

Feb. 14, 1956

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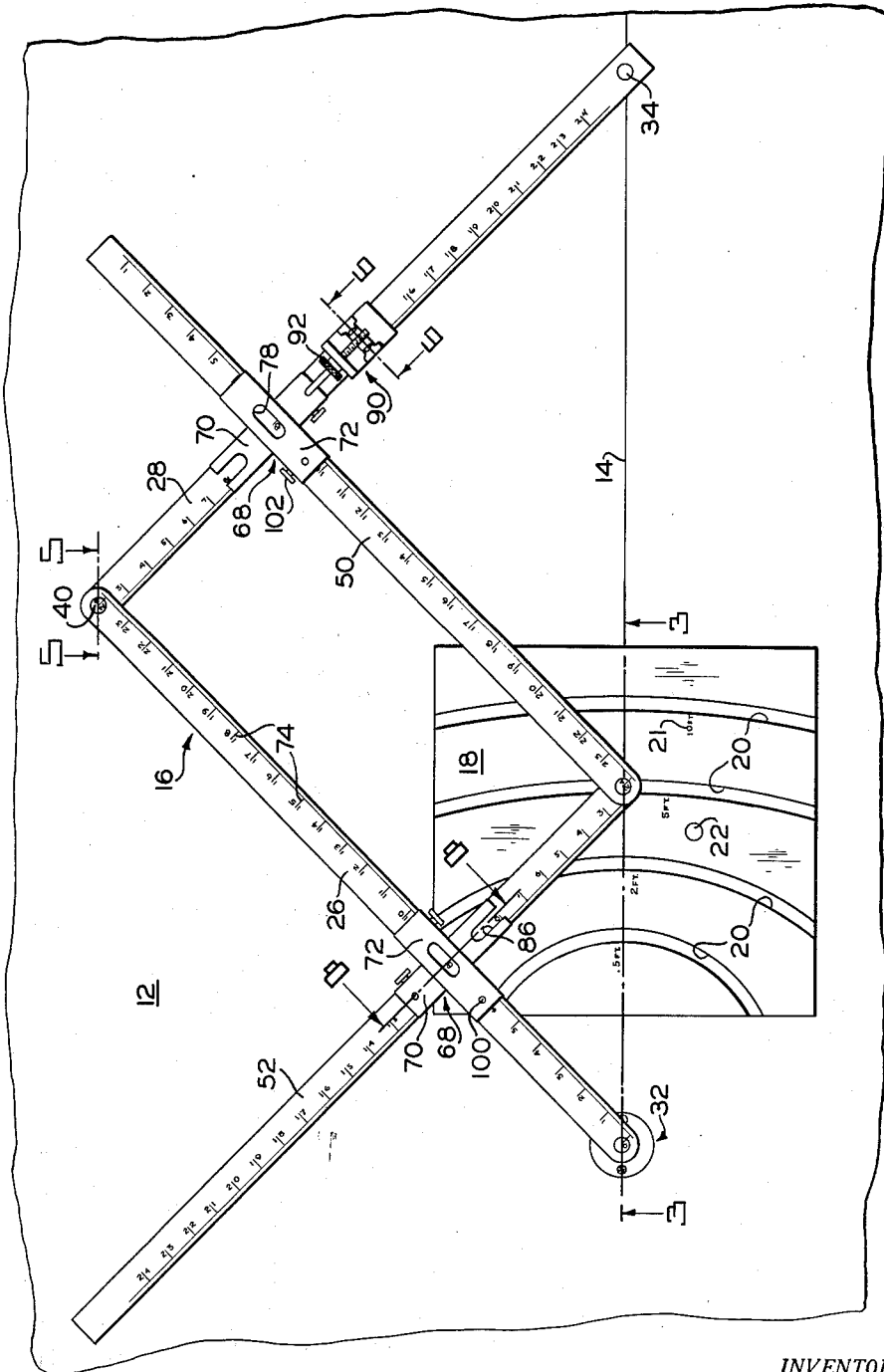
2,734,271

ARC PANTOGRAPH

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3 Sheets-Sheet 1

Fig. 1



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3 Sheets-Sheet 2

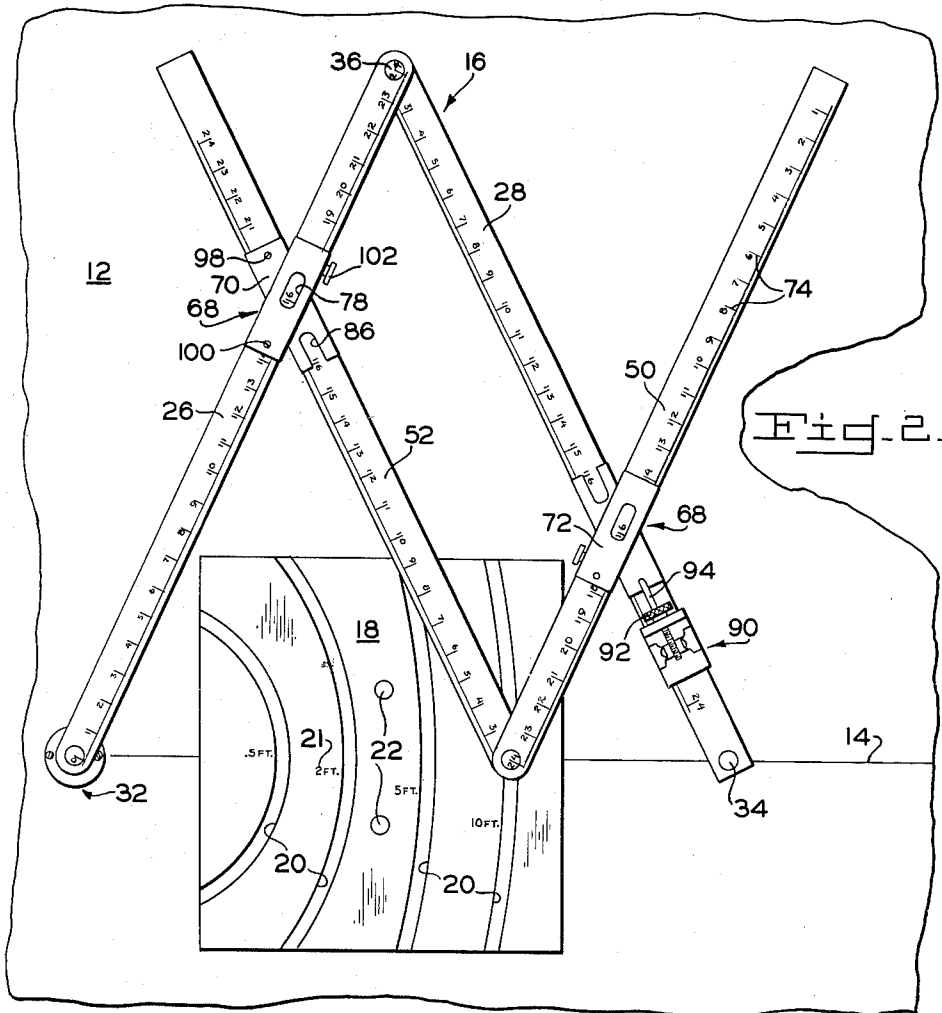
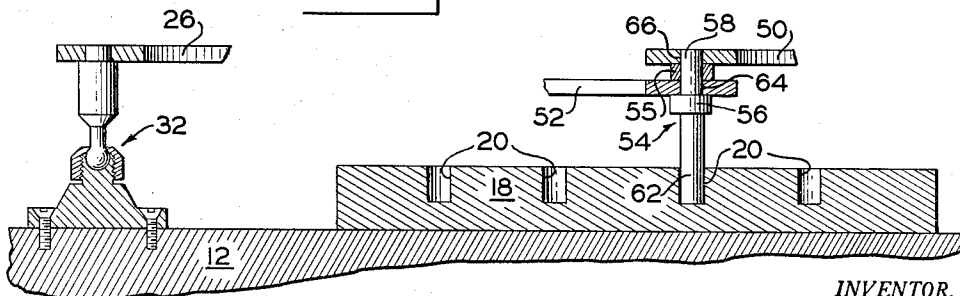


Fig-3-



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3 Sheets-Sheet 3

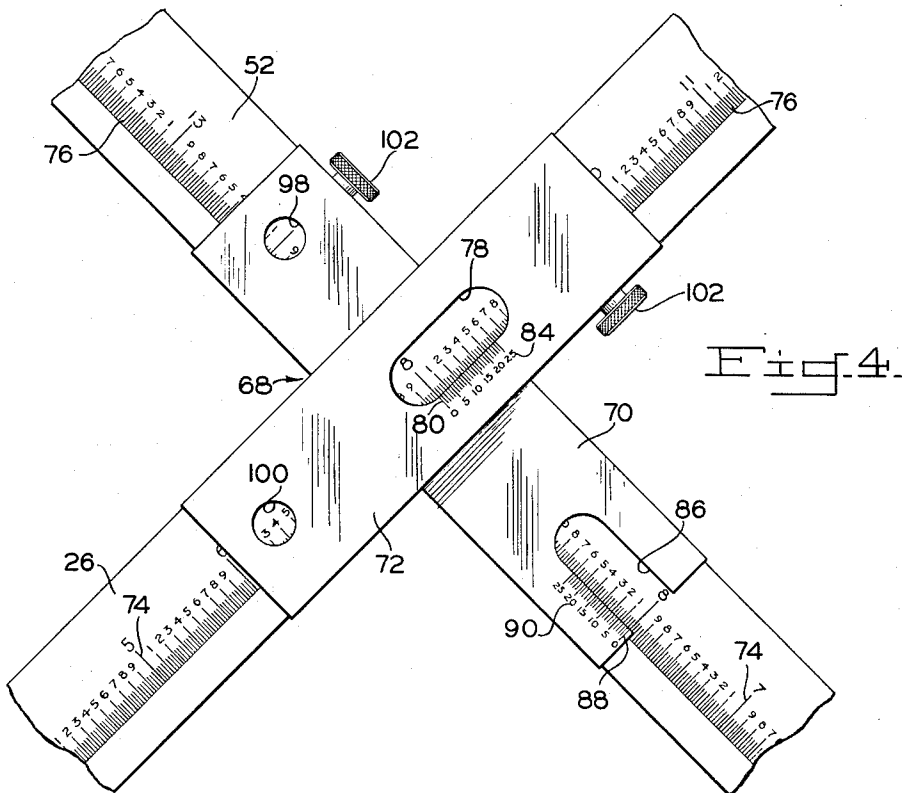


Fig. 4.

Fig. 5.

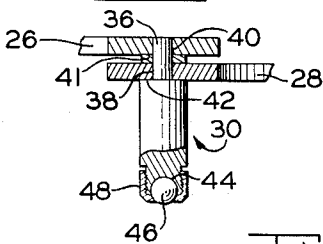


Fig. 6.

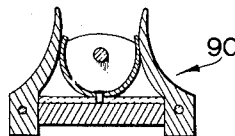


Fig. 7.

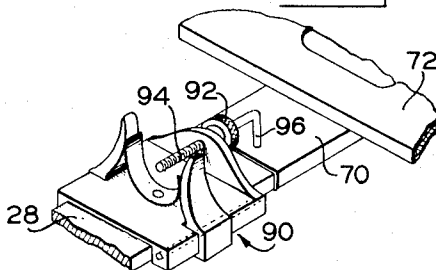
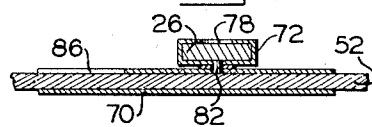


Fig. 8.



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ARC PANTOGRAPH

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Application September 28, 1954, Serial No. 458,995

1 Claim. (Cl. 33—25)

(Granted under Title 35, U. S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the Government for governmental purposes without the payment of any royalty thereon.

This invention relates to devices for generating arcs and more particularly to devices for describing arcs having radii which extend beyond a convenient working area.

It is an object of this invention to provide a relatively simple device for describing arcs of circles having centers which cannot be conveniently located on the available working surface as, for instance, a drawing board.

It is another object of this invention to provide a device for describing arcs of unlimited radii.

It is a further object of this invention to provide an enlarging arc generating device which requires only simple computations for adjustments and is easy to operate.

It is a still further object of this invention to provide a rotatable pantograph which is constrained in rotation by a template having a plurality of grooved arcs of circles having various predetermined radii the centers of which lie along a straight reference line and which is adjustable for multiplying the radius of a selected grooved arc on the template and adapted for describing an arc of desired radius the center of which is also located on such reference line.

It is another and still further object of this invention to provide an arc describing device which is adjustable for enlarging the radius of an arc to a desired power and for positioning the resulting arc in respect to a working surface.

The specific nature of the invention as well as other objects and advantages thereof will clearly appear from a description of a preferred embodiment as shown in the accompanying drawings in which:

Fig. 1 is a top view of the device of this invention showing the pantograph adjusted for multiplying the arc on the template having a five-foot radius to an arc having a fifteen-foot radius;

Fig. 2 is a view similar to Fig. 1 but showing the inscribed arc of fifteen-foot radius being generated from the arc on the template having a ten-foot radius;

Fig. 3 is a view along the line 3—3 of Fig. 1;

Fig. 4 is an enlarged top view of one of the pair of scale slides;

Fig. 5 is a view taken along line 5—5 of Fig. 1;

Fig. 6 is a view taken along line 6—6 of Fig. 1;

Fig. 7 is a perspective view of the clamp assembly; and

Fig. 8 is a view taken along line 8—8 of Fig. 1.

Shown in the figures is a rectangular, planar base 12 having a bisecting reference line 14 thereacross, an adjustable pantograph 16 and a template 18 provided with a series of grooved arcs 20 of circles having increasingly progressive radii of .5, 2, 5 and 10 feet, the centers of which lie in a straight line. The radii of arcs 20 are properly marked for identification, as noted at 21. Template 18 is provided further with a pair of dowels 22 receivable in holes (not shown) in base 12 for accurately fixing such template to such base so that the centers of

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the circles of which arcs 20 are a part align with reference line 14.

Pantograph 16 includes a first arm 26, of a little more than 24 inches in length, one end of which is mounted on one end of a second arm 28 of similar dimensions for pivotal movement therewith by means of a roller spacer 30, as hereinafter explained. The opposite end of first arm 26 is mounted for rotational movement about a fulcrum 32 which is fixedly mounted to base 12 on reference line 14. The center of fulcrum 32 is exactly 24 inches from the center of roller spacer 30. The free end of second arm 28 is provided with a chuck 34 for selectively receiving a conventional lead or ink scribe (not shown) the inscribing point of which is to be exactly 24 inches from the center of roller spacer 30.

Roller spacer 30 is cylindrical in configuration and is provided at the upper end with a concentric, reduced diameter portion 36 which is arranged to extend through a hole 38 in second arm 28 to be fixedly received, as by press fit, by a hole 40 in first arm 26. First and second arms 26 and 28 are separated by a washer 41 and such second arm is supported by means of a shoulder 42 which is formed by reduced diameter portion 36. The bottom end of roller spacer 30 is concaved, as noted at 44, to receive a steel ball 46 which is rotatably held therein by a sleeve 48, threadably mounted to such roller spacer. Thereby, roller spacer 30 provides roller support for first and second arms 26 and 28. Roller spacer 30, fulcrum 32 and chuck 34 are so arranged that first and second arms 26 and 28 are parallelly aligned with base 12.

Pantograph 16 also includes a third arm 50 which is similar in dimensions to first and second arms 26 and 28 and is mounted at one end on one end of a similarly dimensioned fourth arm 52, for pivotal movement therewith, by means of a leader 54. Leader 54 is of cylindrical configuration and is provided with a large diameter portion 56 which is arranged between the ends thereof to form an upper axial portion 58 and a lower follower portion 62 which is slidably cooperable with grooved arcs 20 in template 18. Axial portion 58 is rotatably received through a hole 64 in fourth arm 52 to be fixedly received in a hole 66 in third arm 50, and consequently larger diameter portion 56 provides support for fourth arm 52. Third and fourth arms 50 and 52 are separated on axial portion 58 by a washer 53.

First arm 26 is joined to fourth arm 52 and second arm 28 to third arm 50 for reciprocable adjustment by means of an interchangeable pair of slide scales 68 so that such arms form an adjustable parallelogram. Each of the slide scales 68 is comprised of a first slide 70, of rectangular box-like construction adapted to slidably receive either second arm 28 or fourth arm 52 and a second slide 72 of similar rectangular box-like construction adapted to slidably receive either first arm 26 or third arm 50. The first and second slides 70 and 72 are intermediately joined for rotation about a pivot member 82.

The top sides of arms 26, 28, 50 and 52 are calibrated in consecutively numbered inch divisions, as noted by 74 and to be hereinafter explained, and each inch division is divided into forty equal subdivisions, as noted at 76. Provided in the top side of each of the second slides 72 is a longitudinally disposed elongated oval window 78 in which one of the numbered divisions 74 on first arm 26 or third arm 50 is visible when indexed over the center of pivot member 82. Provided on one side of window 78 is an index line 80 which is aligned exactly with the center of pivot 82, and extending from such index line in the direction of the increasing numbered divisions 74 are calibrations 84 which cooperate with subdivisions 76 to provide a conventional vernier scale by which the adjustments of first arm 26 and third arm 50 are readable to .001 of an inch.

Extending inwardly from the end of each of the first slides 70 which is adjacent the lowest ones of the numbered divisions 74 is a longitudinal, elongated opening 86 in which there is visible one of the numbered divisions on second arm 28 or fourth arm 52 when adjacent thereto. Adjacent the open end of opening 86 is an index line 88 which is exactly two inches from the center of pivot member 82 and extending therefrom in the direction of the increasing numbered divisions 74 of second or fourth arms 28 and 52 mounted therein are calibrations 90 which are similar to calibrations 84 and which in cooperation with the lines 76 on the second or fourth arms provide a conventional vernier scale by which the adjustments of such arms are readable to .001 of an inch.

The numbered divisions 74 on first arm 26 start at the pivotal center of fulcrum 32 and progress consecutively from "1" to "24" which is aligned with the center of leader 54, and the numbered divisions 74 on third arm 50 start at the pivotal center of leader 54 and decrease consecutively from "24," which is aligned with the center of leader 54, to "1," which is one inch from the free end thereof. It is obvious that for index line 88 to indicate the distance from the center of pivot 82 to the center of leader 54 the numbered divisions 74 on fourth arm 52 must be compensated for the distance of such index line from the center of such pivot. Therefore, as the distance from the center of pivot 82 to reference line 88 is two inches, numbered divisions 74 must start with "3" which is located one inch from the center of leader 54 so that when index line 88 is aligned therewith the center of pivot 82 is exactly three inches from the center of such leader. The same is also true with second arm 28 where the numbered divisions 74 start with "3" which is located one inch from the center of roller spacer 30.

Pantograph 16, as has been explained, is adjustable to .001 of an inch, therefore, there is provided to facilitate exactness of adjustment a spring-loaded clamp 90 which is arranged to releasably clamp the sides of the arms of the pantograph. A knurled knob 92 is rotatably mounted to clamp 90 and is arranged to threadably receive a hook member 94 having a right angular hook portion 96 which is arranged to be receivable in a hole 98 in each of the first slides 70 or hole 100 in each of the second slides 72 whereby, turning of knob 92 will move the slide to which the hook portion is engaged. A set screw 102 is threadably mounted in one side of each of the first and second slides 70 and 72 for holding such slides fixed to the associated arms when tightened thereagainst.

Operation

When it is necessary for an arc to be increased to a certain power, as when enlarging detail views of drawings, the radius of the basic arc, identified as "r," is ascertained by conventional means. The radius of the desired larger arc, identified as "R," is then computed using the formula $r \cdot d = R$ where d is the power to which the original arc is to be magnified.

Next, the adjustment of pantograph 16 is ascertained by the formula

$$\frac{Pr}{R} = \frac{S}{L}$$

where Pr is the radius of the one of the arcs 20 in template 18 which is to be used in the generation of the desired arc and which is one of those having a smaller radius than that of the arc to be described, L is the total effective length of the arms of the pantograph, which in the present embodiment is 24 inches, and S is the setting to which the arms are to be adjusted, in reference to slide scales 68.

As an example, there is shown in Figs. 1 and 2 the device of this invention adjusted for inscribing an arc where R was computed to be fifteen feet. It is readily apparent that the desired arc may be generated from either the five foot or ten foot one of the arcs 20 on template 18. If the arc having a five foot radius is selected, as il-

lustrated in Fig. 1, the adjustment of pantograph 16 is computed as follows: using the formula

$$\frac{Pr}{R} = \frac{S}{L}, \frac{5}{15} = \frac{S}{24} \text{ or } S = 8$$

Therefore, first arm 26 and third arm 50 are moved to where the index lines 80 on second slides 72 align with "8" of the numbered divisions 74 on such arm, and second arm 28 and fourth arm 52 are moved to where the index lines 88 on first slides 70 align with "8" of the numbered divisions 74 on such arms. To facilitate exactness of adjustment, clamp 90 is used as hereinbefore described. Then, with follower portion 62 of leader 54 engaged with the five foot one of the grooved arcs 20 movement of such follower therealong will cause the ink or lead scribe (not shown) in chuck 34 to inscribe an arc of a circle having a fifteen foot radius, the center of which lies on the reference line 14.

If the scribe (not shown) in chuck 34 should by the adjustment extend beyond the limits of the drawing board, or other working surface, there is illustrated in Fig. 2 how, by selecting the one of the arcs 20 having a ten foot radius, chuck 34 is brought closer to template 18.

Using the same formula

$$\frac{Pr}{R} = \frac{S}{L}$$

and substituting the known values,

$$\frac{10}{15} = \frac{S}{24}$$

S is seen to equal 16. When pantograph 16 is adjusted to that setting, as heretofore described, the distance between template 18 and chuck 34 is obviously decreased. It is thereby clearly apparent that chuck 34 is adjustable, relative to base 12, through a selection of the arcs 20 as the bases for generating the enlarged arc.

Although in the illustrated embodiment template 18 is shown provided with arcs of .5, 2, 5 and 10 foot radii any combination of arcs may be selected and the radii of the arcs 20 may be of any lengths. In fact, there may be provided a number of templates having different combinations of radii. It is also evident that the lengths of the arms of pantograph 16 may be increased whereby the ratio between S and L would become greater, resulting in an increase in the power by which the pantograph may multiply the radii of arcs 20. Also, although the present embodiment illustrates means for inscribing arcs it is also possible that the device of this invention may be used in forming arcs as by tool means.

From the foregoing, it is clearly apparent that there is here provided a novel device for enlarging and describing arcs of any radii and for adjusting the location of the described arc, which is simple to operate and compute.

Although a particular embodiment of the invention has been described in detail herein, it is evident that many variations may be devised within the spirit and scope thereof and the following claim is intended to include such variations.

I claim:

A device for accurately generating arcs of enlarged radii including a base provided with a reference line, a template, a plurality of grooved arcs of various radii formed on said template, said arcs being parts of circles the centers of which lie on a straight line, dowel means for replaceably mounting said template on said base so that said straight line aligns with said reference line, and a pantograph device cooperable with said arcs for accurately enlarging said arcs to desired arcs of greater radii and for adjustably positioning said enlarged arcs on said base, said pantograph including a first arm pivotally mounted at one end to a fulcrum fixed to said base and at the other end pivoted to one end of a second arm by means of a vertical spacer member rolling on said base, a chuck for holding scribe means mounted on the free end of said second arm so that

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the center of said scribe is the same distance from the center of said spacer member as said fulcrum is, a third arm pivotally mounted at one end on one end of a fourth arm by means of a leader selectively and slidably cooperable with said grooved arcs, a pair of pivotal slides, said slides being comprised of a first boxlike member adapted to slidably receive either said first arm or third arm, and a second boxlike member adapted to slidably receive either said second or fourth arm, means for pivotally mounting said first member intermediately on said second member whereby said arm members are arranged in adjustable parallelogram relationship, an oval window in each of said first members, an elongated opening extending from one end of each of said second members, calibrated scales extending progressively from the center of said fulcrum in said first arm, from the center of said spacer member in said second arm, from the center of said follower in said fourth arm and decreasingly from the center of said follower in said third arm, a first indexing mark extending from said windows in said first members in alignment with the centers of said pivotal means, and a second indexing mark extending from said openings in said second members a predetermined distance from the center of said

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pivotal means with the calibrations on said second and fourth arms being compensated for said predetermined distance, whereby said arms may be adjusted relative to one another and indexed in accordance with the formula

$$\frac{Pr}{R} = \frac{S}{L}$$

where Pr is the radius of the selected one of said grooved arcs, L is the total effective length of said arms, S is the setting to which said first and second indexing marks are to be related to said calibrated scales on said arms and R is the radius of the desired arc of an enlarged radius.

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