No. 720,076. PATENTED FEB. 10, 1903.

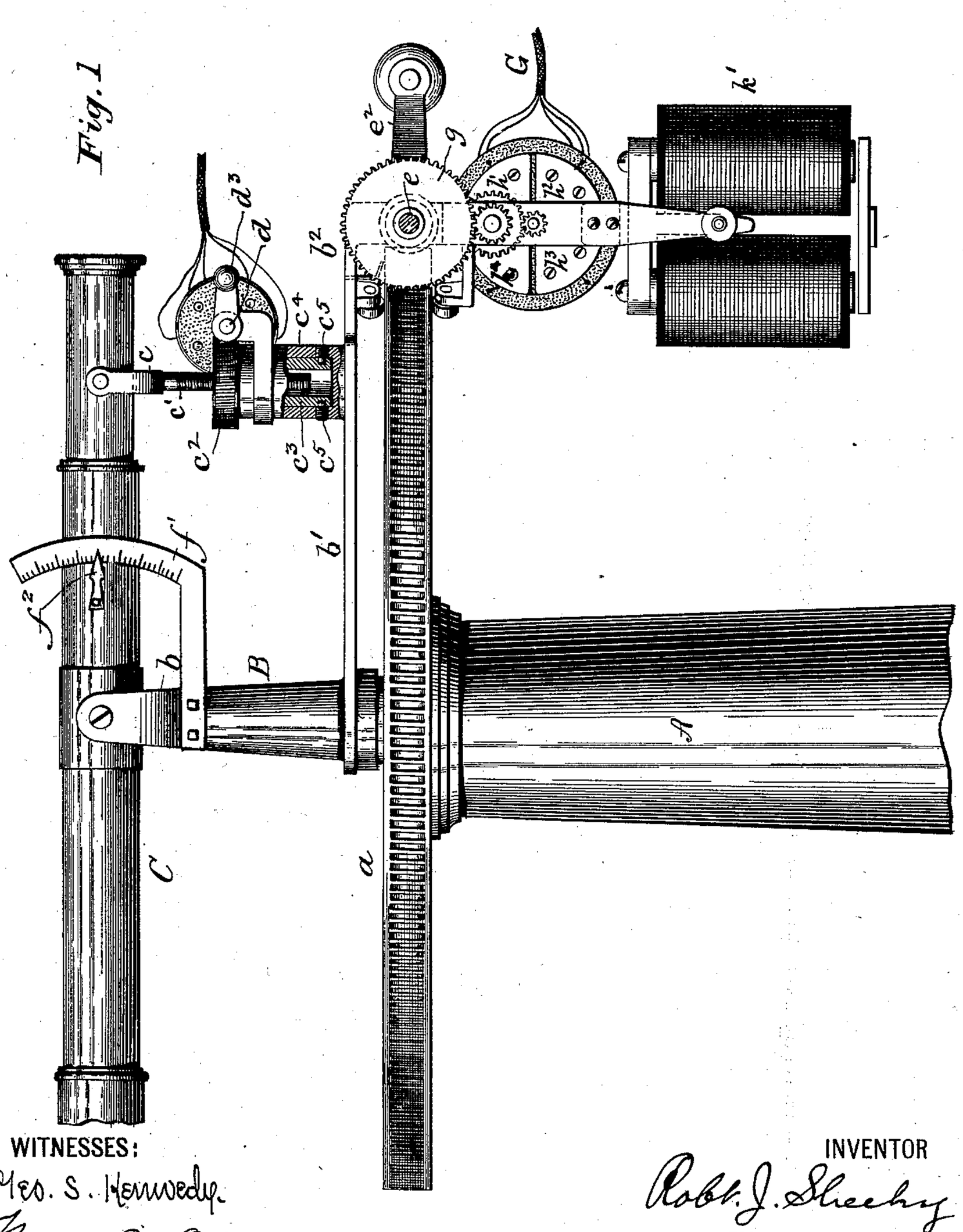
R. J. SHEEHY.

# ATTACHMENT FOR RANGE FINDERS.

APPLICATION FILED DEC. 21, 1899. RENEWED JUNE 7, 1902.

NO MODEL. 6 SHEETS—SHEET 1.

Fig. 1

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NO MODEL. 6 SHEETS—SHEET 2.

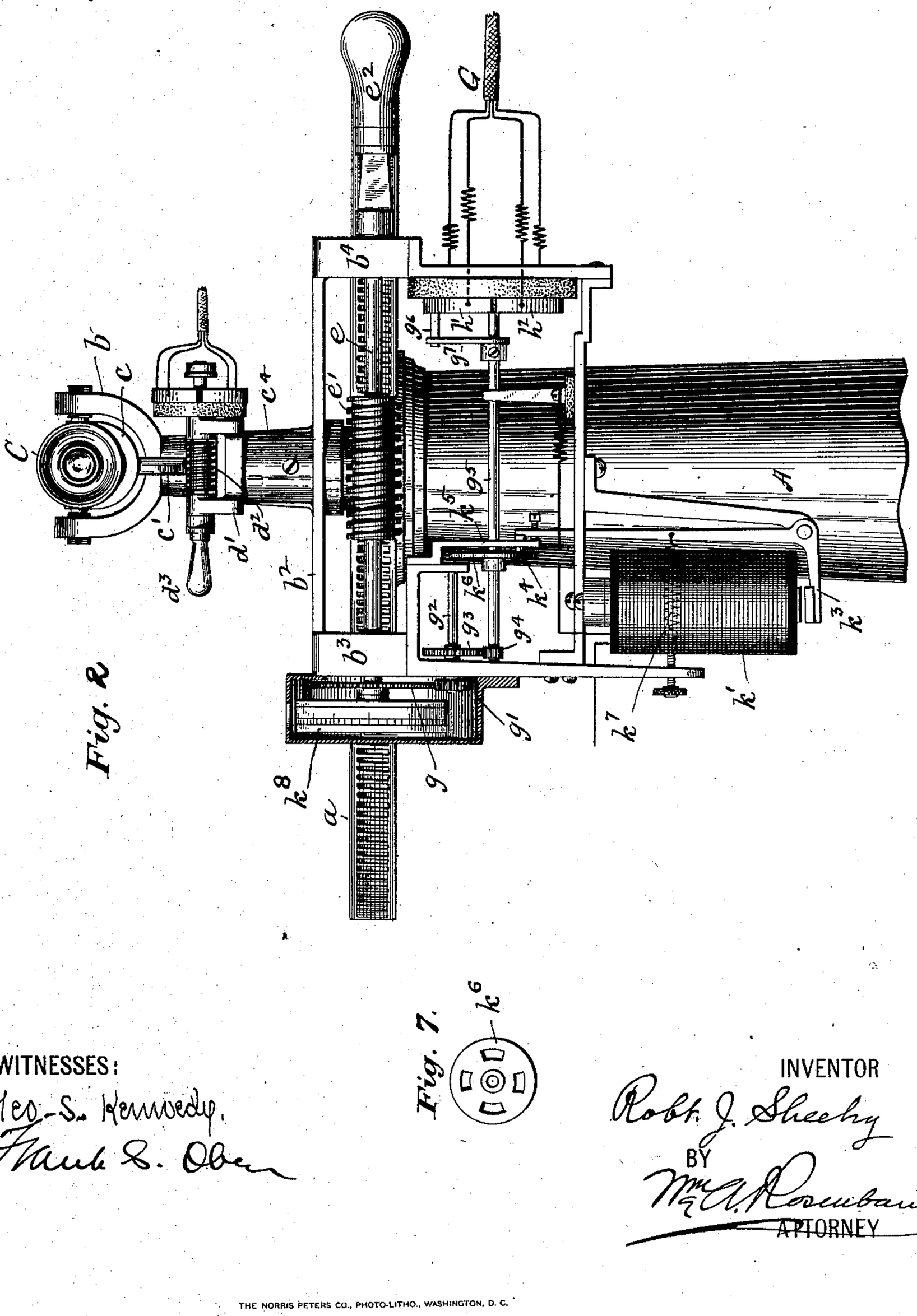


Fig. 2

Fig. 7.

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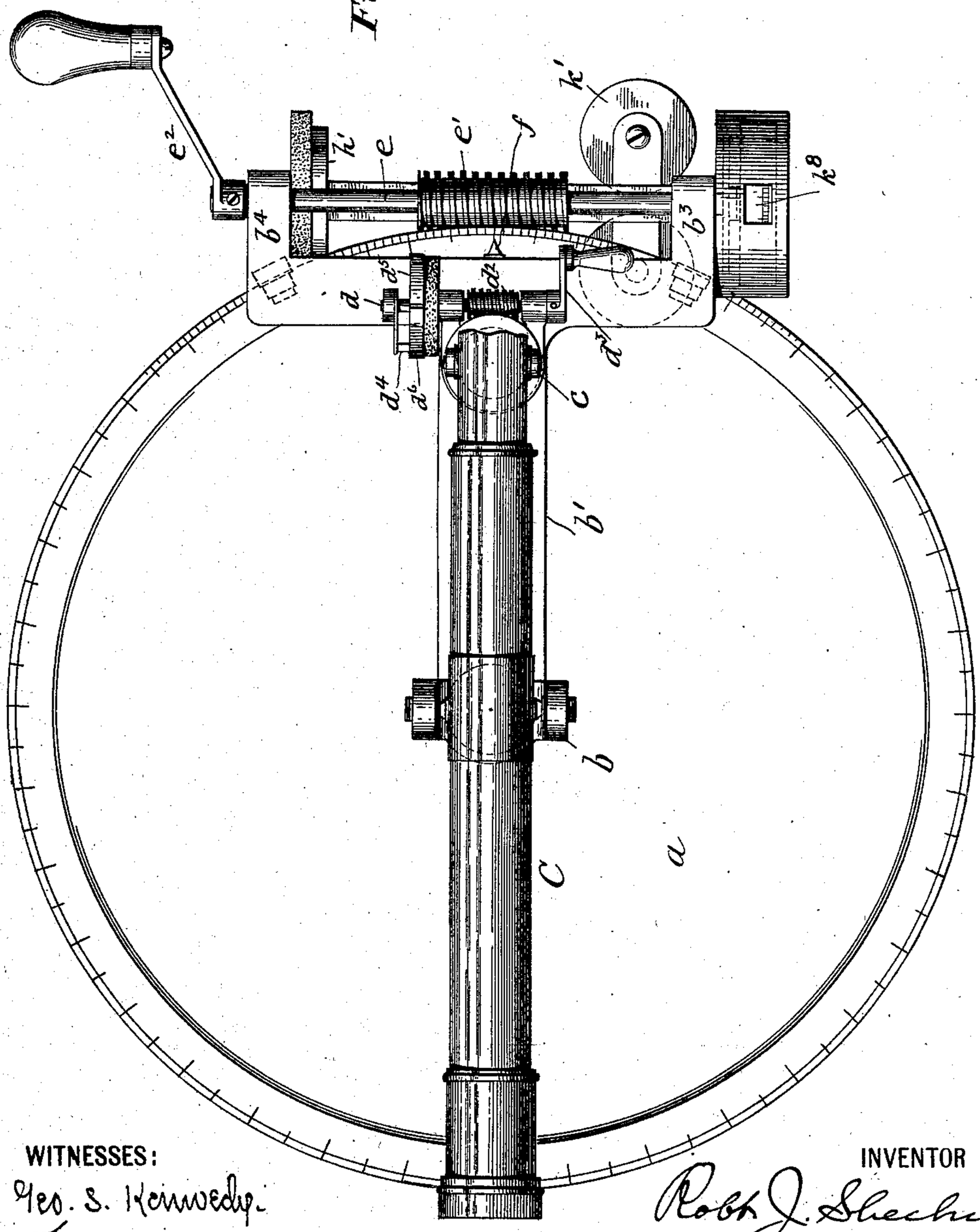
NO MODEL. 6 SHEETS—SHEET 3.

Fig. 3.

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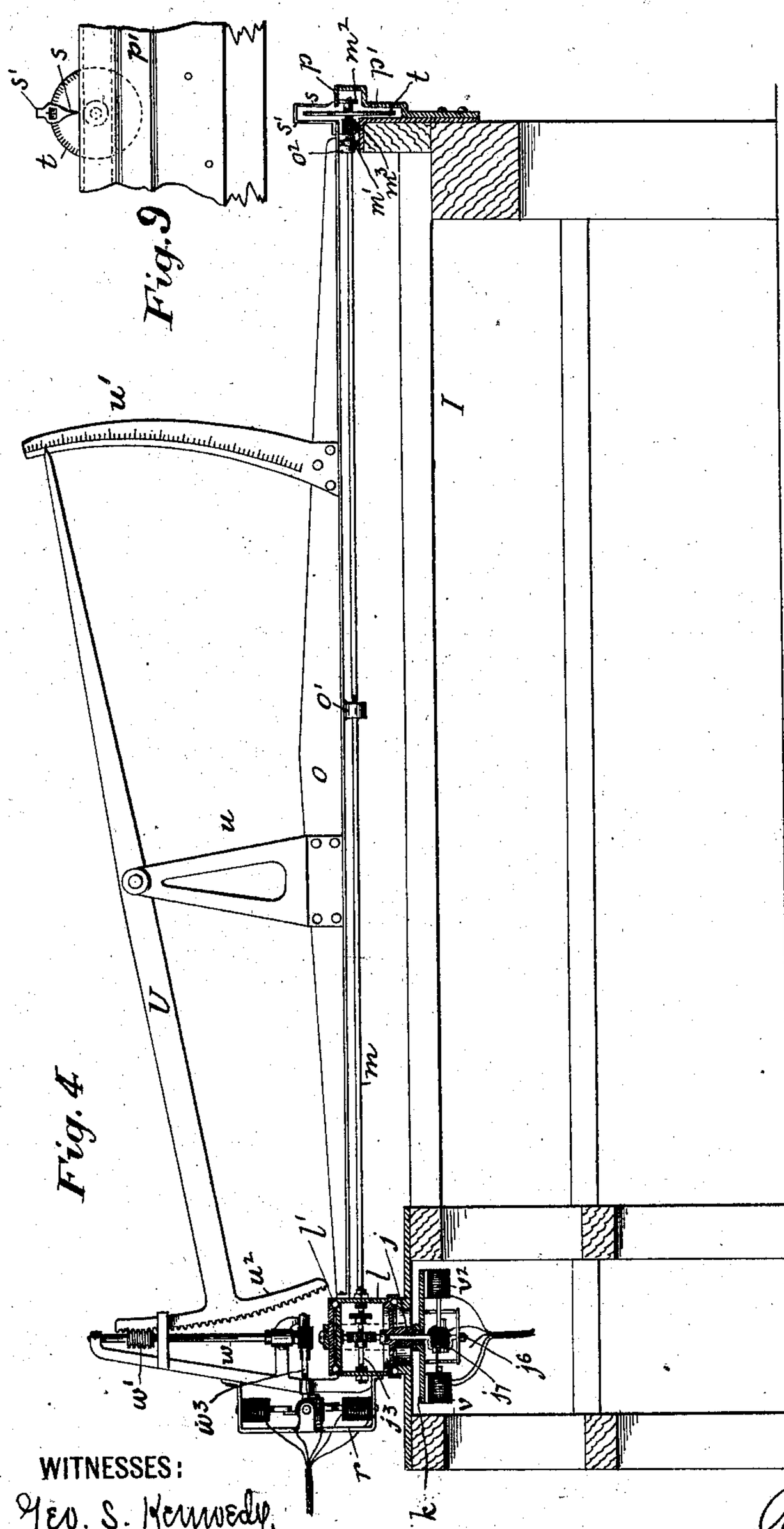
NO MODEL. 6 SHEETS—SHEET 4.

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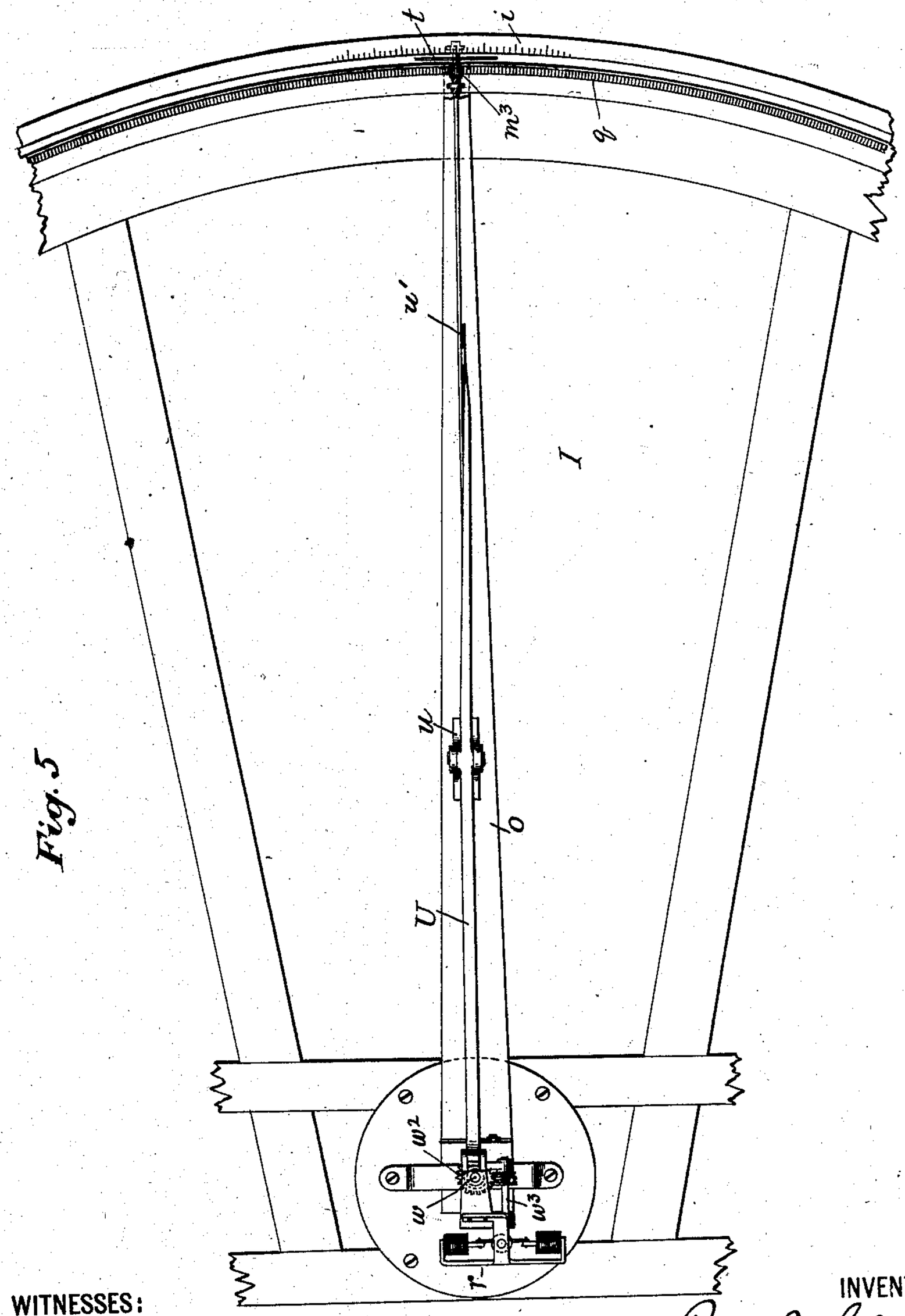
NO MODEL. 6 SHEETS—SHEET 5.

Fig. 5

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APPLICATION FILED DEC. 21, 1899. RENEWED JUNE 7, 1902.

NO MODEL. 6 SHEETS—SHEET 6.

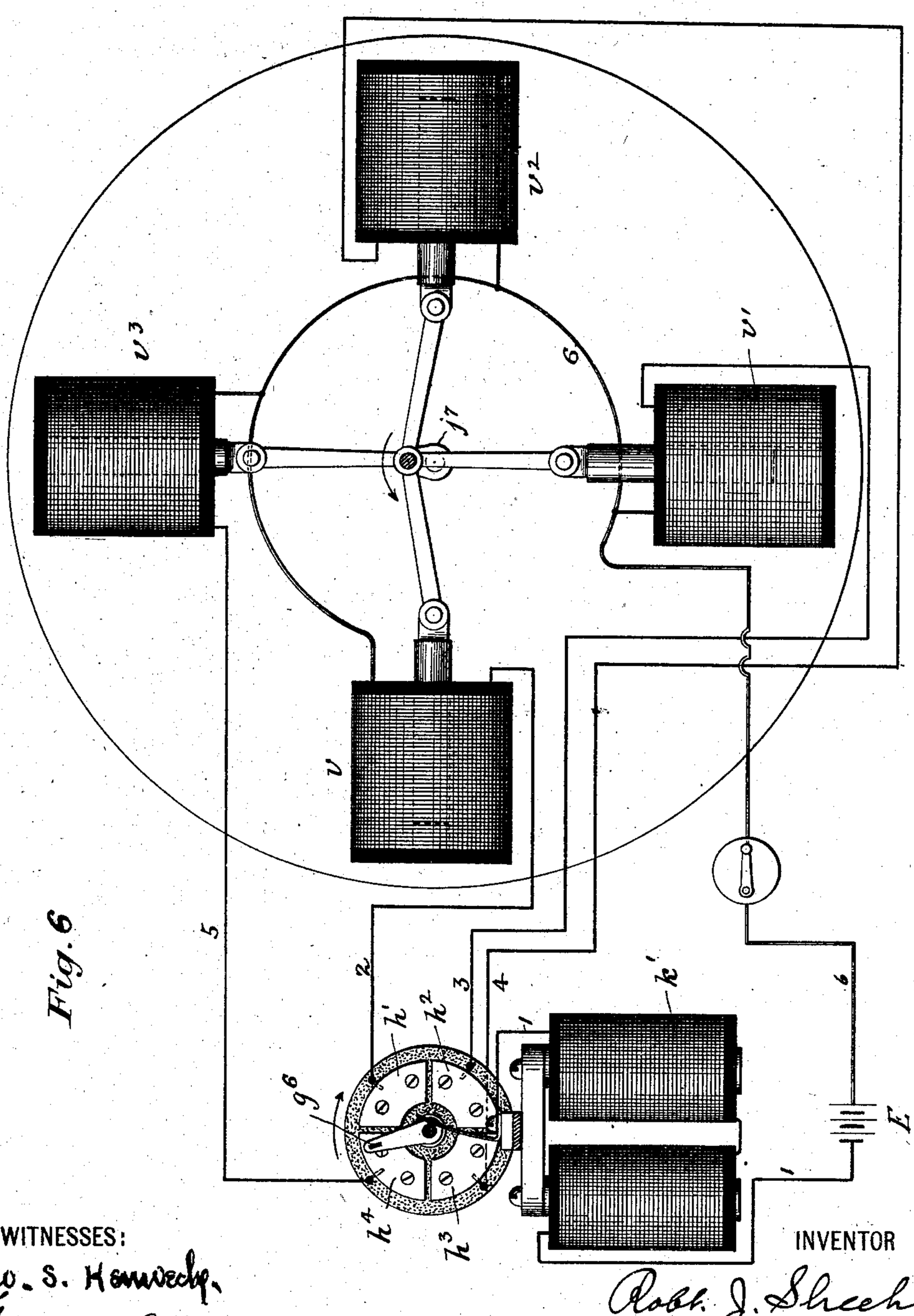


Fig. 6

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# UNITED STATES PATENT OFFICE.

ROBERT J. SHEEHY, OF NEW YORK, N. Y.

## ATTACHMENT FOR RANGE-FINDERS.

SPECIFICATION forming part of Letters Patent No. 720,076, dated February 10, 1903.

Application filed December 21, 1899. Renewed June 7, 1902. Serial No. 110,635. (No model.)

*To all whom it may concern:*

Be it known that I, ROBERT J. SHEEHY, a citizen of the United States, residing at the city of New York, in the borough of Manhattan and State of New York, have invented certain new and useful Improvements in Attachments for Range-Finders, of which the following is a full, clear, and exact description.

This invention is an apparatus for causing a movable element or device to simultaneously partake of the same movements that are made by another element or object distantly and mechanically separated therefrom. The desirability of synchronously and equally moving two or more objects in this way is manifested in various kinds of apparatus and machinery, among which may be noted the steering-gear of vessels, in which it is desirable to be able to move the rudder in exact relation to the movements of a device in charge of the helmsman, the operation from a distance of valves of all kinds, the movement of search-lights, and the control of indicators.

My invention is herein described as applied to range-finders commonly used in connection with the operation of heavy guns. In the ordinary operation of the range-finder the device is usually located more or less distant from the gun, and when the range has been obtained the operator communicates the information to the men at the gun either by telephone, telegraph, or other means of communicating intelligence, and the gunners then aim the gun in accordance with the information thus conveyed. This process often results in mistakes on account of the miscarry of the information or misunderstanding of the signals and is objectionable on account of the time occupied in the transmission of the information, which is often so great that the range changes before the gun can be aimed and fired. For land-batteries the range-finder is often located a considerable distance from the gun, and such methods as above mentioned for transmitting the readings of the instrument have been heretofore necessarily relied upon.

The object of my invention is to provide an attachment for the range-finder by means of which every movement of the telescope or other moving element of the range-finder is simultaneously and automatically reproduced at or near the gun or battery in an indicator or in the gun itself, so that the range will be known at the gun as soon as it is known at the range-finder and with the same degree of accuracy as is exhibited by the range-finder itself. Thus liability of mistakes in transmission and receipt of signals and the element of delay are at once eliminated.

As applied to range-finding for guns the most serviceable operation of my invention can be obtained by causing the movements of the range-finder to be at once reproduced in the gun itself; but in the description which follows and in the drawings I have used merely an indicator at the gun or receiving station, the index of which is caused to follow the movements of the range-finder. Hence it will be understood that my invention, broadly considered, may be applied direct to the operation of the gun.

In carrying out my invention I apply to a range-finder, which we will understand to consist, essentially, of a telescope mounted to swing on horizontal and vertical axes, separate devices for moving the telescope on its two axes for the purpose of obtaining the range, which devices operate through electrical circuits and motive devices to create the same movements in an indicator or gun. I also necessarily use a motor that will start, stop, and reverse simultaneously with similar motions of a part of the transmitting device, which therefore becomes a part of the invention.

My invention also includes other devices and combinations thereof, all of which will be fully described hereinafter and pointed out in the claims.

In the accompanying drawings, Figure 1 is a side elevation of a range-finder with a portion of my apparatus applied thereto. Fig. 2 is a side elevation of the same apparatus, the view being taken at right angles to that of Fig. 1. Fig. 3 is a plan of the same apparatus. Fig. 4 is a sectional view of the receiving instrument or indicator, taken along the radius thereof. Fig. 5 is a plan of a portion of the receiver with parts in section and other parts removed for the sake of clearness of illustration. Fig. 6 is a diagram of the circuits between the transmitting and receiv-

ing instruments and an illustration of the type of motor adapted for the purposes of my invention. Fig. 7 is a view of the locking-disk of the transmitter. Fig. 8 is a plan of the gearing at the axis of the horizontally-swinging element of the receiver. Fig. 9 is an end elevation of a portion of the receiver, and Figs. 10 and 11 are side and front views of a modified form of receiver.

Referring first to the range-finder and to the transmitting apparatus applied thereto, there is provided a pedestal A or other suitable frame or support, to the upper end of which is fixed a horizontal disk *a*, of quite large diameter, having cut in its periphery the teeth of a worm-gear. Mounted centrally above this disk and adapted to turn on a vertical axis is a post B, having a yoke *b* at its upper end, in which the trunnions of a telescope C have their bearings, as shown, the telescope thereby being free to move in a vertical plane afforded by the trunnion-axis and in a horizontal plane afforded by the axis of the post B. To obtain the motion in a horizontal plane, the post B is provided with an arm $b'$, extending to the edge of the disk *a*, where it is formed into a frame $b^2$, having two bearing-brackets $b^3$ $b^4$, in which is a rotary shaft *e*. This shaft carries a worm $e'$, which engages with the worm-gear in the periphery of disk *a*. On the end of shaft *e* is a crank $e^2$ for manual operation and by means of which it will be understood that the shaft *e*, the frame in which it is supported, the post B, and the telescope can be swung around the axis of post B, thus giving the horizontal movement to the telescope. For the vertical movement of the telescope the end thereof containing the eyepiece has pivotally attached to it a yoke *c*, ending in a threaded rod $c'$, which passes through a threaded hole in a worm-gear $c^2$. This worm-gear has an elongated hub $e^3$, extending downward into a socket $c^4$ for a bearing, the socket being mounted upon the arm $b'$. The worm-gear is free to turn in this socket, but is prevented from moving in the direction of its axis by pins $c^5$, which enter a groove in the hub. Thus when the worm-gear is rotated the threaded rod $c'$ must move vertically. For obtaining this rotation of the worm-gear a shaft *d* is mounted in a frame $d'$, fixed to the socket part $c^4$, which shaft carries a worm $d^2$, engaging with the worm-gear $c^2$. On the end of the shaft is a crank $d^3$ for rotating it by hand. Thus it will be seen how the movement of the telescope in a vertical plane is accomplished. These two motions of the telescope are the ordinary motions used for the telescope of a range or position finder. The operator places his eye to the telescope and moves it in the vertical and horizontal planes by means of the cranks, one in each hand, until he sees the object. The angular position of the telescope indicated in degrees in both the vertical and horizontal planes is the data or information required and which is then to be transmitted to the gunners. It is of course a simple matter to place degree-marks around the edge of the disk *a*, as shown in Fig. 3, which in connection with the pointer *f* will indicate at once to the operator at the range-finder the position of the telescope in the horizontal plane, and in like manner a scale $f'$ and pointer $f^2$ may be used to indicate the position of the telescope in the vertical plane. Heretofore the practice has been to take these readings from the range-finder and telephone or telegraph them to the gun; but in such transmission there is loss of time and great danger of errors, which, as before stated, my invention is designed to eliminate. For this purpose on the crank-shaft *e* I place a gear-wheel *g*, which meshes with a pinion $g'$ on a counter-shaft $g^2$, the counter-shaft carrying a wheel $g^3$, which engages a pinion on another shaft $g^5$. This latter shaft carries a sliding contact $g^6$ at the end of a rotary arm $g^7$. On the frame adjacent to the contact is a plurality of electrical contacts $h'$, $h^2$, $h^3$, and $h^4$, arranged in a circle and insulated from each other and from the frame across the face of which the contact $g^6$ is adapted to be swung in the rotation of the shaft. These contacts and the traveling member constitute a commutating switch. An electrical conductor leads from each segment of the switch and from the contact $g^6$ through a cable G to the receiving or gun station. A similar arrangement is used in connection with the shaft *d*, except that the sliding contact $d^4$ is carried directly by the shaft *d* and operates against segments $d^5$ $d^6$, &c. From these segments and the contact-circuits inclosed in a cable extend to the receiving-station.

We can now refer to the apparatus at the receiving-station, whereat it will be understood is a device of some character, such as an arm of an indicator or a gun which is to automatically assume the position of the telescope simultaneously with any change in position thereof. For simplicity of description I have used an indicator instead of a gun for the responding device. This consists of a board or frame *l*, having a curved edge forming more or less of the arc of a circle, but which ordinarily will not be more than a semicircle. Around the edge of this board are marked the degrees of a scale (indicated by *i*) and corresponding to the scale on the edge of the disk *a* of the transmitter. At a point on the board concentric with its circular edge is a vertical shaft *j*, having its bearing in a box-like frame *l* and provided with a worm $j'$, engaging with a worm-gear $j^2$ on a shaft $j^3$, mounted in said box-like frame *l*. This shaft carries a pinion $j^4$, engaging with another pinion $j^5$ of the same size, fixed upon the end of a long shaft *m*, extending radially from the shaft *j* across the face of the board to the circular edge thereof and having its bearings at one end in the box-like frame *l* and at the other end in the manner hereinafter described. This box-

like frame is mounted upon ball-bearings $l'$ in the main frame, so as to turn with very slight friction, and it will be understood that the two gears $j^4$ and $j^5$ are used so as to maintain the shaft $m$ always in a radial position with respect to shaft $j$. Power is to be applied to shaft $j$ and transmitted to shaft $m$ in the manner hereinafter described. Attached to the box-like frame $l$ and extending across the board and immediately above the shaft $m$ is a light truss-like frame $o$ for the purpose of protecting the shaft and furnishing a support for another device, to be referred to hereinafter. It also carries bearings $o'$ for the shaft $m$ for rigidity. At the outer end of the shaft $m$ it is provided with a loose roller $m'$, which rolls upon the edge of the board, and so prevents the shaft from sagging. At this point also the shaft passes through bearings $o^2$, carried by the truss $o$. Around the outer edge of the board and offset from it by brackets $p'$ is an inwardly-turned flange $p$, under which the end of the shaft $m$ projects, and at which point the shaft carries another loose roller $m^2$, bearing against the flange to prevent the shaft from lifting. Between the two rollers $m'$ and $m^2$ the shaft carries a pinion $m^3$, which engages with a circular stationary rack $q$, fixed to the face of the board at the circular edge thereof. The position of this shaft $m$ upon the scale before described being the indication desired, a pointer $s$, attached to the end of the truss $o$ by means of a U-shaped bracket $s'$, is used. Since the scale gives the degrees only and since one complete rotation of shaft $m$ moves the shaft the space of one degree to obtain the minutes, I place upon the shaft a disk $t$, divided into sixty numbered parts, and by observing these numbers and the pointer $s$ the degrees and minutes may be accurately ascertained. The bracket $s'$ is given the peculiar shape shown in order to carry the pointer around the edge of the disk. The shaft $j$ is extended below the box-like frame $i$ and stepped in a suitable bearing $j^6$. The shaft is provided with a crank $j^7$, to which are connected the cores of four solenoidal magnets $v$, $v'$, $v^2$, and $v^3$, respectively. These magnets are arranged horizontally at ninety degrees apart, and each is capable of imparting a quarter-turn to the crank $j^7$. The set of magnets constitute an electric motor, by means of which it will be understood that if the magnets are energized successively rotary motion will be imparted to the shaft $j$, and through the interposed gearing the shaft $m$ will also be rotated, and since the latter shaft engages a rack at its outer end the shaft, together with the truss $o$, will swing across the face of the board in a direction depending upon the direction of rotation of the motor. The motor-frame $k$ and the box-like frame $l$ also partake of this motion, since they are all attached together. Consequently the rotation between the worm and worm-gear does not change.

Mounted upon the truss $o$ is a standard $u$, on the upper end of which is a horizontal pivot carrying an indicator-arm U, the free end of which plays in front of an upright plate $u'$, also attached to the truss $o$ and carrying a scale with degree-marks upon it. The arm U is in the same vertical plane as the shaft $m$. In alinement with the shaft $j$ and arranged above it is an independent shaft $w$, mounted in a suitable frame attached to the box-like frame $l$ and carrying a worm $w'$, engaging with a segment of worm-gear $u^2$ on the end of the arm U. Shaft $w$ also carries a worm-gear $w^2$, with which a worm on shaft $w^3$ engages. This shaft extends into the box $r$, where there is located a motor of the same type as that described in connection with the shaft $j$, said motor being arranged to drive the shaft $w^3$.

The cable G from the transmitter extends to the motor connected with the shaft $j$, while the cable from the other commutating switch leads to the motor in box $r$, it being understood that the wires from the segments of the switch connect, respectively and in the same succession, with the solenoids of the motor. This connection is illustrated in Fig. 6, wherein E represents a source of electricity from which a wire 1 leads to the sliding contact of the commutating switch, and from the respective segments the wires 2, 3, 4, and 5 lead to the respective solenoids of the motors and from each solenoid to a common return-wire 6. The same connection exists between the commutating switch and the motor in each case.

The operation is as follows: The officer in charge of the range-finder swings the telescope to the right or left and up or down by simultaneously or successively turning the two cranks $e^2$ and $d^3$. Every movement of the cranks is followed by a similar movement of the sliding contacts $g^6$ and $d^4$. When the sliding contact is on a certain segment of the switch, the corresponding magnet of the motor is energized and pulls the crank to which it is attached ninety degrees around. From this position the sliding contact may be moved in either direction, and the corresponding magnet of the motor on one side or the other of the magnet which last operated will be energized and the crank of the motor given another quarter-turn. These motions may be fast or slow and in either direction in accordance with the hand manipulations by the operator. The motion imparted to the cranks by the two motors is through the gearing transmitted to the rotary shafts $m$ and $w$. Shaft $m$ by the engagement of its pinion $m^3$ and rack $q$ is caused to swing across the face of the board in exact correspondence with the swinging movement in a horizontal plane of the telescope, and the pointer $s$ will always indicate on the scale in front of which it plays the same position as is indicated by the pointer $f$ of the transmitting instrument. Likewise the fractions of a degree (indicated in minutes) will be shown on the face of the disk $t$,

and this will be in accord with the showing of minutes on the disk $k^8$, mounted at the end of shaft $e$ of the transmitter, which turns at the same speed as the shaft $m$ of the receiver. In similar manner the rotary motion of shaft $w$ will be communicated to the arm U, and this arm will be caused to assume an angle in a vertical plane corresponding with the angular position in the vertical plane of the telescope, which position will be indicated on the scale in front of which the free end of the arm U moves. It will thus be seen that every movement of the telescope in either direction will be at once reproduced by the receiving instrument and that the position occupied by the arm U will at all times correctly indicate the position of the telescope both as to vertical and horizontal positions, since it is carried by the horizontally-swinging arm, as well as partaking of its own independent motion. Now if we consider the receiving instrument as an indicator only the attendant may call off the readings of the two scales to the men at the gun and the pieces fired at once; but if the receiving instrument be considered as the gun itself, which is the more direct, speedy, and satisfactory condition, the firing may be done at once either by men at the gun or by any suitable electrical appliance operated by the same person who manipulates the range-finder. It may be stated in this connection that when the movements of the telescope are to be imparted direct to the gun the usual allowance in the elevation of the gun for the range or distance must be provided for by predetermined gearing, which will give to the gun a movement in a vertical direction in addition to that corresponding with the movement of the telescope.

It will be understood that any number of indicating instruments or guns may be connected in series, branch, or multiple circuits and operated simultaneously by the same range-finder. It will be further understood that any auxiliary electrical apparatus—such as relays, local circuits, &c.—that may be necessary to bring into operation power devices for moving the gun may be adopted without departing from the spirit of my invention.

I will now refer to another feature of my invention of considerable importance consisting of a device to prevent the receiving and transmitting instruments from being maliciously or accidentally thrown out of step. It will be understood that the sliding contacts $g^6$ and $d^4$ must never be allowed to shift their positions upon the commutators without a similar movement on the part of the motors. When the circuit is open and the instrument not in use, an inquisitive or malicious person might turn the crank $e^2$, which would of course displace the sliding contact $g^6$ without a corresponding movement of the motor. To prevent this, I mount upon the frame an electromagnet $k'$, whose armature $k^3$ carries a pin $k^4$, passing loosely through a hole in a part $k^5$ of the frame. Opposite this pin is a disk $k^6$ on shaft $g^5$, provided with four slots corresponding in position to the position of the segments of the commutators. When no current is flowing in the magnet $k'$, the spring $k^7$, acting upon the armature, forces the pin $k^4$ into one of the slots of the disk, and thereby prevents shaft $g^5$ from turning sufficiently to carry the sliding contact $g^6$ off of the segment upon which it was left when the machine was last in operation. When the machine is in operation, magnet $k'$ is energized, and the pin is held out of engagement with the disk. By leaving the circuit of the magnet open when the instrument is not in use it is obvious that the crank cannot be turned, it being understood that the machine is suitably covered by a case which leaves exposed the two cranks only. As another example of the moving element of the receiver I have shown in Figs. 10 and 11 an endless tape $x$, having the degree-scale marked thereon and caused to move over suitable guide-pulleys at a rate corresponding to that of the transmitter. By suitable speeding-up gear $y$ between the shaft $z$, driving the tape, and a hollow shaft carrying the minute-disk $x'$ the latter is caused to rotate in accordance with the rotation of the minute-wheel on the transmitter.

Having described my invention, I claim—

1. The combination of a pivoted telescope forming part of a range-finder, a crank-shaft and gearing rotated thereby adapted to swing said telescope in a certain plane, another crank-shaft and gearing rotated thereby adapted to swing said telescope in a plane at right angles to the first plane, commutating switches controlled respectively by said crank-shafts, a series of circuits connected with the commutating switch, two electric motors having electromagnets respectively in the circuits of each switch, and an indicating element or movable device adapted to be moved in two directions by said motors, substantially as described.

2. The combination of two movable devices distantly separated from each other, each adapted to move in two planes at right angles to each other, mechanical devices for imparting such motion to one of said elements, and electromagnetic devices under the control of said magnetic devices, for moving the other elements in both planes, substantially as described.

3. The combination of a movable device and means for moving it at will in either of two different planes, two other movable devices distantly located from the first device, and means whereby the motion of the first device in one plane will be followed by a corresponding movement of both of the other devices, while a movement of the first device in the other plane will be followed by a corresponding movement of one only of the other devices.

4. An attachment for range-finders, consisting of an indicator comprising a shaft piv-

otally mounted at one end, a motor geared to the pivoted end of the shaft and adapted to rotate it, a pinion at the opposite end of the shaft, a stationary segmental rack with which said pinion engages and a scale arranged parallel to the rack to indicate the angular position of the shaft, substantially as described.

5. An attachment for range-finders, consisting of an indicator comprising a shaft pivoted at one end, a motor arranged to rotate the shaft, a pinion on the shaft opposite its pivotal end, a segmental rack with which said pinion engages and a wheel carried by said shaft and provided with a circumferential scale.

6. An attachment for range-finders, consisting of an indicator comprising a shaft pivotally mounted at one end, a motor geared to said shaft and adapted to rotate the same, a frame in which said shaft is mounted and which is pivoted on the same center as the shaft, an indicating-arm carried by said frame and a motor geared to said arm, substantially as described.

In witness whereof I subscribe my signature in presence of two witnesses.

ROBERT J. SHEEHY.

Witnesses:

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