(No Model.) 2 Sheets—Sheet 1.

T. H. BERGH & A. M. JOHNSON.

THEODOLITE.

No. 543,122. Patented July 23, 1895.

Fig. 1.

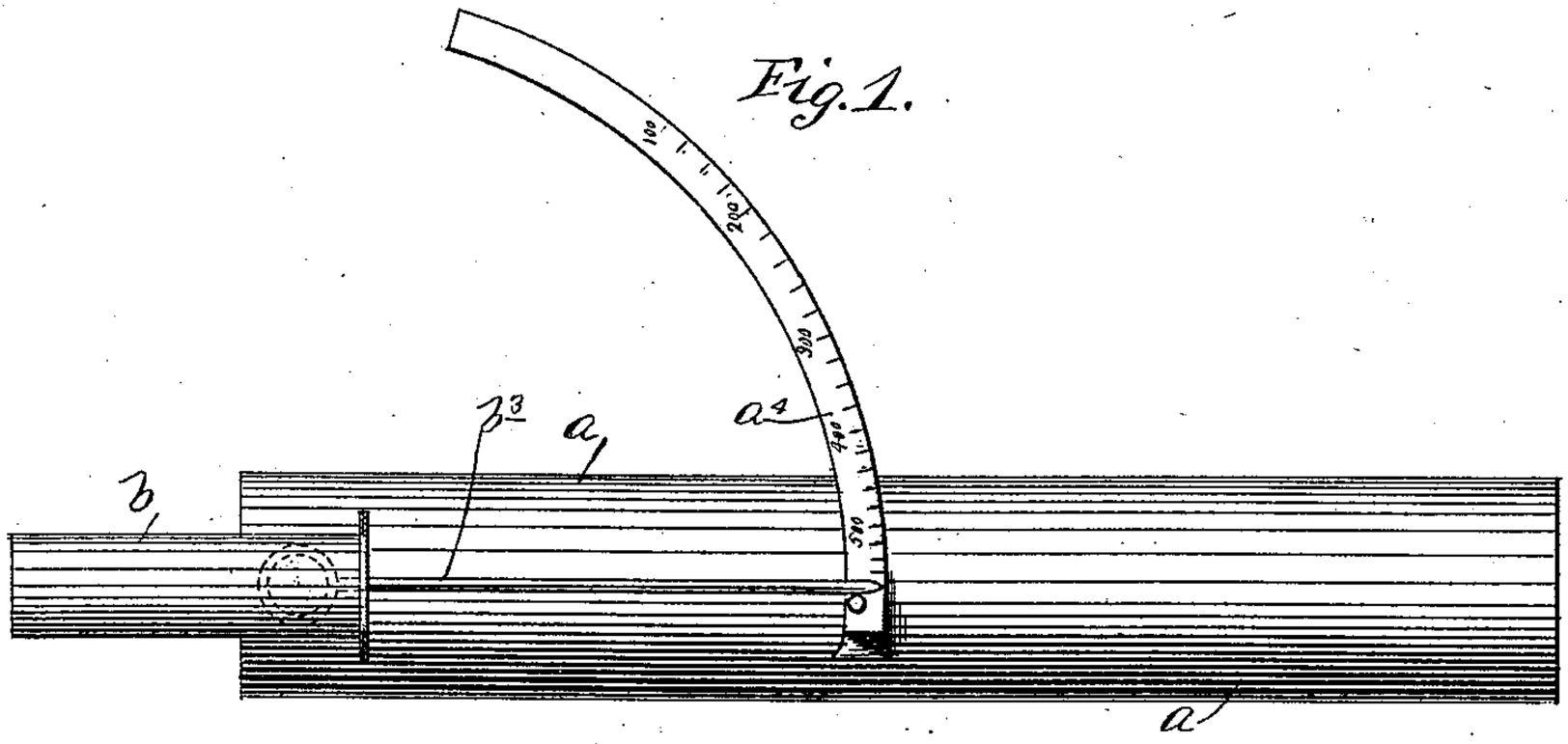


Fig. 2.

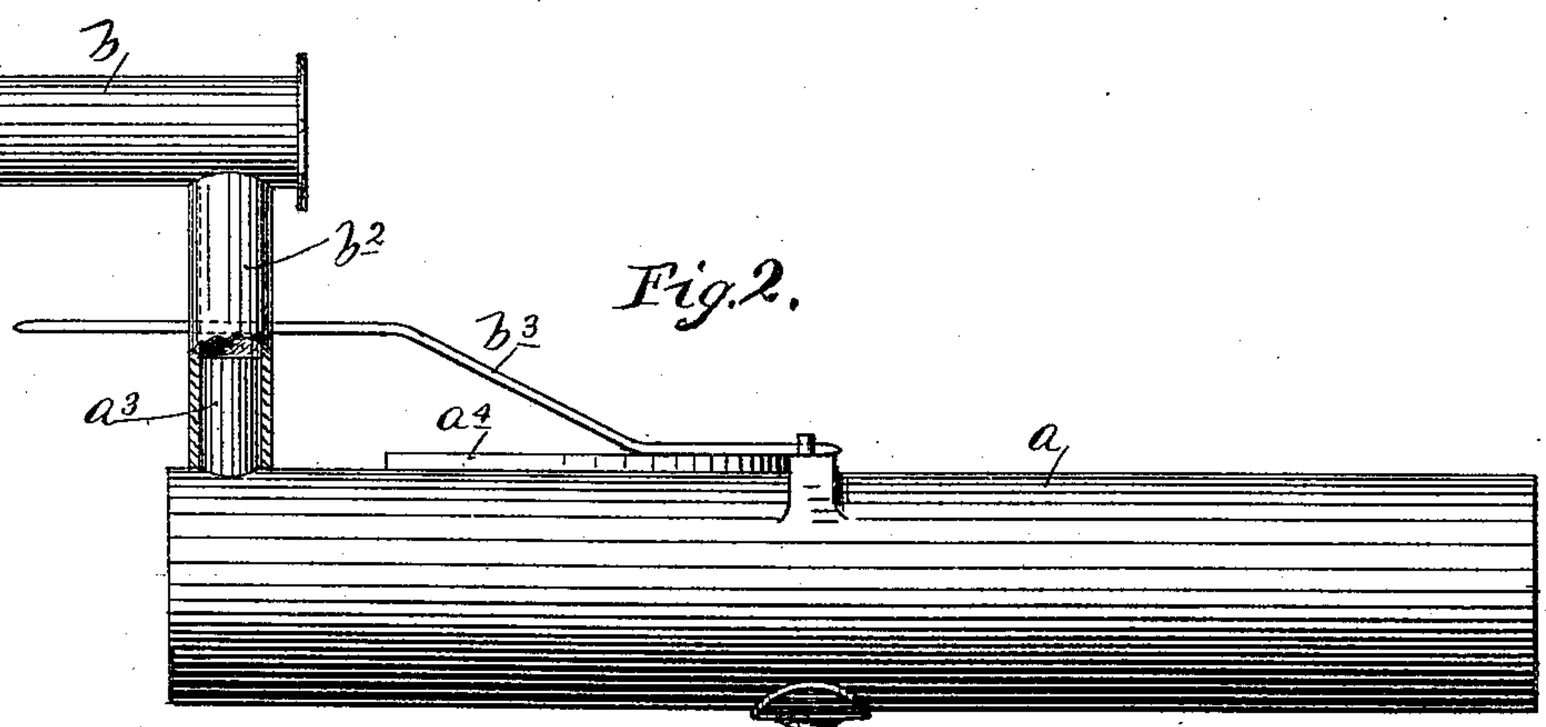
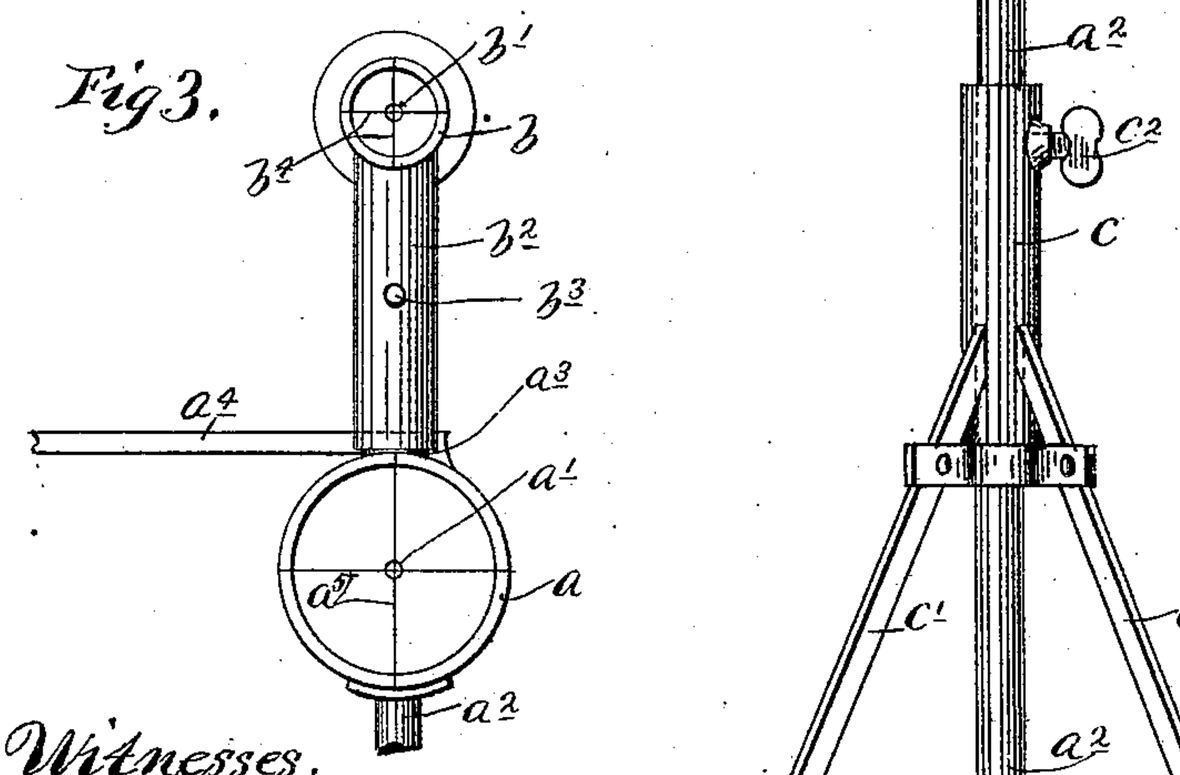


Fig. 3.



Witnesses.
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By their Attorney.
Jas. F. Williamson

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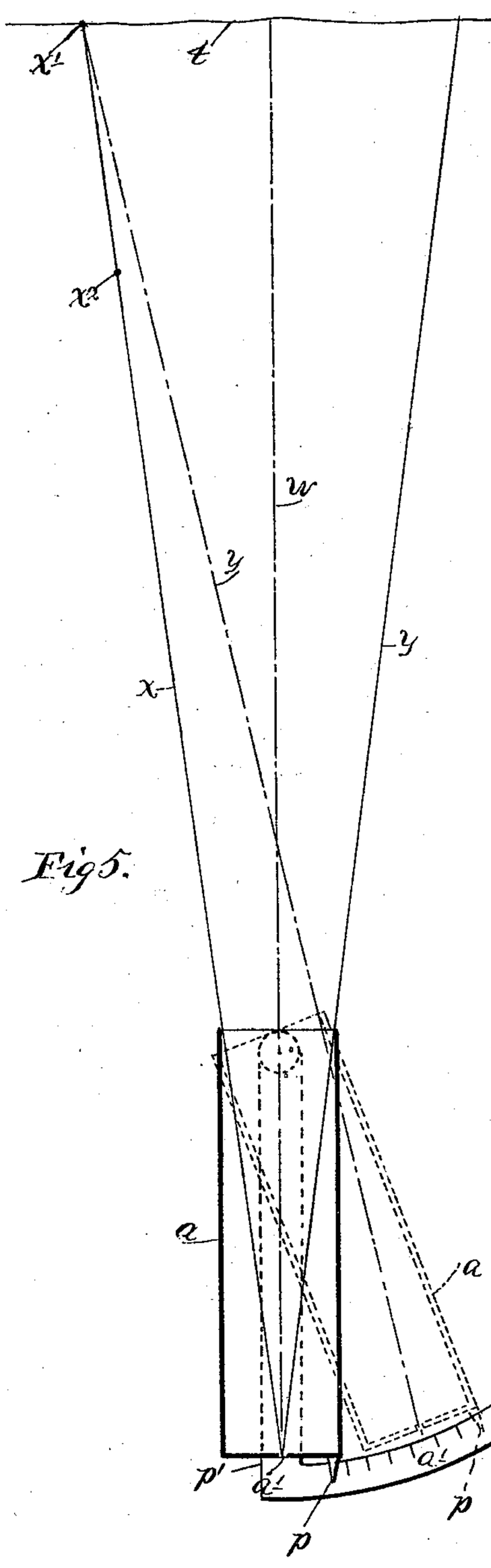

Fig 5.

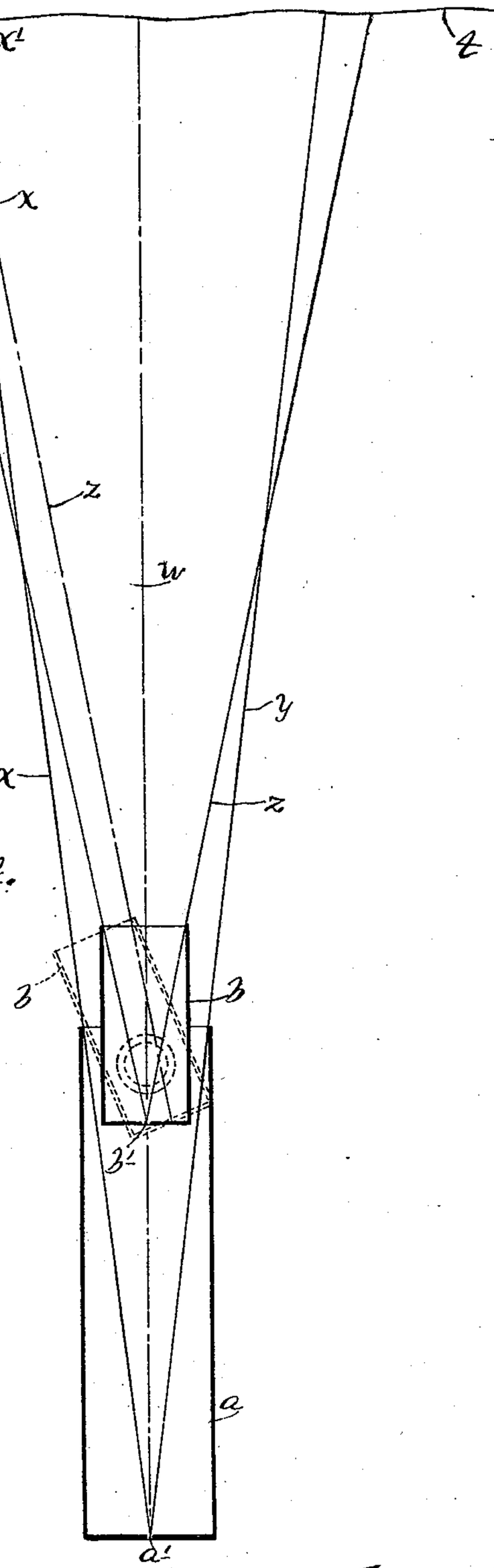

Fig 4.

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UNITED STATES PATENT OFFICE.

THORWALD H. BERGH AND ANDREW M. JOHNSON, OF MINNEAPOLIS, MINNESOTA.

THEODOLITE.

SPECIFICATION forming part of Letters Patent No. 543,122, dated July 23, 1895.

Application filed January 25, 1895. Serial No. 536,201. (No model.)

To all whom it may concern:

Be it known that we, THORWALD H. BERGH and ANDREW M. JOHNSON, citizens of the United States, residing at Minneapolis, in the county of Hennepin and State of Minnesota, have invented certain new and useful Improvements in Theodolites; and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

Our invention relates to theodolites, and has for its object to provide a cheap and efficient instrument of the above class.

To these ends our invention comprises the novel devices and combinations of devices, the preferred form of which, as well as a modification of the same, are illustrated in the accompanying drawings, wherein like letters refer to like parts throughout the several views.

In the preferred form of our device we employ one or more sighting-tubes, each of which have open outer ends, and at their inner ends small sight-openings located centrally of said tubes and co-operating with said open ends to give the diverging sighting-lines. The pivot points of the sighting-tubes must be eccentric to or offset from the focal point of the sighting-lines to give a base to the angle of measurement, as will appear later on.

Referring to the drawings, Figure 1 is a plan view of the preferred form of our device. Figs. 2 and 3 are respectively a side elevation and a front elevation of the same, some parts being broken away. Fig. 4 is a view in plan representing, in diagram, the sighting-lines and cross-sections of the sighting-tubes employed in said preferred form; and Fig. 5 is a similar view to Fig. 4 showing a simplified modification of the device, illustrating the manner of measuring distances with a single sighting-tube.

a b are a pair of sighting-tubes having open outer ends and the sight-openings a' b', respectively, at their inner ends. Of these tubes the one a is held in its properly-adjusted position by means of a rigidly-secured pivot-stem a^2 working through a bearing c of a tripod or standard c' and subject to a thumb-screw c^2. The tube b is pivoted to the forward end of the tube a by means of a depending tube-like support b^2, fixed to said tube b and working around a stud a^3 projecting from said tube a. Thus the tubes a and b are both mounted for pivotal adjustment in horizontal planes. The tube a has secured thereto and projecting therefrom a segmental scale a^4, which is marked to indicate the distances measured by the different angular positions of the two tubes a and b with respect to each other, and the stem b^2 of the tube b carries a pointer b^3, which co-operates with said segmental scale to indicate this adjustment.

The outer open ends of the tubes a and b are preferably provided with cross-wires a^5 b^4, respectively, which serve to clearly mark the diametrical opposite points of said tubes both with respect to horizontal and vertical planes. The use of the single tube a is shown in Fig. 5.

It is thought that it will facilitate the ready understanding of the principles of construction of our invention by considering first the use of the single tube illustrated in Fig. 5, which is as follows: Let t represent, for instance, the bank of a distant river, the distance of which from the instrument is to be determined. Now let the observer, looking through the sight-hole a', sight an object on the bank t which falls on the visual line x, as marked at x'. Then let the observer, looking on the visual line y against the opposite side of the open end of the tube, turn said tube until this visual line y is directed onto the object x'. Now, as is evident, the farther this object x' is from the instrument the less will be the necessary angular movement of the sighting-tube to bring successively the visual lines x and y in line thereon, and conversely, the nearer this object x' the greater will be this angular movement of the tube. To illustrate, suppose the object to be at a point on the line x, represented at x^2. As is obvious, it would take a farther angular movement of said tube a to bring the visual line y in line therewith.

In case the single tube a alone is used, as indicated above, the same may be provided with a pointer p and be pivoted to a rela-

tively-fixed bracket p', which terminates in a scale p^2, co-operating with said pointer p to indicate the angular movement of said tube a.

From the foregoing it must be evident that with a single tube, by calculating the angular movement through which the tube is moved in the above-described operation, the distance of objects from the observer may be determined; but this device is subject to an objection, which arises from the fact that it is extremely difficult to keep from losing an object which is first sighted by one of the visual lines of the tube while the tube is being adjusted to throw the other visual line on said object. Especially is this so in sighting distant objects, such as a mountain, which may present no distinct marks upon which to direct the sight. This objection is removed in the preferred form of my device, wherein two sighting-tubes are employed. The operation of this preferred form is very similar to that described in Fig. 5, and the essential differences may be briefly stated, as follows: The observer, looking through the opening a' of the tube a, sights the object x' on the line x, and the tube a is fixed in this position. Then the observer, looking through the sight-opening b' of the tube b on the visual line z, turns said tube b until the visual line z is directed onto the object x'. With this arrangement, as is evident, the observer, after having once sighted an object or a particular point on an object, need not lose sight of the same while adjusting the second tube into its proper sighting position thereon. It will be further noted that the visual angle or cone of vision of the tubes a and b are greater one than the other. In view of this fact, as is evident by reference to Fig. 4, distances may be measured in several different ways—as, for example, by bringing the visual line y of the tube a and the visual line z of the tube b to a focus on the object; or, again, by bringing one of the side lines of the cone of vision of either one of the tubes and the central line of vision of the other tube to a focus on said object. The central line of vision of the tubes is indicated by the line marked w.

As the constant angle of the cone of vision of any particular sighting-tube is known, it follows that the diametrical dimensions of said cone at all distances are determinate; and hence, after the distance of an object is determined, the transverse distance of the landscape or object surveyed, looking through said tube, can therefore be determined.

It will be readily understood that various alterations in the details of construction of our device may be made without departing from the spirit of our invention.

What we claim, and desire to secure by Letters Patent of the United States, is as follows:

1. In a theodolite, the combination with a suitable support, of the sighting-tube, pivoted thereto, having an open outer end, and the centrally located sight-hole at its inner end, cooperating with said open outer end to give a predetermined cone of vision, substantially as, and for the purposes set forth.

2. In a theodolite, a pair of sighting-tubes pivoted one upon the other, each of said tubes having open outer ends, centrally located sight-holes at their inner ends, which sight-holes cooperate with the open ends of their respective tubes, to give predetermined cones of vision, and an indicating device for measuring the angle of rotation of said tubes substantially as, and for the purpose set forth.

3. In a theodolite, the combination with a pair of sighting-tubes pivoted one upon the other, each of said tubes having open outer ends, and centrally located sight-holes at their inner ends, which sight-holes cooperate with the open ends of their respective tubes, to give predetermined cones of vision, of an indicator-scale and pointer, carried one with each of said tubes, said scale being marked with notations which denote distances represented by different angular adjustments, substantially as described.

In testimony whereof we affix our signatures in presence of two witnesses.

THORWALD H. BERGH.
ANDREW M. JOHNSON.

Witnesses:
JAS. F. WILLIAMSON,
E. F. ELMORE.