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J. D. FOLEY, ADMINISTRATOR.

RANGE FINDER.

APPLICATION FILED JULY 13, 1910.

998,765.

Patented July 25, 1911.

6 SHEETS—SHEET 1.

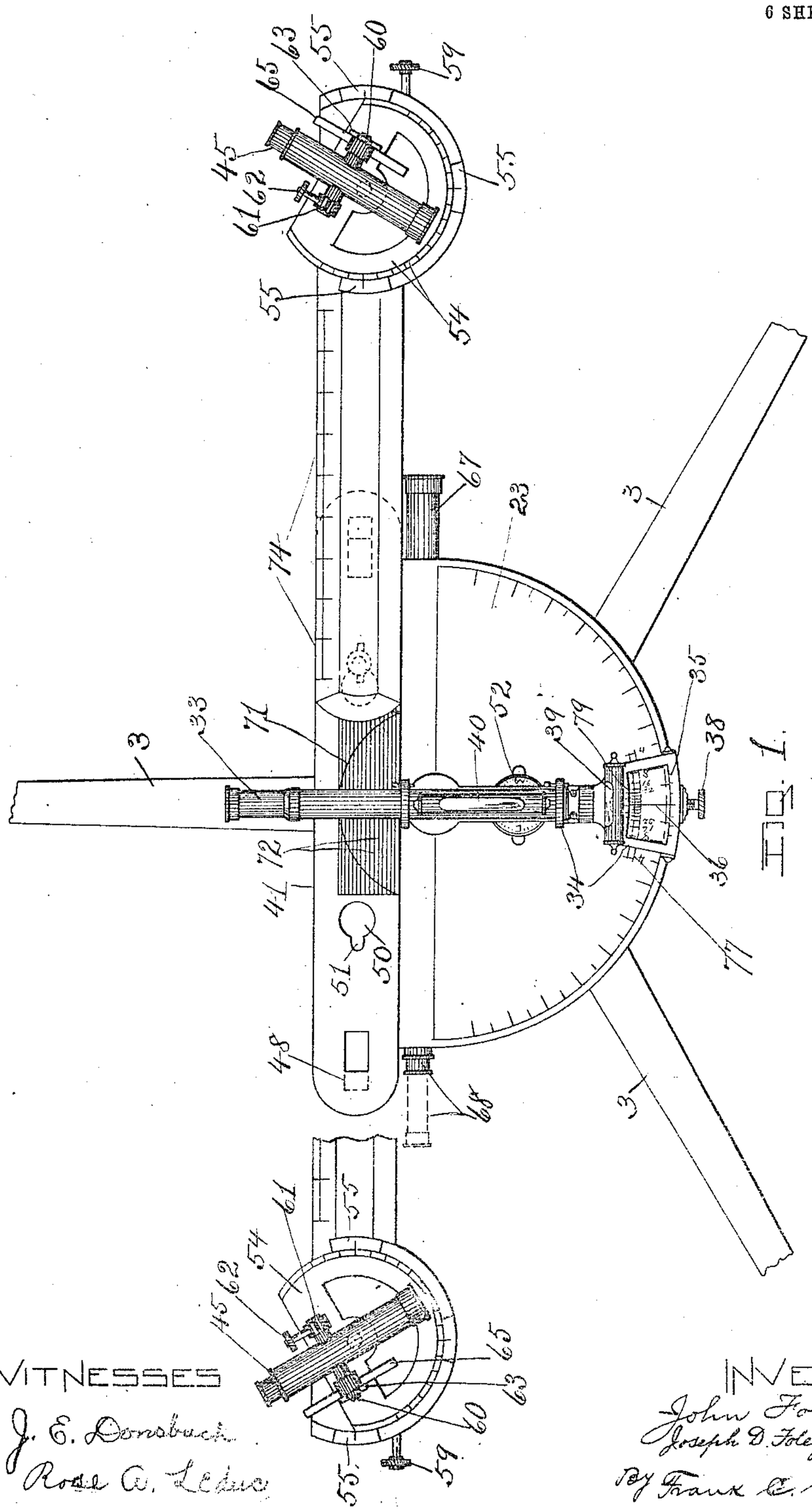

FIG. 1.

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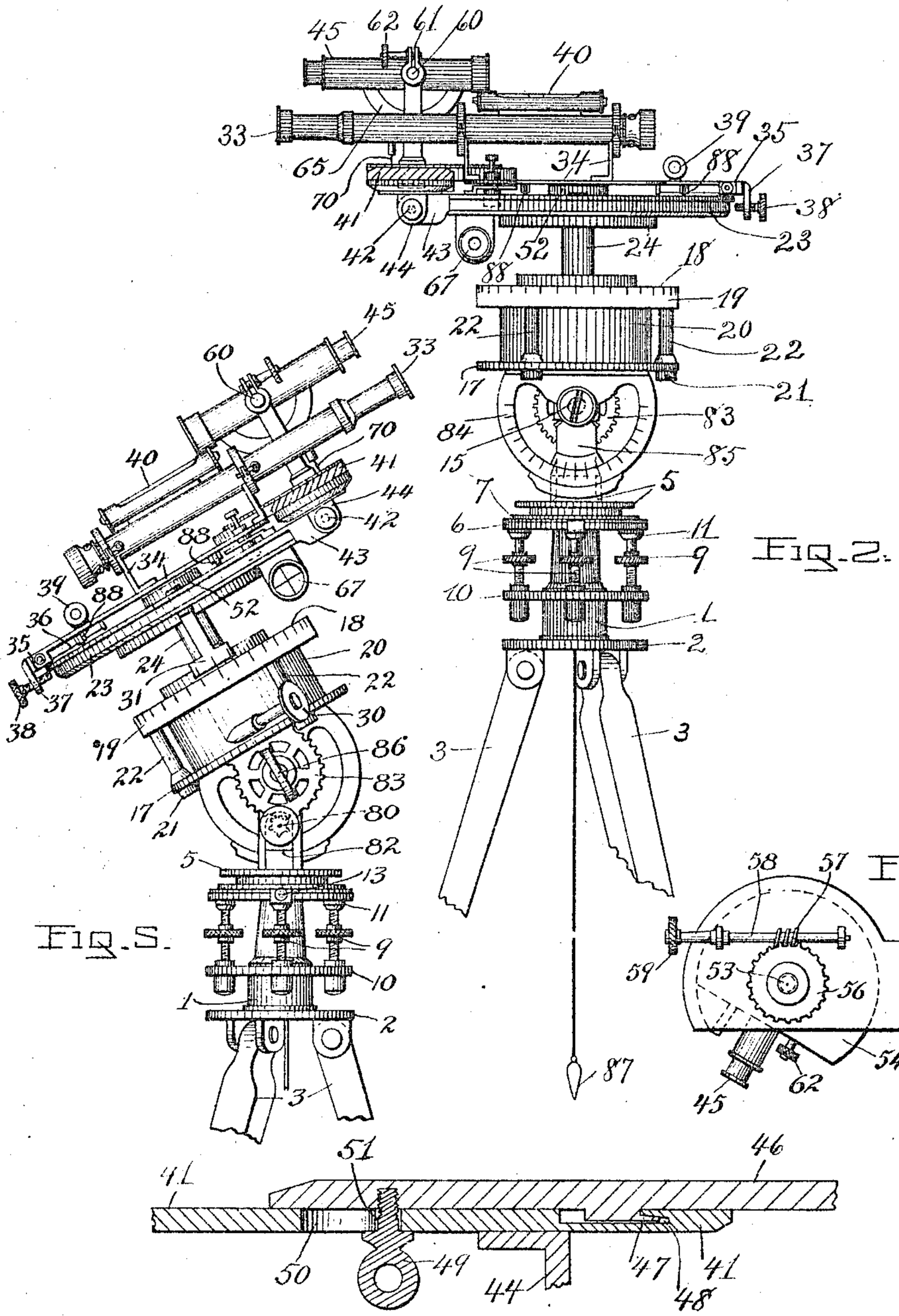

FIG. 2.

FIG. 5.

FIG. 6.

FIG. 3.

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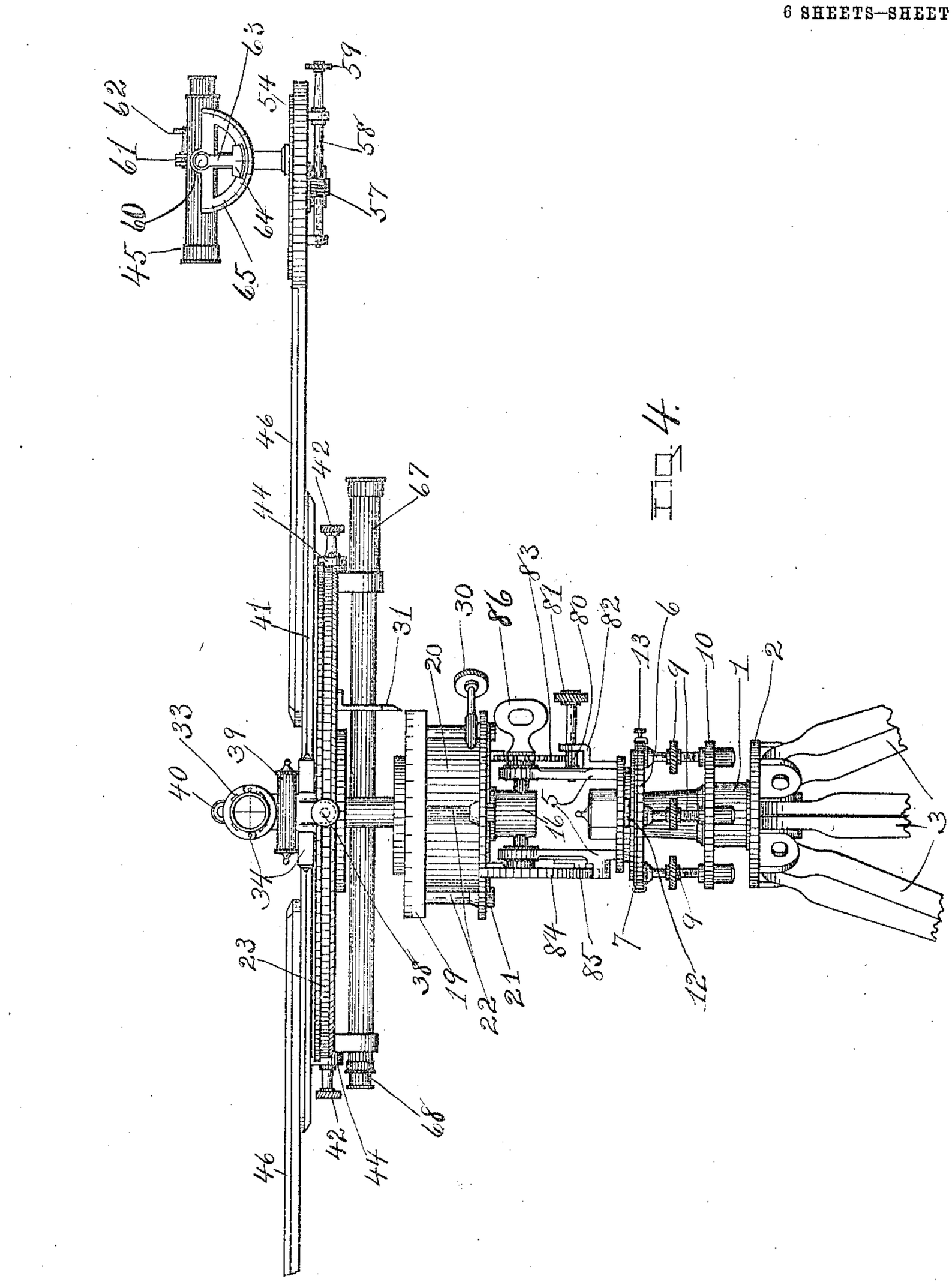

FIG. 4.

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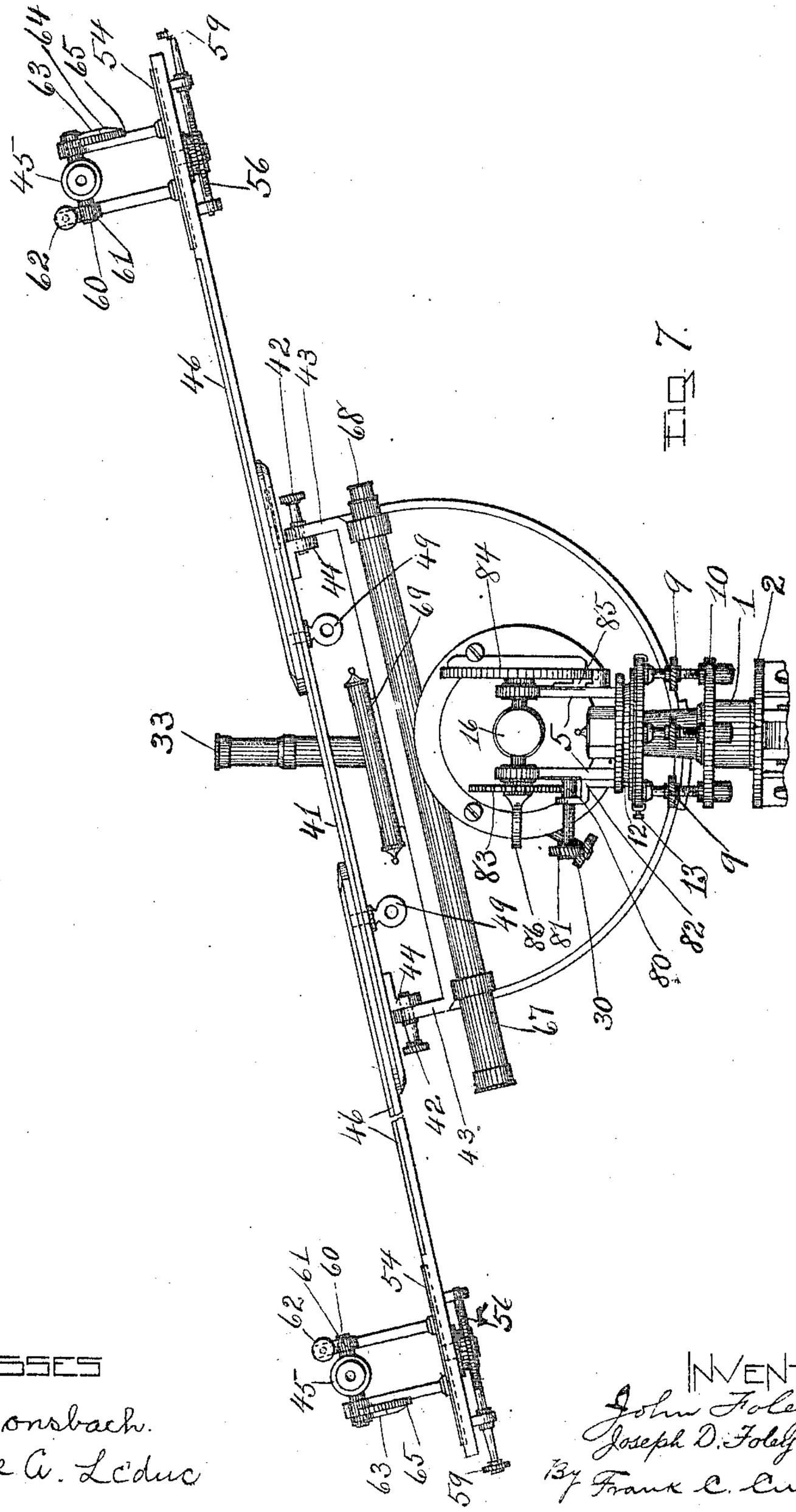

FIG. 7.

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6 SHEETS—SHEET 5.

FIG. 8.

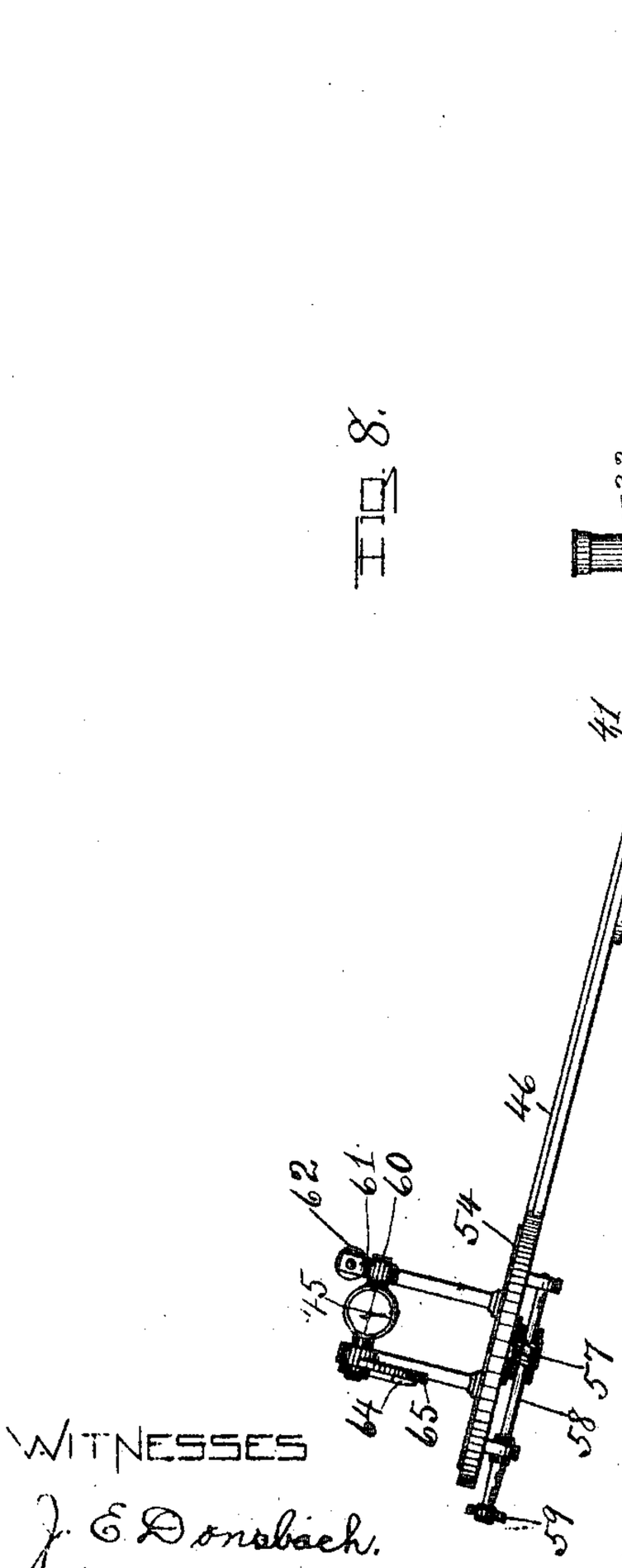
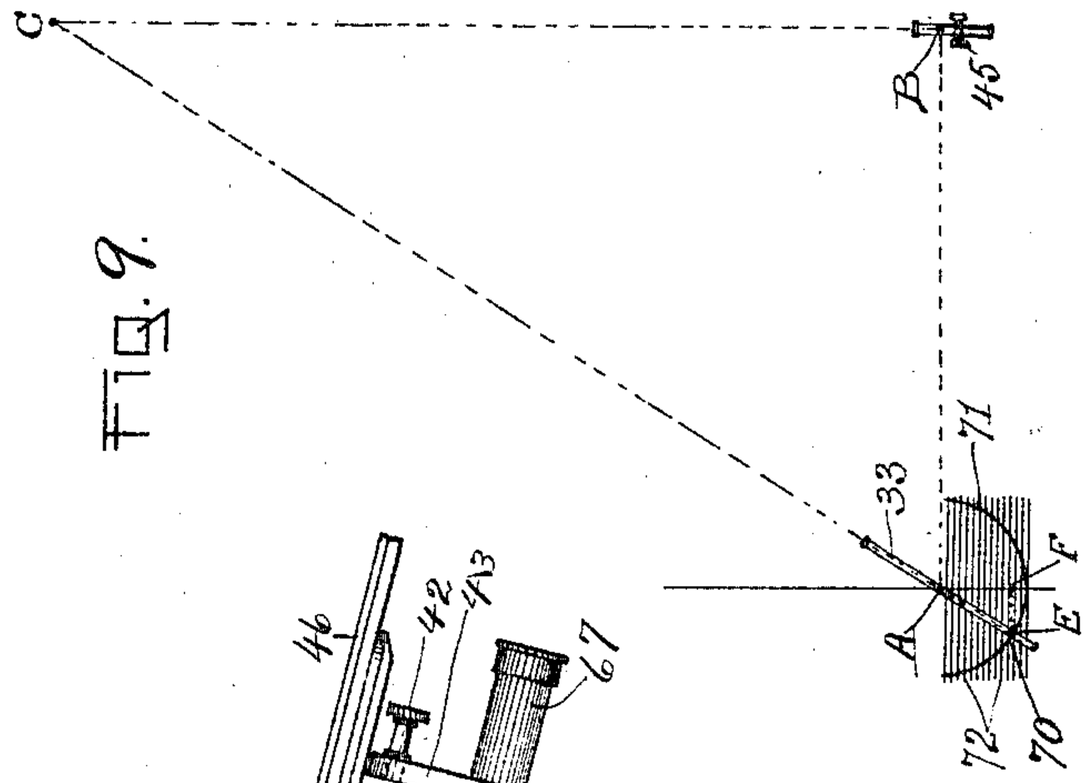


FIG. 9.



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6 SHEETS—SHEET 6.

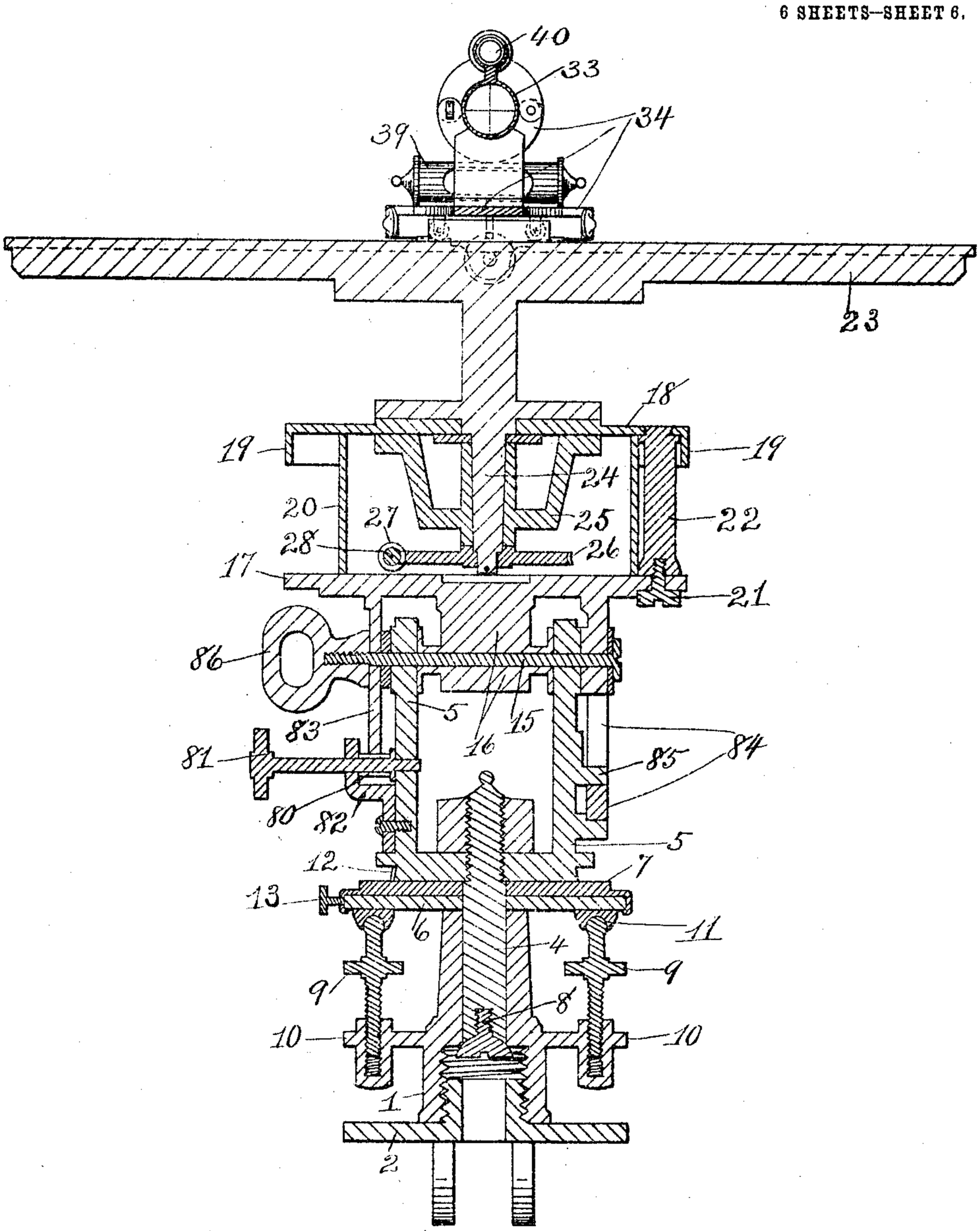

Fig. 10.

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UNITED STATES PATENT OFFICE.

JOHN FOLEY, DECEASED, LATE OF NAAS, IRELAND, BY JOSEPH D. FOLEY, ADMINISTRATOR, OF TROY, NEW YORK.

RANGE-FINDER.

998,765. Specification of Letters Patent. **Patented July 25, 1911.**

Application filed July 13, 1910. Serial No. 571,697.

To all whom it may concern:

Be it known that JOHN FOLEY, late a citizen of Great Britain, residing at the town of Naas, county of Kildare, Ireland, did invent new and useful Improvements in Range-Finders, of which the following is a specification.

The invention relates to such improvements and consists of the novel construction and combination of parts hereinatfter described and subsequently claimed.

Reference may be had to the accompanying drawings, and the reference characters marked thereon, which form a part of this specification. Similar characters refer to similar parts in the several figures therein.

Figure 1 of the drawings is a top plan view of the instrument, with certain portions broken away for convenience of illustration. Fig. 2 is a view in side elevation of the same, as seen from the left of Fig. 1, with one of the auxiliary telescopes removed and its extension-plate shown in cross-section. Fig. 3 is a vertical longitudinal section showing the manner in which an extension-plate for an auxiliary telescope is detachably mounted. Fig. 4 is a view in front elevation of the instrument as seen in Fig. 1. Fig. 5 is a view in elevation of the instrument viewed from the side opposite that of Fig. 2 the nearer auxiliary telescope being omitted. Fig. 6 is a bottom plan view of a broken-away portion of an extension-plate for an anxiliary telescope. Fig. 7 is a view in rear elevation of the instrument, with the vernier-segment occupying a vertical plane, and the support for the auxiliary telescopes seen in mid position. Fig. 8 is a front elevation of the same. Fig. 9 is a diagrammatic view illustrating one method of determining distances by the use of the instrument. Fig. 10 is a central vertical section of the instrument.

The principal object of the invention is to determine from points of observation within a portable instrument the distance of various objects and the measurement of vertical and horizontal angles and gradients at a distance from the instrument; also to provide in the one portable instrument a plurality of means for making the required measurements whereby one set of results can be compared with and corrected by another to insure accuracy.

Referring to the drawings wherein the invention is shown in preferred form, 1, is the upper member and, 2, the lower member of a stand mounted upon a folding-tripod 3. The parts, 1 and 2, are screwed together as shown. The upper member, 1, of the stand is centrally apertured to receive a stud, 4, the upper end of which is screw-threaded and has tightly fixed thereon a bearing-yoke 5.

Interposed between the bearing-yoke, 5, and the member, 1, of the stand is a friction-disk, 6, and a vernier-disk, 7, each apertured to receive the stud 4. Upward movement of the stud, 4, is limited by the head of a screw, 8, inserted in the lower end of the stud. Thumb-screws, 9, are inserted in screw-threaded apertures in a peripheral flange, 10, on the stand-member, 1, with their upper ends adapted to abut upon the underside of the friction-disk, 6, to force said disk and the vernier-disk, 7, upward against the bearing-yoke, 5, to hold said yoke against rotative movement. One or more of the thumb-screws, 9, occupies a seat or recess, 11, on the underside of the friction-disk, 6, whereby rotation of said disk relatively to the stand is prevented. By loosening the thumb-screws, 9, slightly, the bearing-yoke, 5, is permitted to rotate with its stud, 4, relatively to the stand, friction-disk, 6, and vernier-disk 7. The angular movement of the bearing-yoke, 5, can be measured by means of an index-plate, 12, mounted on the bearing-yoke, and a graduated scale on the vernier-disk 7. When the thumb-screws, 9, are loosened, the vernier-disk, 7, can be rotated relatively to the friction-disk, 6, and then locked by means of the thumb-screw, 13, in a selected rotary position. The vernier-disk, 7, can thus be set to indicate zero, relatively to the index-plate, 12, in any angular position in which it may be desired to have the bearing-yoke, 5, begin the rotative movement which is to be measured.

A cross-shaft, 15, is mounted in the bearing-yoke, 5, at right angles to the axial line of the stud 4. A post, 16, is mounted upon the shaft, 15, to turn thereon, said post supporting a box comprising a bottom-plate, 17,

on the upper end of the post, a top-plate, 18, having a circumferential vernier-flange, 19, and a hollow cylinder, 20, interposed between said top and bottom-plates, said parts all being clamped and held together by means of screws, 21, inserted through the bottom-plate, 17, into posts, 22, depending from the top-plate 18. A vernier-segment, 23, is rotatively mounted upon the box thus formed by means of a stud, 24, which is rotatively mounted in a central aperture in the top-plate, 18, and an aperture in a bracket, 25, attached to the underside of said top-plate.

Fixed upon the lower end of the stud, 24, is a worm-gear, 26, adapted to be engaged by a worm, 27, fixed upon a worm-shaft, 28, which projects out through an aperture in the cylindrical wall, 20, upon which wall is fixed a bearing for the worm-shaft, 28, said shaft being provided on its outer end with a small hand-wheel, 30, whereby a gradual rotative movement can be imparted to the gear, 26, stud, 24, and vernier-segment 23. The vernier-segment has mounted thereon an index-plate, 31, graduated to be read in connection with graduations on the vernier-flange 19.

A telescope, 33, is rotatively mounted upon the vernier-segment, 23, to turn thereon upon an axis perpendicular to the plane of the vernier-segment, 23, and coincident with the center of the circle of which said vernier-segment forms a part, and parallel with, and some distance in rear of, the axis of the stud 24. The frame, 34, by means of which the telescope, 33, is thus mounted, is formed to overhang a graduated scale arranged along the arc formed by the circular edge of the segment, which frame carries an index-plate, 35, graduated to be read in connection with said graduations on the segment, and also carries a wire, 36, adapted to serve as an index for reading the graduations on said segment. The front end of said frame, 34, has a depending-lug, 37, located just outside the periphery of the segment, through an aperture in which lug a set-screw, 38, is inserted adapted to be set into engagement with the peripheral edge of the vernier-segment to lock the telescope, 33, and its supporting-frame at any desired point.

The telescope, 33, has mounted thereon parallel with its axis, a spirit-level, 40; and the frame which supports said telescope has mounted thereon a similar spirit-level, 39, in a position at right angles to that of the level, 40, both of said levels occupying planes parallel with the plane of the vernier-segment 23. The vernier-segment also has mounted thereon a magnetic compass, 52, in the radial line which extends through the middle of, or zero-point of the graduated scale on said segment.

A plate, 41, is rotatively mounted upon the vernier-segment at the rear thereof to turn upon an axis substantially in the plane of said segment, and just in rear of, and parallel with, the straight side of said segment which forms the core thereof, said plate being so mounted by means of set-screws, 42, passing through and adapted to frictionally clamp together brackets, 43 and 44, mounted, respectively, upon said segment and said plate, whereby said plate can be rocked through approximately 180 degrees, and clamped in any selected position in its path of movement, said plate in its extreme positions having its surface substantially parallel with the vernier-segment 23.

Mounted upon and carried by the plate, 41, are a pair of telescopes, 45, equidistant from the middle radial line of the vernier-segment, and from the axis of rotary movement of the telescope 33.

In order to secure a sufficiently long base-line to facilitate and secure the necessary accuracy in the calculations based upon the measurements for which the instrument is adapted, without making the instrument too cumbersome for convement transportation, each of the telescopes, 45, is preferably mounted upon the plate, 41, by means of an extension-plate, 46, having a hook, 47, on its underside adapted to enter and fit a socket, 48, on the plate, 41, and also having a set-screw, 49, adapted to pass freely down through an aperture, 50, in said plate, 41, and to slide along a slot, 51, opening from said aperture until said hook is fully seated, whereupon said set-screw can be tightened to engage the underside of the slotted portion of the plate, 41, to securely lock the parts together. For convenience in transportation, each of said extension-plates with its telescope, 45, can be detached and separately packed.

Each of the telescopes, 45, is mounted to rotate upon an axis, 53, perpendicular to the plane of the extension-plate, 46, and has fixed thereto to rotate therewith a vernier-segment, 54, the graduations on which are adapted to be read with relation to either of the index-plates, 55, mounted on the extension-plate 46. A gradual rotative movement of the telescope, 45, upon said axis, 53, can be accomplished by means of a worm-gear, 56, in fixed relation to the telescope, 45, and adapted to be engaged by a worm, 57, on a worm-shaft, 58, adapted to be operated by means of a small hand-wheel 59. Each of the telescopes, 45, is also adapted to rock upon an axis, 60, by means of trunnions on said telescope, which are adapted to be clamped in any selected position within the split-bearing, 61, by means of a hand-operated set-screw 62. Each of said telescopes, 45, has fixed upon

one of its trunnions an arm 63, carrying an index-plate, 64, adapted to traverse the vernier-segment, 65, and having graduations adapted to be read in connection with graduations on said vernier-segment.

Mounted upon the underside of the vernier-segment, 23, parallel with the straight edge thereof, is a comparatively large telescope, 67, having an extension eye-piece, 68; and mounted adjacent thereto and parallel therewith is a spirit-level 69.

The telescope, 33, has a pointer or needle, 70, depending therefrom somewhat in rear of its axis of rotation, which needle is adapted to traverse an arc, 71, on the surface of the plate, 41, and the movement of said needle is read in connection with a series of equidistant parallel lines, 72, which intersect said arc, 71, said lines extending parallel with the straight edge of the vernier-segment 23.

The plate, 41, and extension-plates, 46, have their rear edges arranged to form a practically continuous straight edge 74.

The instrument above described is practically universal in its capability of adjustment, and can be adjusted to measure angles in practically any plane, horizontal, vertical or oblique, having within the instrument itself a base-line of known length extending from axis to axis, 53, of the telescopes 45.

In Fig. 9, of the drawings is illustrated by means of a diagram one manner of quickly computing the range or distance of an object by means of the above described instrument. The telescope, 33, and one of the telescopes, 45, are both brought to bear upon the distant object, with the telescope, 45, at right angles to the base-line of the instrument. In the diagram, C, is the distant object; A, is the axis upon which the telescope, 33, rotates, and, B, is the point where the line of sight of the telescope, 45, is intersected by a line, A B, perpendicular thereto, extending from the axis upon which the telescope, 33, rotates, which line, A B, is the base-line. Two similar right-angled triangles are thus formed, one, A B C, of which only the side, A B, is known, and the other, A E F, of which, A E, is known being the radius of the arc traversed by the needle, 70, and, A F, is known, being the distance from the center, A, of the cord-line, 72, which intersects the arc, 71, at the point, E. The lines, 72, being equidistant from one another, and running twenty or even more to the inch, make it possible to quickly determine by observation the length of, A F, with reasonable accuracy. The hypotenuse, A E, and one side, A F, thus being known, the remaining side, E F, of this right-angled triangle, A E F, can be quickly computed; and with the three sides of the triangle, A E F, known, and one side, A B, of the similar triangle, A B C, known, the remaining sides, A C, and, B C, can be readily determined by a simple arithmetical computation.

As a means for directly indicating the distance of a distant object, the vernier-segment, 23, is shown provided on its upper side with a scale, 77, the lines of which have been located either by computation or by actual measurement of distances to be read quickly and approximately in connection with the wire, 36, carried by the frame, 34, upon which the telescope, 33, is mounted, or to be more accurately read by means of an index-plate, 79, also carried by said frame, 34, to indicate directly the distance of an object upon which the telescope, 33, is brought to bear convergently with one of the telescopes, 45, with the latter at right angles to the base-line of the instrument. For convenience, the value of the lines of the scale, 77, may be numerically indicated on the surface of the vernier-segment, 23, if desired.

The post, 16, and parts carried thereby can be rocked upon the shaft, 15, by means of a gear-segment, 83, fixed to the plate, 17, and adapted to be engaged by a pinion, 80, fixed upon a short shaft rotatively mounted in bearings in the yoke, 5, and a bracket, 82, attached to the yoke, said shaft having an operating handle 81. The post, 16, can be locked in adjusted rotative position by means of the nut, 86, which fits a screw-threaded end of the shaft 15.

The movement of the frame, 34, may be facilitated by mounting the same upon small rollers, 88, adapted to travel upon the upper surface of the vernier-segment 23. The instrument may also be provided, if desired, with a plumb 87.

Some of the uses of the instrument above described are as follows: In measuring a horizontal angle between two points in different horizontal planes, the telescope, 33, fixed at right angles to its base-line, is trained upon one of said points; the vernier-disk, 7, is then set and locked at zero, and the thumb-screws, 9, are slightly loosened to permit the yoke, 5, to rotate upon its vertical axis; the post, 16, is then rocked upon the horizontal axis, and the vernier-segment, 23, with the telescope, 33, fixed thereto is rotated about what originally was its vertical axis, but which has become an inclined axis due to the rocking of the post, 16, until said telescope, 33, bears upon the other of said points, whereupon the horizontal angle will be indicated in connection with the index-plate 12. For use as an altazimuth, the vernier-segment, 23, can be rotated to bring the telescope, 67, at right angles to the cross-shaft, 15, whereupon the altitude can be read upon the vernier-scale, 84, by means of the index, 85, while the azimuth can be read upon the vernier-disk, 7, by means of the

index-plate 12. When it is desired to use the telescope, 33, simply as a leveling or surveying instrument, the extension-plates, 46, with the auxiliary telescope fixed thereon, respectively, can be removed and the plate, 41, can be swung back and down out of the way to permit unrestricted use of the telescope 33.

What I claim as new and desire to secure by Letters Patent is—

1. In an instrument of the class described, and in combination, a supporting-head rotatory upon a vertical axis; a pair of telescopes mounted upon said rotatory head, and each rotatory upon a vertical axis; a third telescope mounted upon said rotatory head, and independently rotatory upon a vertical axis; means for supporting said third telescope upon said rotatory head at right angles to a line extending through the axes of rotation of said pair of telescopes; and graduated scales for measuring the angular movement of each of said pair of telescopes.

2. In an instrument of the class described, and in combination, a support rotatory upon a horizontal axis; a head mounted upon said support and rotatory upon an axis at right angles to the axis of rotation of said support; a pair of telescopes mounted upon said rotatory head, and each rotatory upon a vertical axis; and graduated scales for measuring the angular movement of each of said pair of telescopes.

3. In an instrument of the class described, and in combination, a support rotatory upon a horizontal axis; a head mounted upon said support and rotatory upon an axis at right angles to the axis of rotation of said support; a pair of telescopes mounted upon said rotatory head, and each rotatory upon a vertical axis; a third telescope mounted upon said rotatory head; and graduated scales for measuring the angular movement of each of said pair of telescopes.

4. In an instrument of the class described, and in combination, a support rotatory upon a horizontal axis; a head mounted upon said support and rotatory upon an axis at right angles to the axis of rotation of said support; a pair of telescopes mounted upon said rotatory head, and each rotatory upon an axis parallel with the axis of said head; a third telescope mounted upon said rotatory head, and independently rotatory upon an axis parallel with the axis of rotation of said head; and graduated scales for measuring the angular movement of each of said pair of telescopes.

5. In an instrument of the class described, and in combination, a support; a head rotatively mounted upon said support; a telescope rotatively mounted upon said head; an auxiliary telescope-support hinged upon said head on an axis at right angles to the axis of rotation of said telescope; a pair of telescopes rotatively mounted upon said auxiliary telescope support; and graduated scales for measuring the angular movement of said telescopes.

6. In an instrument of the class described, and in combination, a supporting-head rotatory upon a vertical axis; a telescope rotatively mounted upon said head; an auxiliary telescope-support hinged upon said rotatory head on an axis at right angles to the axis of said telescope; a pair of telescopes each rotatively mounted upon said auxiliary telescope-support; and graduated scales for measuring the angular movement of said telescopes.

7. In an instrument of the class described, and in combination, a supporting-head rotatory upon a vertical axis; a telescope rotatively mounted upon said head; an auxiliary telescope-support rotatively mounted upon said head; a pair of extension-plates projecting in opposite directions from said support, and each detachably connected therewith; a pair of telescopes rotatively mounted upon said extension-plates, respectively; and graduated scales for measuring the angular movement of said telescopes.

8. In an instrument of the class described, and in combination, a supporting-head rotatory upon two axes at right angles to each other; a telescope rotatively mounted upon said head; an auxiliary telescope-support hinged upon said rotatory head, and having along one of its sides a straight edge; a pair of telescopes each rotatively mounted upon said auxiliary telescope-support; and graduated scales for measuring the angular movement of said telescopes.

9. In an instrument of the class described, and in combination, a lower supporting-member; an upper supporting-member rotatively mounted upon said lower supporting-member on a vertical axis; adjustable means for locking said members together against relative rotation; a vernier-plate adjustably mounted upon one of said members to be read in connection with an index on the other; a support rotatively mounted upon a horizontal axis upon said upper supporting-member; and a telescope mounted upon said support.

10. In an instrument of the class described, and in combination, a lower supporting-member; an upper supporting-member rotatively mounted upon said lower supporting-member on a vertical axis; adjustable means for locking said members together against relative rotation; a vernier-plate adjustably mounted upon one of said members to be read in connection with an index on the other; a support rotatively mounted upon a horizontal axis upon said upper supporting-member; a pair of telescopes mounted upon said support, each ro-

tatory upon an axis at right angles to the axis of said support; and graduated scales for measuring the angular movement of said last-mentioned telescopes.

11. In an instrument of the class described, and in combination, a lower supporting-member; an upper supporting-member rotatively mounted upon said lower supporting-member on a vertical axis; adjustable means for locking said members together against relative rotation; a vernier-plate adjustably mounted upon one of said members to be read in connection with an index on the other; a support rotatively mounted upon a horizontal axis upon said upper supporting-member; a pair of telescopes mounted upon said support, each rotatory upon an axis at right angles to the axis of said support; a third telescope mounted upon said support and independently rotatory upon an axis at right angles to the axis of said support; and graduated scales for measuring the angular movement of said telescopes.

12. In an instrument of the class described, and in combination, a lower supporting-member; an upper supporting-member rotatively mounted upon said lower supporting-member on a vertical axis; adjustable means for locking said members together against relative rotation; a vernier-plate adjustably mounted upon one of said members to be read in connection with an index on the other; a support rotatively mounted upon a horizontal axis upon said upper supporting-member; a vernier-segment rotatively mounted upon said support on an axis at right angles to the axis thereof; and a telescope rotatively mounted upon said vernier-segment on an axis at right angles to the axis of said support.

13. In an instrument of the class described, and in combination, a lower supporting-member; an upper supporting-member rotatively mounted upon said lower supporting-member on a vertical axis; adjustable means for locking said members together against relative rotation; a vernier-plate adjustably mounted upon one of said members to be read in connection with an index on the other; a support rotatively mounted upon a horizontal axis upon said upper supporting-member; a vernier-segment rotatively mounted upon said support on an axis at right angles to the axis thereof; a telescope rotatively mounted upon said vernier-segment on an axis at right angles to the axis of said support; and a pair of auxiliary telescopes each rotatively mounted upon said vernier-segment.

14. In an instrument of the class described, and in combination, a support; three telescopes rotatively mounted upon parallel axes upon said support; means for rotatively supporting said support with capability for rotative movement upon two axes at right angles to each other; and graduated scales for measuring the angular movement of said telescopes.

15. In an instrument of the class described, and in combination, a support; three telescopes rotatively mounted upon parallel axes upon said support; means for rotatively supporting said support with capability for rotative movement upon three axes, two of which are at right angles to the third; and graduated scales for measuring the angular movement of said telescopes.

16. In an instrument for measuring distances, and in combination, a support; a telescope rotatively mounted upon said support; another telescope mounted upon said support; means for holding said other telescope in fixed relation to said support at right angles to a line extending from one to the other of said telescopes; and a pointer carried by said rotatively mounted telescope, said support having parallel graduation-lines at right angles to the axis of said second mentioned telescope, and forming chords to the arc traversed by said pointer.

17. In an instrument for measuring distances, and in combination, a support; a telescope rotatably mounted upon said support; another telescope mounted upon said support; means for holding said other telescope in fixed relation to said support; and a pointer carried by said rotatably mounted telescope, said support having along the arc traversed by said pointer marks indicating distances from the axis of rotation of said rotatably mounted telescope along a line parallel with the line of sight of said fixed telescope.

In testimony whereof, I have hereunto set my hand this 11th day of July, 1910.

JOHN FOLEY,
By JOSEPH D. FOLEY,
Administrator.

Witnesses:
J. E. DONSBACH.
ROSE LE DUC.