March 17, 1953 E. L. CALLAHAN 2,631,376

GEOMETRICAL INSTRUMENT

Filed June 11, 1947

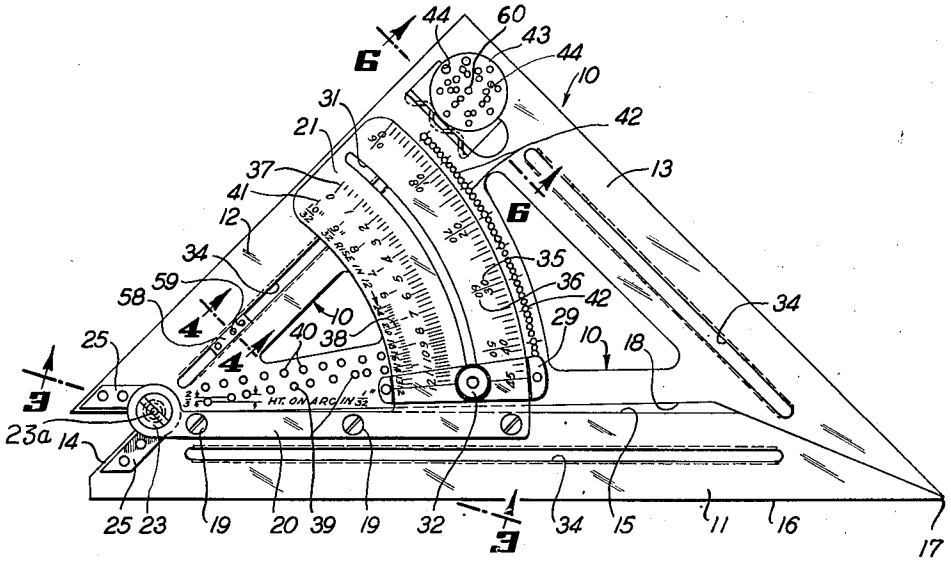

Fig. 1.

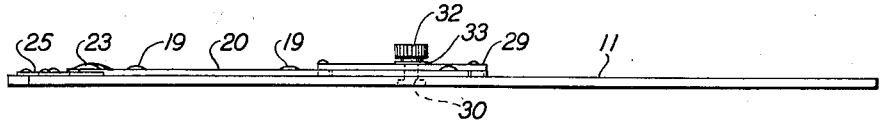

Fig. 2.

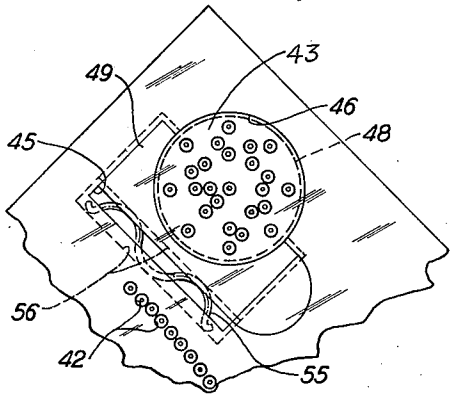

Fig. 5.

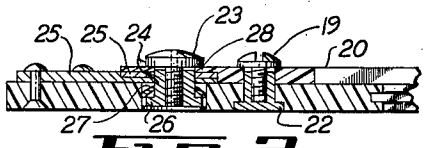

Fig. 3.

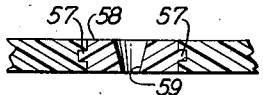

Fig. 4.

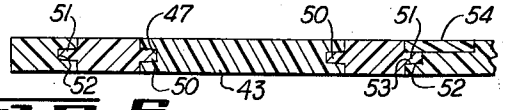

Fig. 6.

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GEOMETRICAL INSTRUMENT

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5 Claims. (Cl. 33—93)

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This invention relates to geometrical instruments, and more specifically to sectional triangles adapted for utility in drafting, and having particular application to construction work.

A principal object of the present invention is to provide a jointed triangle adapted to lie flat upon a drafting board comprising a side hinged to the body of the triangle for pivotal movement with respect to the other sides thereof, each side being formed with slots parallel to the respective adjacent edges of the triangle to facilitate the marking of lines adjacent the bottom or side edges of the paper or board.

Another and highly important object is to provide a triangle having a lettering guide comprising a plurality of sets of pencil-guide holes formed therein, the holes of each set being variably spaced from one edge of the triangle to enable the delineation of lines on the work by the successive insertion of a pencil into the holes and drawing the triangle across the work, the edge of the triangle being placed contiguous with a T-square or other member to assure proper direction of the lines.

Another object is to provide a triangle having a hinged side and a protractor arc connected to said hinged side, overlying the body of the triangle and bearing a dual degree scale to indicate the complementary angles formed between said hinged side and the respective adjacent sides of the body throughout the adjustment of said triangle, the numbers identifying the degree calibrations of said scales, respectively, being inverted relative to one another and readable from the ends of the hinged side at which the angles measured by said scales, respectively, are formed.

Still another object is the provision of a circular lettering guide releasably and rotatably carried in the body of the triangle, comprising sets of pencil-retaining holes for guiding a pencil in the formation of parallel, arcuate lines, in combination with a sliding compass point movable on a radius of the guide to permit the formation of lettering lines in arcs of variable degree, the circular guide being removable for use in the formation of series of parallel arcuate lines around a French curve or the like.

Another and related object is to provide, in a triangle having a pivoted side, a pencil guide block slidable in a slot aligned with a compass hole coinciding with the center of the pivot of the triangle to enable the formation of a series of arcuate lettering lines of variable radius about the pivot incident to swinging the triangle around the compass point.

Still another object is to provide a series of pencil-guide holes in the body of the triangle, equi-spaced apart and arranged in an arc having a center on the pivot between the body and

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movable side of the triangle, whereby angles formed between the pivoted side and lines passing through the respective pencil holes may be determined or laid out with facility, and points for the plotting of curves as in the drafting of projections may be more quickly and accurately set.

Another object is the provision of a protractor arc carried by the pivoted side and extending across the body of the triangle, bearing a scale of rise in twelve inches with one edge of the body representing the slope and the pivoted side representing the run throughout the range of movement of said side, and having a continuation scale to indicate greater rises in twelve inches of the opposite edge of the body relative to the edge of the pivoted side, all figures identifying calibrations of the respective scales being positioned to be legible from the vertex of the angle correlated with the rise measured by said dual scale.

Another and highly important object is the provision of a pivoted triangle of the character above alluded to embodying the above-mentioned and other features arranged in a novel manner with respect to one another for most facile cooperative utility in numerous additional applications.

Various other objects and salient advantages of my invention will be apparent to those of skill in the art upon examination of the following desciption read in the light of the accompanying drawings, in which:

Fig. 1 is a plan view of a triangle embodying the inventive aspects hereof with the parts in folded relationship;

Fig. 2 is an edge elevation of the triangle;

Fig. 3 is an enlarged sectional view taken on line 3—3 of Fig. 1;

Fig. 4 is an enlarged sectional view on line 4—4 of Fig. 1 through the sliding compass block, illustrating particularly the means for releasably retaining the latter in the slot;

Fig. 5 is an enlarged broken plan view of the rotatable lettering guide and of the means by which it is retained in the body of the triangle;

Fig. 6 is an enlarged sectional view taken on line 6—6 of Fig. 1 through the rotatable lettering guide.

Referring to the drawings more in detail, the numerals of which indicate similar parts throughout the several views, 10 designates generally the flat body, and 11 one side, of an isosceles right triangle, both body and side being composed of Celluloid or other lightweight transparent and flexible material. The side 11 of the triangle forming the hypotenuse of the right angle defined by edges of the body is pivoted to one side 12 of the body, whereby it may be swung outwardly from a position forming a 45°

angle with each side 12 and 13 of the body to a position forming a 90° angle with side 12. To permit this range of movement, the bar comprising side 11 is cut away at its pivoted end as at 14. The inner edge 15 of bar 11 is parallel to the outer edge 16 and coincides with a radius of the pivot from the latter to a point adjacent its outer end, at which point the inner edge 15 converges upon the outer edge 16 in a point 17. The adjoining end of side 13 of body 10 is complementarily formed, whereby the ends of the bar and body are contiguous with one another when the bar is in folded relationship. For a purpose hereinafter described, the lower edge 18 of the body 10, opposed to the inner edge 15 of bar 11, is also radially aligned with the pivot, but is spaced one degree from edge 15.

Secured to the marginal inner edge of bar 11 by a plurality of nut and bolt assemblies 19 is the shank 20 of a protractor arc 21 whereby the arc is held in a position extending across the body of the triangle. In order to preserve the undersurfaces of the triangle body and bar flush with one another, the nuts are accommodated entirely within holes in the bar. The threaded bore of each nut is closed at its lower end by integral disk 22, the undersurface of which is flush with the complementary surface of the bar as indicated in Fig. 3.

Both bar 11 and body 10 are semi-circularly cut away to accommodate the pivot screw 23 which is threaded downwardly through a nut 24, the upper portion of which forms a bearing for a pair of pivot elements 25—25 riveted or otherwise secured to the bar and body, respectively. Interposed between the lowermost pivot element 25 and an annular flange 26 integral with the bottom of nut 24, is a spring washer 27, arcuate in cross-section, adapted to impose an expansive urge upon each of these parts to frictionally resist disengagement of screw 23 and maintain firm relationship between the body and bar. On the upper pivot element 25 and beneath the head of screw 23 is an extension 28 of shank 20 of the protractor arc 21, which extension is reduced in thickness so as to overlie the pivot elements 25—25 while permitting the shank proper of the arc to fit snugly against the upper surface of the bar.

It will be understood that the arc 21 of the protractor has a center on the pivot screw 23, and with the body and bar in folded relationship extends completely across the body. An index strip 29 overlies the arc adjacent bar 11 and has its ends riveted or otherwise secured to the body on either side of arc 21. Strip 29 is composed of transparent material, and bears an index line adapted to register with various scales hereinafter more fully identified borne by arc 21. The arc may be secured frictionally to body 10 in any adjusted position by a nut and bolt assembly. The bolt 30 extends upwardly through the body, through an arcuate slot 31 in the protractor arc 21, and through the middle of the index strip 29. The nut 32 is knurled to facilitate tightening which is effective to clamp the arc 21 between the index strip 29 and body of the triangle. A washer 33 of a thickness equal to that of the pivoted extension 28 of shank 20 of arc 21 encircles the bolt 30 between nut 32 and index strip 29.

It will be observed that protractor arc 21 normally overlies the inner edge 15 of the pivoted bar 11 and accordingly restricts the use of this edge as well as the use of the lower opposed edge

18 of the body. However, arc 21 may be removed, if desired, by the displacement of the nuts of assemblies 19 and nut 32 and the disengagement of shank extension 28 from the pivot. In order to assure uniformity in the relationship of the parts incident to tightening of the pivot assembly 23—24 when arc 21 is removed, the washer 33 is taken from beneath the nut 32 and may be substituted for the arc extension 28 beneath the head of the screw 23 of the pivot assembly.

Each side of the triangle is formed with an elongated slot 34 longitudinally parallel to the outer edge of the side in which it is disposed. The center line of slot 34 in the pivoted side 12 of body 10 of the triangle is in exact alignment with the axis of pivot 23 for a purpose later described. The arrangement of slots 34 with respect to the adjacent edges of the pivoted bar 11 and body 10 constitutes a principal feature of the present invention. As the light upon a drafting board usually is directed onto the work from the top or an upper corner of the board, the lower edge of a straight edge casts a narrow shadow upon the work, making it difficult to align the edge with points to be connected on the work. Moreover, it is generally much easier for a draftsman to mark along the upper edge of a guide, i. e., a T-square or triangle, particularly when the line is to be drawn close to the lower edge of the board. The lower edge of the slots 34 in the pivoted bar, being upwardly directed, receives the light from above and may be moved in close proximity with the bottom edge of the work. The slots 34 in the two sides of the body of the triangle are adapted for utility in a similar manner. It will be observed that due to the pivoting of the bar to the body of the triangle, lines adjacent an edge of the board may be drawn at any angle using a T-square or another triangle as an aid in positioning the device, and in such position the light is directed against the edge along which the line is to be drawn, regardless of the direction from which the light is cast.

The outer marginal edge of arc 21 is calibrated in degrees designated by two sets of figures. The first degree scale 35 comprises figures from zero to 45, facing the side 13 of the body so as to indicate the angle formed between the free end of bar 11 and the last-named side of the body throughout the range of adjustment of these parts. The second scale 36 comprises figures from 50 to 90° indicating on the same calibrations the angle formed between the bar and pivoted side 12 of the body toward which the last-named figures are directed. With the bar in folded relationship, the index line of strip 29 registers with the 45° mark of the dual scale and indicates the angle formed at each lower corner of the triangle. As the bar 11 is swung outwardly, the angle between the edge 16 of the bar and the side 13 of the body decreases, as is indicated by the numerals of the scale 35 readable from that side of the body, while the angle between the pivoted side 12 of the body and bar increases proportionately, forming the complementary angle as indicated by the numerals of scale 36 directed toward the center of arc 21.

Across the face of arc 21 within the arc of slot 31 is a dual rise in twelve inch scale 37, upon which the index line of strip 29 indicates the rise in twelve inches for the side 13 of the triangle with respect to the bar, corresponding to the degree calibrations of scale 35 formed between these parts. As in the case of the degree

scale 35, the numerals of scale 37 indicating the rise of the side 13 are directed toward the last-named side so as to provide a guide to the user as to the side of the body representing the slope on the scale. Rises greater than twelve inches per foot are indicated by a continuation scale 38 with the pivoted side 12 of the body representing the slope. As the smallest angle which may be formed between the pivoted side 12 and bar 11 is 45°, the first figure in this scale 38 is 12'' registerable with the index line when the bar is folded. The scale 38 continues up to a value of twenty-four inches per foot, all figures in this continuation scale being directed to the pivoted side 12 of the body to obviate inadvertent marking along the wrong edge.

Directly above the lower edge of triangle body 10 and intermediate the pivot 23 and arc 21, are two parallel rows of holes 39 and 40, the holes of the lower row 39 being arranged in groups of three to form lettering line guides. It will be observed that the lower row of holes 39 is aligned with a radius of pivot screw 23, for a purpose later referred to. In accordance with the use of the lettering guides, a pencil inserted into the first hole of the first group of holes 39 comprising the lower row, with the bar in folded relationship and the triangle, guided by a T-square or the like, is drawn across the paper. In a like manner, and without shifting the triangle vertically on the paper, the pencil is inserted in each of the other holes of the first group so as to form in like manner two additional lines above the first and in parallel relationship with the latter. If additional lines of lettering are desired, they may be drawn by successive use of the pencil in each of the holes of the other groups thereof comprising the lower row so as to form three sets of parallel lines for a corresponding number of lines of lettering. The distance between the lines of lettering is determined by the distance in spacing of the last holes of each of the first two groups of holes 39 above the lower edge of the bar 11 relative to the spacing of the first holes of the following groups, respectively, above the lower edge of the bar, as will be obvious. It will thus be seen that as the lines are drawn parallel to the lower edge of the bar, the spacing of holes 39 with respect to one another is of no particular consequence when the bar is folded, the relative spacing of the holes above the bar being the factor which determines the relative disposition of the lines. In the present embodiment the difference in spacing of the first two holes above the edge of the bar is twice as great as the difference in spacing of the second and third holes of each group from the lower edge of the bar. More specifically, it is desirable to space the holes 39 alternately ¼'' and ⅛'' apart with one of the holes spaced an even inch from the center of the axis of pivot screw 23. However, this spacing of the guide lines produced in the manner described may be increased by swinging the body 10 of the triangle above bar 11 so as to increase the angle of the line of holes 39 with respect to the edge 16 of the bar. In order to maintain the proportionate spacing of the lines produced by each group of holes, in accordance with the described use of the guides, throughout the range of movement of the body on pivot 23, the first two holes of each group are spaced apart a distance twice as great as the distance between the second and third holes thereof so that the two-thirds ratio indicated by the legend on the bar is maintained throughout the variable adjustment of the body.

In an arc across the face of the protractor arc 21 between the rise in twelve inch scale 37 and its continuation 38, are a series of calibrations 41 to be used in conjunction with the lettering guide hereinabove described. When the bar is in folded position, the sets of holes 39 forming the lower row of the lettering guide are each disposed to enable the formation of two lines, two thirty-seconds of an inch apart with an intermediate third line above the lower of the outside lines a distance two-thirds the distance between the outer lines of each set of three. As indicated by the legend "HT. on arc in $\frac{1}{32}$''" on the arc, the scale 41 designates the measure of the lettering lines produced as a result of variable relative shifting of the body 10 and bar 11. Thus with the bar folded, the index line registers with the two thirty-seconds calibration, which, like the next three succeeding calibrations are not so identified on the arc. The $\frac{6}{32}$'', $\frac{7}{32}$'' and $\frac{8}{32}$'' marks are indicated by the numerals 6, 7 and 8, respectively, and the $\frac{9}{32}$'' and $\frac{10}{32}$'' calibrations are completely so designated. It will be appreciated that by swinging body 10 of the triangle away from the bar, lettering lines from $\frac{3}{32}$ to $\frac{10}{32}$ of an inch may be made with the same sets of holes 39, the second and third sets of holes of the lower row providing guides for additional lines above the first set, correspondingly spaced apart in accordance with repeated operations of the instrument, as hereinabove described.

The second or upper row of holes 40 are equispaced apart and progressively spaced greater distances from the lower edge of the bar. As the difference in the distances between successive holes and the bar is less than the distance between adjacent holes, the effect upon the spacing of lines drawn by the aid of holes 40 incident to positioning the body successively greater distances from the bar is to progressively increase the spacing of the lines out of proportion to the extent to which the body is moved.

Arranged in an arc of the same degree as arc 21 and adjacent the outer edge of the latter, are a plurality of pencil holes 42 spaced apart one degree so as to fall in alignment with the degree calibrations of the dual scale 35—36. Holes 42 may be employed in conjunction with the degree scales to perfectly set one or more points in an arc and obviate the problem of parallax presented when aligning a pencil point with a calibration delineated on the surface of a protractor. The pencil holes 42 are highly useful in laying out lines for purposes of projecting a drawing, as will be apparent.

In the body of the triangle within the right angle is a rotatable lettering guide adapted for use in laying out curved lines for arcuate lettering of any of a variety of sizes. The guide consists of a disk 43 having several sets of three pencil guide holes 44 formed on different radii of the disk. To accommodate disk 43, a rectangular opening 45 is cut in the body, one side of which opening is further cut away as at 46 to provide an arcuate recess of approximately 180°. The arc of recess 46 conforms to the contour of the periphery of disk 43 whereby the latter fits snugly therein. Disc 43 is formed with an annular groove 47 in its circumference, into which projects a complementary spline 48 integral with the edge of the arcuate recess 46 and normally retained in such engagement in response to pressure of a spring-pressed slide 49 accommodated

in the rectangular opening 45. The slide 49 is arcuately recessed to complete the encirclement of disk 43. The recessed edge of the slide is equipped with an integral laterally-projecting spline 50 to engage in the groove 47 of the disk. Slide 49 is retained in the body by splines 51 projecting from opposite ends, one of which is recessed in a groove 52 in body 10, and the other accommodated upon a shoulder 53 formed in the body and held against displacement by a retainer plate 54 overlying the adjacent spline 51 of the slide 49 and cemented to the body. The slide is free to move laterally due to the greater width of opening 45 in the body in which it is retained, but is normally pressed against the disk 43 by a spring wire 55 interposed between the straight longitudinal edge of the slide 49 and the opposed edge of the opening 45, which edges are grooved as at 56 to receive, and to resist lateral displacement of, spring 55. Thus the disk is normally retained in a position axially coinciding with the vertex of the angle formed between the center lines of the slots 34 in sides 12 and 13 of body 10.

The opposite edges of each of slots 34 are grooved to accommodate laterally-projecting splines 57 of a sliding compass block 58 (as indicated in Fig. 4) adapted to be selectively engaged in any of said slots. Three holes 59 are formed in compass block 58 in alignment with the axis of the latter, for a purpose about to be described.

As above indicated, the pencil holes 44 in disc 43 are arranged in groups of three, the holes of one group all being aligned with a radius of the disk. By placing a pencil point in one of the holes 44 of any of the groups and a compass point through one of the holes in compass block 58 with the latter located in the slot 34 in the pivoted side 12 of body 10, an arc may be drawn around the compass point of a radius variable with the disposition of block 58 in the slot. Successive use of the triangle in a like manner with the pencil in the other two holes 44 of the group selected in disk 43 results in making additional lines parallel to the first to complete the set of lettering guide lines spaced apart as determined by the spacing of the holes 44 of the set selected. The holes of the other groups in the disk are differently spaced and, as they are somewhat closer together than the holes of the radially-aligned group, but individually of the same diameter, the middle hole of each of these groups is offset slightly. However, as the spacing of the annuli in which the respective holes 44 of the disk are located, are different for each group, eight different sizes of lettering guide lines may be drawn. As the compass block 58 is slidable in slot 34, the radii of the arc of the lettering lines may be varied to permit the delineation of letters around curved areas varying widely in radius as is sometimes required in map making.

It will be observed that the pressure of spring 55 transmitted through the slide 49 to disk 43 resists rotative displacement of the disk from its preadjusted position during utility. However, by manually withdrawing the slide from contact with the disk in opposition to the urge of spring 55, the disk may be shifted slightly away from the arcuate spline 48 of the body to effect disengagement of the latter so as to permit the disk to be removed. Disk 43 may be employed individually to form a series of parallel lines around a French curve or other arcuate guide by placing the disk against the edge of the curve and inserting a pencil into one of the holes 44 therein so as to coincidentally move the disk along the edge of the curve and draw a line parallel with said edge but spaced therefrom a distance determined by the spacing of the selected hole of the disk.

The compass block 58 may be removed from the slot 34 in which it is disposed by flexing the triangle body, and in a like manner inserted in the slot in either the bar 11 or opposite side 13 of the body. As hereinabove noted, the compass block 58 is formed with three holes 59 spaced in accordance with the spacing of preferred lettering lines, e. g., with the outer holes spaced apart $\frac{3}{32}$", and the intermediate hole located from one of the former two-thirds of the distance to the other. Thus by inserting a compass point through a coaxial hole 23*a* in the pivot screw 23 or merely swinging the body on the pivot with the pencil inserted successively in the three holes thereof, the block provides a lettering guide for arcs of varying degrees having a center on the pivot screw. By inserting and using compass block 58 in the slots in the bar 11 and side 13 of the triangle in a similar manner, curves of various configurations may be produced.

In the center of disk 43 is a hole 60 which lies on the vertex of the angle of the center lines of the slots 34 in the sides 12 and 13 of the body, and may be utilized in various ways in conjunction with other elements of the triangle. For example, the compass block 58 may be installed in the slot 34 in side 13 of the body, and with either the hole 60 or one of the holes 59 in the block as a center, a pencil inserted in the hole of the other element may be used to circumscribe a circle of a radius of any dimension within the limits prescribed by the length of the slot 34.

It will thus be seen that I have provided an instrument of triangular form, having a pivoted side to permit the formation of angles of any degrees between adjoining sides, each side being slotted to facilitate the delineation of lines at any angle as indicated by the degree and rise in twelve inch scales carried by the protractor arc associated therewith, adjacent the edges of the paper, in combination with composite lettering guides for the marking of either curved lines of variable radius or straight lines in groups of three, all arranged in novel manner for most expeditious utility.

It will be understood that the embodiment of my invention depicted in the drawings is merely illustrative of the novel features hereof in a preferred arrangement, and is not to be regarded as restrictive in form, shape, size, number or proportion of the parts, and that other conventional means for securing the rotatable lettering guide disk 43 in the body of the triangle may be substituted, that the opposed edges 15 and 18 of the pivoted bar and body may coincide throughout all or any part of their lengths, that the means for pivoting the bar and body may be varied in any well-known manner, that additional lettering guide holes for different size lettering may be formed in the body, that conventional means may be incorporated in the compass block to vary the friction between the latter and the body of the device, and that a series of holes in the body may replace the sliding compass block if desired—all without departing from the spirit of my invention as defined in the appended claims.

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

1. In a device of the character described, a flat

body comprising two sides having straight edges forming an angle therebetween, a bar pivoted to said body having a straight edge forming, with said first-named edges, a triangle, said body having a plurality of holes therein arranged in an arc having a center on said point of pivoting of said bar, and means associated with said bar and overlying said body bearing a scale in degrees to indicate the angle formed between the outer edge of said bar and line from the point of pivoting through each of said holes throughout the range of movement of said bar on said pivot.

2. In a device of the character described, a flat body forming two sides of a triangle and a bar pivoted to said body normally forming the third side of the triangle, said body having a slot in one side thereof parallel to the edge of said side, and a block having a hole therein, slidable in said slot, and a disk rotatable in said body having a plurality of pencil guide holes therein.

3. In a device of the character described, a flat body forming two sides of a triangle and a bar pivoted to said body normally forming the third side of the triangle, said body having a slot in one side thereof parallel to the edge of said side, a block having a hole therein, slidable in said slot, and a disk rotatable in said body having a plurality of pencil guide holes therein, and means to releasably secure said disk in said body.

4. In a device of the character described, means comprising a flat body forming a triangle, and having a slot therein, a block having a hole therein slidable in said slot, a flat disk, and means to secure said disk rotatably in said body, said disk having a plurality of pencil guide holes therein adapted to be turned with said body around a center coincident with the hole in the block to form arcs of various radii.

5. In a device of the character described, a flat body composed of flexible material forming two sides of a triangle, one of said sides having a slot therein, a bar pivoted to said body, forming the third side of the triangle, and having a slot therein extending parallel to the outer edge of said bar to provide a pencil guide adapted to receive light directed across the inner edge of said third side of the triangle, a block, having a hole therein, slidable in said first-named slot, a flat disk, and means to secure said disk rotatable in said body, said disk having a plurality of pencil guide holes therein adapted to be turned with said body around a center coincident with the hole in the block to delineate arcs of various radii.

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