No. 886,695. PATENTED MAY 5, 1908.

J. A. GRENIER.

PROTRACTOR.

APPLICATION FILED FEB. 15, 1907. RENEWED APR. 1, 1908.

3 SHEETS—SHEET 1.

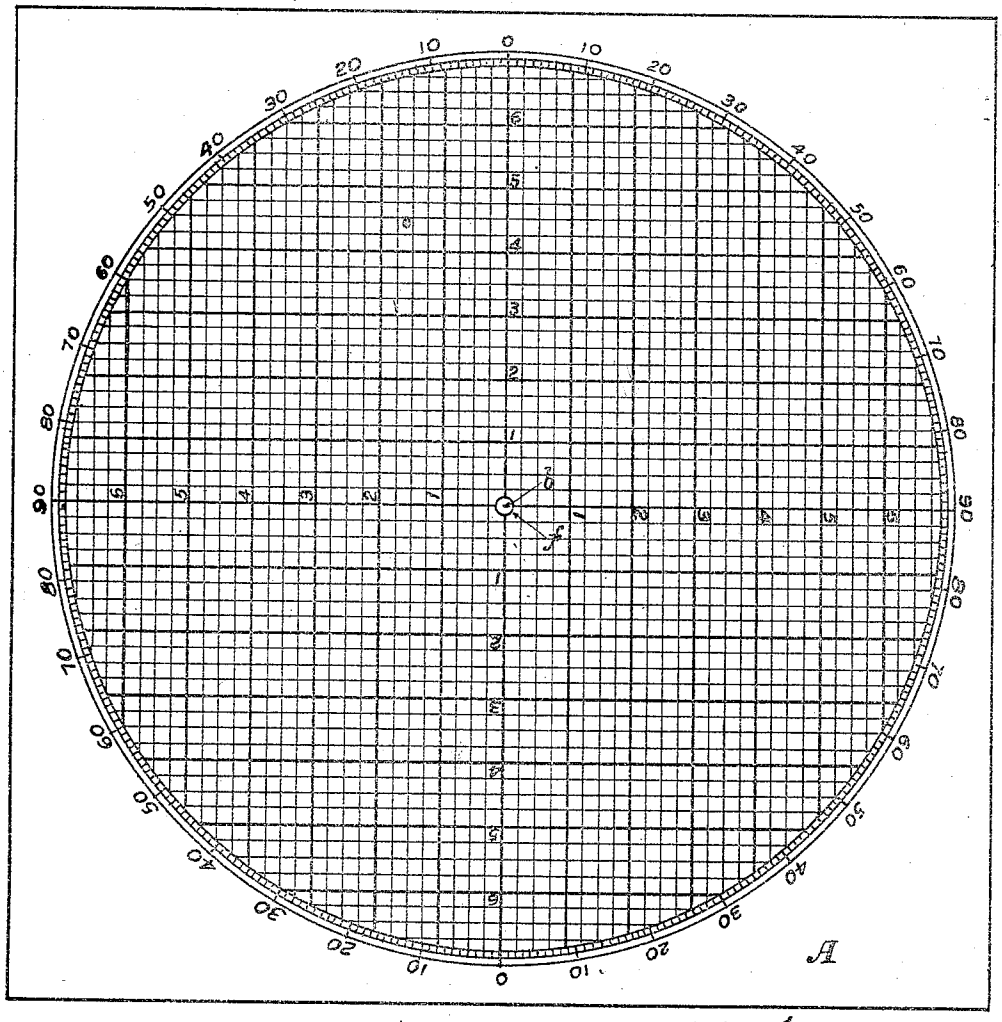


Fig. 1

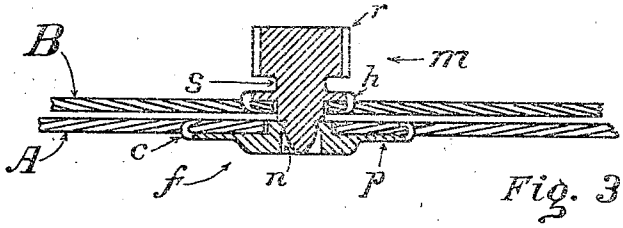


Fig. 3

Witnesses,
Dimpsey L. Reehl.
Dean Burris Carr

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3 SHEETS—SHEET 2.

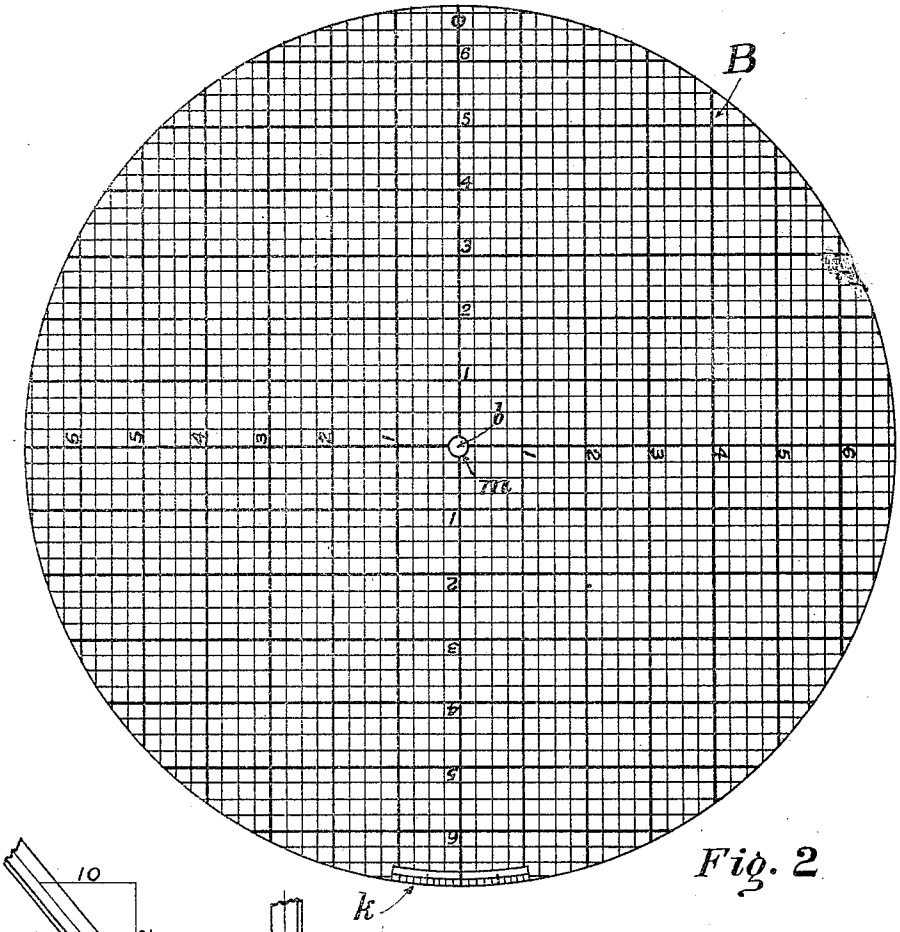


Fig. 2

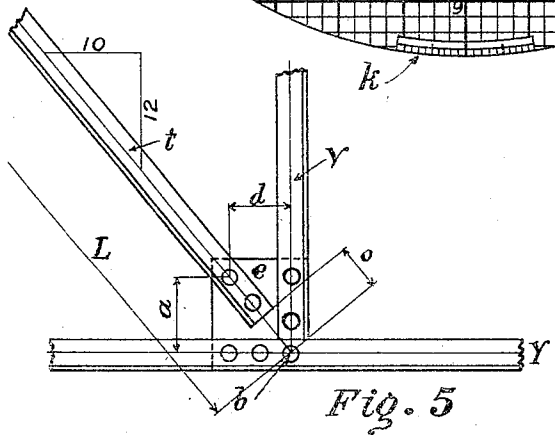


Fig. 5

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3 SHEETS—SHEET 3.

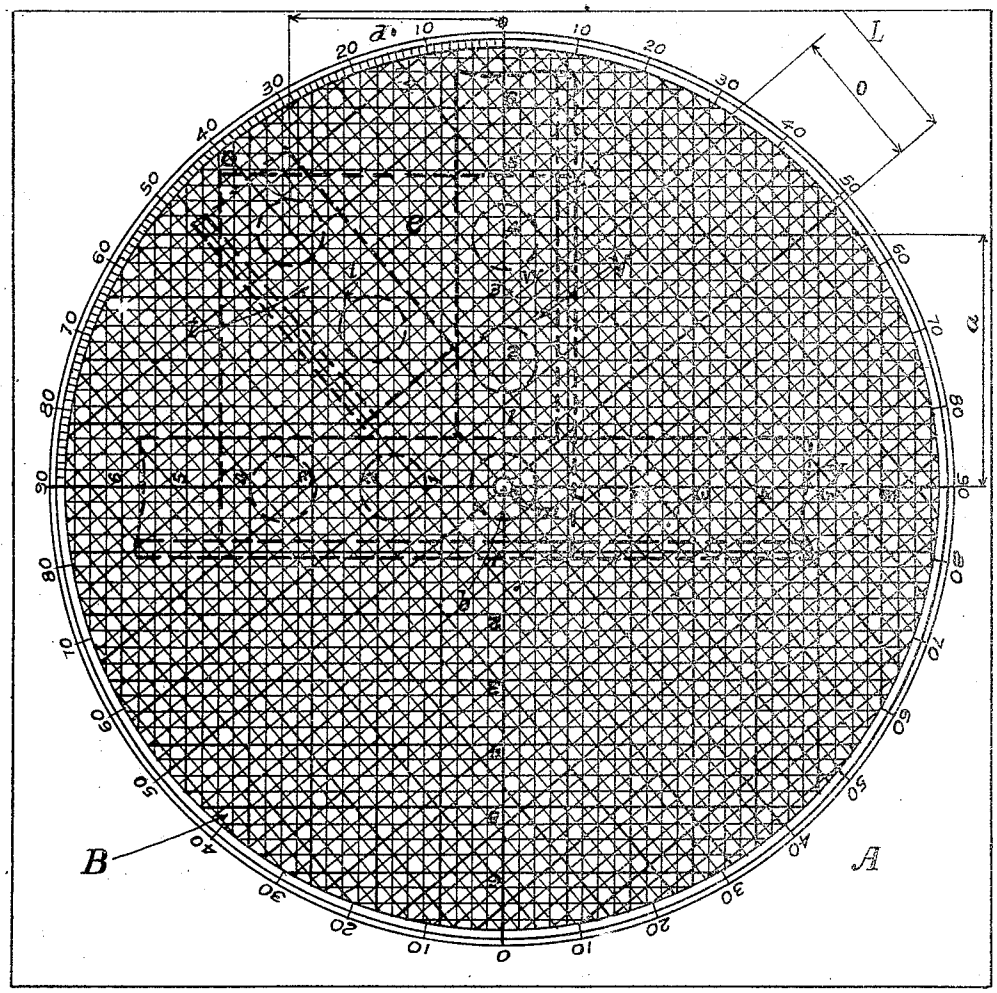


Fig. 4

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Inventor,
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UNITED STATES PATENT OFFICE.

JOSEPH ARTHUR GRENIER, OF BEAVER FALLS, PENNSYLVANIA.

PROTRACTOR.

No. 886,695. Specification of Letters Patent. Patented May 5, 1908.

Application filed February 15, 1907, Serial No. 357,542. Renewed April 1, 1908. Serial No. 424,539.

To all whom it may concern:

Be it known that I, JOSEPH ARTHUR GRENIER, a citizen of the United States, residing at Beaver Falls, in the county of Beaver and State of Pennsylvania, have invented certain new and useful Improvements in Protractors; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to a mathematical device or contrivance, commonly called protractor, and is designed for measuring the functions and properties of angles; it is made in various forms,—namely, circular, semicircular or rectangular.

The objects of my invention are,—first: to readily determine the trigonometrical functions of angles, their measure in degrees and fractions thereof being known. Second: to readily determine the measure in degrees and fractions thereof, of angles their trigonometrical functions being known. Third: to readily determine the stresses in members of roof and bridge trusses or other structures, and fourth: to readily determine the sizes and dimensions of the material to be employed in the construction of roof and bridge trusses or other structures. I attain these objects by the instrument illustrated in the accompanying drawings and which I call a trigonograph.

My invention consists of a bottom sheet graduated for the purpose, a top transparent sheet also graduated for the purpose; these two sheets being connected by a pivot, so that the top sheet may be revolved upon the face of the bottom sheet; all as more clearly described hereafter in this specification.

In the accompanying drawings, Figure 1 represents a bottom sheet graduated, as described here below. Fig. 2 represents a transparent top sheet graduated as described below. Fig. 3 is a section through the pivot. Fig. 4 shows the top and bottom sheets connected together by the pivot, as they must be to carry out their object. In this figure the oblique lines and figures indicate the graduations on the top transparent sheet, the vertical and horizontal lines and figures and the circle of degrees indicate the graduations on the bottom sheet; and Fig. 5 represents, for the purpose of demonstration, a truss connection.

Similar letters refer to similar parts throughout the several views.

The bottom sheet "A", Fig. 1, is made of bristol board or any other material suitable for the purpose, having its face graduated, as follows:—first, from the pivot point "*b*" in the center, inches and fractions thereof, or other denominations of measure, indicated upwards and downwards by horizontal lines and corresponding figures in vertical rotation. Second, from the said pivot point "*b*" in the center, inches and fractions thereof, or other denominations of measure, indicated to the right and to the left, by vertical lines and corresponding figures in horizontal rotation. Third, on the circumference of a circle, having for its center the said pivot point "*b*," degrees and fractions thereof indicated by radial lines and corresponding figures. To the bottom sheet, "A," Fig. 1, at the pivot point "*b*" is very accurately and solidly attached by means of little prongs "*c*," the pivot support "F," see Fig. 3.

The top sheet "B," Fig. 2, is made of transparent celluloid or any other transparent material suitable for the purpose; it is of circular form, the diameter of which is a trifle less than the diameter of the circumference described on the bottom sheet "A," Fig. 1, and has for its center the said pivot point "*b*." The said top sheet is graduated the same as, and correspondingly to the said bottom sheet, excepting the circle of degrees which is omitted on the said top sheet. To the top sheet "B," Fig. 2, at the pivot point "*b*" is accurately and solidly attached by means of little prongs "*h*," the pivot "*m*," see Fig. 3.

The pivot bearing, Fig. 3, consists of two parts:—the pivot support "*f*" and the pivot "M." The support "*f*" has a thin circular flange "*p*" with two or more pointed prongs "*c*" extending out of the circumference of the flange. A hollow stock "*n*" forming part of the support "*f*," extends up the full thickness of the bottom sheet "A." The diameter of the hollow part of the stock "*n*," at the top, is a trifle less than the diameter of the remainder of the said hollow part. The pivot "*m*" has a knob "*r*" and a shaft "*s*"; the pivot "*m*" has two or more prongs "*h*" for the purpose of fastening it to the top sheet "B." The shaft "*s*" has its upper part turned to a diameter a trifle larger than the diameter of the hollow part of the stock

"*n*" at the top; this upper part of the shaft "*s*" extends downward a trifle more than the thickness of the top sheet "B" where its diameter is reduced to the same diameter as the top of the hollow part of the stock "*n*"; the lower part of the shaft is turned to a diameter a trifle larger than the top of the hollow part of the stock "*n*" and down to a point. Thus the pivot "*m*" is so constructed that its shaft "*s*" may be forced in and out of the hollow stock "*n*" and when it is in, that it may turn freely but without looseness in the said hollow stock "*n*." The pivot "*m*" and the support "*f*" are made of brass or any other material suitable for the purpose.

On the circumference of the top sheet "B," Fig. 2, a small arc will contain a vernier scale "*k*" when particularly fine work is required. One example will suffice to demonstrate the manner in which my invention is operated.

In the truss connection, Fig. 5, in which the distance "L" center to center of intersections of the member "*t*" and the angle of obliquity of said member "*t*," 10 in 12, are known, it is necessary to determine the distance "*o*," from intersection "*b*" of the member "*t*" to the end of said member "*t*," at each end, in order to ascertain the length of the material required to construct said member "*t*." It is also necessary to determine the distance "*a*" vertically from the intersection line of bottom chord "*b*—*y*" to the farthest rivet on plate "*e*" in line of member "*t*," and the distance "*d*" horizontally from intersectional line of post "*v*" to said rivet, in order to ascertain the size of the plate "*e*." Heretofore the draftsman, to obtain these results, had to make a full size layout of the connection, which required considerable time, labor and material. With my invention, as shown in Fig. 4, I place the zero line of the top sheet "B" so that it will intersect a point "*i*" twelve parts up from and ten parts to the left of the pivot point "*b*" which is the angle of obliquity of the member "*t*," then I sketch out temporarily, on the top sheet "B" the said truss connection, as shown by dotted lines in Fig. 4. Then I read on the line "*b*—*i*," the said distance "*o*", two and one-fourth inches vertically the said distance "*a*" four inches and horizontally the said distance "*d*" three and three-eighths inches. I also find that the line "*b*—*i*" extended intersects the circle of degrees at thirty-nine degrees and forty-eight minutes, which is therefore the angle of obliquity of the member "*t*" in degrees and minutes. Then the length of the member "*t*" is "L−(*o*+*o*)" and the plate "*e*" after adding the necessary edge distances must not be less than six and one-half inches long and six inches wide. If on the line "*b*—*i*" I take a unit "*b*—*i*" equals one, I read horizontally the sine "*i*—*w*" and vertically the cosine "*w*—*b*" of the angle of obliquity of the member "*t*." If the stress in the member "*t*" is, say, "*b*—*i*", the stress in the post "*v*" will be "*w*—*b*," and the stress in the bottom chord "*b*—*y*" will be "*i*—*w*." It is not even necessary to sketch out the subject, as shown by dotted lines in Fig. 4, as it can be mentally read on the instrument. No scale is required in these operations, as the instrument is a scale in itself. The lines and figures on sheets "A" and "B" may be in black or colors.

I am aware that prior to my invention protractors have been made with a circular sheet or frame having its circumference graduated in degrees and minutes, and a corresponding sheet or frame having an index thereon and made to turn concentrically one on the other for the purpose of measuring angles. I therefore do not claim such a combination broadly; but

What I claim as my invention and desire to secure by Letters Patent is:

A protractor composed of a graduated bottom sheet, a transparent top sheet graduated correspondingly to said bottom sheet and containing a vernier scale, a pivot support fastened to the center of the said bottom sheet, and a pivot made to turn in the said support and fastened to the center of the said top sheet, all substantially as and for the purpose described.

In testimony whereof, I affix my signature in presence of two witnesses.

JOSEPH ARTHUR GRENIER.

Witnesses:

DEMPSEY L. REEHL,

DEAN ORRIS CARR.