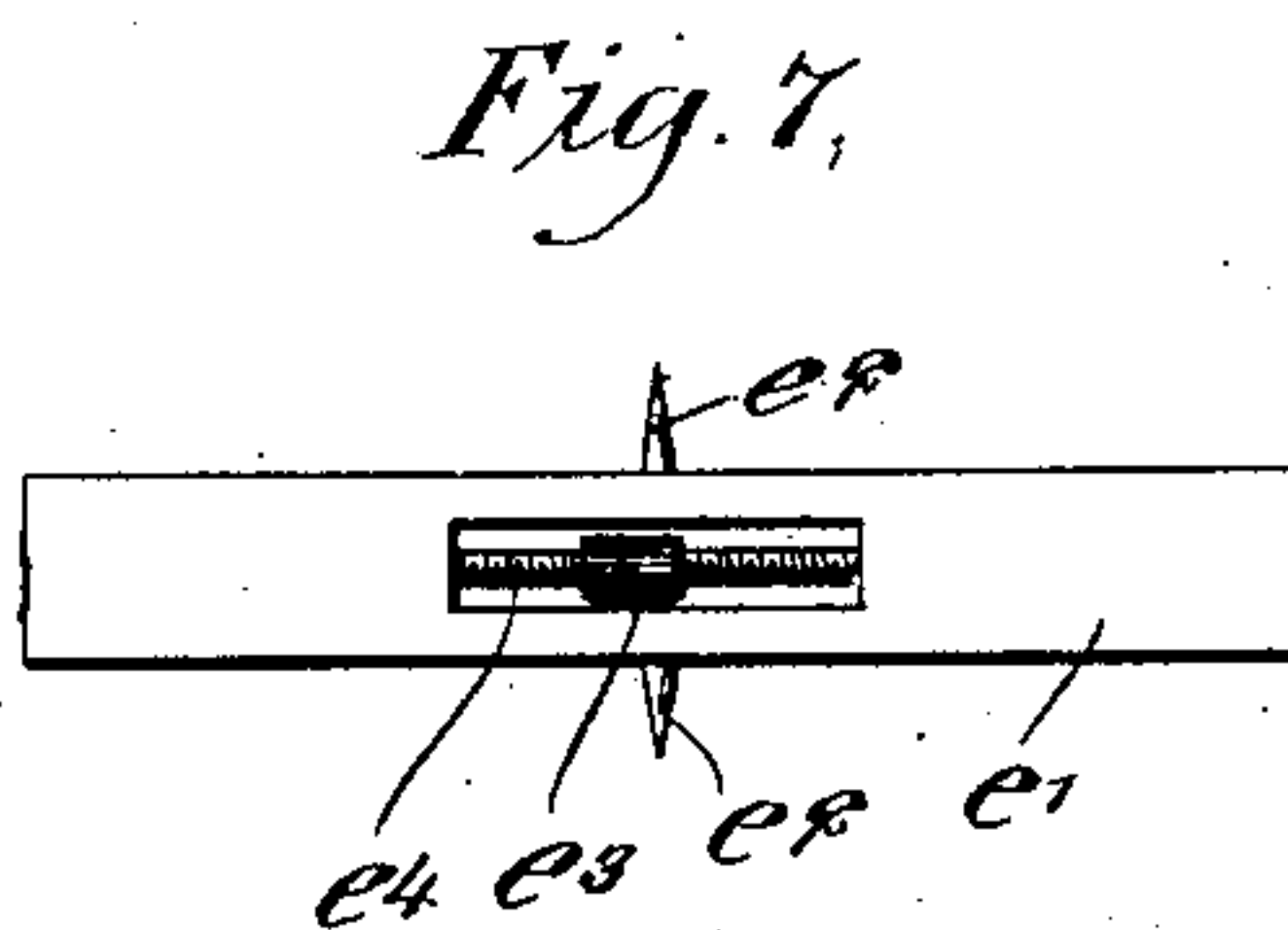
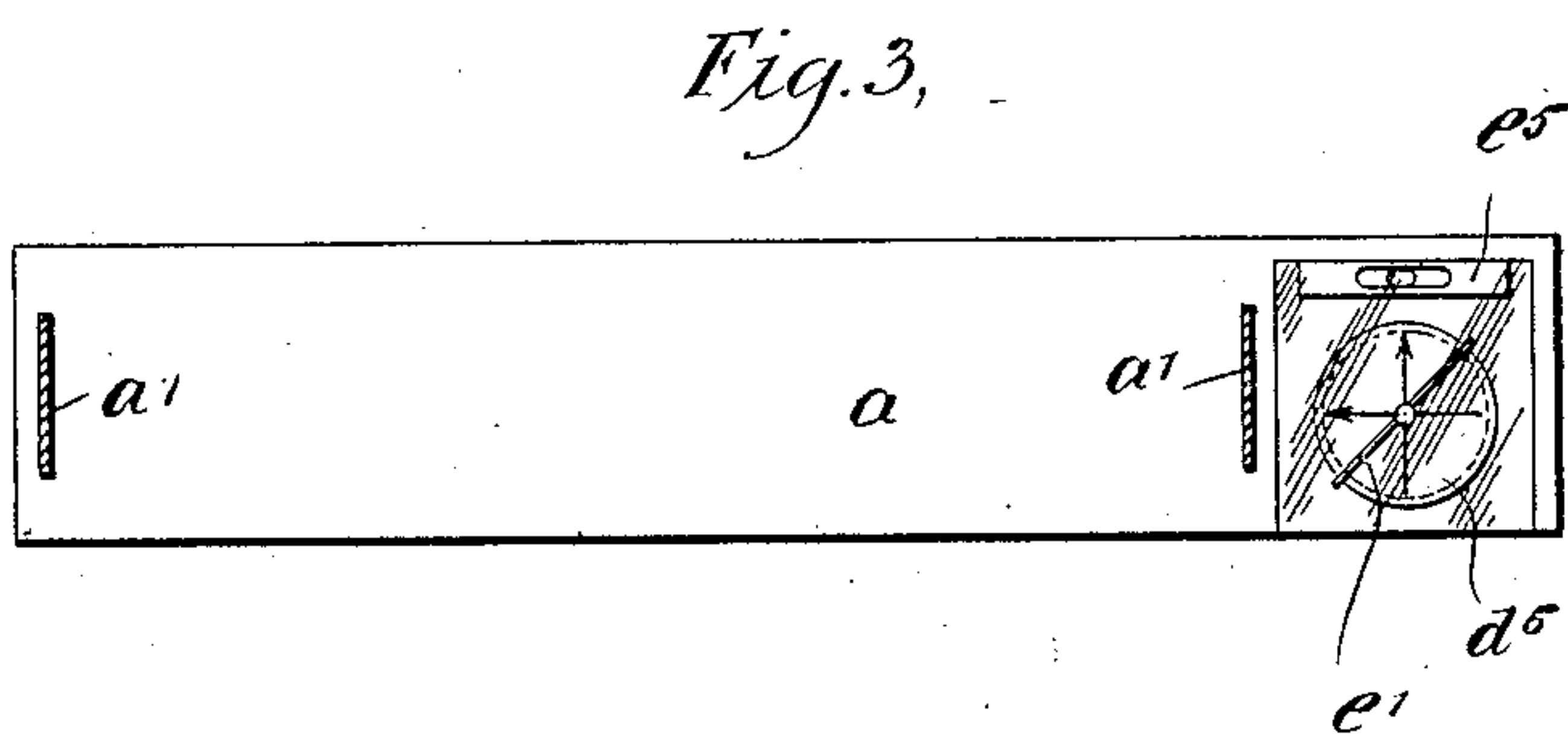
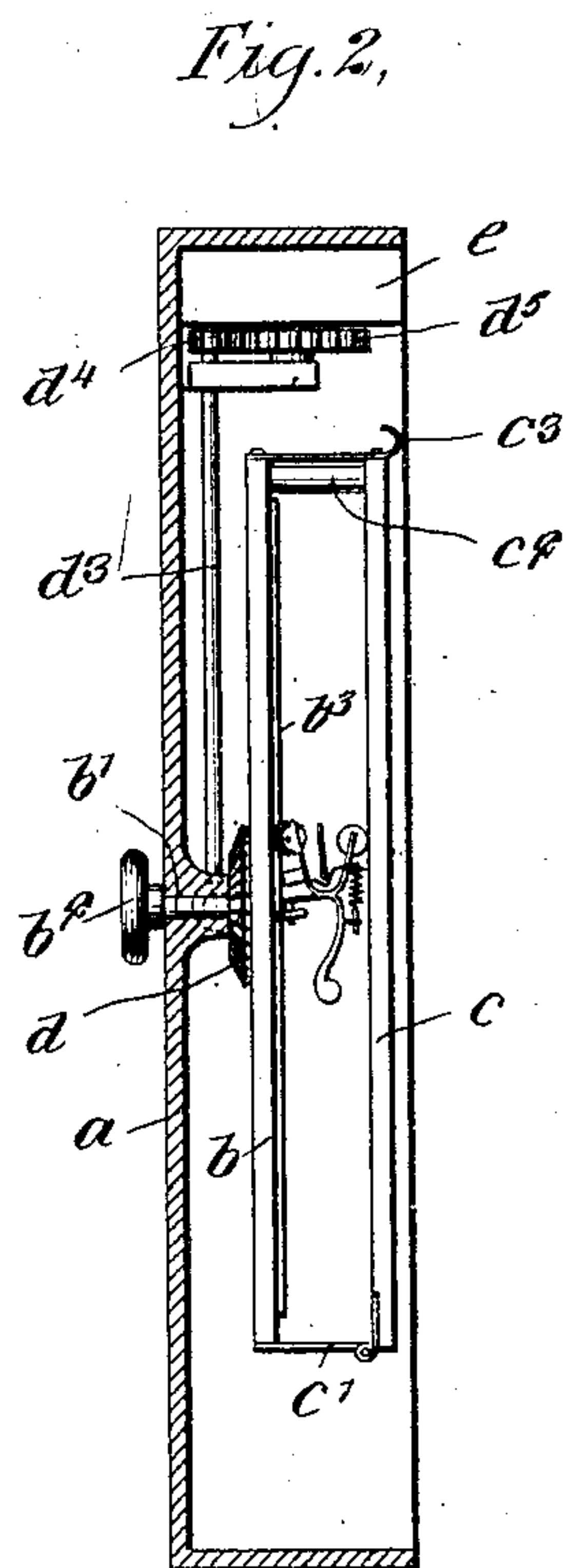
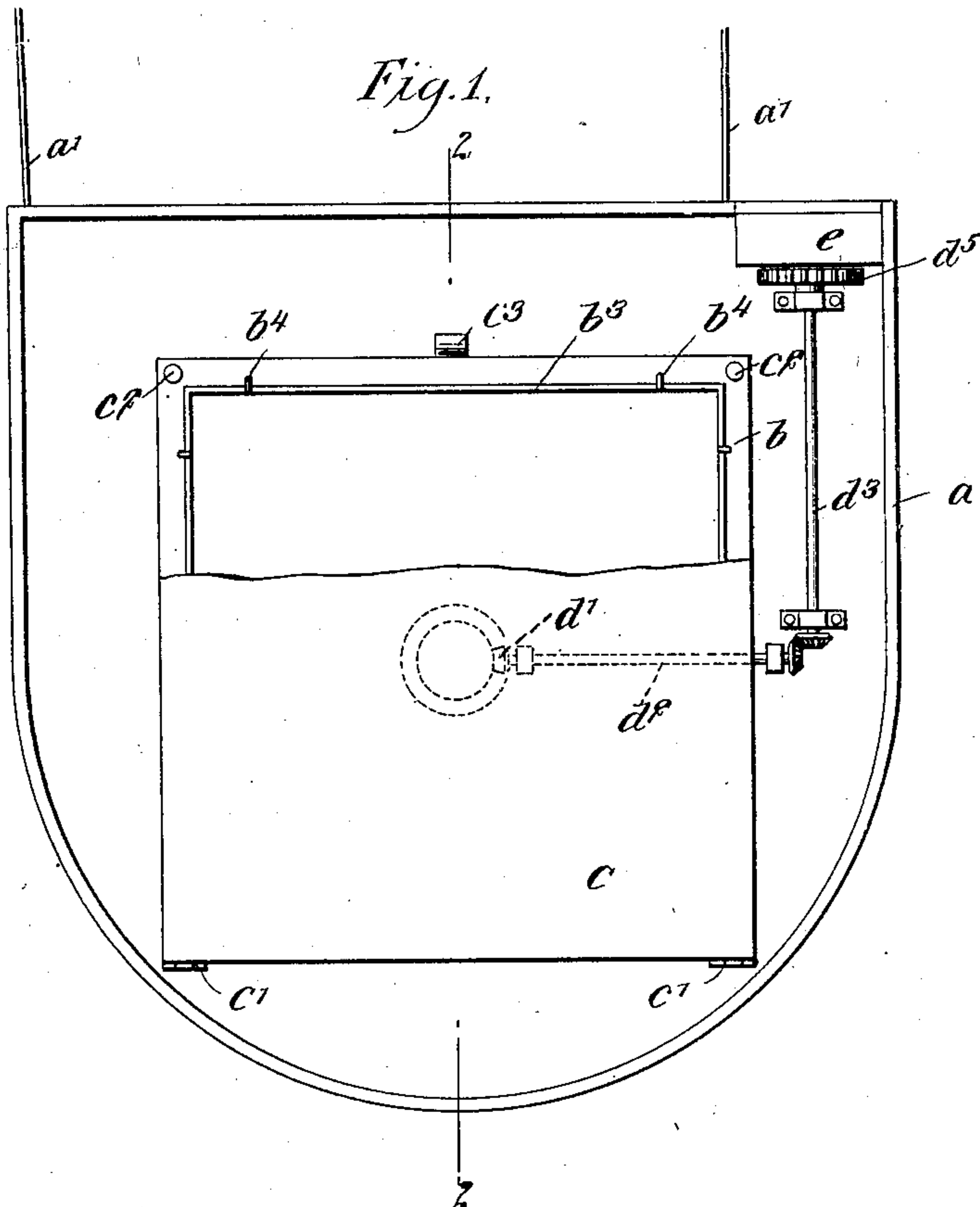


T. T. H. FERGUSON.
SURVEYING INSTRUMENT.

(Application filed Nov. 23, 1901.)

(No Model.)

2 Sheets—Sheet 1.



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No. 709,313.

Patented Sept. 16, 1902.

T. T. H. FERGUSON.
SURVEYING INSTRUMENT.

(Application filed Nov. 23, 1901.)

(No Model.)

2 Sheets—Sheet 2.

Fig. 4,

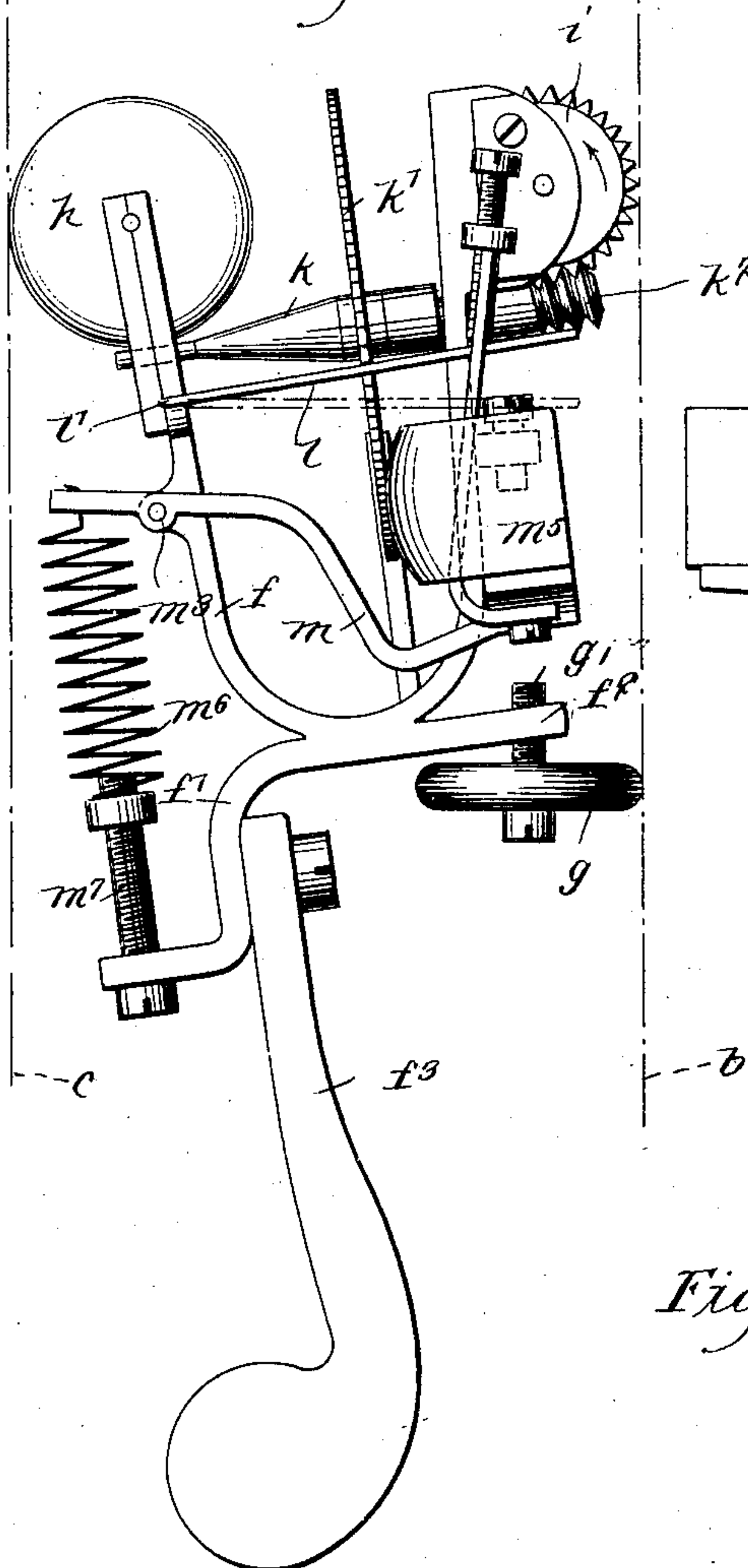


Fig. 5,

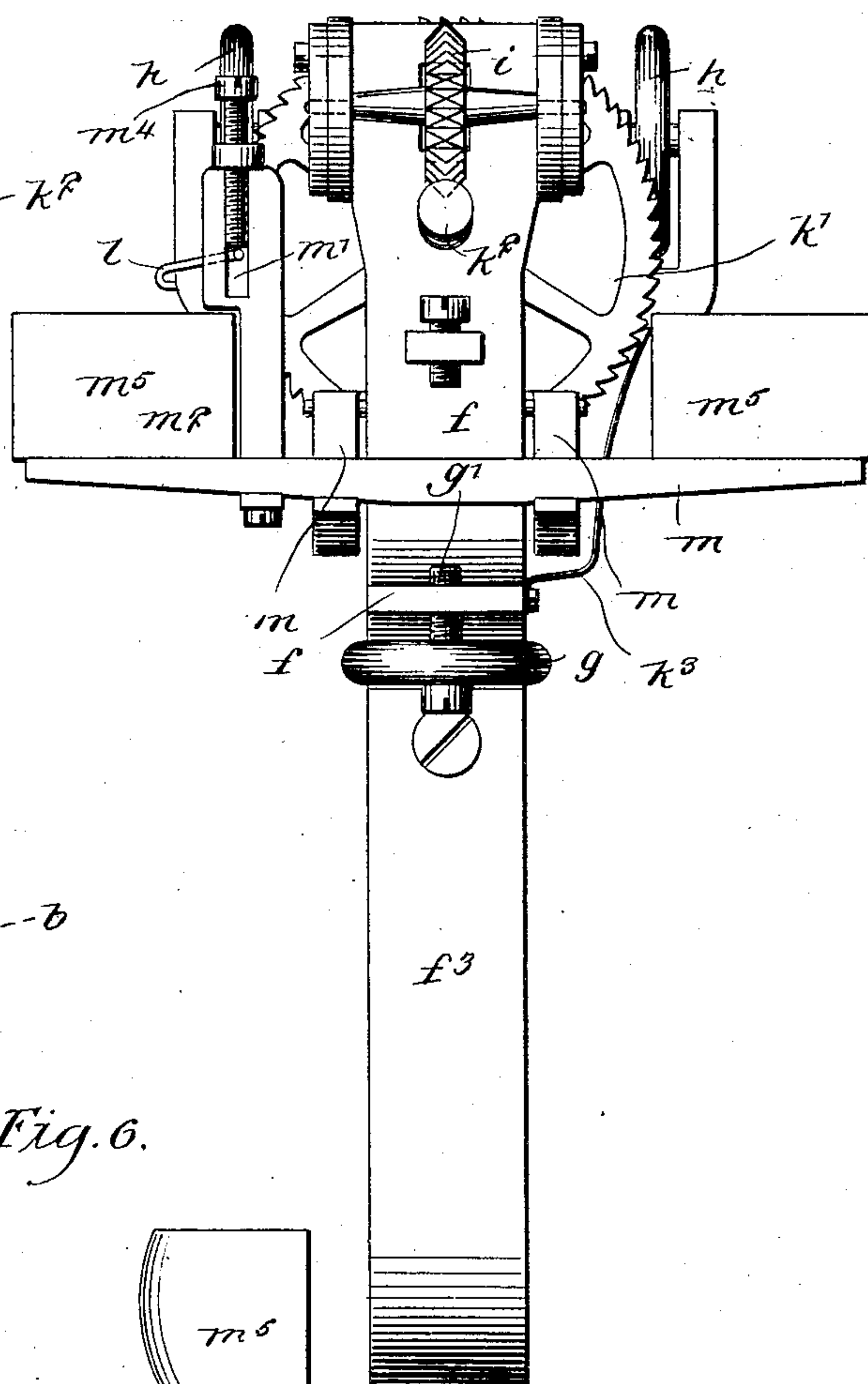
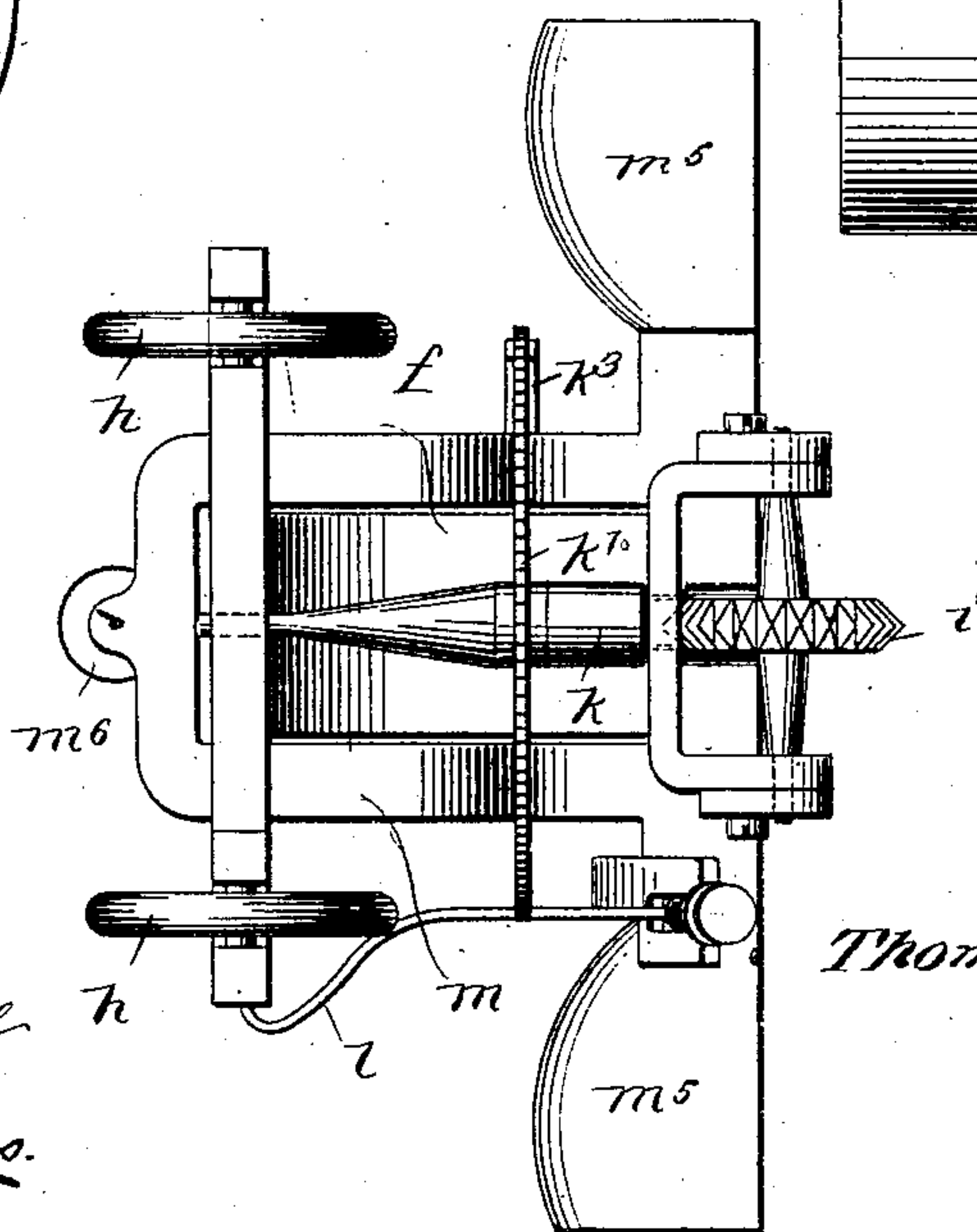


Fig. 6.



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THOMAS TAPLEY HELENUS FERGUSON, OF SOOCHOW, NEAR SHANGHAI,
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SURVEYING INSTRUMENT.

SPECIFICATION forming part of Letters Patent No. 709,313, dated September 16, 1902.

Application filed November 23, 1901. Serial No. 83,389. (No model.)

To all whom it may concern:

Be it known that I, THOMAS TAPLEY HELENUS FERGUSON, a subject of the Queen of the Netherlands, residing at Soochow, near Shanghai, China, have invented a new and Improved Surveying Instrument, of which the following is a full, clear, and exact description.

This invention relates to an instrument for measuring and automatically recording the distance traveled by a person, animal, or vehicle and the direction or directions of the route taken.

This specification is a specific description of one form of the invention, while the claims are definitions of the actual scope thereof.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which similar characters of reference indicate corresponding parts in all the views.

Figure 1 is a front view of a box with its front wall removed to illustrate the parts therein. Fig. 2 is a section on the line 2 2 of Fig. 1. Fig. 3 is a plan view of the box, parts appearing in section. Fig. 4 is a side view of the recorder. Fig. 5 is a front view thereof. Fig. 6 is a plan view thereof, and Fig. 7 is a side elevation of the magnetic needle employed.

The various parts of the instrument are inclosed in an exterior casing or box *a*, which is provided with a strap or other means *a'* whereby it may be slung from the shoulder of a person, so as to be carried with that person. Within the box *a* is mounted a board *b*, having a stub-shaft *b'*, mounted to turn freely in the box *a* and fitted outside of the box with a hand-wheel *b²*, so that the board *b* may be turned freely to any desired position within the box. This board carries a metallic rim *b³*, removably held in place by clamping devices *b⁴*, which may be of any form desired. The rim *b³* serves the twofold function of securing a sheet of paper to the board *b* and also of preventing the recorder from running off of the board, as will be hereinafter explained.

At one side edge of the board *b* projecting lugs *c'* are fastened, and to these lugs is hinged a board *c*, which is of the same size and shape as the board *b*. At the side edge of

the board *b*, opposite the projections *c'*, posts *c²* are arranged, which are equal in length to the projections *c'* and which are adapted to be engaged by the board *c*, so as to hold the board in true parallelism with the board *b*.

c³ represents a catch of any suitable form for holding the board *c* in any desired position. This board may, however, upon the release of the catch be thrown downward so as to expose the inner face of the board *b*. Fastened to the outer face of the board *b* is a miter-gear *d*, which is coaxial with the shaft *b'* and with which meshes a gear *d¹* on a shaft *d²*, mounted to turn in bearings carried by the box *a* within the same. This shaft *d²* is geared with a vertically-extending shaft *d³*, also mounted in the box and having at its upper end a pinion *d⁴*, meshing with a spur gear *d⁵*, arranged on a vertical axis just beneath a case *e*, which incloses the magnetic needle *e'*. The case *e* has a glass top and bottom, so that the needle is not only visible, but the top of the gear *d⁵* may also be seen. The needle *e'*, as shown in Fig. 7, has pivots *e²* projecting vertically upward and downward therefrom, these pivots being mounted in suitable bearings on the top and bottom wall of the casing *e* or in any manner desired. By mounting the needle *e'* on double pivots it is held more steady and is not so subject to the jolting action due to the transportation of the instrument.

e³ represents a balance-weight, which is arranged in an opening in the needle *e'* and carried on a screw *e⁴*. By adjusting this weight the poise or the needle may be correctly secured. The top face of the gear *d⁵* should be provided with diametric arrow-marks crossing each other at right angles, as shown in Fig. 3, so that the gear *d⁵* may be set with respect to the needle *e'*. This gear *d⁵* constitutes an indicator for the position of the drawing-board *b* and the cover-board *c*. It will be seen that by turning the shaft *b'* the boards *b* and *c* may be adjusted around their axes to any position desired, and also that each movement of these boards is transmitted to the indicator *d⁵*. Therefore the boards *b* and *c* may be set in a certain relation with respect to the compass-needle. This is necessary to the operation of the apparatus, as

will be brought out hereinafter. The box *a* is provided with a spirit-level *e*⁵, directly adjacent to the compass-needle, so that the operator can determine when the apparatus is held level.

The recorder illustrated in Figs. 4, 5, and 6 is adapted to work between the boards *b* and *c*, and comprises a framing made up of a U-shaped spring *f*, to the lower part of which are attached arms *f*¹ and *f*², the former carrying a weight *f*³ and the latter carrying, through the medium of a screw-axle *g*¹, a wheel *g*, the axis of which is vertical. The upper end of the U-shaped spring *f* is spread horizontally and carries two wheels *h*. The other arm of the spring *f* carries a toothed or spur wheel *i*. The axles of the wheels *h* and *i* are horizontal and by reference to Fig. 6 it will be seen that the wheel *i* is arranged in a plane which is median to the wheels *h*. The wheels *h* are adapted to run on the inner face of the board *c*, as indicated by the dotted line *c* in Fig. 4, and the wheels *i* and *g* are adapted to run on the inner face of the board *b* and against the paper which is secured thereto, as indicated by the dotted line *b* in Fig. 4. Mounted to turn in the spring *f* in such a manner as not to affect the compression or expansion thereof is a shaft *k*, which extends across the axes of the wheels *h* and *i* and carries between the arms of the spring *f* a ratchet-wheel *k*¹. One end of the shaft *k* is projected under the toothed wheel *i* and formed with a worm *k*², which meshes with the wheel, so that the wheel *i* may be driven from the rotation of the shaft *k*. *k*³ represents a pawl, which engages the ratchet-wheel *k*¹ to prevent back movement thereof. When the parts are arranged as indicated in Fig. 4 and rotary movement is imparted to the shaft *k*, the spur or toothed wheel *i* will be driven, and thus move the recorder between the boards *b* and *c*. The recorder in thus traveling will cause the wheel *i* to produce marks on the paper which is held on the board *b*. This movement of the recorder over the surface of the boards is parallel with the planes of the wheels *h* and *i*, the wheels *h* turning around their axes and the wheel *g* sliding lightly over the board *b*. Owing to the relative position of the parts *h*, *i*, and *g*, the wheel *h* touches the board *b* but lightly, and therefore the sliding of the wheel is not attended by undue friction such as would hamper the movement of the recorder. When the parts *h* and *i* are at rest, the wheel *i* engages one of its teeth on the board *b* and being incapable of turning except when driven from the shaft *k* the recorder is then held immovable between the boards *b* and *c*. It is capable of oscillating in a plane parallel with the planes of the boards *b* and *c*, and during such movement the wheel *g* rolls over the board *b*. The spring *f* keeps the various wheels *d*, *k*, *i*, and *g* properly engaged with the drawing and cover boards.

The ratchet-wheel *k*¹, and consequently the

shaft *k*, is driven with a step-by-step rotary movement through the action of a bar *l*, which is pivoted to one arm of the spring *f* at the point *l*¹ and which has its other arm held loosely in a slot *m*¹ in a plate *m*², carried fast on a rocking frame *m*, pivoted at the point *m*³ on the arm of the spring *f* to which the bar *l* is pivoted. The plate *m*² has a screw *m*⁴ carried thereby and projected into the slot *m*¹, so as to permit lengthening or shortening of this slot, and consequently regulating the movement which the plate *m*² may have without influencing the movement of the bar *l*. As the frame *m* swings on its pivot *m*³ this moves the bar *l* up and down on its pivot *l*¹, as indicated by the dotted lines in Fig. 4, and this bar being in engagement with the ratchet-wheel *k*¹ imparts a step-by-step movement to this wheel, the degree of which may be regulated by adjusting the screw *m*⁴. The frame *m* straddles the U-shaped spring *f* and carries at its longer arm two weights *m*⁵. The short arm of the frame is connected with a spring *m*⁶, which has its lower end joined to a screw *m*⁷, adjustably carried in the arm *f*¹ of the frame of the recorder. Now it should be understood that this instrument is carried about over the course which is to be measured and recorded, and the jolting of a person in walking or the other movements due to the transportation of the instrument, however it may be transported, will cause the weighted frame *m* to oscillate, the spring *m*⁶ acting against the weight *m*⁵ and the said movement of the frame being compensated. This movement is measured with the amount of jolting which the instrument receives. Therefore as the person walks and the frame *m* is moved up and down the bar *l* is driven and from this the shaft *k* and finally the wheel *i*. This propels the recorder along the space between the boards *b* and *c*. According to the arrangement here shown the wheel *i* will be turned in the direction of the arrow shown in Fig. 4, and this will cause the recorder to descend. If desired, however, the wheel *i* may be driven oppositely and the device made to climb upward.

In using the invention a sheet of paper is secured to the drawing-board *b* by the rim *b*³, and the recorder, with its parts properly adjusted, is placed between the boards *b* and *c*. The instrument is then adjusted on the person who is to carry it. It may be supported by the strap *a*¹ or by any other means desired, and these means should hold the box *a* as nearly level as possible. The spirit-level *e*⁵ may be used to determine this point. The instrument may be carried on a horse or, indeed, on a vehicle, although it is best adapted to a man or horse, since the movement of walking is well calculated to operate the recorder. When the start is made, the boards *b* and *c* should be adjusted by turning the knob *b*² so that a certain one of the arrow-marks on the indicator *d*⁵ will coincide with the magnetic needle *e*¹. Then as long as the person walks

in the direction in which he started the recorder will steadily travel downward over the drawing-paper and the wheel i will leave its track thereon. Should the direction in which the person walks be changed, the needle e' will of course swing out of coincidence with the selected mark on the indicator d^5 . It will then be the duty of the operator to turn the knob b^2 in the direction in which the needle swung until the selected mark on the indicator again registers with the needle. This will turn the boards b and c exactly in proportion to the turn made by the person walking, and then the recorder will start on a new course and will leave its track, as before. This should be continued until the journey is finished. Then the exact distance traveled and the direction of the course taken may be derived from the marks on the paper. By fixing a certain point on the paper, as north, for a basis of measurement the compass-bearings of the various courses may readily be determined, and by the use of a scale or by calculations based on the number of marks on the wheel i the distance may be secured.

It should be understood, of course, that the parts will be constructed and adjusted according to a certain relation to miles or other units of distance measurement, so that a certain movement of the wheel i will be known to stand for a certain length. The boards b and c may be made in the shape shown or they may be made in other shapes, as convenient. The indicator d^5 is given the two crossing arrow-marks, so that by arranging it in a certain relation to the boards b and c the exact position of the boards may be determined without looking into the box a —that is to say, one of the arrow-marks may be set to represent one edge of the boards and the other arrow-mark to represent another edge of the boards at right angles to the first edge. The marks may be given different colors to distinguish them, and thus by merely turning the knob b^2 and examining the indicator d^5 the position of the boards b and c may be determined at all times.

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

1. In a surveying instrument, the combination of a means forming a flat supporting-surface arranged in a vertical plane, a recorder arranged thereon and adapted to maintain a vertical hanging position, and a device for propelling the recorder over the supporting-surface in a vertical direction, such device being actuated by the jolting of the instrument.

2. In a surveying instrument, the combination of a board forming a support having a plane surface arranged in a vertical plane, a recorder movable vertically over the said surface, and a device for propelling the recorder, said device comprising a poised propelling member driven by the jolting of the instrument.

3. In a surveying instrument, the combination of a member forming opposing supporting-surfaces, a recorder movable between the said surfaces and comprising a marking device, working on one of the surfaces, and a means for driving the recorder, said means being actuated by the jolting of the instrument.

4. In a surveying instrument, the combination of a means forming a supporting-surface, a recorder adapted to move thereon, gearing for driving the recorder, and a poised member connected with the gearing and oscillated by the jolting of the instrument, whereby to impart movement to the gearing.

5. In a surveying instrument, the member having parallel supporting-surfaces, the recorder arranged between the supporting-surfaces and comprising a marking device, and means for driving the recorder, said means being actuated by the jolting of the instrument.

6. In a surveying instrument, the recorder, comprising a marking device, gearing for driving it, and a poised member oscillated by the jolting of the instrument and connected with the gearing to drive it.

7. In a surveying instrument, a recorder comprising a spring frame member, wheels carried by the frame member and adapted to engage opposing supporting-surfaces, and means for driving one of the wheels, said means being actuated by the jolting of the instrument.

8. In a surveying instrument, a recorder having a spring frame member, wheels mounted on the frame member and pressed apart by the spring tendency thereof, the wheels being capable of engaging opposing supporting-surfaces and having their axes parallel with each other, means for driving one of said wheels to move the recorder, said means being actuated by the jolting of the instrument, and an additional wheel mounted on the frame below the first-named wheels and having its axis disposed at right angles to the axes of the first-named wheels.

9. In a surveying instrument, the recorder, comprising a frame, a toothed wheel mounted thereon, a worm meshing with the wheel to drive it, a ratchet engaged with the worm, a swinging bar to drive the ratchet, and a pivoted member connected with the bar and oscillated by the jolting of the instrument.

10. In a surveying instrument, the combination of an adjustably-mounted member forming a support, a recorder arranged thereon and working therewith, and a magnetic needle juxtaposed to said adjustable member to permit moving the adjustable member in coincidence with the movement of the needle.

11. In a surveying instrument, the combination of an adjustably-mounted member forming a support, a recorder arranged thereon and working therewith, means for driving the recorder, such means being actuated by

the jolting of the instrument, and a magnetic needle juxtaposed to the movable member to permit of adjusting the said member in accord with the position of the needle.

5 12. In a surveying instrument, the combination of an adjustably-mounted member forming a support, a recorder arranged thereon and working therewith, a magnetic needle, an indicator juxtaposed to the needle, 10 and gearing connecting the indicator and the said adjustably-mounted member.

13. In a surveying instrument, the combination of a box or body member, two boards connected together and spaced apart and adjustably mounted in the box, a recorder movable between the boards, means for moving the recorder, such means being actuated by the jolting of the instrument, and a magnetic needle carried by the box adjacent to the said 20 boards to permit adjusting the boards in accord with the position or positions of the needle.

14. In a surveying instrument, the combination of two boards spaced apart and secured together, means for adjustably mounting the boards, a recorder situated and movable between the boards, and a magnetic needle juxtaposed to the boards to permit adjusting them in accord with the position of the 30 needle.

15. In a surveying instrument, the combination with a box or body portion, of a member adjustably mounted thereon, a recorder working with said member, means for driving the recorder, said means being actuated by the jolting of the instrument, an indicator, gearing connecting the indicator with the adjustably-mounted member, and a magnetic needle juxtaposed to the indicator. 35

16. In a surveying instrument, the combination of a member forming opposing supporting-surfaces, a recorder arranged between the supporting-surfaces and movable over the same, the recorder being adapted to maintain a vertical hanging position, and means actuated by the jarring or jolting of the instrument when carried for moving said recorder. 40 45

17. In a surveying instrument, an adjustable supporting member having its supporting-surface adapted to stand in a vertical plane when the instrument is in use, a recorder comprising a marking device coacting with said supporting-surface and adapted to travel vertically over the same, and means actuated by the jolting of the instrument for 50 55 driving the recorder.

18. In a surveying instrument, a member comprising parallel flat supporting-surfaces, one of which is adapted to be covered with paper, a recorder arranged between the said 60 surfaces and having a spring frame member, the recorder being provided with a toothed marking-wheel, the said recorder being adapted to hang perpendicularly between the said surfaces and to be held in position by frictional contact with the opposing surfaces, and mechanism actuated by the jolting of the instrument for revolving the said wheel to cause the recorder to move vertically between the said surfaces. 65 70

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

THOMAS TAPLEY HELENUS FERGUSON.

Witnesses:

C. C. COLE,
G. MOULE.