(No Model.) 2 Sheets—Sheet 1.

A. M. ENGLISH.

MATHEMATICAL AND DRAWING INSTRUMENT.

No. 534,099. Patented Feb. 12, 1895.

Fig: 1.

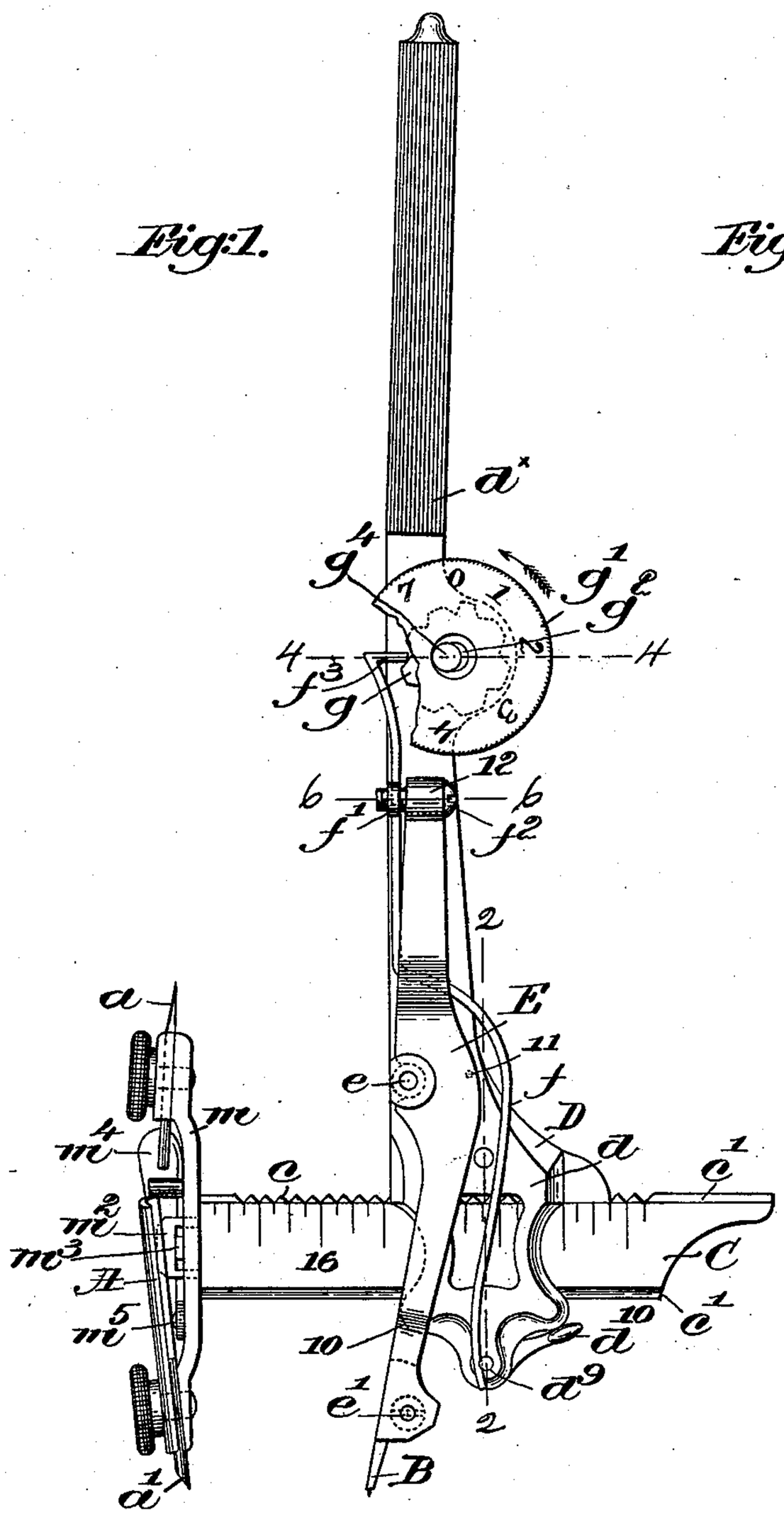
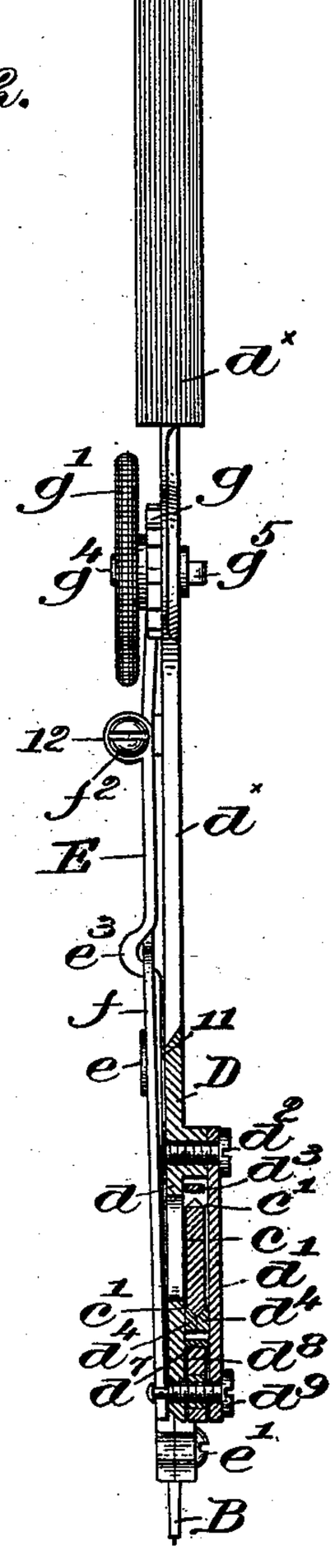


Fig: 2.



Witnesses.
Edward F. Allen.

Thomas J. Drummond.

Inventor:
Arnaldo M. English
by Crosby & Gregory, Attys.

(No Model.) 2 Sheets—Sheet 2.

A. M. ENGLISH.

MATHEMATICAL AND DRAWING INSTRUMENT.

No. 534,099. Patented Feb. 12, 1895.

Fig: 3.

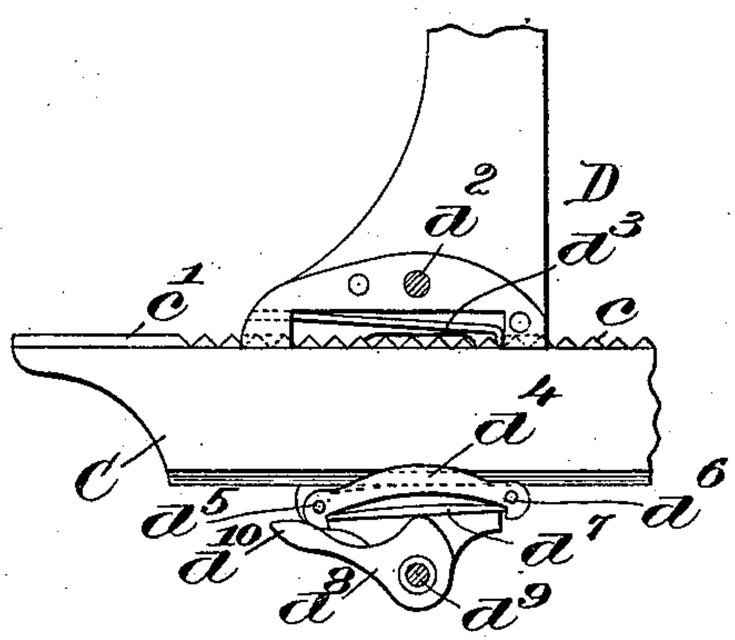


Fig: 3a.

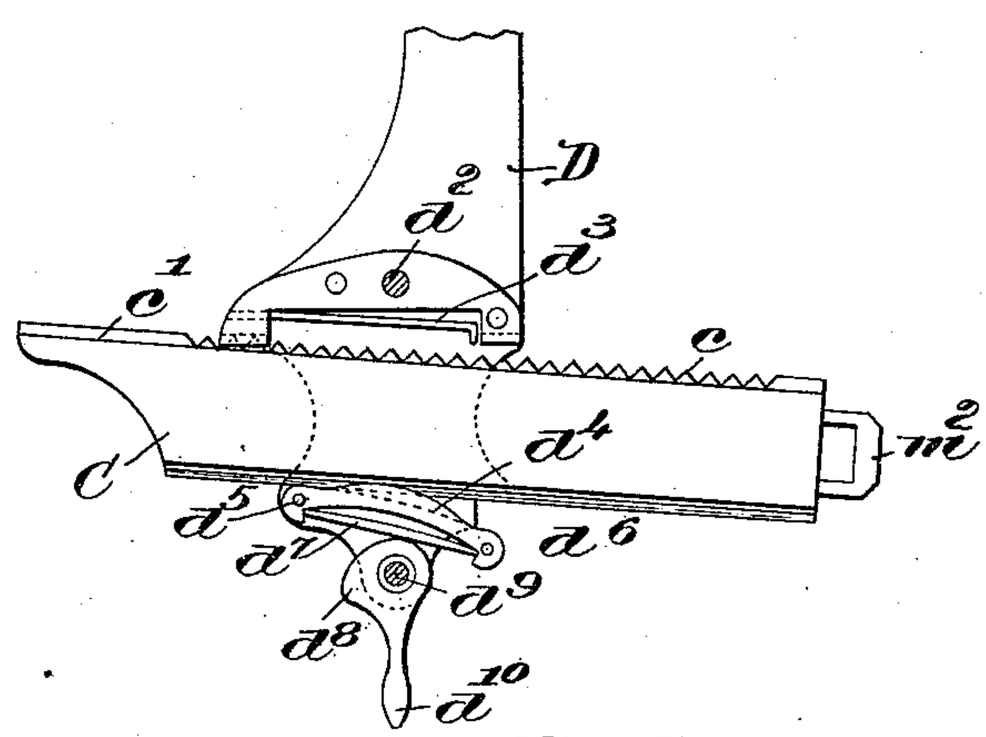


Fig: 4.

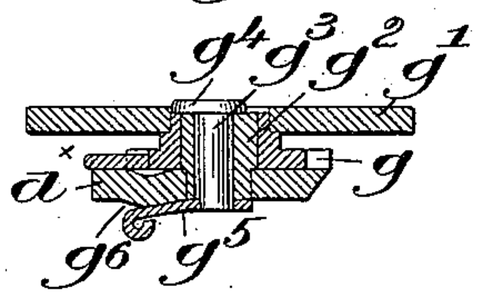


Fig: 5.

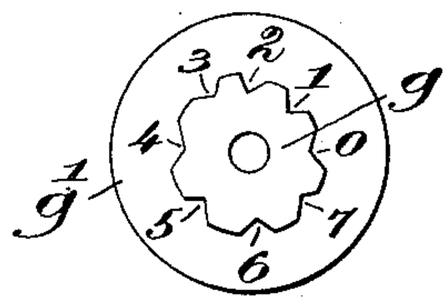


Fig: 6.

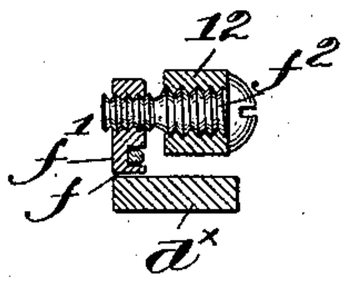


Fig: 7.

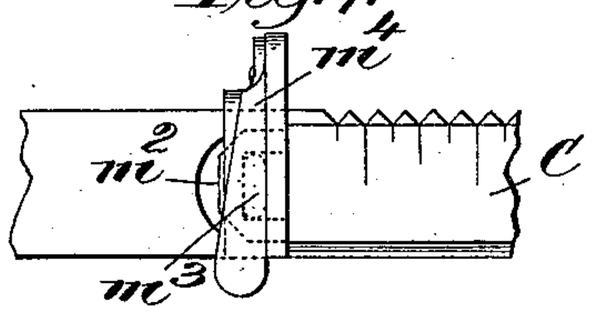
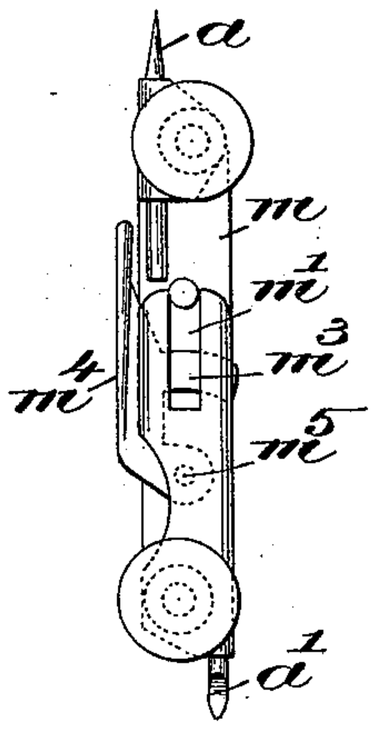


Fig: 8.



Witnesses.
Edward F. Allen.
Thomas J. Drummond.

Inventor:
Araldo M. English
by Crosby & Gregory. Attys.

UNITED STATES PATENT OFFICE.

ANALDO M. ENGLISH, OF BOSTON, MASSACHUSETTS, ASSIGNOR OF TWO-THIRDS TO HIRAM M. FRENCH AND FREDERICK E. FRENCH, OF SAME PLACE.

MATHEMATICAL AND DRAWING INSTRUMENT.

SPECIFICATION forming part of Letters Patent No. 534,099, dated February 12, 1895.

Application filed May 10, 1894. Serial No. 510,706. (No model.)

To all whom it may concern:

Be it known that I, ANALDO M. ENGLISH, of Boston, county of Suffolk, State of Massachusetts, have invented an Improvement in Mathematical and Drawing Instruments, of which the following description, in connection with the accompanying drawings, is a specification, like letters and figures on the drawings representing like parts.

This invention relates to mechanical and drawing instruments of the class in which are employed two working members, which may be respectively, a needle point and drawing pen or pencil, or two needles or other points, as may be necessary to adapt the instrument to any desired character of work.

In the subsequent description, and in the drawings, I have disclosed my invention as embodied in a drawing instrument, it being understood, however, that my invention is equally applicable to a mechanical or measuring instrument, if desired.

My invention particularly relates to the means for adjusting or varying the relative positions of the working members, whereby the finest work may be performed with the instrument.

In the preferred embodiment of my invention, the two working members are connected by a toothed or serrated bar, one of the members being mounted upon a slide adjustable longitudinally on the said bar. The notches in the bar furnish convenient means for adjusting the slide thereon in one or another position for coarse or approximate measurements, and for finer adjustments I employ a lever mounted upon the slide, and which, when moved into one or another position, varies the relative positions of the working members within the limits of adjustment possible by means of the notches in the bar referred to. In the preferred construction, the slide is provided with a co-operating spring or other detent adapted to engage one or another of the notches in the bar for adjustment of the slide, suitable clamping devices being employed to clamp the slide in adjusted position upon the bar. One of the working members is attached to the bar, while the other working member is attached to the lever referred to, which latter is fulcrumed upon the slide, and is provided with a suitable adjusting device, preferably a step cam, by means of which the position of the lever upon the slide may be varied accurately for fine adjustments within the limits of the adjustment by the notches upon the bar.

My invention further comprehends various details of construction to be hereinafter fully described and pointed out in the claims.

In the drawings, Figure 1 is a side elevation of one form of instrument embodying my invention. Fig. 2 is a section taken on the dotted line 2—2 Fig. 1, looking to the left; Fig. 3, a detail looking at the rear side of the instrument Fig. 1, with one of the side plates of the slide removed, said figure showing the means for clamping the slide in adjusted position upon the bar; Fig. 3ª, a detail similar to Fig. 3, but showing the parts in another position. Fig. 4 is an enlarged sectional detail taken on the dotted line 4—4, Fig. 1. Fig. 5 is a view looking at the rear side of the rotatable step cam detached; Fig. 6, an enlarged sectional detail taken on the dotted line 6—6 Fig. 1; Fig. 7, a detail showing the manner of connecting the bar with an extension piece therefor, and Fig. 8 an enlarged detail view looking from the left toward the combined pencil and point head constituting one of the working members of the instrument.

Referring to the drawings in the particular construction selected to illustrate my invention, A and B are two working members of an instrument, the member A, as shown, being a combined needle point *a* and pencil *a'*, and the member B being also a needle point.

C is the bar connecting the two working members, and notched or serrated at *c* along one of its edges, and preferably beveled at its opposite sides along both of its edges, as at *c'*, *c'*, see Fig. 4, for a purpose to be described.

D is the slide mounted to move longitudinally on the bar C, and consisting of plates *d*, *d'* screwed together, as by screws d^2, d^9, one of the said plates, as *d*, being extended upward in the form of and to constitute a handle $d^\times$. See Figs. 1 and 2.

Referring particularly to Figs. 3, 3ª, and 4,

the slide D, at its upper side, adjacent the serrated edge of the bar, is shown provided with a spring or yielding detent d^3, which is adapted to enter one or another of the notches in the bar to assist in positioning the slide on the said bar, the side of the latter being preferably graduated, as shown in Fig. 1. At the under side of the bar, the slide D, between its two plates or members d, d', is provided with two clamping members d^4, d^4, pivoted at one of their ends, as at d^5 Fig. 3, and shown as loosely secured together at their opposite ends by a pin or connection d^6, the upper edges of the said members being beveled as shown in Fig. 4, to fit and contact with the beveled or V-shaped edge of the bar C. A spring d^7, shown as immediately below and attached to the ends of the clamping members d^4, is acted upon by a suitable actuator shown as a cam d^8, pivoted at d^9 in the slide, and provided with a handle d^{10}. See Fig. 3. When the cam is turned into its position Fig. 3, it acts through the spring d^7 to press the clamping members d^4, d^4, firmly though yieldingly against the bevel or V-shaped edge of the bar C, clamping the latter firmly between the said members and the opposite grooved edge of the slide, the action of the V-shaped edge of the bar, co-operating with the clamping members d^4, being such as to press the said clamping members laterally and tightly against the inner faces of the plates d, d', of the slide, so that the said bar is not only firmly clamped against longitudinal movement by the pressing of the clamping members against its edges, but is also held against lateral or twisting movement by firm contact of the clamping members with the inner faces of the slide plates.

By interposing a yielding member, as the spring d^7, between the actuator d^{10} and clamping members d^4, a superior movement is obtained, and the cam-portion d^8 of the actuator may more easily be carried past the dead center to be locked in clamping position and still hold the clamping members in firmer contact with the bar, than would be possible without the interposition of said yielding member.

To adjust the slide into one or another approximate position, the cam d^8 is turned down into its position Fig. 3^a, thereby permitting the clamping members, turning upon their pivots d^5, to drop away from the adjacent edge of the clamping bar, thereby enabling the latter to be tilted sufficiently in the slide, as shown, to clear the detent d^3, thereby enabling the slide to be moved along on the bar into desired position, where it is clamped, as shown in Fig. 3.

The cam d^8 is so shaped and positioned with relation to its handle d^{10}, that when in its clamping position, Fig. 3, its summit is carried past the vertical line of force, so that the action of the spring d^3 and clamping members is to retain the cam in its clamping position, rather than to release it.

The slide D is provided, at one side, with a fulcrum stud e, shown as headed, and upon which is fulcrumed the lever E carrying at its lower end one of the working members, as B, secured to the said lever in suitable manner, as by the clamping screw e'. The lever, at one side, is provided with a notch, which receives the fulcrum stud e, the said notch acting upon the said stud at two points approximately ninety degrees apart, to insure always a firm and accurate contact unaffected by wear, said lever, at a point intermediate its fulcrum and upper end, being provided with an off-set, as e^3, see Fig. 2, grooved at its opposite upper and lower corners to receive and hold a spring f caught at its lower end under the neck point of the lower screw d^9, securing the two plates of the slide together, said spring, at its upper end and at the opposite side of the lever, being acted upon by the grooved nut f' threaded upon the end of a screw f^2 tapped into the upper end of the said lever.

In Fig. 6, the screw f^2 is shown as provided at its opposite ends with differential threads, whereby a complete rotation of the screw moves the spring a distance less than the throw of any single thread, thereby rendering the adjustment extremely fine and accurate.

Referring now particularly to Fig. 1, the upper end of the spring f is prolonged above the topmost end of the lever, and has its end turned inwardly, as at f^3, and co-operates with the step cam g secured to an actuating disk g', both journaled upon a stud g^2 on the operating handle $d^\times$. The stud g^2 is provided with an eccentric hole for the reception of a shank g^3 of a locking button provided with a head g^4 at one end, and with a short operating handle g^5 at its opposite end, the said head g^4 being also eccentric upon its shank g^3, so that when the stud is turned into its position Figs. 1 and 4, the said head laps over onto the cam g and retains the same in working position upon the stud g^2. When, however, the locking button g^3 is rotated through one-half a rotation, its eccentric head g^4 is turned upon and to substantially register with the end of the stud g^2, thereby enabling said disk and its cam to be removed from the said stud.

The handle $d^\times$, see Fig. 4 at its side adjacent the operating arm g^5, is shown as provided with a slight hump g^6 upon which the operating handle is moved, and which acts to frictionally hold the said handle against movement, except by the operator for rotation of the locking button.

Referring now to Fig. 5, the cam g is shown as volute in form, *i. e.*, starting from the point O, the said cam gradually increases in radius up to the point 7, between which points, the said cam is shown as provided with a plurality of notches, shown as six in number, the bottom of each notch 1, 2, 3, &c., being at a greater radial distance from the axis of the cam than the notch next preceding it, the rise of the several notches above the preceding ones being substantially uniform. These

notches are preferably V-shape in form, and the co-operating end f^3 of the spring is preferably rounded, so that when the said end springs into any one of the notches, it will act upon the tapering sides of the latter to center the cam with relation to the end of the spring, the latter having line contact upon each tapering side of the notch, thereby insuring accuracy of adjustment. By such a construction, the adjustment is less affected by wear of the parts than by any other construction known to me other than an equivalent construction.

In lieu of the V-shaped notches, I may employ depressions of other desired shape or the inverse of the same, *i. e.*, depressions in the end of the spring and a projection on the cam, or other suitable means to indicate to the operator certain definite steps in the rotation of the cam, and which are preferably so shaped as to cause the co-operating member, herein shown as the spring *f*, to bottom in the notch or depression in each instance, to thereby insure accuracy of adjustment.

In the device shown, the outer face of the disk g' is graduated and numbered to correspond with the steps in the cam at the back of the disk, to thereby enable the operator to turn the cam into one or another desired position.

The shape of the spring *f* is such, that, cooperating with the neck at the point of the screw d^2, it provides a bearing for the lever E at three points only, viz: at the points 10, 11 and 12, thereby rendering the said lever firm and not liable to rock upon and with relation to the slide, the bearing point 11 being herein shown as a short stud projecting at the side of the slide.

Referring now to the working member A, shown as combining in its construction the needle points and pencil, said member, in the present embodiment of my invention, consists of the back plate *m* slotted at m' to receive the tenon m^2 on the end of the bar C, said tenon being provided with a hole for the reception of the locking tongue m^3 of the locking lever m^4 pivoted at m^5 to the said plate *m*. The tongue m^3 is shown as wedge-shape in form, so that when pressed into and through the hole in the tenon, the said tongue will act against one side of the hole therein to draw the bar C tightly against the face of the plate *m*, the said tongue being also preferably slightly curved, as shown, to enable it to spring more or less and maintain the shoulders on said bar firmly seated against the plate. The pencil and needle point are carried by the member A in suitable or usual manner.

To illustrate the operation of the instrument, let us assume that it is desired to draw a series of circles, say seven in number, and all within the limit of one of the notches of the bar C. The operator first turns the cam d^8 into its position Fig. 3^a, and moves the slide along the bar C until the distance between the working members B and A equals the desired diameter of the innermost of the several circles to be drawn. The needle point or member B is then inserted in the paper, and the pencil a' of the member A swept about it in usual manner by means of the handle $d^\times$, drawing the first circle, the step cam *g* during this time being in its position Fig. 1. The operator now rotates the cam *g* one step in the direction of the arrow Fig. 1, causing the end f^3 of the spring on the lever E to be thrown to the left Fig. 1,—in this instance one-eighth of the distance between one and the next of the notches on the bar C,—and the next circle is drawn; the cam *g* rotated another step, and the third circle is drawn, and so on until the cam has been rotated through seven successive steps and the seven required circles drawn, all of which will be found within the limits of one of the notches of the bar C. The cam may now be returned to its first point Fig. 1, and the slide moved along one notch, when the pencil point will be found in proper position to sweep another circle outside of the one last drawn, and separated therefrom by a distance equal to that separating the several circles previously drawn, further rotation of the cam as before enabling a second series of seven circles to be drawn outside of the first, and forming a continuation of the first series.

The operation described illustrates the use of the instrument and its capabilities for fine work.

I have herein shown as a convenient construction, the cam provided with eight steps adapted to draw eight lines with eight equal spaces within the limits of one of the notches of the bar C, but, if desired, the said cam may be provided with a greater or less number of notches, and graduated or spaced in any desired manner to adapt the instrument for any particular class of work.

While I have described the operation of my improved instrument in connection with the pencil and needle points, it is evident that the pen may be substituted for the pencil, or the member A may be reversed, or its needle point employed in connection with the point B for spacing purposes, or the two working members may be otherwise shaped or adapted to perform various classes of work in which fine and accurate and defined graduations are desired.

Fig. 7 shows the manner of connecting an extension bar to the bar proper C shown in Fig. 1, the clamping and locking device being substantially the same as that employed to attach the working member A and the pen to the bar, the opposite end of the extension piece being provided with a mortise and shoulders like the bar C for the adjustment of other bars or working members.

I have herein shown and described my invention in connection with an instrument commonly known and understood by all, but my invention is not restricted to the use of construction shown, for it is evident the same may be varied in many ways without depart-

ing from the spirit and scope of the invention as claimed.

I prefer to employ a rotating step cam for the fine adjustment of the working members, but the step may be omitted if desired, and the graduations upon the disk, or otherwise, be depended upon to determine the several positions of the cam.

The spring *f* from the offset e^3 in the lever to the end n^3, in effect, constitutes a part of the lever itself, and may be so made if desired, it being herein shown as made integral with the spring portion *f* for the sake of convenience of construction and adjustment.

The term "cam" as employed in the claims, includes any device having a gradually rising surface which acts upon its co-operating member to vary the position of one of the working members with relation to the other.

I claim—

1. In an instrument of the class described, the combination with a notched bar to which one working member is attached, of a slide freely movable on said bar and carrying the other working member, a detent on said slide, and a spring to enable it to automatically enter and leave successive notches in said bar as said slide is moved in either direction, to thereby indicate definite lengths of movement on said bar, and independent clamping devices to clamp the slide in adjusted position determined by said detent, substantially as described.

2. In an instrument of the class described, the combination with a bar having a series of centering V-shaped notches at its edge, and an attached working member, of a slide mounted on said bar and carrying another working member, a spring controlled centering detent on said slide adapted to automatically enter and leave successive notches and center the slide with relation thereto, and means to clamp the said slide in adjusted position determined by the detent, substantially as described.

3. In an instrument of the class described, a bar provided with a beveled edge, a working member attached thereto, combined with a slide embracing said bar, a clamping member and means to force the same against the said beveled edge, the latter acting to move said clamping member laterally against said slide to thereby retain said slide firmly in adjusted position on said bar, substantially as described.

4. In an instrument of the class described, a bar beveled at both sides along its edge, a working member attached thereto, a slide embracing said bar and carrying another working member, two independent clamping members arranged within said slide and acting respectively upon the said beveled edges, and means to force said clamping devices toward said edge, whereby said beveled faces, entering between said clamping members act to spread the latter laterally against the said slide to retain the latter firmly in position upon the said bar, substantially as described.

5. In an instrument of the class described, a notched bar, and a working member attached thereto, a slide on said bar provided with a detent co-operating with said notches, and a working member carried by said slide, combined with a clamping member held at one end, its free end being adapted to be moved toward that edge of the said bar opposite said notches; and means to force said clamping members against said edge, the free end of said clamping member, when released, moving away from the said bar to permit the latter to be tipped in the said slide and out of engagement with said detent to enable the bar to be moved through said slide, substantially as described.

6. In an instrument of the class described, a bar, a working member attached thereto, a slide on said bar provided with another working member, a clamping member acting against said bar, a pivoted actuator having a cam-shaped hub, and a spring interposed between the said cam-shaped hub and the said clamping member to permit always a full rotative movement of said actuator, and at the same time create a yielding pressure upon said clamping member, to operate, substantially as described.

7. In an instrument of the class described, a bar, a working member attached thereto; a slide adjustable on said bar, and carrying the other working member; a lever fulcrumed on said slide; a cam having a gradual rising surface; and a spring to press the said lever thereupon, movement of the cam varying the relative positions of the said working members, to thereby effect adjustment of the instrument, substantially as described.

8. In an instrument of the class described, a bar, a working member attached thereto; a slide adjustable on said bar; a lever, and a working member moved thereby; and a rotatable volute cam to act upon and furnish means to vary the position of the said lever, substantially as described

9. In an instrument of the class described, a bar, a working member attached thereto; a slide adjustable on said bar; an adjustable working member mounted thereon; and a step cam to furnish means for varying the positions of said adjustable working member, said step cam determining the various positions of adjustment, substantially as described.

10. An instrument of the class described, containing the following instrumentalities, viz:—a bar, a working member fixedly attached thereto, a slide on said bar provided with a vertically extended handle, an adjustable working member on said slide, an adjusting lever to move said adjustable member relatively to said fixed member, said adjusting lever being extended upwardly along said handle to a convenient point thereon, and means on said handle to move said lever into one or another position, substantially as described.

11. An instrument of the class described, containing the following instrumentalities, viz:—a bar, a working member fixedly attached thereto, a slide on said bar provided with a vertically extended handle, and a second adjustable working member carried by said slide, an adjusting lever to move said adjustable member on and with relation to said slide and thereby vary the relative positions of the said working members, a fulcrum for said lever, a spring to press the latter against its fulcrum, and an adjusting device for said lever against which the latter is pressed by said spring, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ANALDO M. ENGLISH.

Witnesses:
FREDERICK L. EMERY,
AUGUSTA E. DEAN.