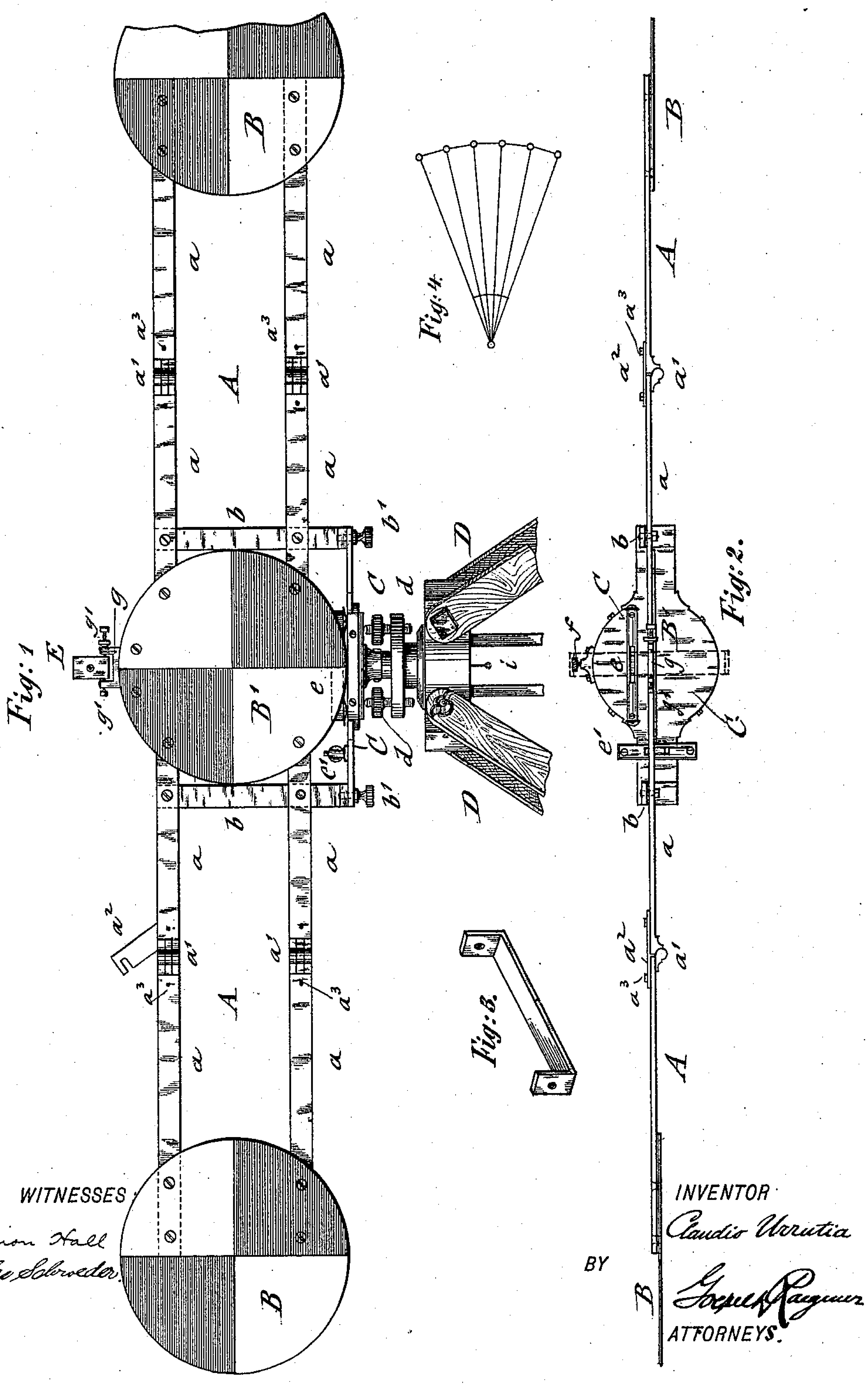
(No Model.)

C. URRUTIA.

SURVEYOR'S TARGET.

No. 486,202. Patented Nov. 15, 1892.



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SURVEYOR'S TARGET.

SPECIFICATION forming part of Letters Patent No. 486,202, dated November 15, 1892.

Application filed March 1, 1892. Serial No. 423,384. (No model.)

To all whom it may concern:

Be it known that I, CLAUDIO URRUTIA, a citizen of the Republic of Guatemala, and a resident of Guatemala, in the Republic of Guatemala, have invented certain new and useful Improvements in Surveyors' Targets, of which the following is a specification.

This invention retates to an improved telemeter, by which the measurement of inaccessible distances and trigonometrical bases can be determined with all desirable precision; and the invention consists of a telemeter which is formed of a horizontal frame provided with targets or disks at its ends, the rod being supported on the head of a tripod, so that it can be rotated thereon, and which is provided with leveling-screws and levels, so that it can be adjusted in the horizontal. To the center of the horizontal frame is pivoted an alidade, which is arranged at right angles to the plane of the frame, so as to swing in a plane at right angles to the plane of the frame and disks.

In the accompanying drawings, Figure 1 represents a front elevation of my improved telemeter. Fig. 2 is a plan of the same. Fig. 3 is a detail perspective view of the alidade that is arranged at the center of the instrument, and Fig. 4 represents a diagram for illustrating the practical working of the instrument.

Similar letters of reference indicate corresponding parts.

A in the drawings represents a horizontal frame, which is preferably formed of two metallic rods *a a*, which are provided with hinges *a'* at intermediate points, so as to permit the folding of the rods for convenience of transportation. The rods *a a* are provided back of the hinges *a'* with pivoted pieces a^2, that are recessed at their outer ends for engaging pins a^3, so as to brace the rods *a* when they are extended in line with each other. At the outer ends of the rods *a* are arranged two targets or disks B, which are preferably made of black and white panels in the nature of the disks usually used on leveling-rods. A third target or disk B' is preferably arranged at the center of the frame A, said center disk serving as an auxiliary to the outer disks, for the purpose hereinafter to be described.

When folding the instrument, the disk at one side is first placed over the center disk and the disk at the other side then placed over the first disk, the disks being then locked together by a suitable fastening device, so as to be retained in folded position. At both sides of the center disk B' the rods *a* are connected by upright rods *b b*, which are firmly attached by screws *b'* to the head C of the Jacob's staff, tripod, or other support D for the instrument, the screws *b'* being detached when the instrument is packed up, so that the tripod-head can be packed in a separate box. The tripod-head C is supported on leveling-screws *d* and mounted in such a manner on the tripod D that the head and instrument can be horizontally rotated on the tripod. The tripod-head C is provided with two levels *e e'*, which are arranged in the usual manner at right angles to each other, and with a clamping-screw *f*, by which the instrument is firmly clamped in position. At the center of the upper rod *a* of the frame or at the upper part of the center disk B is mounted in a U-shaped keeper *g*, provided with pivots *g'*, having conically-tapering ends, an alidade E, which is provided with tapering holes at the center of its base and with peep-sights in its ends, said ends being arranged at right angles to the base of the alidade. By the pivot connection of the alidade E with the horizontal frame or central target the alidade can be swung in a plane at right angles to the plane of the disks, so as to determine the line of sight for the instrument. The tripod is made of any suitable approved construction, preferably of the extension pattern, and provided with an eye *i* at the center of the same for attaching the plumb-bob. The center disk has to be in a vertical line with the plumb-bob, while the distance between the central and outer disks is half a meter and between the centers of the outer disks one meter or other suitable unit of linear measure.

The instrument is used as follows: It is mounted in position by means of the tripod and plumb-bob at the end of the line which is to be measured. It is then accurately leveled and turned on the tripod until the sights of the alidade are aligned with the other end of the line, in which position the instrument is fixed by the thumb-screw *f*. At the other end of the line a transit or any similar instrument is placed in position, said transit being one that will permit the reading off of minutes at least and which will give the angles reduced to the horizon. After leveling the transit the two zeros of the azimuthal limb are brought into coincidence, and the left-hand disk is then sighted, a reading taken, and then the angle to the disk at the right-hand side read off, and this angle is repeated so often that the aggregate shall amount to at least three degrees. In this operation it is advisable to use only the tangent-screw of the transit, for which purpose it has to be previously set, so as to allow the use of its whole length. If greater exactitude is required, it will be better to have the aggregate amount to six or eight degrees by means of the preceding operation, and to better convenience to recommence the same operation again, departing from other points in the limb until an average aggregate be obtained and the defects of the graduation of the limb be detected and corrected. The distance thus obtained is to be reduced to the horizontal and its units to that which forms the distance between the disk by using the following formula:

$$D=\frac{v\times 3437.7468}{m}$$

In this "D" represents the horizontal distance, "v" the number of times the angle has been repeated, and "m" the number of minutes of the aggregate final angle; and

$$3437.7468 \text{ is equal to } \frac{21600}{2\pi}$$

If the transit reads to seconds, they are to be reduced to decimals of minutes to complete the above factor "m." This is on the supposition that the division of the transit is sexagesimal. If it is centesimal, the formula will be:

$$D=\frac{v\times 6366.19772}{m}$$

The numeral 6366.19772 is equal to $\frac{40000}{2\pi}$ that is forty thousand equals four hundred degrees multiplied by one hundred minutes, according to the centesimal division. Using the rod of one meter, the distance in English feet can be obtained directly by using the following formula if the graduation of the transit is sexagesimal:

$$D=\frac{v\times 11278.7}{m}$$

and in this equation 11278.7 is equal to the above 3437.7468 multiplied by 3.2809, as there are 3.2809 feet in one meter; or, if the graduation is centesimal, by the following formula:

$$D=\frac{v\times 20886.4}{m}$$

In this equation 20886.4 is equal to 6366.19772 multiplied by 3.2809. To obtain the distance in any measure with the rod of one meter, the factor 3437.7468 is to be reduced to the unit of the desired measure.

The described operation is based on the circumstance that by repeating the angles formed by the disks of the instrument it will give the equivalent of an operation obtained by placing a number of disks in continuation of each other, so as to form an arc of "m" minutes, the center of which is the point at which the transit is stationed, as shown in Fig. 4. The polygonal sector formed in this way is practically equivalent to a circular sector, and the error contained in it is not appreciable if the distance measured is not less than about ten meters. The angle "m" and the value of the arc equal to "v" units of the disk are known quantities, and from them the value of the radius "R" can be easily computed, because it is equal to the unknown distance "D." Reducing the circumference twenty-one thousand six hundred minutes, the distance can be put in the following proportion:

$$21600 : 2\pi R :: m : v$$

which give

$$v=\frac{2\pi Rm}{21600}$$

From this equation follows:

$$R=D=\frac{v\times 21600}{2\pi m}=\frac{v\times 3437.7468}{m}$$

By arranging a third or central disk on the horizontal frame A the center disk can be used in case any obstacle prevents the sighting on one of the disks at the ends of the rod. In that case the constant factor of the above formulas would have to be divided by two.

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

1. A telemeter formed of a horizontal frame having fixed targets or disks at the outer ends and an alidade pivoted to the center of and at right angles to the frame, substantially as set forth.

2. A telemeter composed of a horizontal frame having fixed targets or disks at the center and outer ends, an alidade pivoted to the center of and at right angles to the frame, and a tripod or other support, to the head of which the frame is attached, substantially as set forth.

3. The combination, with a horizontal frame composed of parallel rods and fixed targets or disks at the center and ends of said rods, of upright rods connecting the horizontal rods near the center disk and screws for connecting the upright rods with the head of the tripod, substantially as set forth.

In testimony that I claim the foregoing as my invention I have signed my name in presence of two subscribing witnesses.

CLAUDIO URRUTIA.

Witnesses:
FELIPE ARRIARA,
MANUEL OMEJQUITA.