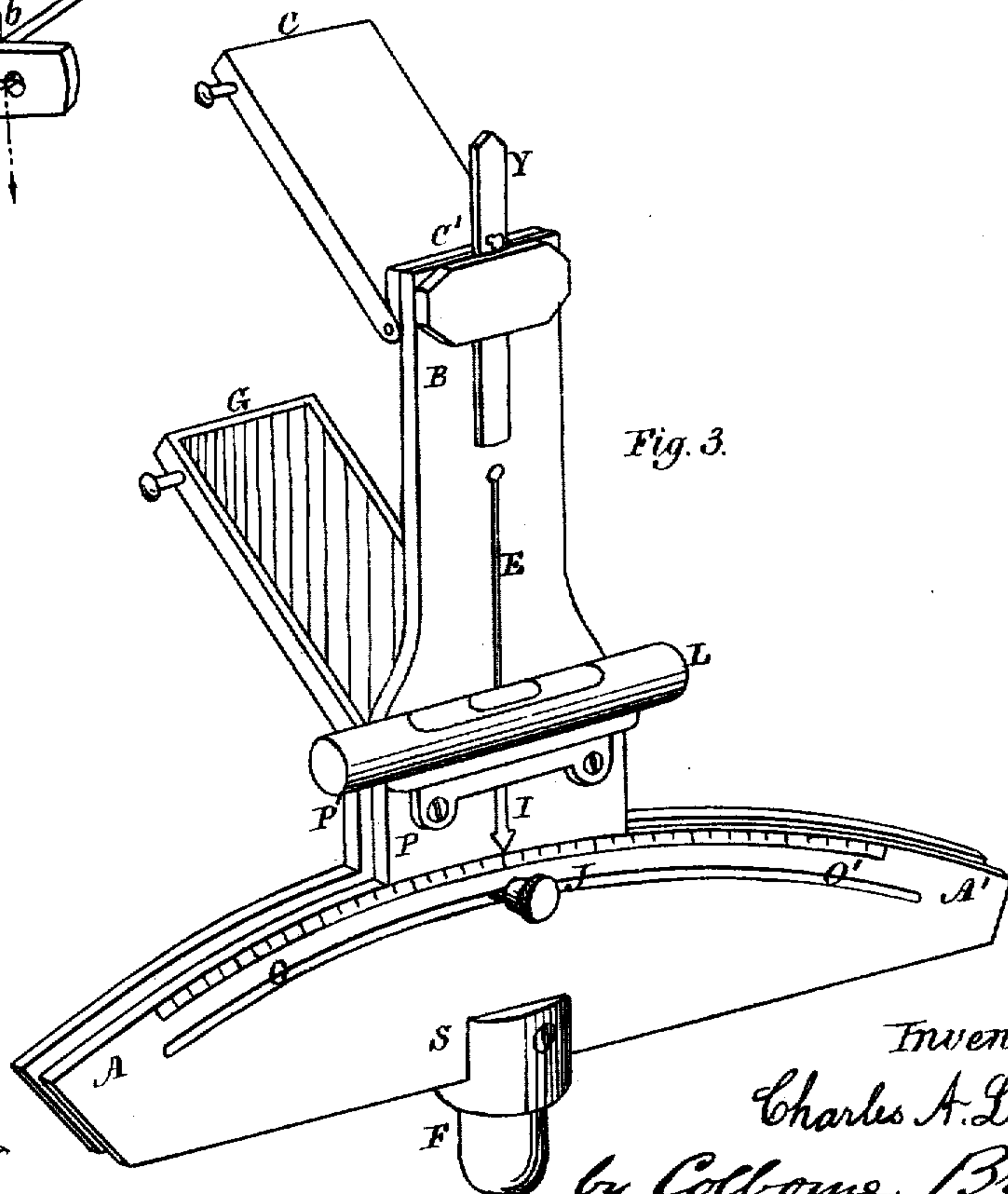
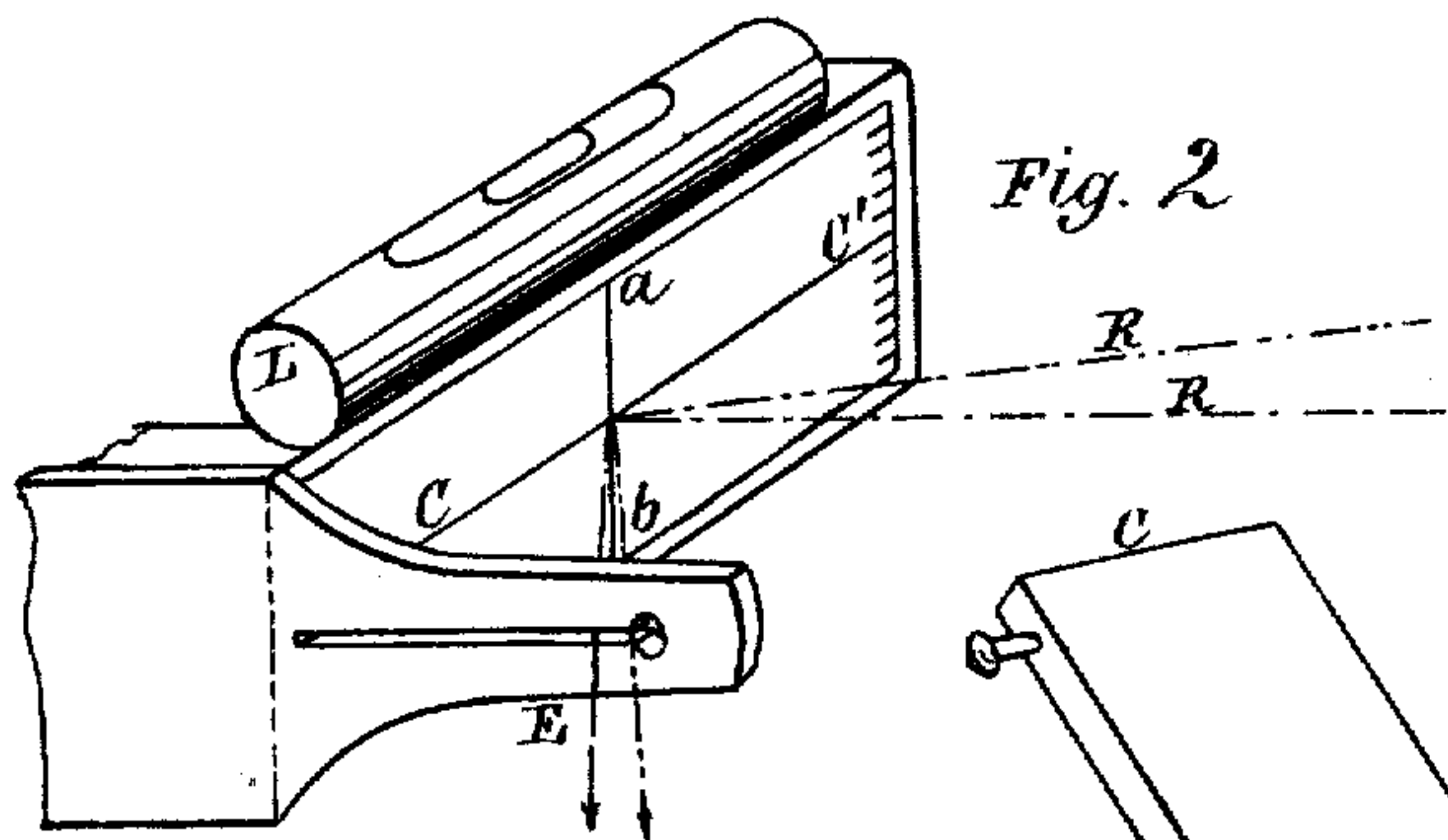
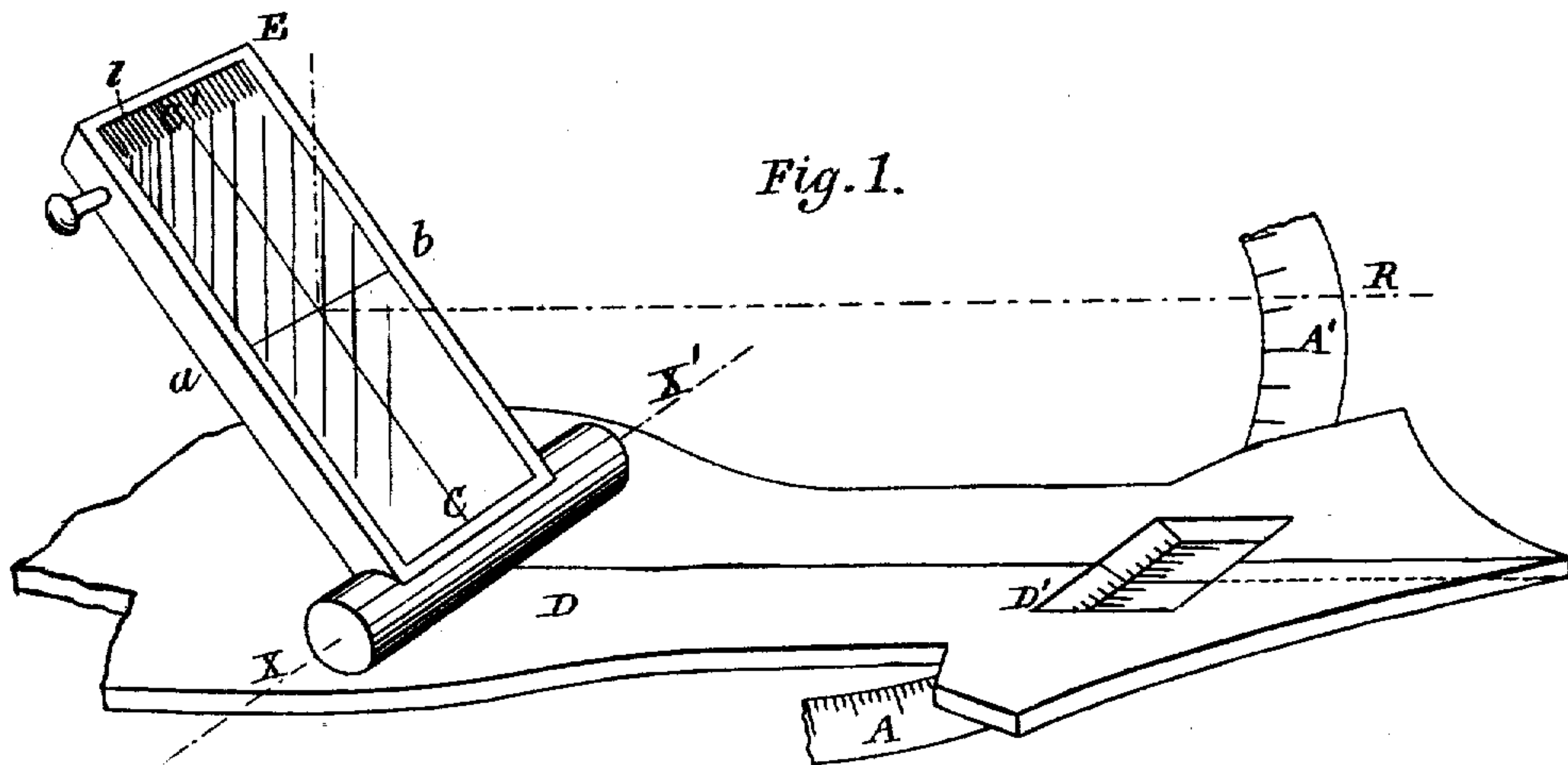


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**COLLIMATING SIGHTS FOR FIRE-ARMS, &c.**  
 No. 187,432. Patented Feb. 13, 1877.



Witnesses.  
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Fig. 4.

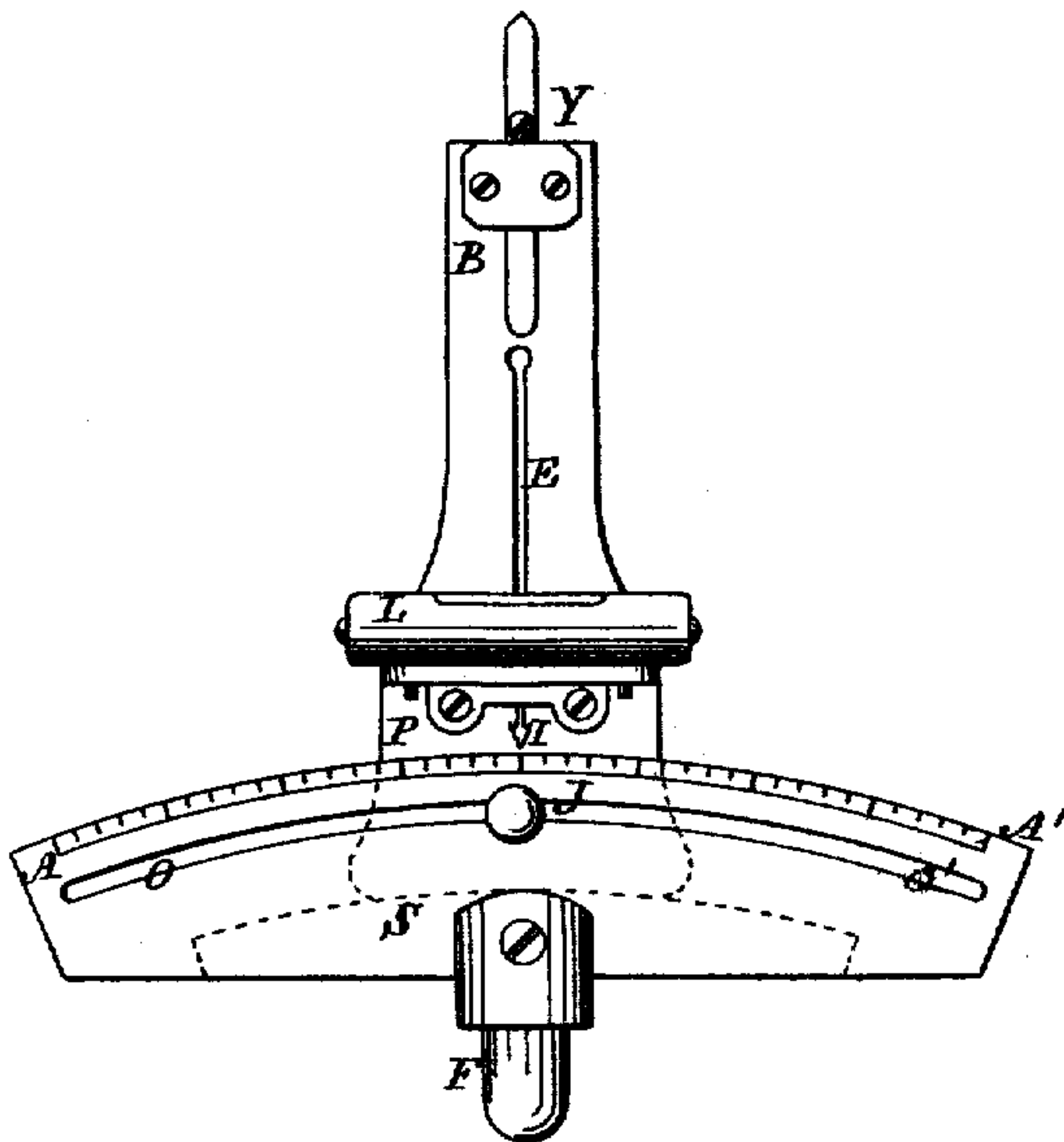


Fig. 5.

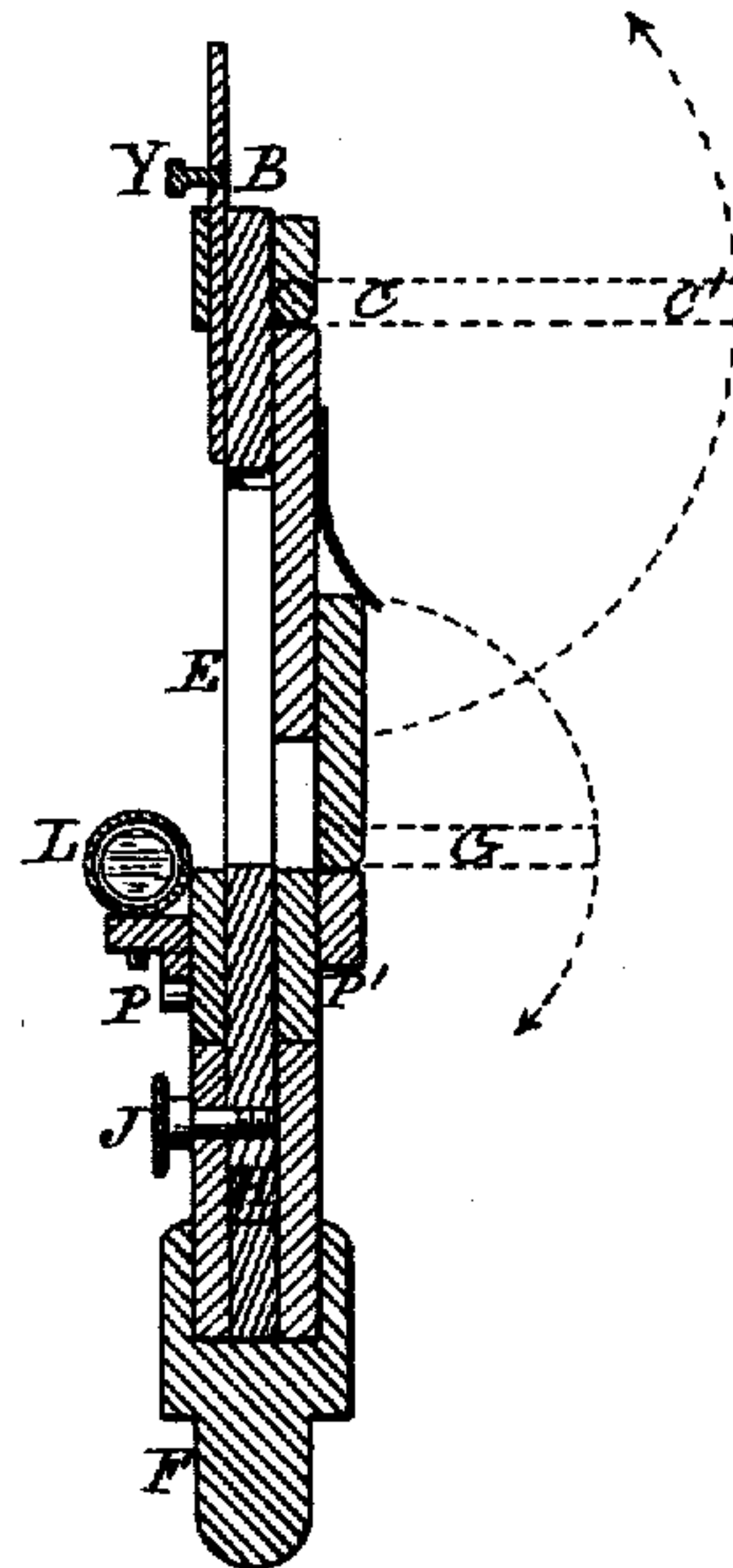


Fig. 6.

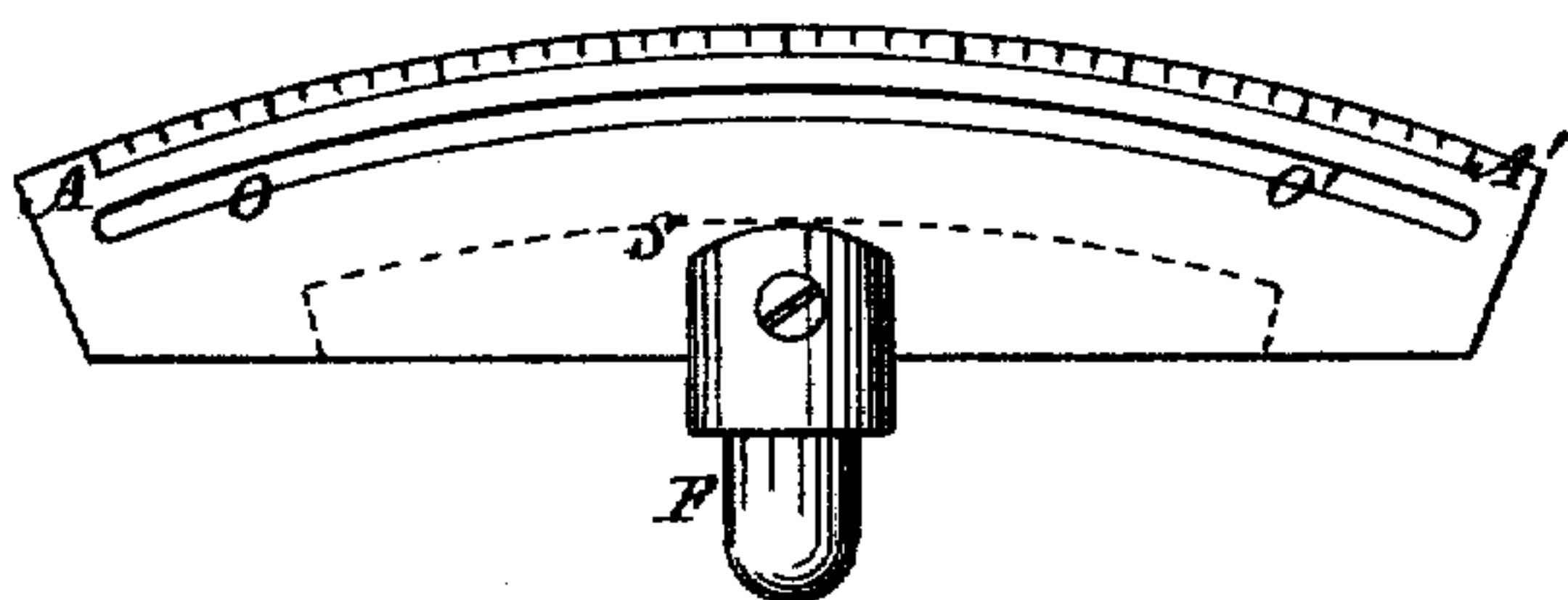


Fig. 7.

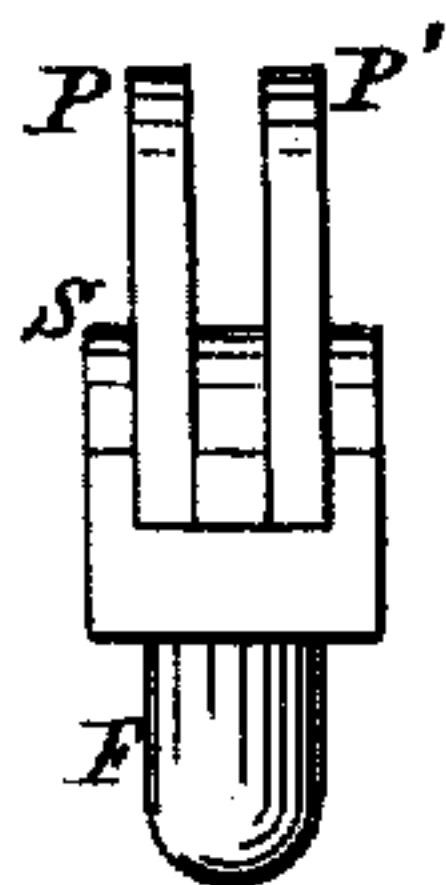
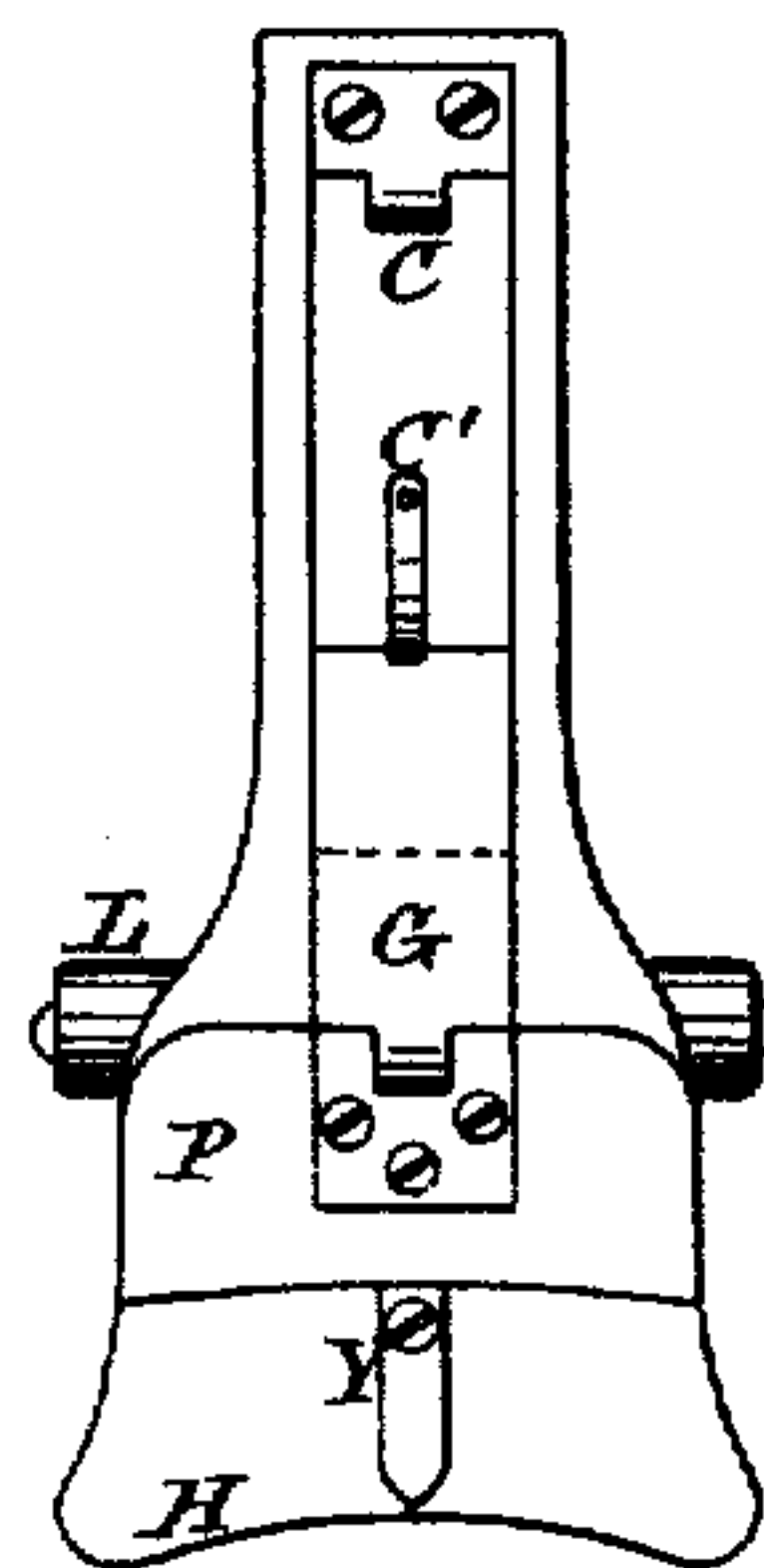


Fig. 8.



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# UNITED STATES PATENT OFFICE.

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## IMPROVEMENT IN COLLIMATING SIGHTS FOR FIRE-ARMS, &c.

Specification forming part of Letters Patent No. 187,432, dated February 13, 1877; application filed January 7, 1875.

*To all whom it may concern :*

Be it known that I, CHARLES A. L. TOTTEN, of the United States Army, have invented a new and Improved Diamond-Reflecting or Collimating Sight; and I do hereby declare that the following is a full, clear, and exact description thereof, which will enable others skilled in the art to make and use the same, reference being made to the accompanying drawings forming part of this specification :

This invention consists chiefly in the application of certain marks, lines, or their equivalents, upon reflectors for collimating purposes, so as to enable one to determine them more promptly and accurately than can now be done by the use of any of the various devices employed, and is equally as accurate as the telescope within the limits of distinct vision.

My device comprehends the whole class of sights, namely, such as are, or may be, employed upon guns, mortars, &c., surveying, philosophical, mathematical, astronomical, and, in fact, all instruments requiring sights. Its value will appear from the following description :

It is especially applicable, astronomically, as a finder on a large telescope, since the whole field appears in the mirror, and the particular star desired may be brought at once into proper relations with the instrument employed.

In its particular application to sighting guns it affords a more certain means of obtaining ranges, this being accomplished by a suitable combination with a graduated arc, or scale, or other means to the same end. It may be still further combined with a spirit-level; moreover, when a graduated arc and a spirit-level are combined, a means is afforded of correcting for inequality of platform, or wheels, &c., wind, and all the aberrations of flight of projectiles, and by employing the same or similar combinations it may be adjusted to the piece in any position into which the latter is liable to be thrown when in service.

By means of the lines upon the reflectors a valuable and reliable means is also offered of constructing instruments to solve all ordinary practical field-problems that may engage the surveyor or the soldier upon the march, recon-

noissance, or in action, such as obtaining directions, running right lines, lines of works, trenches, &c., perpendiculars, parallels, offsets, verticals, horizontals, angles, locating points inaccessible or not, determining intersections, plotting ranges with the plane-table, or obtaining areas, contents, &c.

The above improvements and invention will now be specifically described, reference being had to the accompanying drawings.

Figure 1 represents a view of a reflector with lines upon it, and exemplifies the general principle. Fig. 2 represents another view of a mirror, leveled and with lines upon it, and for use as a level, &c. Fig. 3 represents a view of the "collimating sight." Fig. 4 is a front view of the same. Fig. 5 is a cross-section of the same through its vertical axis. Fig. 6 is a front view of the standard. Fig. 7 is a side view of the same. Fig. 8 is a back view of sight-body.

Similar letters of reference indicate corresponding parts.

*General principles, (Fig. 1.)*—If a right line,  $C C'$ , be perpendicular to another,  $X X'$ , and revolve about the latter as an axis, it will generate a plane perpendicular to this axis, and if the latter be horizontal the plane will be vertical, and vice versa. Such a line,  $C C'$ , is indicated upon a mirror in Fig. 1. It is drawn perpendicular to  $X X'$ , the axis of the hinges, or other means upon which the mirror turns.

$a b$  is another right line on the reflector at right angles to  $C C'$ . Let the axis  $X X'$  be horizontal; then, as the reflector revolves, the diamond-line  $C C'$  will generate a vertical plane of reflection, and to the eye situated at some convenient point,  $E$ , within, it will constitute a plane of sight, and all points of this plane in front of the mirror will appear to coincide with the diamond-line, and points which do not fall upon it are evidently not in such plane of sight; but by a suitable motion to the mirror or its attachments they may be made so to coincide; in other words, we may sight the diamond-line upon any point, and thus determine the vertical plane containing it. It is evidently immaterial whether the eye be stationary and the mirror movable, or the latter fixed and the eye change its position.



Again, both eye and mirror may be movable, or, for the attainment of particular ends, both may be stationary.

Let  $D D'$ , called the director, be another right line in the plane—horizontal, if possible. It will evidently seem to coincide with the diamond-line by reflection, and indicate the direction of the horizontal trace of whatever plane of sight the instrument may show. Thus, in Fig. 1  $C C'$  and  $D D'$  determine a vertical plane, and the ray  $R$  reflected to the eye at  $E$  is in this plane.

A similar consideration of Fig. 2 would show that  $C C'$  determined a horizontal plane of sight, and that all points in such plane were reflected along this line, and were in the same contour or level.

The line or lines upon the reflectors may be engraved, cut with a diamond, etched, or marked by points, or in any other suitable manner. A series of graduated lines,  $l$ , shown at the top of the mirror will indicate, relatively, how far a point or line is from exact coincidence with the diamond-line  $C C'$ . The director  $D D'$  may be either marked upon the sight or instrument itself, or upon some other body which is to be aimed or put in alignment. In most philosophical and mathematical instruments it will be engraved upon some part of the instrument, or indicated thereon, and pass through some determined point, as the zero of a vernier. (See Fig. 1.)

In aiming guns, &c., the line of metal, or other suitable line of sight thereon, becomes the director. Fig. 3 shows a perspective view of the "collimating sight;" it consists of two parts, the standard  $S$ , and the sight-body  $B$ ; the standard  $S$  is shown in front view in Fig. 6, and in position in Fig. 3; it is in the general form of a circular segment, but may be of any other suitable shape; the arc  $A A'$  which terminates its upper surface is described with a radius equal to its distance from the axis of the gun when the sight is in position. This arc covers forty degrees, more or less, and is graduated from zero,  $0^\circ$ , to twenty degrees, more or less, in both directions from its highest point. Perpendicular to its chord at its middle point projects the pedestal  $F$ . The pedestal is adapted to fit into a corresponding socket in the gun near the breech, and perpendicular to its axis. Its seat, however, may be made in any convenient part of the gun, the construction of the sight varying accordingly.

A narrow slot traverses the standard from side to side, into which the lower part of the sight-body fits, and along which it slides. A circular slot,  $O O'$ , is opened in the face of the standard to receive the thumb-screw  $J$ , or other means of clamping the sight-body in any position along the graduated arc. A shoulder on the pedestal prevents the chord or base of the standard from resting on the piece.

The sight-body is a plate of brass, or other suitable material, in general form as indicated

in Fig. 8, and in cross-section is shown in Fig. 5; it is also seen in position in Figs. 3 and 4. It is provided with a spirit-level,  $L$ , a narrow sight-slot, perpendicular to the graduated arc, and shown at  $E$ , two mirrors, to wit, the collimating  $C C'$ , and the reflector  $G$ , and a style,  $Y$ . The lower part of the sight-body fits into the standard, and the whole is supported upon its curved upper surface by two shoulder-plates,  $P$ , in front, and  $P'$  in rear; these plates have their under surfaces concave, and of a curvature corresponding to that of the standard; the front shoulder plate carries the spirit-level  $L$ , and the index-arrow  $I$ . The level may have any other suitable position, and a second level may be placed parallel to the vertical axis of the sight-body, for the purpose of leveling it if necessary.

When the axis of the pedestal is vertical and the index-arrow at zero, the bubble of the level will be in the middle of the tube; the sight-slot is then also in one and the same vertical plane with them all.

The style  $Y$  fits under the rear shoulder-plate and enables the sight-body to be used as a gunner's-level for determining the line of metal, &c.

There are two mirrors, the collimating  $C C'$ , and the reflector  $G$ . The collimating is similar to those shown in Figs. 3, 1, and 2, and is seen in position in Fig. 3, and in cross section in Fig. 5. The axis about which it turns is parallel to that of the level  $L$ , and both are perpendicular to the vertical axis of the sight-body; they are likewise bisected by it. The lower mirror, or reflector,  $G$ , is seen in position in Fig. 3, and in cross-section in Fig. 5. Lines may be upon it or not, as the case may be; generally it is clear. Both reflectors face each other, and turn through one hundred and eighty degrees, more or less, and, for convenience in carrying, one shuts down upon the other. When the collimator is turned up about one hundred and thirty-five degrees, or forty-five degrees with the horizon, it catches the rays from distant objects and sends them down to the reflector, which, placed at a corresponding angle, transmits them through the vertical slot to the eye beyond. The eye, the axis of the slot, the bubble of the level, the index-arrow, the diamond-line, the line of metal, (if the sight be adjusted to the gun,) and the object are then all in the same plane of sight.

The valuable features of this sight and the mode of its employment, and of making the corrections with it for drift, wind, &c., will best be seen by explaining its use.

With the sight-body as a gunner's level, determine the line of metal of the gun. Mark this with chalk or otherwise. The standard  $S$  is then placed in its socket, and brought as near perpendicular to the line of metal as possible; the sight-body is then clamped in position, so that its index  $I$  is at the zero of the scale. The axis of the gun is, in the meantime, brought as nearly horizontal as possible.



(It may be verified by turning the sight parallel to the line of metal, and, by means of the elevating-screw, bringing the bubble to the middle of the tube.) If, now, the platform be level or the axis of the wheels and trunnions be horizontal, then will the bubble of the level be in the middle of the tube; if they are not, it will be indicated by the level, and by unclamping the thumb-screw the sight-body may be slid along the surface of the standard until the bubble indicate its true place. It is then clamped, the mirrors are properly inclined to reflect the line of metal, the eye is applied to the slot, and by turning the standard in its socket the line of metal is made to coincide by reflection with the diamond-line on the collimator, *i. e.*, the perpendicularity of the standard to the line of metal is corrected.

The sight has thus been adjusted to the piece, and, by altering the inclination of the collimator, slightly distant objects will appear upon it; and by traversing the gun, any one of them may be made to come upon the diamond-line.

The line of metal or axis of the piece has thus been correctly pointed.

To elevate it for any required range, re-clamp the sight-body at the zero,  $0^\circ$ , turn the standard till it comes into the vertical plane of sight or parallel to it. By means of the elevating apparatus of the gun, bring its axis horizontal, which will be indicated by the level. Now, to give any number of degrees of elevation or depression, as, for instance,  $10^\circ$ , move the sight-body along the arc till its index points to the required mark,  $10^\circ$ , of graduation, clamp it here, and again bring the bubble to the middle by means of the elevating apparatus.

The axis of the gun has now been correctly elevated and pointed, and by means of the actual line of metal.

If there be drift, or wind, or other aberration of flight, or personal error of gun, to be allowed for, suppose the error of flight to be to the right, then, in the operation of pointing, instead of making the line of metal appear to coincide with the diamond-line, let it fall off of it to the left one, two, or more graduations, as the case may be; then, when an object is brought upon the diamond-line, the line of metal will be aimed to the left of such object, and, according to the amount, an allowance will have been made for drift, &c., to the right; similarly we may correct for other aberrations of flight to the right or left, and the gun will have been pointed with hair-line accuracy, properly elevated by the level, the aim corrected for inequality of platform, wheels, &c., and a suitable allowance made for aberration of flight.

To employ the above instrument, or any mirror so constructed, as an instrumental aid to battle-field surveying, or to the solution of any of the ordinary surveyors' problems, we may either clamp the entire sight or instrument to a suitable support, or hold it in the

hands, or remove the sight-body and use it as follows:

Line the instrument, and, having suitably inclined the mirrors, look through the eye-slot; the diamond-line will then appear projected along the ground in front, and the other line or lines across it at right-angles. Hence lines of stakes, courses, &c., may be set out along these several lines which will be perpendicular to each other, and by regularly moving the collimator a series of parallels may be set out perpendicular to the first, or to any given course, or a new line be run parallel or perpendicular to any indicated direction, or passing through any point or points, &c. Points may also be interpolated, the diamond-line being made to take any given direction, indicating an unlimited right line, at any point of which a stake may be planted. Pointing stakes for mortars may thus be accurately established, or plumb lines put into alignment. The intersection of two or more right lines, or of one with a curved line, or of two planes, or where a line pierces a plane, may similarly be determined. And it is evidently immaterial whether such points be accessible or not. Verticals through given points may also be determined by leveling the instrument and causing the given point to come upon the diamond-line; the latter then, by revolving the collimator, will determine a line upon the earth or other surface; stake out its direction, take a new and suitable position, and repeat the operation; the intersection of the two lines thus determined will be the foot of the vertical, or another of its points.

Horizontal lines, contour lines, or any problem in practical leveling, may be solved by setting both collimator and reflector at  $45^\circ$ , then leveling the instrument; its plane being vertical, all rays are reflected through  $90^\circ$ , hence horizontal ones remain so, and the line on the collimator perpendicular to the diamond-line will indicate all points which are at its own level. Or a mirror arranged as in Fig. 2 may be employed, the principle being the same. Offsets may be set out as indicated for a series of parallels, &c. Other similar problems may likewise be readily solved. Again, the instrument or the sight-body, or a simple collimating mirror, may be clamped to a ruler and thus constitute an accurate alidade for use in plane-table problems, such as ranges, surveys, plottings, &c. Separate instruments for obtaining each or all of the above-mentioned ends may evidently be constructed upon this principle.

By the face of a mirror or reflector I naturally mean either front or rear; *i. e.*, the lines may be upon the clear or silvered side of a glass one, or the polished side of a metallic one, or on either side of a crystal or prismatic reflector, &c.

The use of a single line of course does not preclude the use of two or more for the same purpose, nor does it necessarily follow that a



straight line alone must be used, for curved or broken ones as circles and angles may evidently be employed in exactly the same way. I also claim the right to improve these lines by coloring them, putting chalk and other matter in them for the purpose of defining them more clearly, as well as the blurring or scouring, &c., of the mirror except along the lines of reflection, whereby a brilliant line may be obtained.

In using a level in combination with reflectors for such purposes as are specified, I have also considered the value of a plumb-line for similar purposes, and whether one be employed for obtaining the verticality of the instrument or as the director  $D D'$  of the reflector, I regard it as coming within the meaning of my invention.

In the above specification I employ the term reflector generally, meaning mirrors, &c.

Having thus described my invention, what I desire to claim and secure by Letters Patent is—

1. A mirror or reflector, provided with a

right line or its equivalent upon its surface, so arranged that when any other right line is made by reflection to coincide therewith, the two lines thus coinciding shall determine a plane of collimation, substantially as and for the purposes set forth.

2. The combination of a mirror or reflector provided with lines, as described, in combination with a spirit-level, substantially as and for the purpose set forth.

3. The combination of a mirror or reflector provided with lines, as described, in combination with a graduated arc, substantially as and for the purpose set forth.

4. A sight, consisting of a mirror provided with a line or lines, in combination with a spirit-level and graduated arc, substantially as and for the purpose set forth and described in the foregoing specification.

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