PATENT SPECIFICATION

586,215

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PROVISIONAL SPECIFICATION

Improvements in or relating to Slide Rules

We, EDWARD JOHN WALTER, of 139, Well Hall Road, Eltham, London, S.E.9, a British Subject, ROBERT LANSDOWN, 47, Albion Gate, Bayswater Road, London, W.2, a British Subject, do hereby declare the nature of this invention to be as follows:—

This invention relates to instruments adopted for solving mathematical problems by the use of logarithmic scales.

The object of this invention is to provide an instrument which will simplify and accelerate the working of mathematical problems usually done with a straight type slide rule, by reducing to a minimum the number of scales used.

The nature of the invention is now described, it being understood that modifications not affecting the fundamentals may develop.

The instrument comprises (1) a circular dial which is termed the outer log. scale plate, which is marked by divisions and numbers in a circular form consisting of a continuous logarithmic scale on both its obverse and reverse sides, and is pierced in the centre with a small hole. This may be made from any suitable material, cardboard, paper, wood, metal or plastics.

(2) A circular dial which is termed the inner log. scale plate marked with divisions and numbered in a circular form consisting of a continuous logarithmic scale corresponding to that on the outer log. scale plate (1). This is marked with instructions for operating the instrument to obtain square roots. This dial is also pierced with a small hole in the centre, but is of a smaller over-all diameter than the outer log. scale plate (1) so that when assembled the logarithmic scale can be read off against the logarithmic scale on the outer log. scale plate (1). This may be made of any suitable material, cardboard, paper, wood metal or plastics. As an alternative this may be made from a transparent material in the form of a circular plate of the same over-all diameter as the outer log. scale plate (1). The divisions and numbers being so placed as to form a circle smaller in diameter than that occupied by the logarithmic scale on the outer log. scale plate (1) to permit one scale to be read off against the other when assembled. The clear portion of the inner log. scale plate (2) then acting as a protective shield for the markings on the outer log. scale plate (1). This may be made of any suitable material, glass, paper or plastics.

(3) A circular plate which is termed the trig. scale plate, marked with divisions and numbers in a circular form consiting of three sets of scales comprising cosines, sines and tangents.

This dial is also pierced with a small hole in the centre, and is smaller in over-all diameter than the outer log. scale plate (1) to permit the cosine, sine and tangent scales to be read off against the logarithmic scale on the reverse of the outer log. scale plate (1) by means of the cursor (4) when assembled. This may be made of any suitable material, cardboard, paper wood, metal or plastics. As an alternative this may be made from transparent material in the form of a circular plate of the same over-all diameter as the outer log. scale plate (1). The divisions and numbers of the three scales being so placed as to form a series of circles smaller in diameter than that occupied by the logarithmic scale on the reverse of the outer log. scale plate (1) to permit the three scales to be read off against the logarithmic scale on the reverse of the outer log. scale plate (1) by means of the cursor (4). The clear portion of the trig. scale plate (3) then acting as a protective shield for the markings on the reverse of the outer log. scale plate (1). This may be made of any suitable material, glass, paper or plastics.

(4) A strip of transparent material rectangular in form, on which is marked in the centre along its length a hair line, and pierced at each end with a small hole in line with hair line, and central along the width of the material. As an alternative this may be made up of two strips of transparent material of rectangular form, arked along their length with a hair line and each pierced at one end with a small hole central with the hair line, so that by means of a spacer piece of

[Price 1/-] Price 4s 6d

material, to which these are affixed at their free ends, when assembled, of a thickness equal to the combined thickness of the outer log. scale plate (1) the inner log. scale plate (2) and the trig. scale plate (3) thus enabling the cursor (4) to be rotated without fouling the scale plates when the instrument is assembled. This may be made of any suitable material, glass, paper or plastics.

The assembly of the component parts 1, 2, 3 and 4 to make the complete instrument are as follows:—

(5) (2) is first laid in position on (1) with the centre hole in each lining up, (4) is then laid in position where it is made of a single strip of rectangular form, with one of the holes lining up with the holes in (1) and (2) these are then held in position by inserting through the holes in (1), (2) and (4) an eyelet, rivet, pin or screw. (3) is then laid in position on the reverse of (1) with the centre holes in line. The free end of (4) where it is made of a single strip of rectangular form is then bent over so that the hole in the free end lines up with the holes in (1) and (3) and is finally fixed by burring the fixing eyelet, rivet, or pin, or by a nut threaded on to the screw where a screw fixing is used in such a manner as to permit of free rotation of (2), (3) and (4). Where (4) is made up of two strips of material of rectangular form, fixed at their free ends by means of a spacer piece, (1) (2) and (3) are laid in position with their centre holes in alignment, (4) is then sprung into position with the holes in the end of the strips in alignment with the holes in (1), (2) and (3) and fixed by means of an eyelet, rivet, pin or screw, and nut inserted through the holes in (1), (2), (3) and (4). The instrument is then ready for use.

The application of the instrument for use for the purpose for which it is designed is as follows:—

(6) The operator manipulates the rotating dials in such a way, to bring the figure on the dials corresponding to the known quantities of the problem to be solved in line with a known quantity on its opposite scale, and then reads off against the figure equivalent of the first known quantity the answer on the opposite scale. Thus when computing trigonometrical problems the necessity to refer to mathematical tables is disposed of.

Having described my invention, its construction and application, we give as follows examples of its method of employment.

(7) HYPOTHETICAL CASE No. 1.

MULTIPLICATION.

To multiply 8 by 2: Move the inner log. scale plate (2) so that number one comes under number eight on the outer log. scale plate (1) and read off the answer sixteen above number two on the inner log. scale plate (2).

HYPOTHETICAL CASE No. 2.

DIVISION.

To divide 8 by 2: Move the inner log. scale plate (2) (the divisor) so that the number two comes under the number eight on the outer log. scale plate (1) and read the answer four above the number one of the inner log. scale plate (2).

HYPOTHETICAL CASE No. 3.

SQUARE ROOTS.

To obtain square root of 9: Place the cursor (4) over number nine on the outer log. scale plate (1) now move the inner log. scale plate (2) to the right until the number one of the inner log. scale plate (2) comes under the number three of the outer log. scale plate (1) when it will be seen that the number three of the inner log. scale plate (2) is directly under the cursor (4).

Therefore the square root of 9 is 3. This procedure is followed for numbers one to ten.

To obtain square roots of numbers 1—10: Place cursor (4) over number for which the square root is required on the outer log. scale plate (1) now move the inner log. scale plate (2) clockwise (i.e. to the right) until the number one reaches a number on the outer scale log. plate (1) corresponding to that shown under the cursor (4) on the inner log. scale plate (2).

HYPOTHETICAL CASE No. 4.

SQUARE ROOTS.

To obtain square roots of numbers 10—100: Proceed as in hypothetical case No. 3 moving the number one of the inner log. scale plate (2) anti-clockwise (i.e. to the left).

To obtain square roots of 81: Place cursor (4) over number eighty one of outer log. scale plate (1) move inner log. scale plate (2) to the left until the number one comes under the number nine of the outer log. scale plate (1) and again it will be seen that the number nine of the inner log. scale plate (2) is directly under the cursor (4). Therefore the square root of 81 is 9. This procedure is followed for numbers 10 to 100.

HYPOTHETICAL CASE No. 5.

COMPOUNDING ANGLES.

To find the compound of two known angles e.g. 30° and 35°: Place the zero of

the trig. scale plate (3) under the number one of the outer log. scale plate (1) and place the cursor (4) over the cosine of 30° on the trig. scale plate (3) now move the zero on the trig. scale plate (3) under the cursor (4) and move the cursor (4) on to the cosine of 35° on the trig. scale plate (3) now return the zero on the trig. scale plate (3) back under the number one of the outer log. scale plate (1) and the answer 45° is shown under the cursor (4) on the trig. scale plate (3).

As an alternative method, place 30° cosine on the trig. scale plate (3) under the number one on the outer log. scale plate (1) then place the cursor (4) over the zerocosine of the trig. scale plate (3) and move the 35° cosine on the trig. scale plate (3) under the cursor line of the cursor (4) and read off the answer 45° cosine on the trig. scale plate (3) against the number one on the outer log. scale plate (1).

HYPOTHETICAL CASE No. 6.

TRIGONOMETRY.

To prove a right angled triangle with a known angle D of 30° and a known base C of 10″ adjacent the right angle and angle D.

To find the length of side B opposite angle D, multiply C by tangent D. Set the cursor (4) over tangent 30″ on the trig. scale (3) and read off the logarithmic scale equivalent .5774 on the outer log. scale plate (1) multiply by 10″ (C)= 5.774″.

To find the length of hypotenuse A divide the length of side B i.e. 5.774″ by the cosine of the third angle E, 60°, or by the sine of angle D, 30°. Set the cursor (4) over the cosine 60° on the trig. scale plate 3″ and read off the log. equivalent on the outer log. scale plate (1) i.e.

$$.5 = \frac{5.774}{.5} = 11.548.$$

alternatively set, the cursor (4) over the sine 30° on the trig. scale plate (3) and read off the answer 11.548 on the outer log. scale plate (1). To prove side C multiply length of side A i.e. 11.548 by sine of angle E, 60°. Set the cursor (4) over the sine 60° on the trig. scale plate (3) and read off on the outer log. scale plate (1) the answer .866 therefore 11.548″ × .866″ = 10″.

Note in all the foreging cases the zero should be kept under the number one on the outer log. scale plate (1).

HYPOTHETICAL CASE No. 7.

To find the area of a triangle with two known sides A, 3.6″, and B, 3.4″, and a known included angle C of 30°.

$$\text{Area} = \frac{A \times B \times \text{sine } C}{2}$$

Multiply A 3.6″ by B 3.4″, as in hypothetical case No. 1 and the answer is 12.24. Now turn to the sine scale on the trig. scale plate (3) and place the cursor (4) over the sine 30° on the trig. scale plate (3) then read off on the outer log. scale plate (1) .866. Now multiply as explained in hypothetical case No. 1, 12.24″ × .866″ and the answer is 10.6 square inches. Now divide by two as explained in hypothetical case No. 2 and the answer is 5.3 square inches = area of the triangle.

Dated the 5th day of September, 1944.

EDWARD J. WALTER.
ROBERT LANSDOWN.

COMPLETE SPECIFICATION

Improvements in or relating to Slide Rules

We, EDWARD JOHN WALTER, of 139, Well Hall Road, Eltham, London, S.E.9, and ROBERT LANSDOWN, of 47, Albion Gate, Bayswater Road, London, W.2, both British Subjects, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to slide rules adapted for solving mathematical problems by the use of logarithmic and trigonometric scales.

The object of the invention is to provide an improved slide rule whereby the working of mathematical problems is simplified and accelerated.

A slide rule according to this invention comprises three circular discs mounted side-by-side on a common axis and adapted to rotate relatively to each other, the medial disc being provided on both of its faces with angularly divided scales, the two outer discs being each provided on their relatively outer faces with angularly divided scales, the scales on the two faces of the medial disc being each located outside of a circle having a diameter at least equal to the overall diameter of the scales on the outer discs adjacent the respective faces, and a cursor adapted to rotate concentrically around said discs and provided with a radial cursor line, and is characterised in that one scale is provided on each face of the said medial disc and said scales are both graduated according to a logarithmic scale, one of the said outer discs is provided on its outer face with a single scale graduated according to a logarithmic

scale corresponding angularly with the logarithmic scale on that face of said medial disc adjacent to said one outer disc, and the other of said outer discs is provided on its outer face with three concentric scales graduated, respectively, according to logarithmic cosine, sine and tangent scales.

In the accompanying drawings:—

Fig. 1 is a perspective view of one form of device according to the invention.

Fig. 2 is an elevation looking edgewise;

Fig. 3 is a plan view of the obverse side of the device; and

Fig. 4 is a plan view of the reverse side of the device.

Fig. 5 is a side elevation of a modified form of cursor.

Referring to Figs. 1 to 4 the device comprises a medial scale plate 10 and two outer scale plates 11 and 12, the scale plate 10 being disposed between the two scale plates 11 and 12, all of the scale plates being discs and being assembled together by passing a pin 13 through their centres in such manner that the scale plates 11 and 12 may rotate relatively to the scale plate 10 and independently of each other. The two scale plates 11 and 12 are of equal diameters, whilst the scale plate 10 is of larger diameter than said plates 11 and 12.

The outer face of the scale plate 11, relatively to the assembly of plates, is marked around its periphery by divisions and numbers representing a continuous logarithmic scale 14, the scale reading from " 1 " to " 10 " in a clockwise direction.

The outer face of the scale plate 12, relatively to the assembly of plates, is marked around its periphery with divisions and numbers forming a continuous logarithmic scale 15 representing cosines. Also on the outer face of the plate 12 is a continuous logarithmic circular scale 16 representing sines, the scale 16 being concentric with and of less diameter than the scale 15. A continuous logarithmic circular scale 17, representing tangents, is also provided on the outer face of the scale plate 12, the said scale 17 being concentric with the scales 15 and 16, and of less diameter than the scale 16, the arrangement being such that the scales 15, 16 and 17 are disposed one within another, the scale 17 being the innermost and the scale 15 the outermost.

The cosine scale 15 reads anti-clockwise from zero degrees upwards, the sine scale 16 reads anti-clockwise from ninety degrees downwards, and the tangent scale 17 reads anti-clockwise from forty-five degrees downwards, the zero, ninety degrees and forty-five degrees marks on the scales 15, 16 and 17, respectively, being in radial alignment.

The medial scale plate 10 is marked on one side with a continuous logarithmic scale 18 and on the other side with a continuous logarithmic scale 19. The scale plates 10, 11 and 12 are assembled with the plate 11 adjacent the face of plate 10 bearing the scale 18 and with the plate 12 adjacent the face of the plate 10 bearing the scale 19.

The scale 18 is marked outside of a circle equal in diameter to the scale plate 11, the division marks of scale 18 radiating from said circle, and the scale 18 is angularly divided in a manner exactly similar to the scale 14 on the scale plate 11 so that when " 1 " on scale 14 registers radially with " 1 " on scale 18, other figures on scale 14 will also register radially with similar figures on scale 18.

The scale 19 is marked outside of a circle equal in diameter to the scale plate 12, the division marks of scale 19 radiating from said circle. Both scales 18 and 19 read continuously in a circle from " 1 " to " 10 " in a clockwise direction.

The scales 19, 15, 16 and 17 are calibrated in mathematical relation to each other.

A cursor 20 is provided, being made of transparent material bent medially of its ends so as to embrace all three scale plates 10, 11 and 12, and so as to be pivotally mounted by its ends, outside the plates 11 and 12, on the pivot pin 13. The cursor is provided on both sides with radial inscribed hair lines 21, 21.

The scale plates 10, 11 and 12 may be made of any suitable material, for example, cardboard, wood, metal, celluloid or other plastic.

In use, the operator rotates the scale plates so as to bring a known quantity on one scale into radial registration with a known quantity on another scale, the solution of a problem being then read off on one scale radially opposite a known quantity on another scale, the hair lines 21 on the cursor assisting in the radial registration or reading-off.

Examples of the manner in which the device may be used are given hereinafter.

To multiply eight by two, rotate scale plate 11 until " 1 " on scale 14 registers radially with " 8 " on scale 18; the solution of the problem will then be read on scale 18 radially opposite " 2 " on scale 14 and will be found to be " 16 ".

To divide eight by two, rotate scale plate 11 until " 2 " on scale 14 registers radially with " 8 " on scale 18; the solution of the problem will then be read on scale 14 radially opposite " 1 " on scale 18, and will be found to be " 4 ".

To obtain the square root of a number between " 1 " and " 10 ", for example nine, rotate the cursor 20 until the hair line 21 registers with " 9 " on the scale 18. The scale plate 11 is then rotated clockwise until " 1 " on the scale 14 registers with a number on the scale 18 at the same time that a similar number on the scale 14 registers with the hair line 21; it will be found that this number is " 3 ".

To obtain the square root of a number between " 10 " and " 100 " proceed as described for finding the square root of numbers between " 1 " and " 10 ", but rotate the scale plate 11 anti-clockwise.

In order to compound two known angles, for example, thirty degrees and thirty-five degrees, rotate scale plate 12 until " 0 " on scale 15 registers radially with " 1 " on scale 19, place the hair-line 21 of cursor 20 over the cosine " 30 " degrees on scale 15, then rotate scale plate 12 until " 0 " on scale 15 registers with the cursor hair-line, rotate the cursor to place the hair-line over the cosine " 35 " degrees on scale 15, return scale plate 12 until " 0 " on scale 15 again registers with " 1 " on scale 19, and the solution, " 45 " degrees, will be read on scale 15 under the cursor hair-line. Alternatively, rotate scale plate 12 until the cosine " 30 " degrees on scale 15 registers with " 1 " on scale 19, place the cursor hair-line over " 0 " on scale 15, rotate scale plate 12 until cosine " 35 " degrees registers with the cursor hair-line and the answer " 45 " degrees is read off on the scale 15 against " 1 " on scale 19.

To find the length of the perpendicular of a triangle with a known base of ten inches and known base angles of ninety degrees and thirty degrees, register " 1 " on scale 19 with " 45 " degrees on scale 17, set the cursor over tangent " 30 " degrees on scale 17, read off the number under the cursor on scale 19, namely, " .5774 ", multiply by " 10 ", and the answer " 5.774 " inches is obtained. The third angle will be 180 degrees minus 90 degrees plus 30 degrees, namely, 60 degrees. To find the length of the hypotenuse, set the scale plates 10 and 12 with " 0 " of scale 15 in registration with " 1 " of scale 19, set the cursor over cosine " 60 " degrees on scale 15, read off the number on scale 19 under the cursor, namely, " .5 ", divide " 5.774 " by " .5 " in the manner described, and the answer " 11.548 " is obtained.

To find the area of a triangle with two known sides of 3.4 inches and 3.6 inches and a known included angle of 30 degrees, multiply " 3.6 " by " 3.4 " as described and obtain the answer " 12.24 ". With " 0 " on scale 15 registering with " 1 " on scale 19, place the cursor over the sine " 30 " degrees on scale 16 and read off under the cursor " .866 " on the scale 19. Multiply " 12.24 " by " .866 " as described and obtain " 10.6 ". Divide " 10.6 " by " 2 " as described and the answer of " 5.3 " square inches as the area of the triangle is obtained.

In a modified form of device the scale plates 11 and 12 are transparent and are of the same diameter as the scale plate 10. The scale 14 is inscribed on the plate 11 within a circle and the scale 18 is inscribed on the plate 10 outside a circle, both of said circles being of the same diameter. The scales 15, 16 and 17 are inscribed on the plate 12 within a circle, and the scale 19 is inscribed on the plate 10 outside a circle, both of said circles being of the same diameter. Thereby the scales on plate 10 will be protected by the transparent portions of scale plates 11 and 12 projecting outside the scales 14 and 15 respectively.

Instead of the cursor being made of one piece of material bent to lie on both sides of the device, as shown in Figs. 1 to 4, it may be made of two pieces of material 22, 23, Fig. 5, each adapted to form a cursor for one side of the device, and connected together at their outer ends in any suitable manner by a spacing member 24.

Having now particularly described and ascertained the nature of our said invention, and in what manner the same is to be performed, we declare that what we claim is:—

1. A slide rule comprising three circular discs mounted side-by-side on a common axis and adapted to rotate relatively to each other, the medial disc being provided on both of its faces with angularly divided scales, the two outer discs being each provided on their relatively outer faces with angularly divided scales, the scales on the two faces of the medial disc being each located outside of a circle having a diameter at least equal to the overall diameter of the scales on the outer discs adjacent the respective faces, and a cursor adapted to rotate concentrically around said discs and provided with a radial cursor line, characterised in that one scale is provided on each face of the said medial disc and said scales are both graduated according to a logarithmic scale, one of the said outer discs is provided on its outer face with a single scale graduated according to a logarithmic scale corresponding angularly with the logarithmic scale on that face

of said medial disc adjacent to said one outer disc, and the other of said outer discs is provided on its outer face with three concentric scales graduated, respectively, according to logarithmic cosine, sine and tangent scales.

2. A slide rule according to claim 1, wherein the medial disc is of larger diameter than the two outer discs, and the scale on each face of the medial disc is located outside of a circle at least equal to the overall diameter of the adjacent outer disc.

3. A slide rule according to claim 1 wherein the two outer discs are transparent.

4. A slide rule according to claim 3 wherein all three discs are of equal diameter.

5. The constructional form of slide rule illustrated in Figs. 1 to 4 of the accompanying drawings and described with reference thereto.

6. The constructional form of slide rule according to claim 5 modified as illustrated in Fig. 5 of the accompanying drawings and described with reference thereto.

Dated this 31st day of August, 1945.

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Fig. 1.

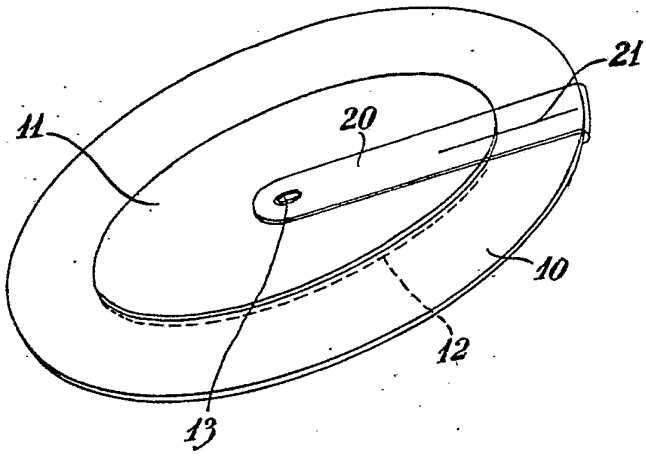

Fig. 3.

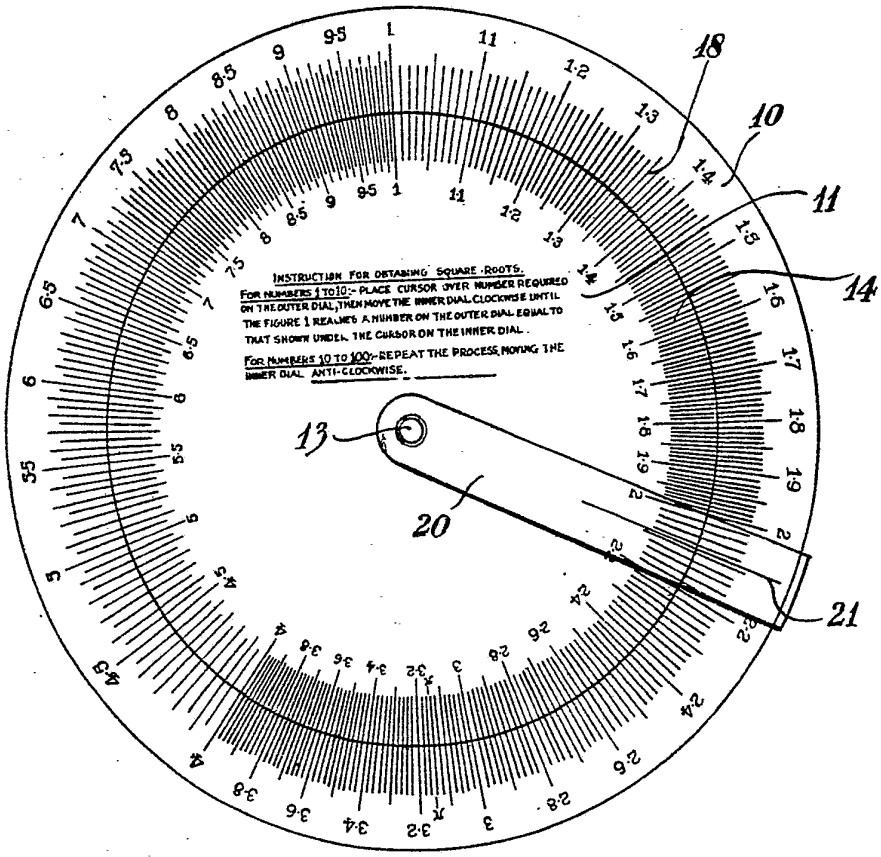

Fig. 2.

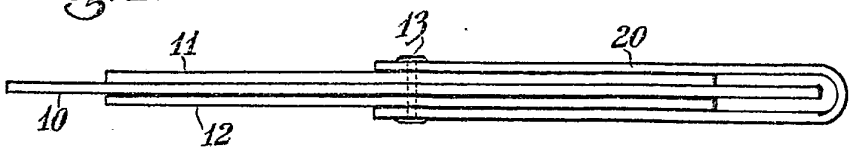

Fig. 4.

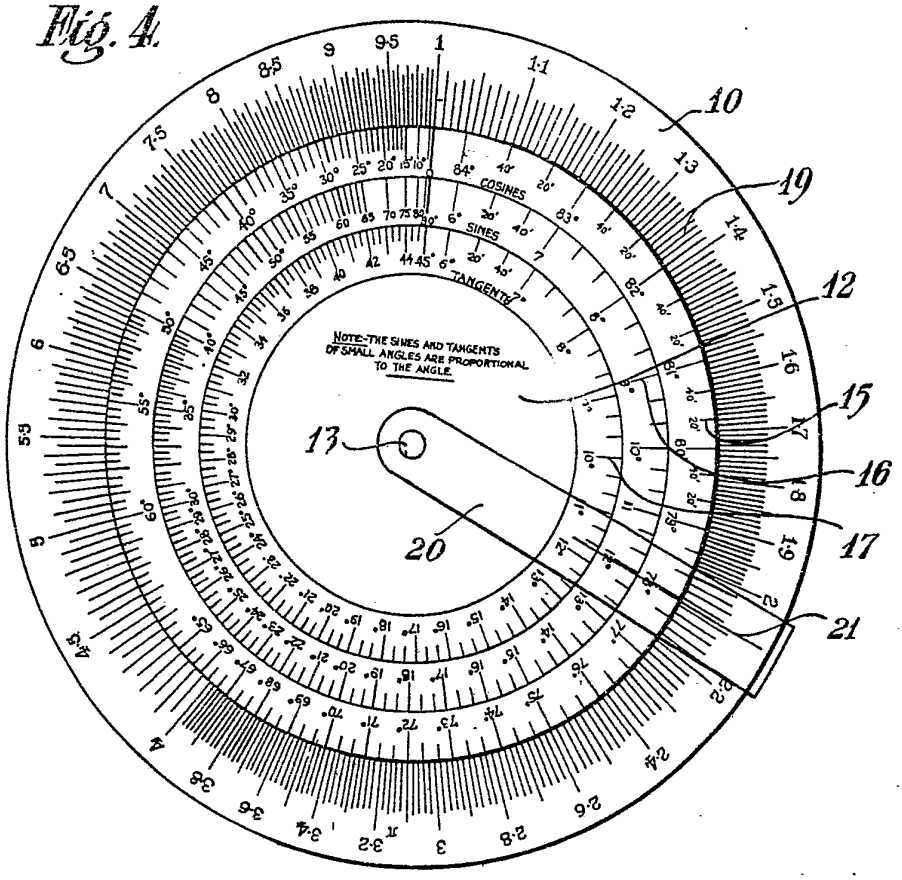

Fig. 5.

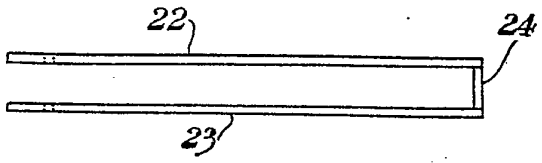

Fig. 1.

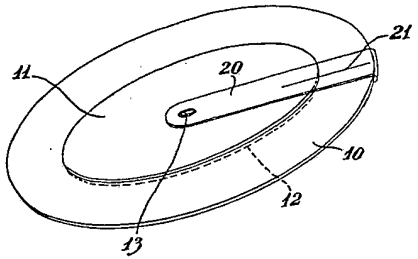

Fig. 3.

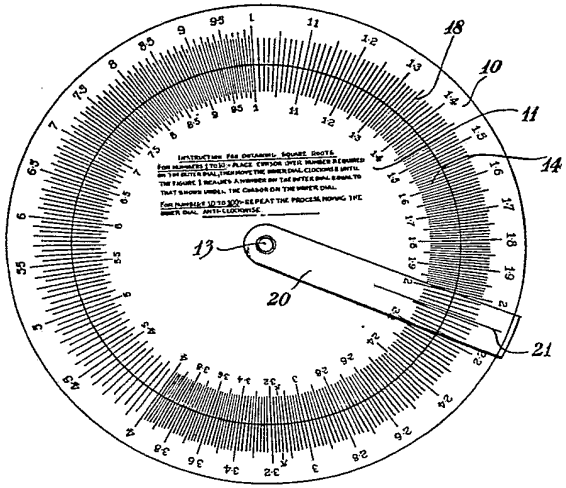

Fig. 2.

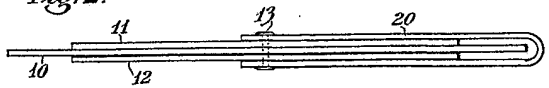

Fig. 4.

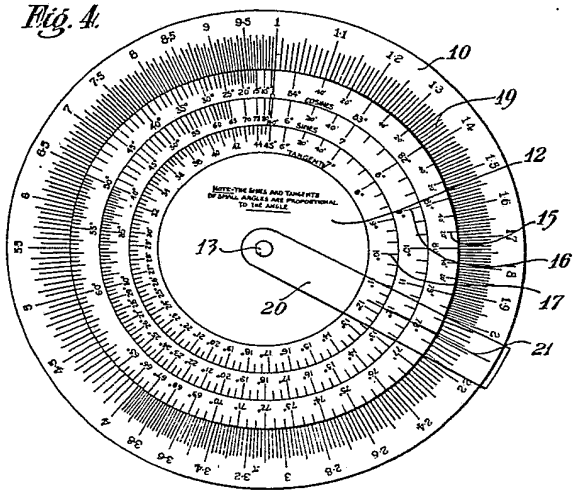

Fig. 5.