No. 673,099. Patented Apr. 30, 1901.

N. TOBIN.

RANGE FINDER.

(Application filed Nov. 1, 1900.)

(No Model.) 4 Sheets—Sheet 1.

FIG.1.

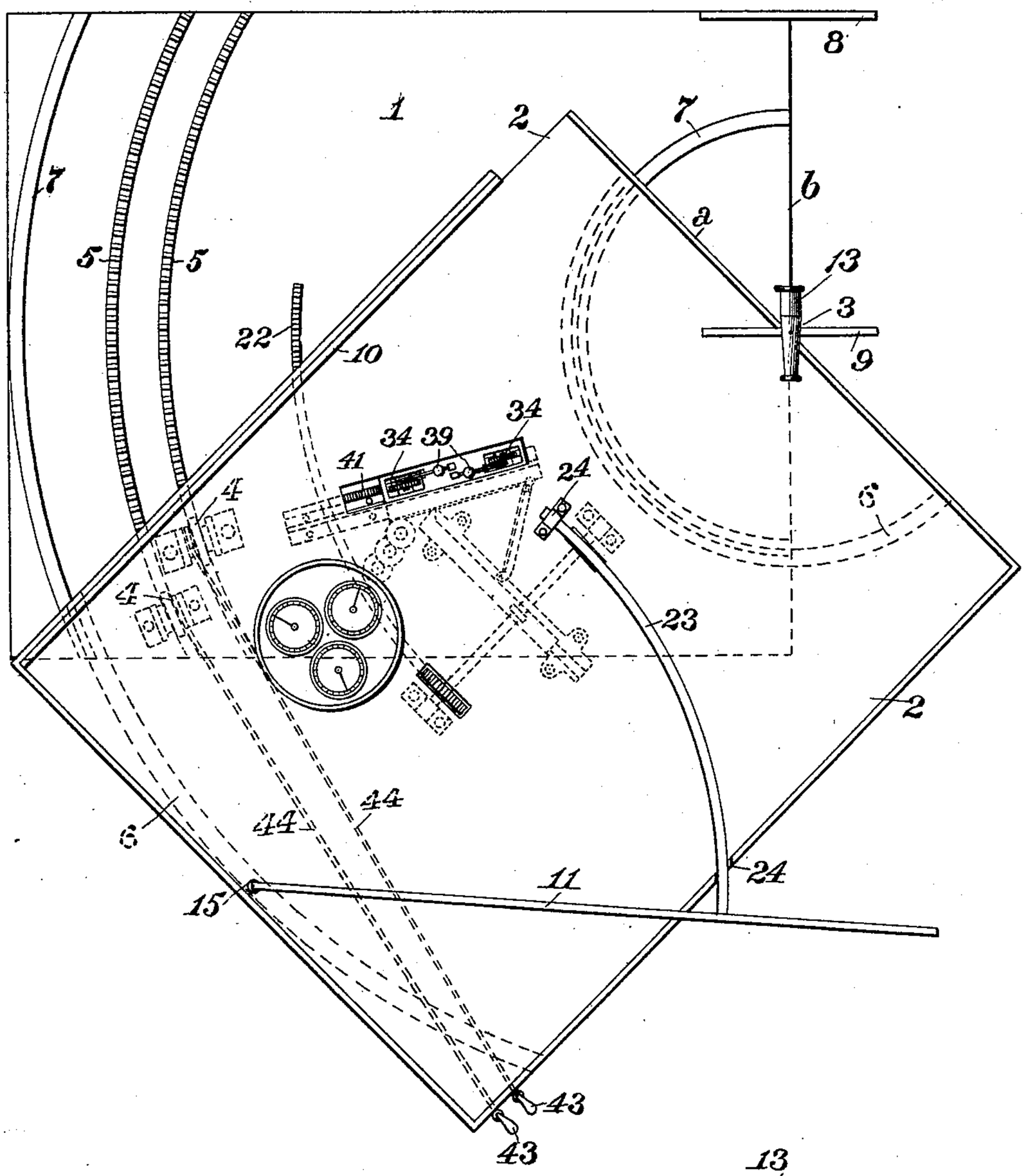

FIG.2.

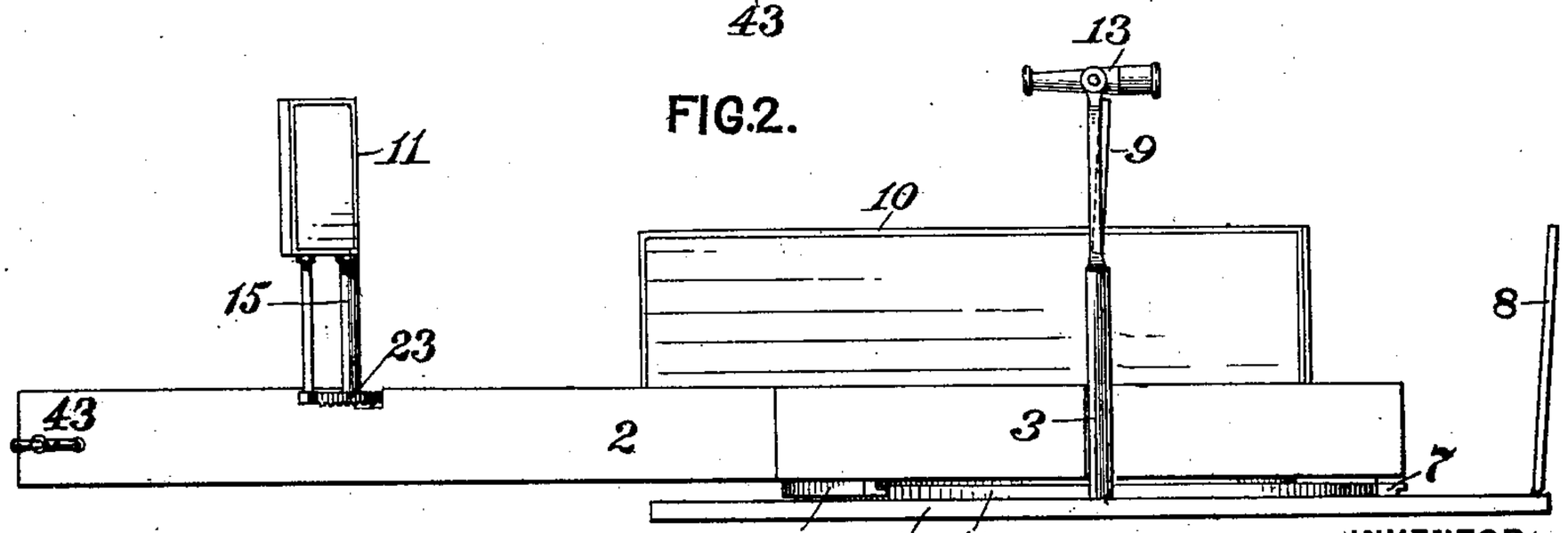

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FIG.3.

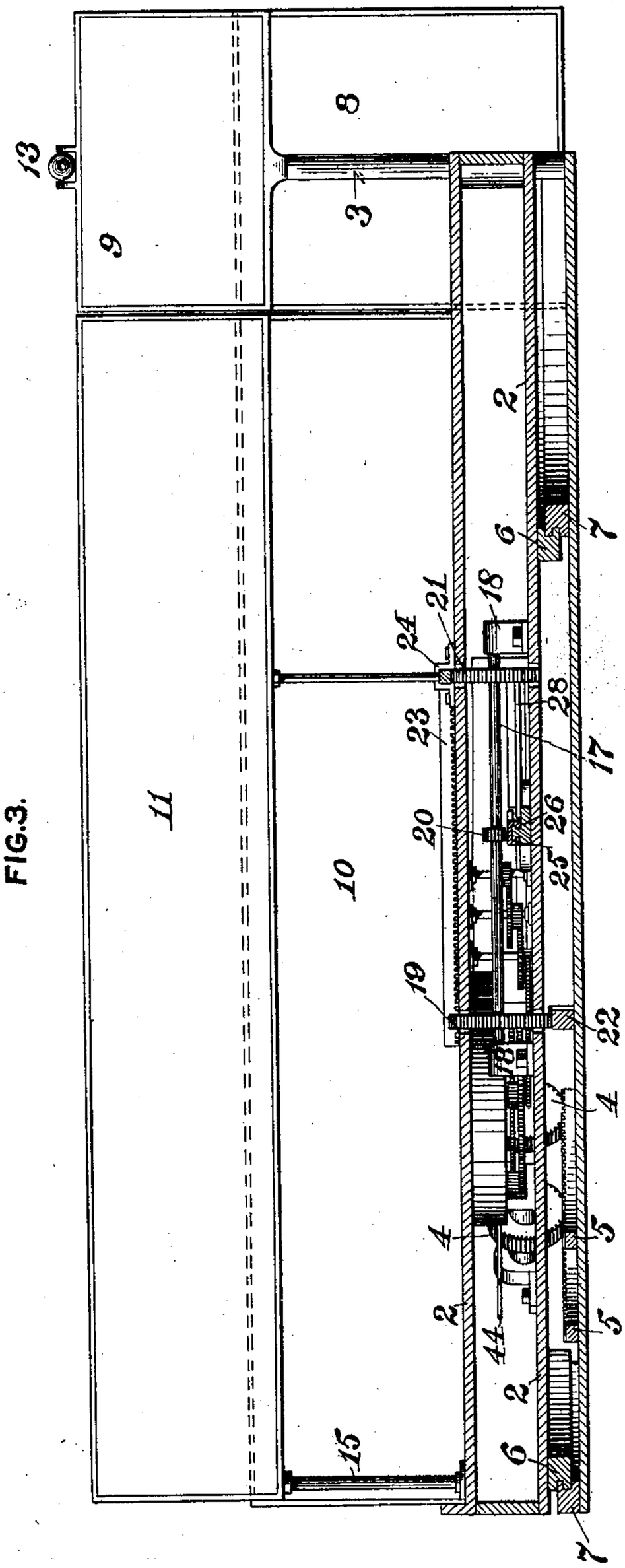


FIG.5.

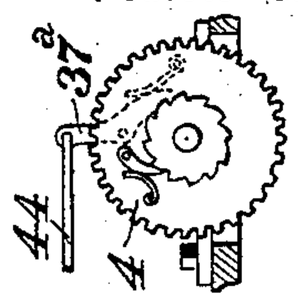


FIG.4.

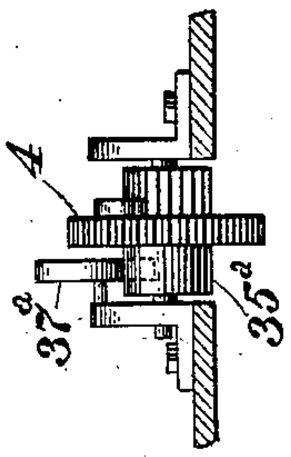
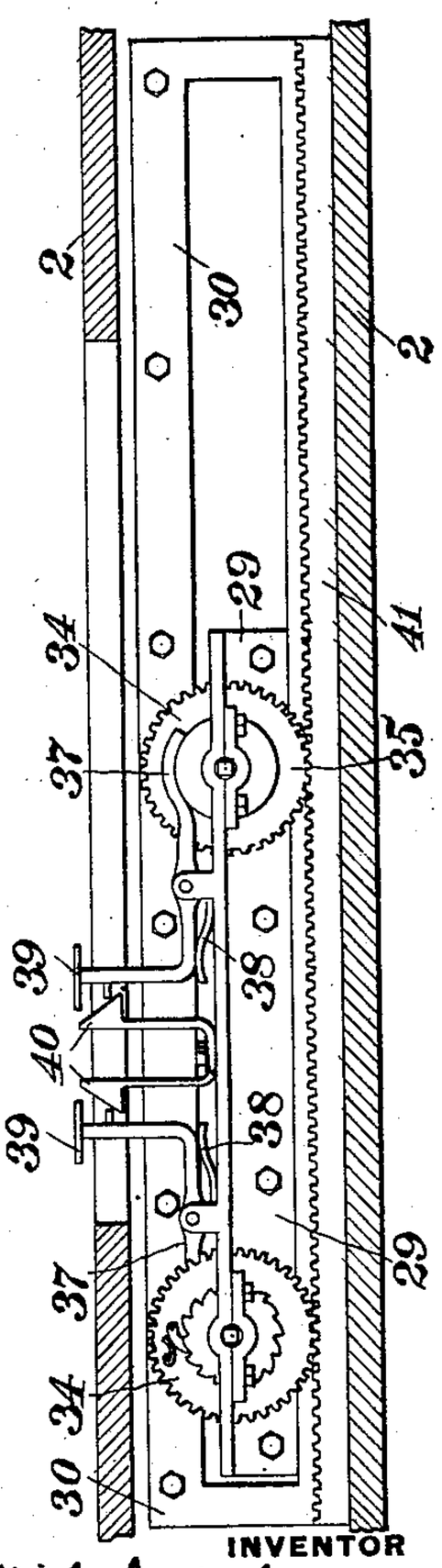


FIG.6.



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(No Model.) 4 Sheets—Sheet 3.

FIG.7.

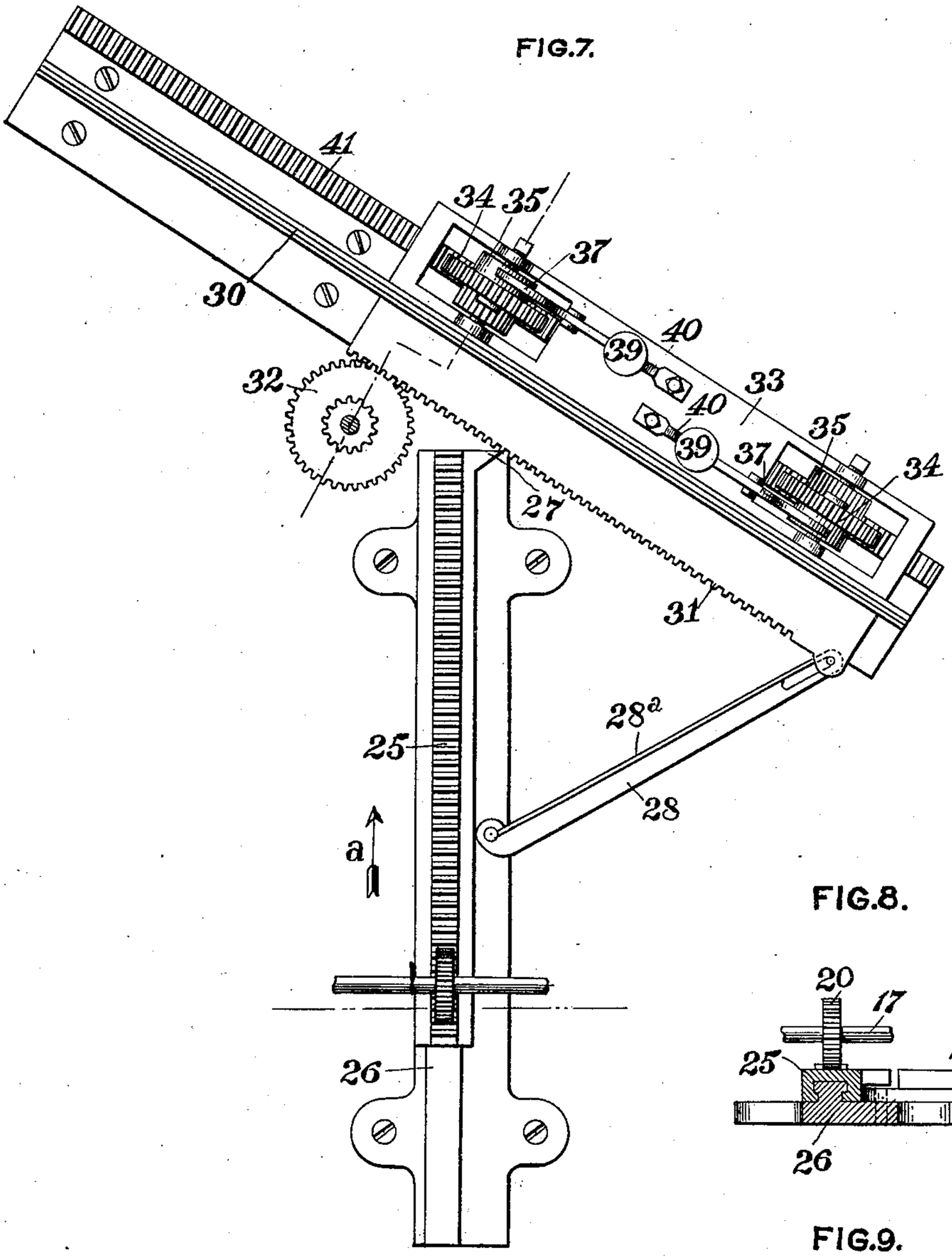
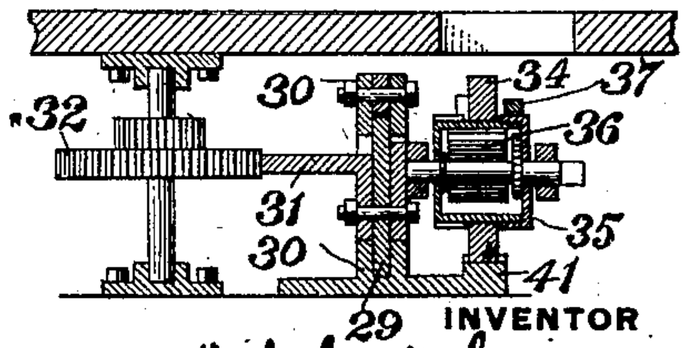


FIG.8.

FIG.9.



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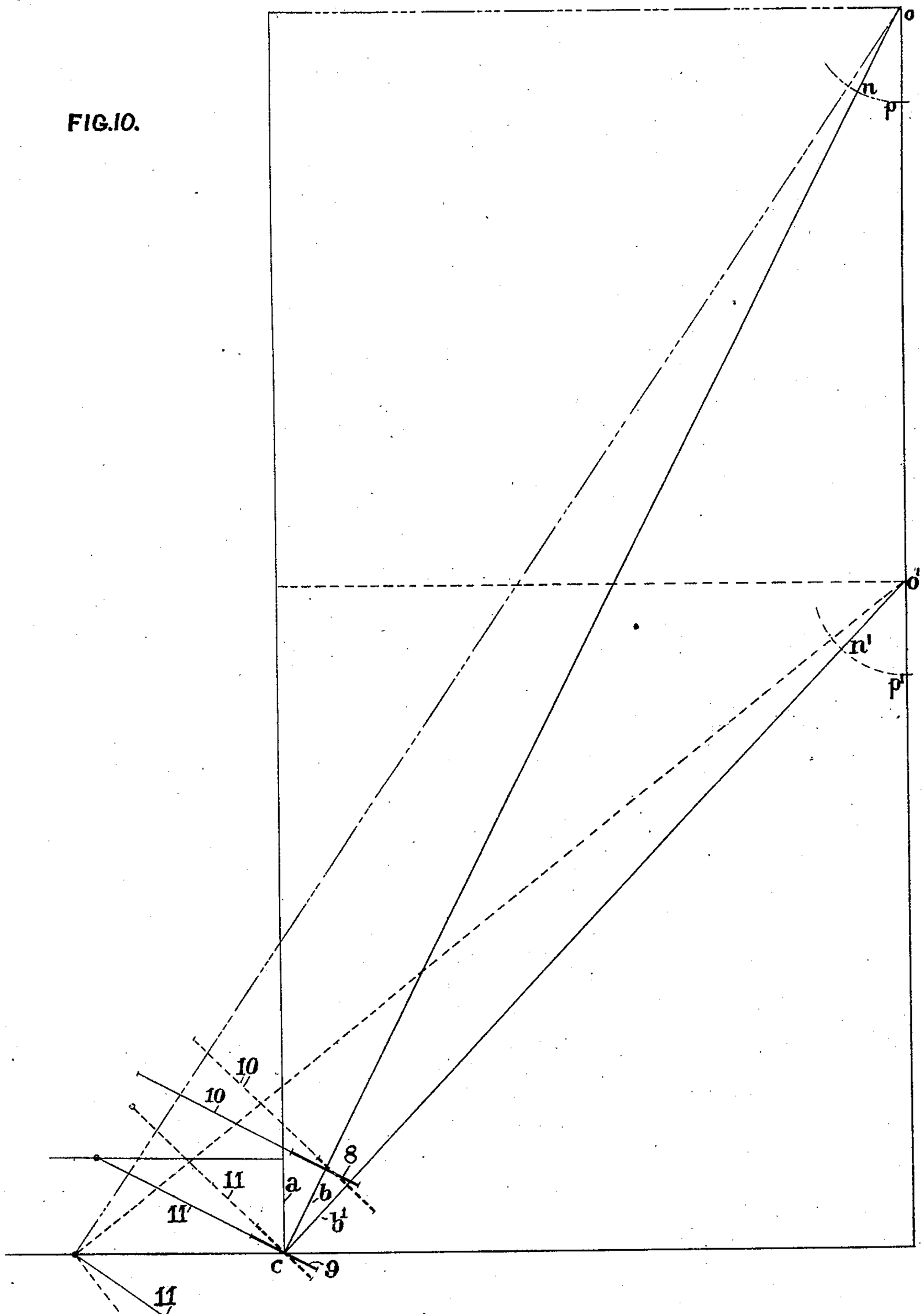
(No Model.) 4 Sheets—Sheet 4.

FIG. 10.



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UNITED STATES PATENT OFFICE.

NICHOLAS TOBIN, OF PITTSBURG, PENNSYLVANIA.

RANGE-FINDER.

SPECIFICATION forming part of Letters Patent No. 673,099, dated April 30, 1901.

Application filed November 1, 1900. Serial No. 35,123. (No model.)

To all whom it may concern:

Be it known that I, NICHOLAS TOBIN, a citizen of the United States, residing at Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented or discovered certain new and useful Improvements in Range-Finders, of which improvements the following is a specification.

The invention described herein relates to certain improvements in range-finders whereby the distance of an object of an observer may be accurately and quickly determined.

The invention has for its object a construction of apparatus whose medial length is a factor of the base of a triangle, the angle at the end of the base of said triangle opposite that at which the apparatus is located having a fixed or constant value regardless of the distance of the object, and the angular movement of the member of the apparatus actuating the dial mechanism shall be proportional to the change of angle at the apex of said triangle for every variation in the distance of the object observed.

The invention is hereinafter more fully described and claimed.

In the accompanying drawings, forming a part of this specification, Figure 1 is a plan view of my improved apparatus in open position. Fig. 2 is an end elevation of the apparatus, the parts thereof being in the same positions as in Fig. 1. Fig. 3 is a sectional elevation of the apparatus. Figs. 4 and 5 are detail views of the mechanism for shifting the frame. Fig. 6 is an enlarged view of the dial-actuating slide and its shifting mechanism. Fig. 7 is a plan view of the dial-actuating mechanism and its controller. Figs. 8 and 9 are sectional elevations on planes indicated by the lines VIII VIII and IX IX, Fig. 7; and Fig. 10 is a diagrammatic view illustrating the operation of the apparatus.

1 is the bed-plate or base, which may be conveniently mounted upon a stationary support, such as a tripod. This bed-plate or base remains in a fixed position in respect to the object the distance of which is to be determined after the apparatus has been directed to the object in the manner which I shall hereinafter explain and which is the first step in determining distance with my improved apparatus. Upon this bed-plate 1 a frame 2 is pivotally mounted. Both the bed-plate 1 and the frame 2 are preferably made rectangular in shape and equal in dimensions, as shown in the drawings. Frame 2 is caused to turn around a center by any suitable driving mechanism interposed between the frame and bed-plate—such, for example, as that shown, consisting of pinions 4 4, which are mounted on the under side of frame 2, engaging racks 5 5, mounted on the upper side of bed-plate 1. The frame and bed-plate are provided also with guides 6 6 and 7 7, which engage one another.

Two mirrors 8 and 9 are mounted upon the bed-plate 1, one of them, as 9, being so supported on a post 3, whose axis coincides with the center of movement of the frame, as to be in a plane passing through the medial line of the apparatus. The mirror 8 is secured on the bed-plate in front of the mirror 9 and parallel therewith and with its reflecting-surface facing the mirror whose reflecting-surface faces the object to be observed. The mirrors 8 and 9 are so arranged with reference to each other that rays of light passing immediately over the upper edge of mirror 8 are received on mirror 9, reflected to mirror 8, and again reflected, so as to pass immediately over mirror 9. This result is best accomplished by placing mirror 9 higher above the bed-plate 1 than mirror 8 and inclining mirror 8, as indicated in Fig. 2. Mirror 9 is provided with a sight-mark or preferably with a small spy-glass 13, placed at the middle of its upper edge. This spy-glass is provided with spider-lines, which of course serve as a delicate sight-mark.

The two mirrors 10 and 11 are so arranged with respect to one another on the frame 2 that when the instrument is closed one of them, as 11, will be in a vertical plane passing through the medial line of the apparatus and the mirror 10 parallel to the medial line of the bed-plate 1. They also are arranged face to face and so inclined that a ray of light from the object whose distance is to be ascertained striking mirror 11 will be reflected to the face of mirror 10. It is then preferable to so arrange these mirrors 10 and 11 that when the instrument is closed mirrors 8 and 10 shall lie in substantially the same plane and form one practically continuous

mirror and that mirrors 9 and 11 shall lie in substantially the same plane and form another practically continuous mirror. The mirror 11, which is pivotally mounted on frame 2, is provided with an index, which may be the pivotal end of the mirror 11 and is so situated as to be reflected in the surface of mirror 10.

It has been stated that frame 2 is pivotally mounted on bed-plate 1 and that mirror 11 is pivotally mounted on frame 2. These two pivotal points are placed, as shown, at the extremities of the medial line of frame 2. Means are provided by which when frame 2 moves on its pivotal point 3 mirror 11 also moves on its pivotal post 15 away from mirror 10, and the rate of motion is definite, as will be hereinafter explained. An axle 17 is mounted in suitable bearings 18 18, secured to the bed of the frame 2. Upon this axle pinions 19 and 21 are mounted. Pinion 19 is adapted to engage a rack 22, fixed on bed-plate 1. This rack 22 is in the shape of an arc of a circle and is so placed that post 3 is the center of that circle. Pinion 19 is preferably made slightly conical, so as to travel accurately upon this arc-shaped rack. Pinion 21 engages a rack 23, which is rigidly attached to mirror 11 and is movable in guides 24 24, mounted upon frame 2. Rack 23 is also arc-shaped and is so placed that the pivot-pin 15 is at the center of that arc. Pinion 21 also is preferably slightly conical in shape, so as to travel accurately upon rack 23. It will be understood that by adjusting the relative sizes of the two pinions 19 and 21 and by adjusting their positions upon axle 17 with respect to one another and the position of the racks 22 and 23 it is possible to vary the rate of movement of mirror 11 upon its pivotal point with respect to the rate of movement of frame 2 upon its pivotal point to any desired extent. In practice I so adjust these pinions and their racks that the angular movement of mirror 11 shall exceed the angular movement of frame 2 (which is the same as the angular movement of mirror 10) by a certain definite amount and that this excess of movement shall be a relatively small fraction of the angular movement of frame 2. A third pinion 20 is secured upon the shaft 17, so as to engage a rack 25, which is mounted in a guide 26, secured to the under side of the frame 2. As the shaft 17 is rotated by the shifting of the frame 2 the movement of the rack will be proportional to the movement of the frame, the proportion being dependent on the relative sizes of the pinions 19 and 20. The sliding rack 25 is provided at one end with a spur 27, which is made of such a length that its point will, when the rack has been shifted to its extreme outward movement, be immediately above or in alinement with the center of movement of an arm 28. This arm has its inner end pivotally mounted on a suitable support, such as the guide 26, on the frame 2 in suitable relation to the line or path of movement of the rack 25 and has its outer end connected to a slide 29, arranged at an angle to the line of movement of the rack 25. This slide is mounted in guides 30, secured to the under side of the frame 2, and is provided with a ledge 31, having its edge toothed to engage a pinion 32, forming a part of a train of gearing for operating the indicating-fingers. The slide is also provided with a ledge 33, on which is mounted the mechanisms for shifting the slide back and forth. A desirable construction of shifting mechanism consists of pinions 34, loosely mounted on drums 35, so as to be rotated on the drum in one direction, but connected by pawls and ratchets to the drums when the latter are driven in the opposite direction by their actuating-springs 36. The drums are held from rotation by means of brakes 37, normally held against the drums by springs 38. The brakes can be shifted and held out of contact with the drums by fingers 39, which are accessible through the bottom board of the frame. The fingers are held depressed by means of spring-catches 40 engaging projections on the fingers. The pinions 34 intermesh with a rack 41, secured to the under side of the frame 2, and their driving mechanisms are oppositely arranged, so that one of them will shift the slide in one direction and the other in the opposite direction.

The arm 28 is provided on its inner edge with a rib 28^a, the inner face of which will coincide with a plane passing through the center of movement of the arm. The inward movement of the arm and also that of the dial-actuating slide 29 is regulated by the position of the spur 27 on the rack 25. As the rack is shifted by the frame the movement of the indicating-dials will be proportional to the movement of the frame.

The pinions 4, which are employed for shifting the frame back and forth, are drawn by spring-actuated drums 35^a, similar to the construction heretofore described. The rotation of the drums is controlled by spring-actuated brakes 37^a, which are moved away from the drums by handles 43, which are preferably located at the edge of the frame and connected to the brakes by rods 44, as shown in Fig. 1. These driving devices are oppositely arranged, one being employed to move the frame and the other to shift it to closed position.

The operation of my apparatus is as follows: The apparatus closed in position—that is, having mirrors 8 and 10 and 9 and 11 alined—is placed upon its support, and the object the distance of which from the observer is to be determined being selected the instrument is so placed that the observer, looking through the spy-glass 13 or sighting upon a sight-mark placed in the same position, shall see the object reflected from mirror 8 and shall bring the image of that object into alinement with the sight-mark. Having done this, the position of frame 1 is fixed for the observation. The operator then shifts one of the handles 43,

releasing one of the frame-shifting devices, so as to turn the frame 2 upon its pivotal center. It being understood that mirror 11 travels slightly more rapidly that mirror 10, the frame 2 is revolved until the observer, looking in the mirror 10 over a mark or small telescope on a convenient part of the instrument, as above the pivot-point 15, where the image of the object and the point 15 can be seen in the mirror 10, will see the image of the object reflected from mirror 11 moving along mirror 10 toward the left until such image of the object coincides with the reflection in mirror 10 of the indicator on mirror 11, which in the construction shown is the left-hand end of the mirror 11. When this alinement of the image of the object with the end of mirror 11 reflected in 10 has been effected, the operator releases the handle 44, thereby checking the movement of the frame. Prior to shifting the frame the slide 29 should be in the position shown in Fig. 7. By the turning movement of the frame 2 the rack 25 is moved in the direction of the arrow *a* a distance proportional to the outward movement of the frame. As soon as the movement of the frame is stopped the operator depresses one of the fingers 39, so that the slide 29 will be moved to the left, actuating the indicating-dials until arrested by the rib 28^a on arm 28 striking against the spur 27 on the rack 25. As soon as the movement of the slide 29 is arrested the operator can read the distance of the object observed on the dials.

In constructing my improved range-finder I take a triangle, preferably a right-angled triangle, having a base which is a multiple of the medial length of the apparatus or the distance between the pivotal center of the frame and the pivotal center of the mirror 11 and whose apex is at the object—as, for example, if the apparatus has a medial length of two feet the base of the triangle will have a length of seven hundred and twenty feet or any other length of which two is an exact divisor. The mirrors 10 and 11, which might properly be termed "focusing-mirrors," are so arranged and shifted in relation to each other that when the images of the object and the indicator on mirror 11 have coincided in mirror 10 a given point on the frame will have moved an angular distance from a given point on the base-plate, said points coinciding or registering one with the other when the mirror 11 is parallel with mirror 9, such angle having a certain fixed relation to the angle at the object or at the apex of the triangle having the given base—as, for example, in the construction shown the edges *a* and *b* of the frame and base-plate coincide or register with each other and when the instrument is closed lie in a plane passing through the center of movement of the frame and may be taken as reference-points, above referred to. When the apparatus has been sighted on the object by mirrors 8 and 9 and focused by shifting the frame, as above described, the edge *a* of the frame will be at an angle to the edge *b* of the base-plate, and the apparatus is so constructed that the angle *a c b* will have a certain fixed relation to the angle at the apex of the right-angled triangle. It is preferred to so construct the apparatus that when focused the angle will equal the angle *n o p* at the apex *o* of the right-angled triangle, whose base is a multiple of the medial length of the instrument.

By reference to Fig. 10 it will be seen that the angle *a c b*, formed by lines passing through the reference points or edges *a b* and the axis of movement of the frame, is equal to the angle *n o p* and that the angle *a c b'* is equal to the angle *n' o' p'*.

The frame 2 in its movement shifts the spur or stop 27 a distance proportional to its angular movement. The position of the spur 27 determines the movement of the slide 29, which actuates the indicating mechanism of the apparatus. The indicating mechanism is so constructed in accordance with rules known in the art that for every change of position of the frame 2 the dial will indicate the corresponding change in the distance of the center *c* of the apparatus to the object.

I claim herein as my invention—

1. A range-finder having a medial length which is a factor of the base of a right-angled triangle in combination with a member movable on a center, which forms one terminus of the base of said triangle, a distance-indicating mechanism controlled by the movable member and focusing mechanism for determining the range of movement of the movable member, substantially as set forth.

2. A range-finder having in combination two movable mirrors arranged so that the image of an object will be reflected from one to the other, means for shifting said mirrors one at a greater speed than the other to bring the image of an indicating-mark reflected in one mirror into indicating relation to the image of a distant object reflected in both mirrors, and an indicating mechanism operated in accordance with the movements of the mirrors, substantially as set forth.

3. A range-finder having in combination a base, a frame pivotally mounted on the base, a mirror secured on said frame, a second mirror pivotally mounted on the frame, means for shifting the frame, means shifting the second mirror independent of the frame and an indicating mechanism movable independent of but controlled by the movement of the frame, substantially as set forth.

4. A range-finder having in combination a base, a frame pivotally mounted on the base, a mirror mounted on the frame, a second mirror pivotally mounted on the frame, means for shifting the frame, connections from the frame to the second mirror whereby the latter may be shifted at a greater speed than the frame, and an indicating mechanism operated by the frame, substantially as set forth.

5. A range-finder having in combination a

base, a frame pivotally mounted on the base, a mirror carried by the frame, means for shifting the frame, a second mirror pivotally mounted on the frame and movable thereby, a stop device operated by the frame and a spring-operated indicating mechanism controlled by the stop, substantially as set forth.

6. A range-finder having in combination a base, a frame pivotally mounted on the base, a mirror carried by the frame, a second mirror pivotally mounted on the frame, means for moving the frame and second mirror at different rates of speed, a slide operated by the frame, a stop carried by the slide, a spring-actuated slide and an indicating mechanism operated by the slide, substantially as set forth.

In testimony whereof I have hereunto set my hand.

NICHOLAS TOBIN.

Witnesses:
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F. A. DANNER.