out an octagonal hollow column composed of boards to form the longitudinal sides of the column.

Referring to Fig. 4 consider the protractor 1 as being a cross section of one of the longitudinal boards or members comprising a hollow octagonal column.

It will be observed that seven other boards similar in cross section laid edge to edge would form an octagonal column and that to bevel the edges of said boards to make them fit it would be necessary to remove a wedge from both edges of each board equal to an angle of 22½° which is the degree of the arc indicated by the protractor 1 or the arcuate edge 2 thereof. Were the members made of solid wedges instead of flat boards said wedges would include angles of 45° each, eight of them being required to form an octagonal column.

It will be found that this is true of other required polygons. In forming a hexagonal column there would be six wedges, each including an angle of 30°. To find the proper bevel for the edges of six boards to make them form a hollow hexagonal column the protractor 1 would be first laid as indicated in full lines in Fig. 4 of the drawings and then turned over on its upper edge so that the protractor 1 would be reversed or inverted and occupy the adjacent section or eighth of the circle of which the arcuate edge is a portion.

The index 6 on the arcuate surface 2 would then be found opposite the radial graduation indicated by the index 30, or at 30° as marked on the arcuate edge 2 of the protractor 1. This would indicate 6 sides to be beveled at an angle of 30° from each edge of each board.

It is obvious from the foregoing that the number of sides required or desired may be obtained and simultaneously the degree each board is to be beveled from the sides thereof will be indicated by the degrees on the arcuate edge 2.

As shown in Fig. 1 the ends of the plate are inclined at an angle of 67½ degrees from the back or straight edge of the plate and the face of the plate is provided with an index numeral 22½ degrees meaning the degree of angle of the edge from a line which is perpendicular to the plane of the face of the board and which indicates accurately the bevel at the edge of the board necessary in matching boards to form an octagonal column the included angle of each segment being 45 degrees of which the 22½ degree angle or ends of the protractor is one-half.

A further use and advantage of the protractor 1 may be as follows:

The protractor may be used to determine the length of a side of any polygon of a diameter other than that of the protractor.

To determine the length, in a straight line, for cornice or sheet metal work as well as for carpentry, of any portion of a circle of any radius or diameter or any chord, the protractor 1 is laid down as indicated in Fig. 4 of the drawings.

The present protractor has for an arcuate edge a portion of a circle struck with a twelve-inch radius. If it is desired to find the length of one side of a polygon inscribed within a circle of six-inch radius the protractor 1 is first laid on the plot in the position indicated in dotted lines in Fig. 4 of the drawings and a chord A equal in length to, let us say, an arc of twenty degrees of a twelve-inch radius, is marked off on an arc corresponding to the arcuate edge 2 of the protractor 1. A radius B is then drawn from the upper end of the chord A to the center C of the circle of which the arcuate edge 2 is a portion.

An arc D, of the required radius is then produced and the chord E of the arc D is the required length of a piece of material which will produce an arc of twenty degrees on the required radius which may be greater or lesser than the radius of the edge 2.

This is evident from the principle that triangles having similar corresponding angles have similar sides and are in direct proportion to each other, and the angle included between the base line G and the radius B is similar in both triangles produced.

Any side of a given polygon inscribed in circles of different diameters may be obtained in a similar manner.

It is obvious from the foregoing that I have provided an improved protractor wherein the length in a straight line of any portion of an arc may be determined as well as the length of one side of any polygon.

Having thus described my invention what

I claim as new and desire to secure by Letters Patent is—

1. A protractor having a graduated arcuate edge and an opposite straight edge graduated to give the length in a straight line of a corresponding portion of the arcuate edge.

2. A protractor having an arcuate edge and means on the said edge for indicating the length of one side of various polygons inscribed within any circle.

3. A protractor having an arcuate edge and an opposite straight edge and graduations on both sides of the protractor dividing the arcuate and straight edges into spaces of equal length, the graduations on one face being numbered successively with the graduations on the opposite face.

4. A protractor having an arcuate edge and an opposite straight edge and graduations on both faces of the protractor dividing the arcuate and straight edges into spaces of equal length.

5. A protractor having an arcuate edge graduated with degree marks and indices, coördinate to the degree marks, on the face of the arcuate edge for indicating the length of one side of several polygons.

6. A protractor having a graduated arcuate edge and an opposite straight edge graduated to indicate the length in a straight line of any portion of the arcuate edge, the ends of said protractor being arranged radial to the arcuate edge and 67½ degrees to the straight edge.

In witness whereof I hereunto set my signature.

CONRAD SCHREIBER.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."