(No Model.) 4 Sheets—Sheet 1.

C. L. CLARKE.

TELETHERMOMETER.

No. 285,572. Patented Sept. 25, 1883.

Fig. 1.

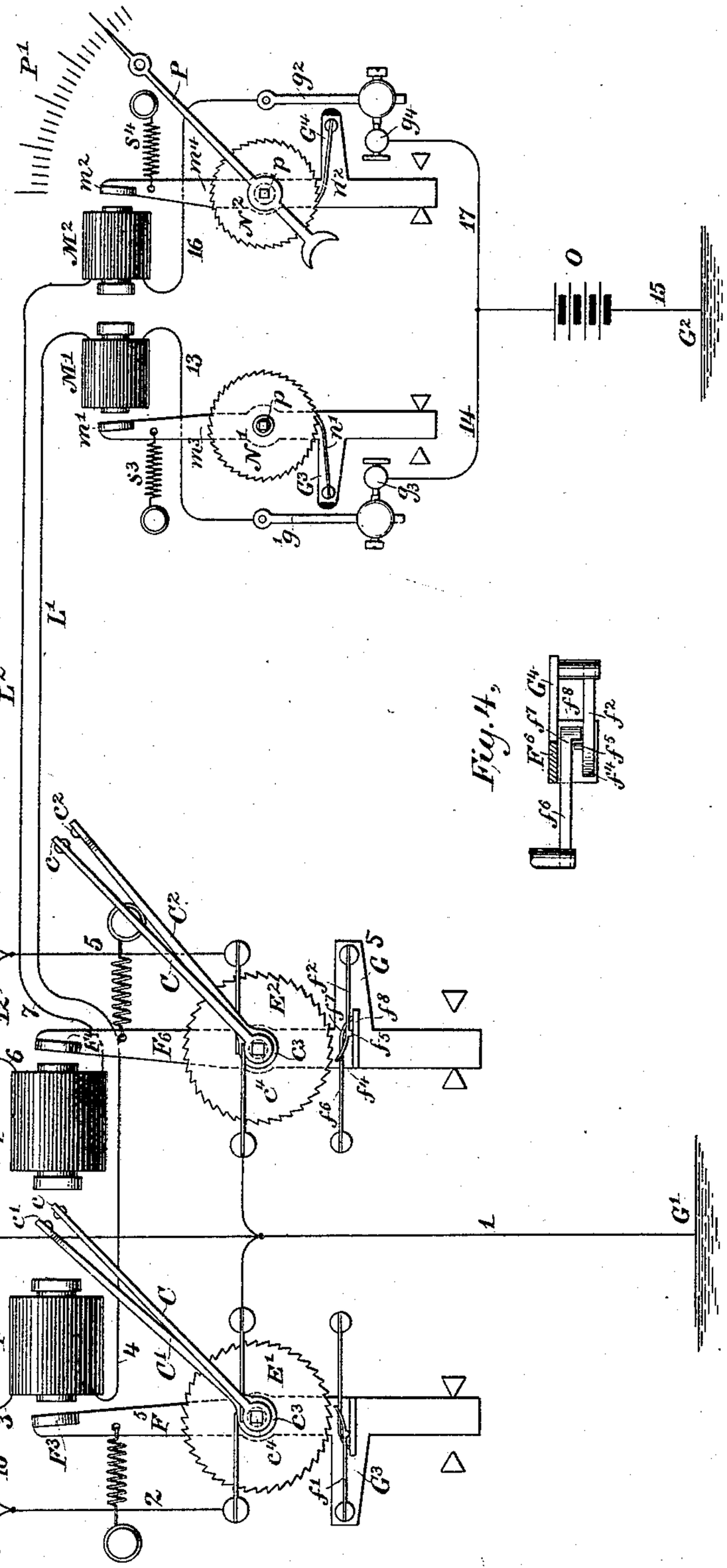

Fig. 4.

WITNESSES

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Geo W. Breck

INVENTOR

By his Attorneys Charles L. Clarke,

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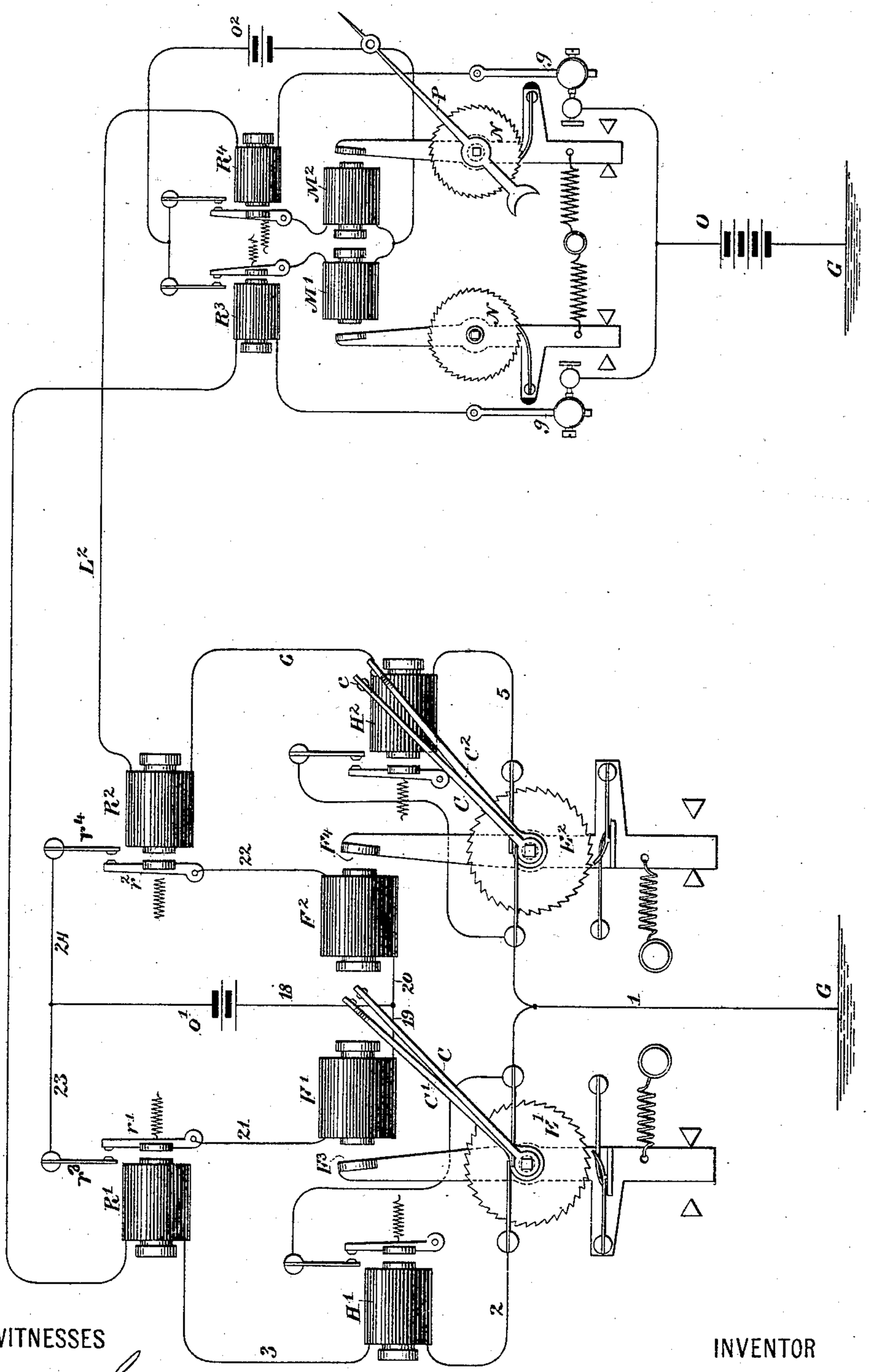

Fig. 2.

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(No Model.)

4 Sheets—Sheet 3.

C. L. CLARKE.

TELETHERMOMETER.

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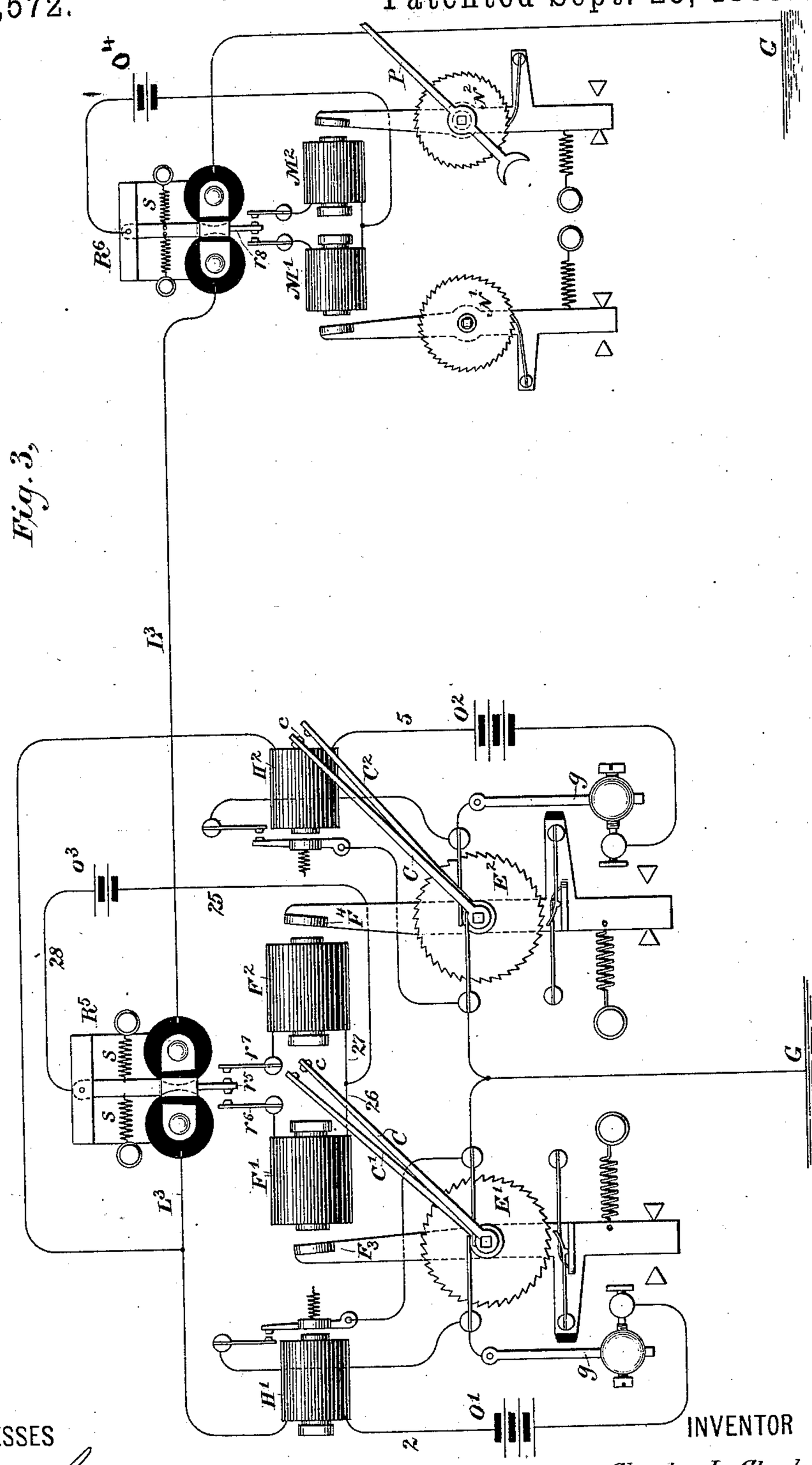
Fig. 3.



WITNESSES

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(No Model.) 4 Sheets—Sheet 4.

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TELETHERMOMETER.

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Fig. 5.

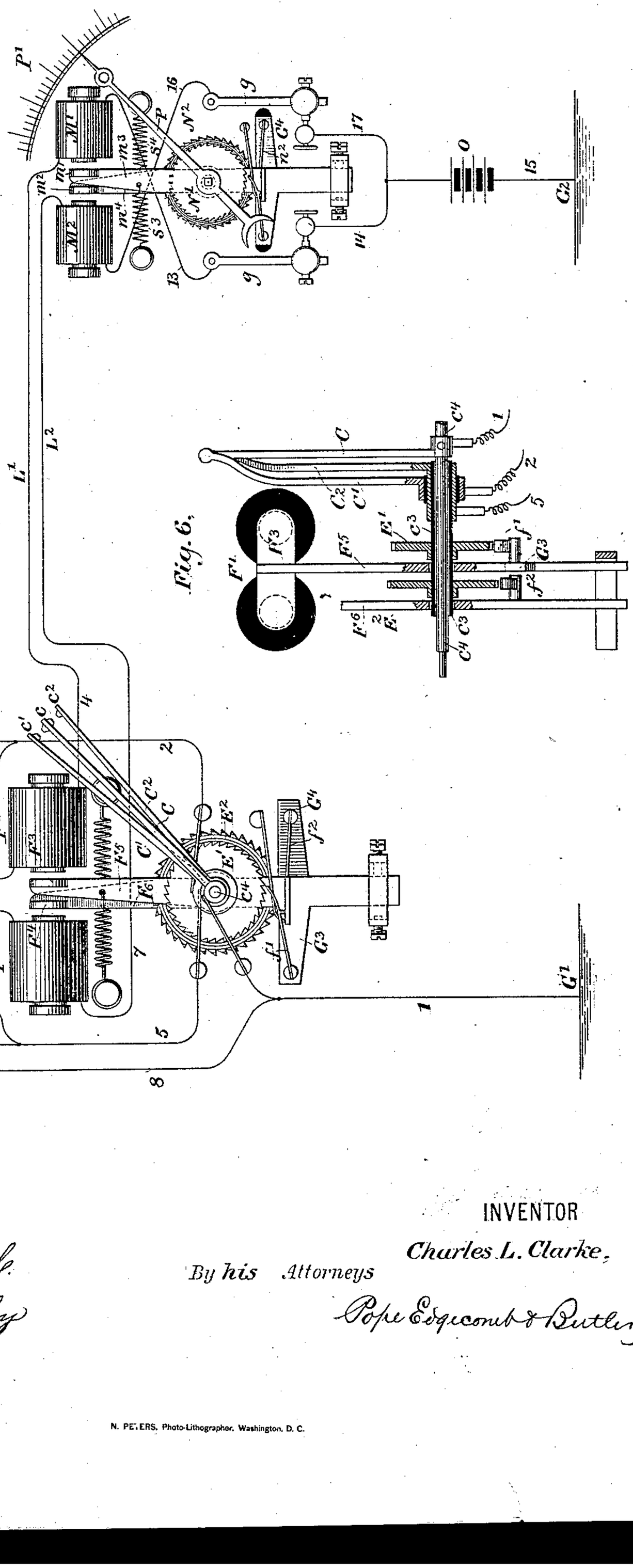

Fig. 6.

WITNESSES

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UNITED STATES PATENT OFFICE.

CHARLES L. CLARKE, OF NEW YORK, N. Y., ASSIGNOR TO ROBERT HEWITT, JR., OF SAME PLACE.

TELETHERMOMETER.

SPECIFICATION forming part of Letters Patent No. 285,572, dated September 25, 1883.

Application filed June 18, 1883. (No model.)

To all whom it may concern:

Be it known that I, CHARLES L. CLARKE, a citizen of the United States, and a resident of New York city, in the county of New York and State of New York, have invented certain new and useful Improvements in Telethermometers, of which the following is a specification.

My invention relates to certain improvements in the arrangement of circuits and in the construction of apparatus for indicating at distant points the variations in temperature, atmospheric pressure, or other similar changing force, occurring in any particular locality, through the agency of electricity.

The object of the invention is to cause such indications to be made automatically and simultaneously with the occurrence of any change of an appreciable amount, to so organize the apparatus as to most economically apply the electrical energy employed, to prevent the more delicate parts of the instrument from becoming injured by constant use, and to secure perfect reliability of action.

The invention consists, generally, in combining with any suitable instrument adapted to respond to changes in temperature, pressure, or other varying force, as the case may require, a circuit-closing device constructed to transmit to a suitable recording or indicating device electrical impulses of a character and frequency dependent upon the direction, rapidity, and amplitude of the movement of the thermostatic instrument, pressure-gage, or other equivalent device. The various parts of the apparatus are so constructed that, immediately upon the closing of a circuit by the movement of the primal circuit-closing device, an electro-magnet will be vitalized, causing a shunt-circuit to be completed around the contact-points of this device. This shunt-circuit remains closed until after a separation of the more delicate contact-points is effected, thereby insuring a more perfect circuit-connection, preventing it from being broken before it has vitalized the other magnets in circuit, and also preventing electrical discharges from occurring at the delicate contact-points, which would tend to corrode them. A second electro-magnet is included in circuit, in series with the electro-magnet thus vitalized. This electro-magnet, however, is constructed to respond more slowly to the influence of an electric current transmitted therethrough, and its armature is therefore actuated after the shunt-circuit has been closed. The movement of this armature causes a pawl to engage a ratchet-wheel upon which one of the circuit-closing points is carried. The backward movement of the armature, after the circuit through its electro-magnet has been interrupted, acts through the agency of this pawl to move the corresponding contact-point away from that through which the circuit was originally closed. The indicating or recording device is actuated correlatively with the movements of the transmitter by means of a corresponding electro-magnet arranged in series with those of the transmitter, acting upon an armature, the movements of which cause the advance of a ratchet-wheel step by step, in the same manner as the ratchet-wheel of the transmitter is advanced. A suitable indicating device moving with that ratchet-wheel is employed for showing at all times the position of the transmitting element. The interruption of the circuit is effected after the electro-magnets have all become vitalized by means of a pendent arm, which normally rests against a contact-stop by virtue of its own weight. The circuit is closed through this pendent arm and contact-point. The arm is, however, so placed relative to one of the armatures that it will be momentarily thrown away from the contact-point when that armature is actuated. Before the circuit is again closed therethrough the circuit at the primal circuit-closer will have been opened and all the electro-magnets demagnetized. The movements of the several parts in the opposite direction are effected by a system of electro-magnets precisely similar to those described, but acting to move the revolving parts in the opposite direction.

Various modifications may be made in the organization of the apparatus without substantially departing from the invention.

The invention further involves certain details of construction, which will be hereinafter fully set forth.

In the accompanying drawings, which illus-

trate the invention, Figure 1 is a diagram showing the organization of the apparatus as I usually prefer to employ it. Fig. 2 illustrates one of the more important modifications of which it is susceptible. Fig. 3 represents a modification adapted to transmit the necessary impulses upon one line-wire, and Fig. 4 is a plan view of the pawl which I employ for actuating the ratchet-wheels of the mechanism. Fig. 5 is a detached view, illustrating the actual arrangement of apparatus; and Fig. 6 is a vertical cross-section of the mechanism of the transmitter.

Referring to the drawings, C represents a circuit-closing arm which is adapted to be moved in one direction or the other under the influence of changes in temperature, pressure, &c. Mounted upon a sleeve, c^3, which surrounds the arbor c^4 of the arm C, is a ratchet-wheel, E′. An arm, C′, extends from the sleeve c^3 outward, and terminates in a contact-point, c', which is in the same plane with a contact-point, c, carried at the outer extremity of the arm C. A similar ratchet-wheel, E^2, also mounted upon the sleeve c^3, carries a corresponding arm extending upon the opposite side of the arm C. If, therefore, the arm C be moved in the one direction, the contact-point c will be placed in electrical contact with the point c' at the end of the arm C′, and if it is moved in the opposite direction it will in like manner be placed in like contact with the point c^2, carried at the end of the arm C^2. A conductor, 1, leading from the earth at G′, is connected with the arm C, and thus with the point c. The arm C′ is in like manner connected, through a conductor, 2, with one terminal of the coils of an electro-magnet, H′. The remaining terminal of this coil is connected, through a conductor, 3, the coils of an electro-magnet, F′, and conductor 4. with a conductor, L′, constituting a main line which leads to a receiving-station, or through any desired number of receiving-stations. The arm C^2 is in like manner connected, through a conductor, 5, the coils of an electro-magnet, H^2, conductor 6, and electro-magnet F^2, with a conductor, 7, leading to a main line, L^2, corresponding to the line L′. After traversing the various devices at the receiving-stations in a manner hereinafter described, the conductors are connected with one pole of a battery, O. The remaining pole of this battery is connected through a conductor, 15, with the earth at G^2.

It will be seen thus that whenever any change has occurred in the position of the arm C (which, it may have been observed, is capable of moving independently of the arm C′ and C^2) to place the point c in contact with either the point c' or c^2 the circuit of the battery O will be completed through the various electro-magnets H′ and F′ or H^2 and F^2, as the case may be.

The electro-magnets H are constructed to respond more quickly to the effects of a current traversing their coils than are the electro-magnets F. The first effect, therefore, of an electric current traversing either of the circuits indicated is to vitalize the corresponding electro-magnet, H′ or H^2, and cause its armature h' or h^2 to be drawn forward. Two contact-points, h^3 and h^4, are respectively carried at the extremities of these armatures, and when either is in its forward position the corresponding point impinges against one or the other of two circuit-closing springs, h^5 or h^6. The spring h^5 is connected through conductors 9 and 8 with the conductor 1, leading to the arm C′, and the spring h^6 is in like manner connected through the conductors 11 and 8 with the same conductor, 1. The armatures h' and h^2 are respectively connected with the conductors 2 and 4, leading to the electro-magnets H′ and H^2. It will be seen thus that immediately after either electro-magnet H′ or H^2 has become vitalized a circuit will be closed through its coils (independently of the contact-points c) at the points h. This shunt-circuit will, as hereinafter appears, remain closed after the contact-points c have become separated, thereby preventing the occurrence of disruptive discharges at those points.

The electro-magnets F, which are preferably constructed to respond to stronger currents only than are required to vitalize the electro-magnets H, are respectively provided with armatures F^3 and F^4 and armature-levers F^5 and F^6. These levers are pivoted upon suitable arbors, preferably in the same axial line or concentric with the wheels E. Each lever carries a pawl, f' or f^2, which, when the corresponding electro-magnet is vitalized, moves backward over the periphery of the corresponding wheel, E, and places it in a position to engage a tooth of the same. When the electro-magnet has become demagnetized by the interruption of the circuit through the main line L′ or L^2, the backward movement of the armature will cause the wheel E′ or E^2 to advance through the distance represented by one tooth, carrying with it the remaining wheel E^2 or E′ and both the arms C′ and C^2. The contact-points c will thus be separated, and will remain so until a subsequent movement of the arm C shall again place them in contact. The gradual diminution in the strength of the currents traversing the electro-magnets at the moment of or immediately after the interruption of the circuit at another point will permit the backward movement of the armature F^3 or F^4 before the armature h' or h^2 is released from its electro-magnet, owing to the less inductive effect produced upon the cores of the former than upon the cores of the latter by a current of given strength. In this manner a shunt-circuit around the delicate contacts c will always be closed at the moment of interruption of the contacts at those points. The impulses which are thus transmitted through the conductors L′ or L^2 are employed at the receiving-station to actuate an indicating device in the following manner:

Two ratchet-wheels, N′ and N^2, similar to the wheels E′ and E^2, and having their teeth pitched

in opposite directions, are carried upon a common arbor, *p*. An index-finger, P, or other suitable device, moves over the surface of a dial or graduated scale, P′, in correspondence with the movements of the wheels N. The wheels N are moved in one direction or the other correlatively with the movements of the wheels E by means of two pawls, n' and n^2, carried upon the armature-levers m^3 and m^4, respectively, of two electro-magnets, M′ and M^2. The electro-magnets M are respectively included in the circuits of the main lines L′ L^2. When an impulse of sufficient strength is transmitted upon either of these lines, the corresponding electro-magnet M′ or M^2 will be vitalized and its armature-lever actuated. The corresponding pawl, n' or n^2, will thereby be caused to engage a tooth upon the wheel N′ or N^2, and when the armature is released by the interruption of the circuit and consequent demagnetization of the electro-magnet the wheel will be revolved in the same manner as described with reference to the wheels E. The index P will thus be advanced in one direction or the other, according to the direction of motion of the arm C.

The method of interrupting the circuit at the proper moment is as follows: A pendent arm, g', normally rests, by virtue of its own weight, against a stop, g^3. This arm is electrically connected through a conductor, 13, with the coils of the electro-magnet M′. The contact-stop g^3 is connected through a conductor, 14, with the battery O. A corresponding pendent arm, g^2, and stop g^4 are provided for the electro-magnet M^2, and is in like manner connected through conductors 16 and 17 and the coils of that magnet with the battery O. Upon each of the armature-levers is carried an extension, as shown at G^3 and G^4, respectively. When either armature-lever is drawn into its forward position, this extension will strike against the corresponding pendent arm and throw it away from its contact-spring. Before it shall have had time to again fall into contact with its contact-spring the armature-lever will have fallen away from the poles of its magnet, as also the armatures of the electro-magnets at the transmitting-station. The circuit will thus be in its normal condition—that is to say, open—being interrupted at the points *c*. The pendent arms may, it is evident, be applied to various other electro-magnets in the system, it being essential only that the circuits of the respective main lines should extend through them.

In Figs. 1 and 4 I have represented a pawl of peculiar construction which I prefer to employ for actuating the ratchet-wheel, although pawls of any well-known construction may be used. The construction of these pawls will be described in connection with that shown as applied to the armature-lever F^6. It consists of a flexible arm, f^2, mounted upon the arm or extension G^5 of the armature-lever F^6, and moving therewith. The resilience of this arm normally maintains its extremity f^4 away from the teeth of the corresponding ratchet-wheel. A pin, f^5, projects laterally from the arm f^2 beneath a flexible arm, f^6. The arm f^6 is supported independently of the armature-lever, and its extremity normally rests upon a bed-plate, f^8. When, however, the armature-lever is swung in the direction indicated by the arrow, the pin f^5 passes beneath the extremity of the arm f^6. The return movement of the armature-lever will cause the pin f^5 to slide upward over the curved extremity of the arm f^6, thereby causing the extremity f^4 to engage a tooth of the wheel E and advance the same the required distance. An indentation, f^7, is formed in the arm f^6 at the proper position to permit the pin f^6 to fall downward when the wheel E has been advanced the required distance, thereby releasing the wheel from the pawl. Any suitable form of friction-brush may be employed for preventing the wheels from moving at other times than when positively actuated.

In Fig. 2 I have illustrated an organization of circuits which is especially adapted to working over long distances. The general plan of this organization is to employ local batteries and circuits for vitalizing the electro-magnets F′ and F^2 and M′ and M^2. For this purpose a local battery, o', is provided at the transmitting-station and a similar battery, o^2, at the receiving-station. One pole of the battery o' is connected by a conductor, 18, with two conductors, 19 and 20, respectively leading to the coils of the electro-magnets F′ and F^2. The remaining terminals of these coils are respectively connected through conductors 21 and 22 with the armature-levers r' and r^2 of two relay-magnets, R′ and R^2. The magnets R′ and R^2 are respectively included in the conductors 3 and 6, leading from the shunting-magnets H′ and H^2, respectively, to the main lines L′ and L^2. The armature-levers r' and r^2 are respectively provided with contact-springs r^3 and r^4, against which they impinge when in their forward position. These contact-springs are respectively connected through conductors 23 and 24 with the remaining pole of the battery o'. It will be evident thus that when either electro-magnet R′ or R^2 is vitalized the circuit of the battery o' will be completed through one or the other of the two electro-magnets F′ or F^2. The electro-magnet thus vitalized will act through its armature-lever to move the wheels E, in the manner described with reference to Fig. 1. The electro-magnets H′ and H^2 act in the same manner as described with reference to Fig. 1 to short-circuit the circuit-closing points *c*, and they should be constructed to respond more quickly to the electric currents transmitted therethrough than the remaining magnets.

At the receiving-station the main lines, instead of traversing the electro-magnets M′ and M^2, are connected through two relay-magnets, R^3 and R^4. In other respects these connections are the same as described with reference to Fig. 1. The electro-magnets M′ and M^2 are,

however, included in branch circuits of the local battery o^2, the connections of which are completed in precisely the same manner as described with reference to the battery o'. It will be understood that as the only work required to be done by the electro-magnets R is to actuate their respective armatures, and thereby close the corresponding local circuit, a considerable saving in the expenditure of the current from the battery O is secured.

Any required number of receivers may be included in series in this system, as also in that described with reference to Fig. 1. There should, however, preferably be but one pair of circuit-interrupters, *g*, included in the system, and in general the electro-magnets to which these interrupters are applied should be less sensitive to electric currents than the other magnets of the system.

In Fig. 3 I have represented an organization of apparatus adapted to transmit the necessary impulses for actuating the indicating devices over a single main-line conductor. This modification consists in replacing the battery O by two batteries, O′ and O², respectively included in the conductors 2 and 5, leading from the arms C′ and C². These conductors, after traversing the coils of the shunting-magnets H′ and H², respectively, unite with a common main line, L³. The batteries O′ and O² are so arranged that when the circuit of the one is completed a current will be transmitted to line of the opposite polarity from that which will be transmitted when the circuit of the other is completed. A polarized relay, R⁵, of well-known construction, is included in the main line L³ at the transmitting-station. This relay is provided with an armature-lever, r^5, extending between two contact-springs, r^6 and r^7. One pole of a local battery, o^3, is connected, by means of a conductor, 25, and branch conductors 26 and 27, through the coils of the two electro-magnets F′ and F², respectively, and thus with the two contact-springs r^6 and r^7, respectively. The armature-lever r^5 is connected by means of a conductor, 28, with the remaining pole of the battery o^3. When, therefore, the armature-lever r^5 is against either one of the contact-springs r^6 or r^7, a current will be transmitted from the local battery through the corresponding electro-magnet, F′ or F², and the ratchet-wheels E will be actuated in the manner described with reference to Fig. 2. The parts are so arranged that when the circuit of the battery O′ is completed the armature-lever r^5 will be impelled in the direction of the spring r^6, thereby closing the circuit of the local battery o^3 through the electro-magnet F′. When, however, the circuit of the battery O² is completed, the circuit of the local battery o^3 will be completed through the electro-magnet F² by the movement of the lever r^5 in the opposite direction.

At the receiving-station a second polarized relay, R⁶, is included in the main line. The armature-lever r^8 of this relay acts in the same manner as described with reference to the relay R⁵ to complete the circuit of the battery o^4 through one or the other of the two electro-magnets M′ or M². The parts are so arranged that the index P will be impelled in the direction corresponding with the movement of the arm C. Suitable retractile springs, *s*, are applied to the armature-levers r^5 and r^8, for the purpose of maintaining them out of contact with their respective contact-springs when no current is traversing the line L³.

The circuit-interrupters *g* are preferably applied to the armature-levers of the electro-magnets F′ and F² of the transmitting-instrument in this organization, one being included in the conductor 2 and the other in the conductor 5.

The shunting-magnets H′ and H² should be constructed to respond more quickly than the polarized relays; and the electro-magnets M′ and M² of the receiving-instruments should respond more quickly than the electro-magnets F′ and F², thereby insuring the movement of the index P before the circuit has been interrupted by either of the devices *g*.

I hereby disclaim, so far as this specification and these Letters Patent are concerned, all inventions which are shown, described, and claimed or to be claimed in an application relating to the same subject-matter filed by me January 19, 1882, Serial No. 82,379, and which are not specifically claimed herein.

I claim as my invention—

1. The combination, substantially as herein-before set forth, of an automatically-actuated circuit-closing arm, two contact-arms, one upon each side of the same, a battery having one pole connected with said circuit-closing arm and its remaining pole connected through independent conductors with said contact-arms, respectively, an electro-magnet included in each of said conductors, acting when vitalized to complete the circuit of said battery independently of said circuit-closing arm, two additional electro-magnets, likewise respectively included in said conductors, and acting when successively magnetized and demagnetized to effect the movement of said contact-arms in the direction of the movement of said circuit-closing arm.

2. The combination, substantially as herein-before set forth, with one or more indicating arms or fingers, of an automatically-actuated circuit-closing arm, a contact-arm extending in proximity thereto, a battery having its opposite poles respectively connected with said circuit-closing and contact arms, three or more electro-magnets included in series in the circuit of said battery, one of said electro-magnets acting when it is vitalized to complete the circuit of the battery independently of said circuit-closing and said contact arms, a second of which electro-magnets acts to effect the movement of said contact-arm away from said circuit-closing arm, while the remaining one or more electro-magnets effect the movement of said indicating arms or fingers correlatively with the movement of said contact-arm.

3. The combination, substantially as herein-before set forth, of a battery, an automatically-actuated circuit-closing arm electrically connected with one pole of said battery, two contact-arms near said circuit-closing arm, which contact-arms are electrically connected with branch conductors leading to the remaining pole of said battery, two electro-magnets respectively included in said branch conductors, an armature and armature-lever applied to each of said electro-magnets, each acting to move both of said contact-arms in the direction of motion of said circuit-closing arm whenever the movement of the latter has completed the circuit of said battery through the corresponding electro-magnet, two additional electro-magnets respectively included in said branch conductors, an armature and armature-lever applied to each of the last-named electro-magnets, an index arm or finger actuated by the movements of the last-named levers correlatively with the movements of said contact-arms, and two circuit-interrupters applied to one pair or the other of said electro-magnets, and respectively included in said branch circuits, each of which circuit-interrupters is caused by the movements of the corresponding armature-lever to momentarily interrupt the connections of the branch circuits in which it is included.

4. The combination, substantially as herein-before set forth, of a revolving circuit-closing arm, one or more revolving contact-arms near said circuit-closing arm, a battery having one of its poles connected with said circuit-closing arm and its other pole connected with the said contact arm or arms, and an electro-magnet acting, when vitalized, to complete a shunt-circuit around said circuit-closing and contact arms, and to interrupt said shunt-circuit when demagnetized.

5. The combination, substantially as herein-before set forth, of a battery, an automatically-actuated circuit-closer, a series of electro-magnets included in the circuit of said battery, one of which electro-magnets is so constructed that its armature and armature-lever respond last in said series, and a circuit-interrupter included in said circuit, which is caused by the movements of said last actuated armature-lever to interrupt the circuit of said battery after it has been completed by the action of said circuit-closer.

6. The combination, substantially as herein-before set forth, of a toothed wheel, a battery, an electro-magnet, its armature and armature-lever, a resilient arm carried upon said lever, a pin projecting laterally from said arm, a stationary arm normally projecting above said pin, and a lateral opening formed in said stationary arm, whereby at each vibration of said armature said resilient arm is first caused to engage and advance said wheel and to be subsequently released therefrom.

In testimony whereof I have hereunto subscribed my name this 15th day of June, A. D. 1883.

CHARLES L. CLARKE.

Witnesses:
DANIEL W. EDGECOMB,
MILLER C. EARL.