No. 693,262. Patented Feb. 11, 1902.

G. W. GILLESPIE.

SELF ADJUSTING ELECTROMAGNETIC CIRCUIT CLOSING MECHANISM.

(Application filed Apr. 27, 1901.)

(No Model.) 3 Sheets—Sheet 1.

Fig. 1.

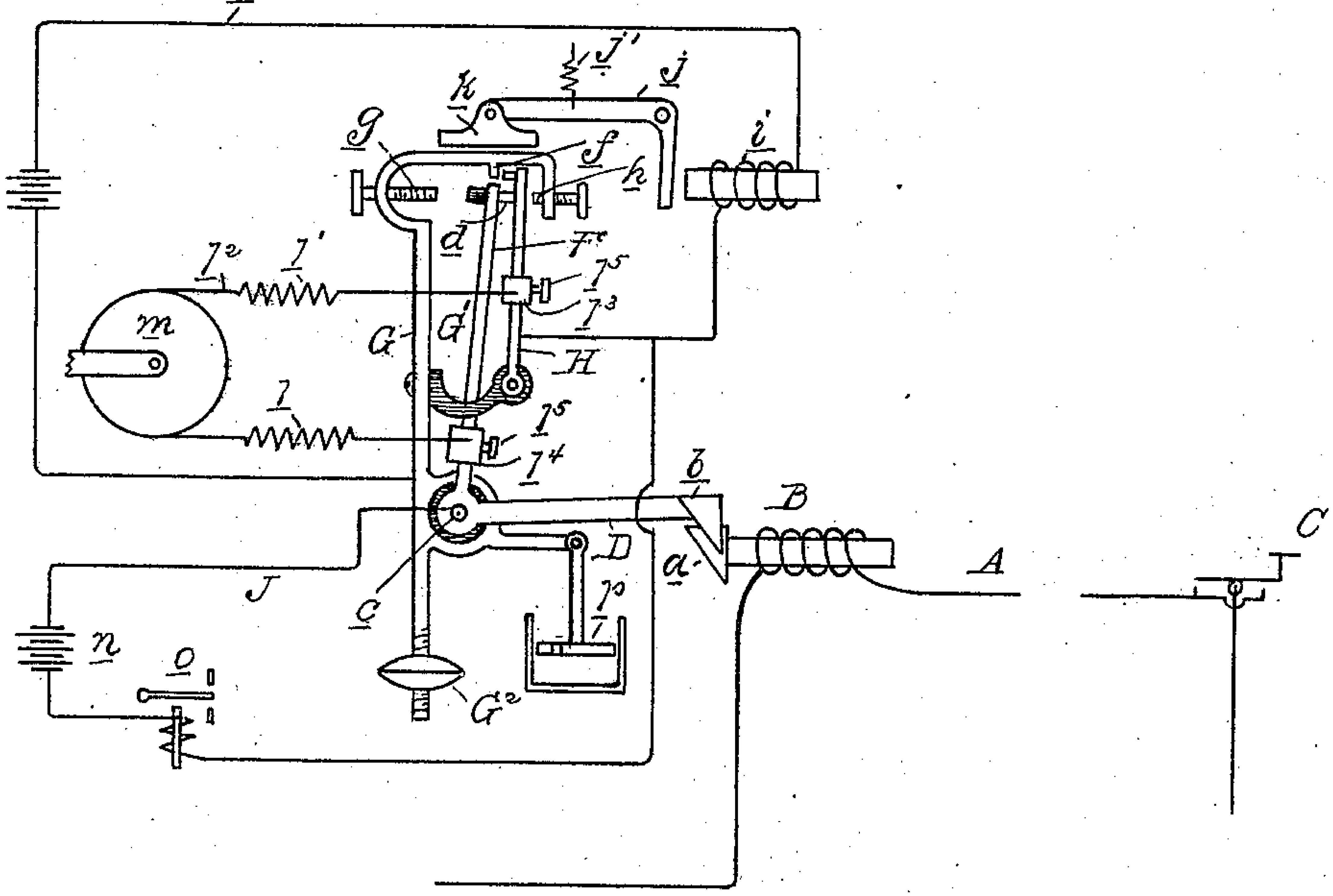
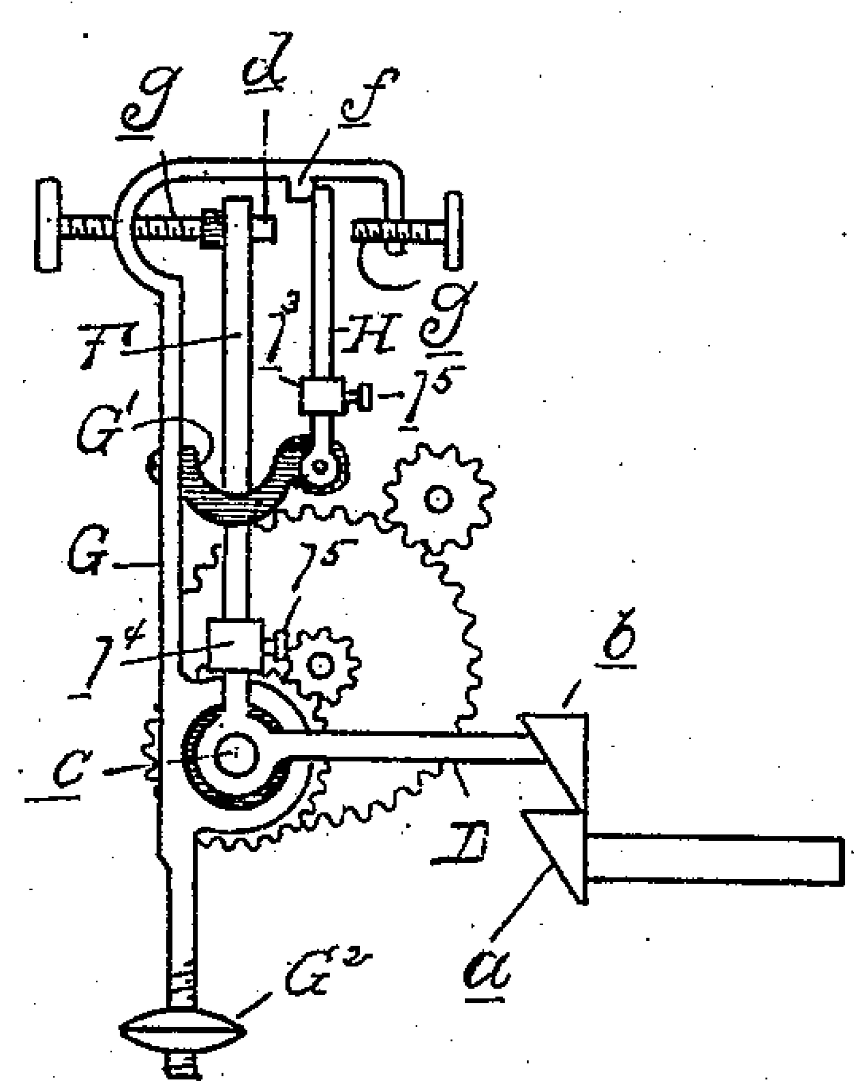


Fig. 2.



Witnesses
H. C. Smith.
M. B. O'Dogherty.

Inventor
George W. Gillespie
By Thos. S. Sprague & Son,
Attys.

No. 693,262. Patented Feb. 11, 1902.

G. W. GILLESPIE.

SELF ADJUSTING ELECTROMAGNETIC CIRCUIT CLOSING MECHANISM.

(Application filed Apr. 27, 1901.)

(No Model.) 3 Sheets—Sheet 2.

Fig. 3.

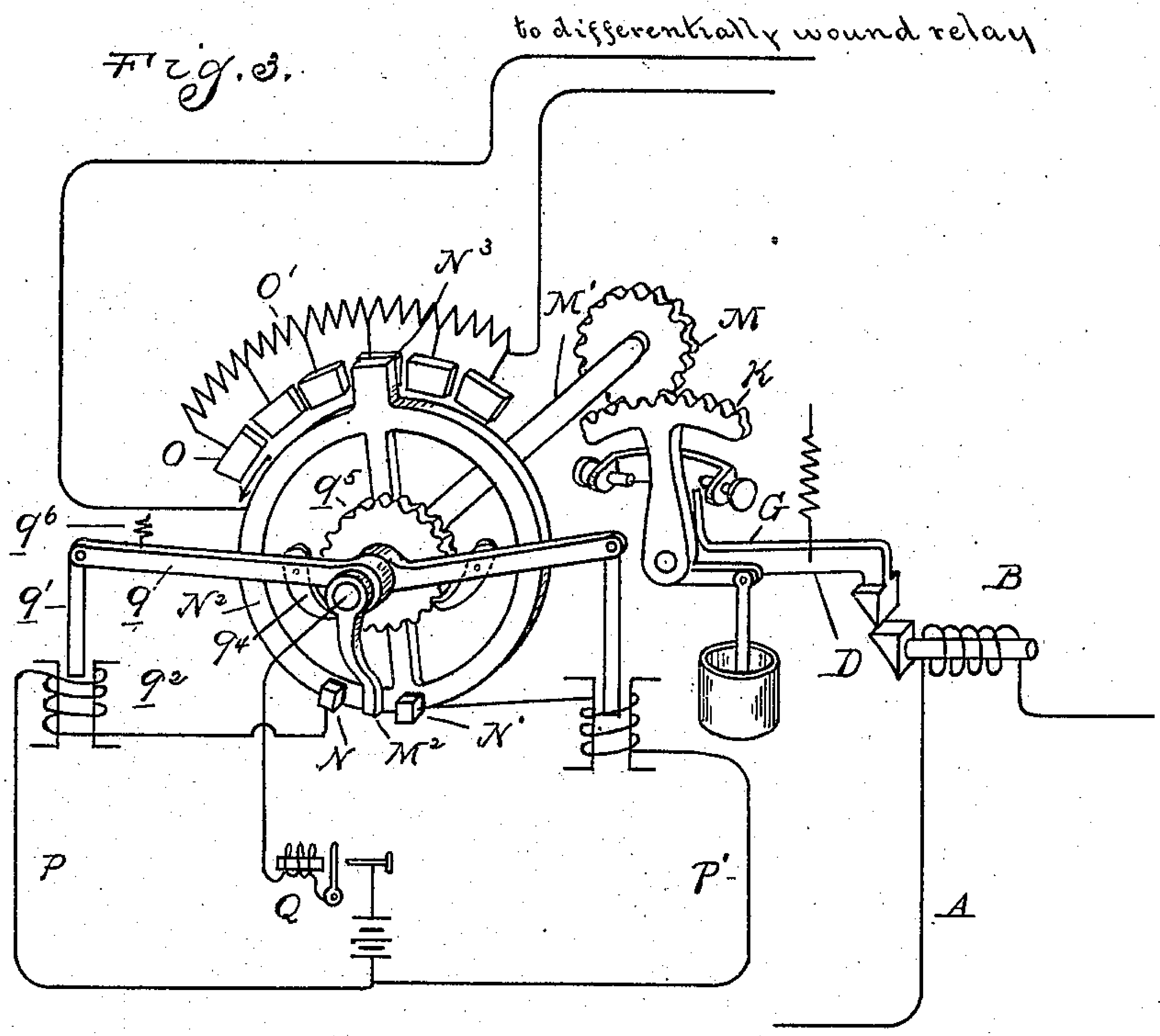
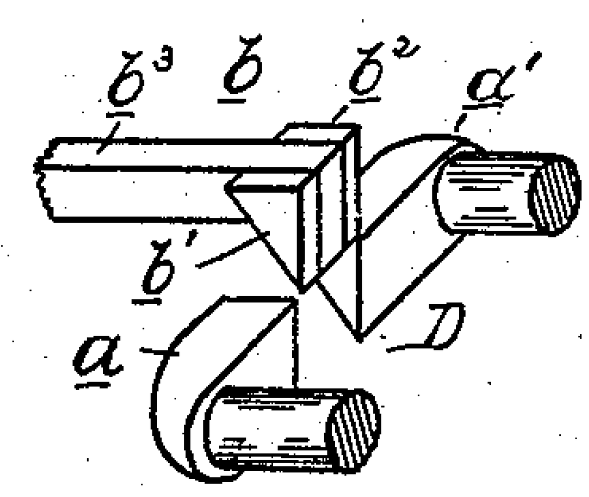


Fig. 7.



Witnesses
H. C. Smith.
M. B. O'Dogherty

Inventor
George W. Gillespie
By Thos. S. Sprague & Son
Attys.

No. 693,262.

Patented Feb. 11, 1902.

G. W. GILLESPIE.

SELF ADJUSTING ELECTROMAGNETIC CIRCUIT CLOSING MECHANISM.

(Application filed Apr. 27, 1901.)

(No Model.)

3 Sheets—Sheet 3.

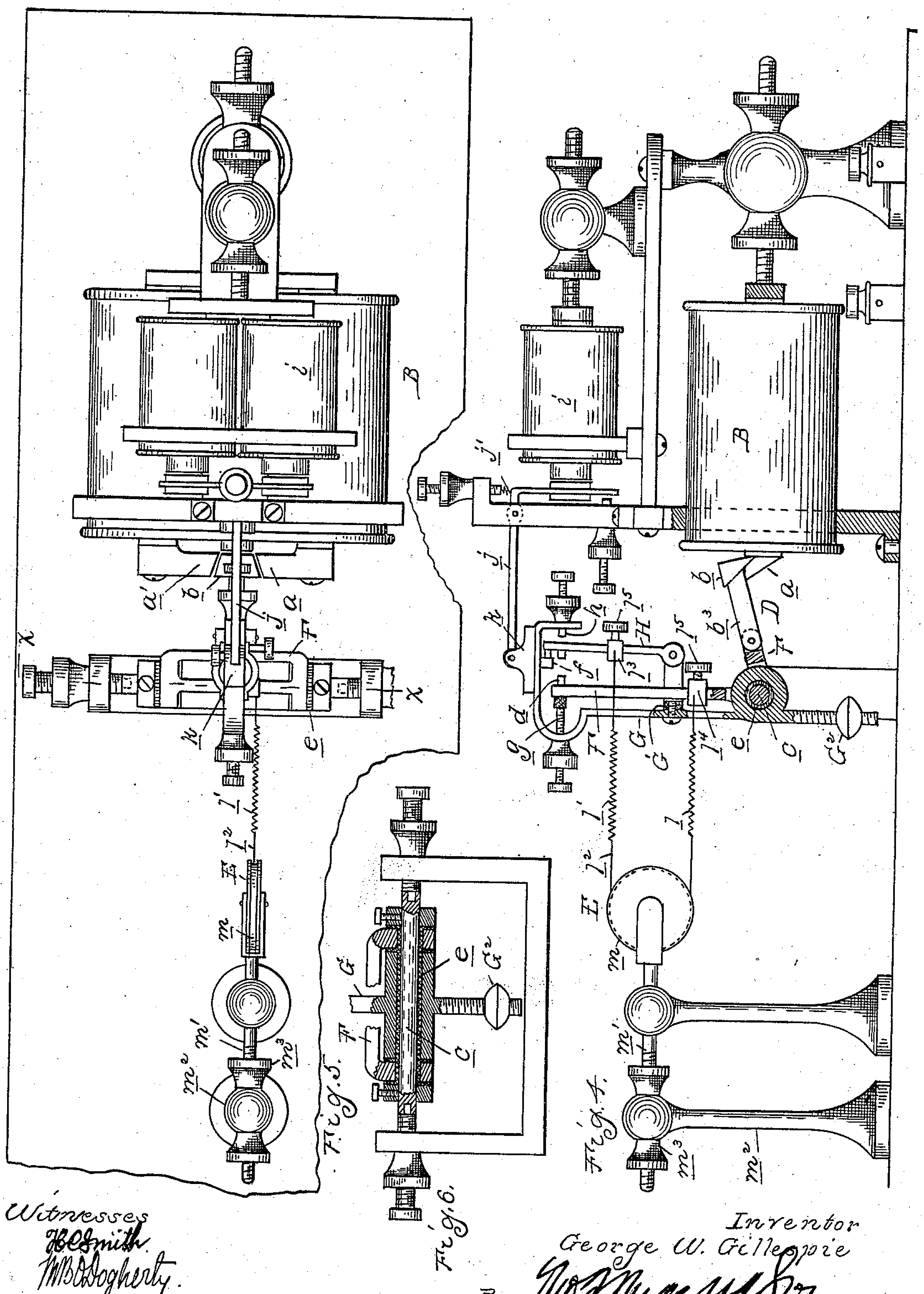


Fig. 4. Fig. 5. Fig. 6.

Witnesses
H.C. Smith
W.B. Dogherty.

Inventor
George W. Gillespie
By Thos. S. Sprague & Son
Attys.

UNITED STATES PATENT OFFICE.

GEORGE W. GILLESPIE, OF LONDON, CANADA.

SELF-ADJUSTING ELECTROMAGNETIC CIRCUIT-CLOSING MECHANISM.

SPECIFICATION forming part of Letters Patent No. 693,262, dated February 11, 1902.

Application filed April 27, 1901. Serial No. 57,743. (No model.)

To all whom it may concern:

Be it known that I, GEORGE W. GILLESPIE, a citizen of the United States, residing at London, in the county of Middlesex and Province of Ontario, Canada, have invented certain new and useful Improvements in Self-Adjusting Electromagnetic Circuit-Closing Mechanism, of which the following is a specification, reference being had therein to the accompanying drawings.

The invention relates to self-regulating magnetic circuit-closers, and is more particularly designed for use as a self-adjusting relay for electric telegraph. In its broader scope the invention is, however, applicable to other uses, such as the regulation of electric currents, &c.

It is the object of the invention to obtain a construction in which the circuit-closer will be uniform and certain in its action under variations in the strength of the actuating electric current.

To this end the invention consists, first, in the peculiar construction of an electromagnetic motor for operating the circuit-closer; further, in the peculiar construction and arrangement of the coöperating contacts relative to the motor and counter-tension device whereby an abnormal movement of said motor will effect a change in the position of said contacts, so that the same differential force will be exerted thereon.

The invention further consists in the peculiar construction, arrangement, and combination of parts, as hereinafter described and claimed.

In the drawings, Figure 1 is a diagram of my device as used as a telegraph-relay. Fig. 2 is a similar view illustrating a modification. Fig. 3 shows still another modification adapted for use in connection with duplex and quadruplex systems. Fig. 4 is a side elevation of the instrument shown in diagram in Fig. 1. Fig. 5 is a plan view thereof. Fig. 6 is a cross-section on line $x\ x$, Fig. 5. Fig. 7 is a perspective view of the adjacent armature and magnet poles of the actuating-motor.

I shall first describe that embodiment of my invention in which it is employed as a self-regulating relay for electric telegraph.

As shown in Fig. 1, A designates the main line, B is the relay-magnet included in circuit with said line, and C is the operator's key at a distant station. The magnet B is provided with an armature D, adapted to have a variable movement in relation thereto, according to the strength of the magnetic pull, and E is a counter-tension device for said armature. In order to increase the amplitude of movement of the armature corresponding to the variation in magnetic pull, I preferably employ the construction shown, in which a and a' are the pole-pieces of the magnet, having oppositely-arranged triangular faces. b is an armature-pole which is of similar triangular shape. The pole-piece b may be formed of a solid piece of magnetic metal, such as soft iron, but preferably comprising the magnetic facing-plates b' and b^2, secured to the non-magnetic filling or intervening plug b^3. The armature B is arranged so that the apex of the triangular pole-piece b is in the retracted position of the magnet adjacent to the base of the triangular pole-pieces $a\ a'$. When the magnet is energized, the armature pole-piece b moves toward the pole-pieces $a\ a'$, the limit of its movement being that point where it is in complete registration with said pole-piece.

The armature as above described is preferably carried by a bell-crank lever F, which is pivotally secured at c to a suitable framework or supporting-post. The opposite arm of the bell-crank lever carries a movable contact d for closing the local or sounder circuit.

G is an arm preferably fulcrumed upon the same pivot c which supports the lever F, but electrically insulated therefrom, as by means of the sleeve e. This arm extends upward adjacent to the bell-crank and carries at its upper end an electric contact f and the oppositely-arranged insulator-stops g and h, the former bearing against the bell-crank lever F in the retracted position thereof.

H is a short arm pivotally secured to and carried by the arm G, but electrically insulated therefrom, preferably by securing it to an insulating-bracket G'. The free end of the arm H extends into proximity to the contact f and in the retracted position of the armature contacts therewith. In this position it is out of contact with the contact d; but in the movement of the armature by the attraction of the magnet the bell-crank lever F will be swung upon its pivot, so as to press the contact d against the arm H, and in the further movement separate said arm from the contact f and press it against the insulator-stop h. The still further movement of the bell-crank lever will cause the rocking of the arm G on its pivot without change of relation to said bell-crank.

The arm G is held normally in an upright position by any suitable means, such as the pendent weight G^2, which forms a counterbalance, and if swung from said upright position by the striking of the arm H against the stop h will be returned again by said weight when released by a counter-tension device, such as E. This return movement is, however, retarded or temporarily arrested by suitable mechanism, which, as shown in Fig. 1, consists of an electromagnet-brake comprising a magnet i, arranged above the magnet B, and a bell-crank armature j, carrying at its free end a brake-shoe k, adapted to bear against a horizontal portion of the arm G. The magnet i is included in a local electric circuit I, which also includes the arms G and H and the contact f, the connections being such that whenever the arm H bears against the contact f the circuit will be closed and when said arm is separated from said contact the circuit will be broken. The closing of the electric circuit I will cause the magnet i to attract its armature, and thereby press the brake-shoe k against the arm G, holding said arm in whatever position it may have assumed.

The counter-tension device E is, preferably, of the form shown, comprising coil-springs l and l', attached to a flexible band l^2, which passes around a pulley m. These springs are connected at their opposite ends respectively to the bell-crank F and pivotal arm H. The pulley m is preferably made adjustable in position by being secured to a screw-threaded shank m', passing through a post m^2 and provided with adjusting-nuts m^3.

J is the sounder-circuit, which includes the electric generator n, the sounder o, and a circuit-breaker, the latter comprising the arm H, the bell-crank lever F, and the contact d thereon. This circuit is closed whenever the contact d is pressed against the arm H and is opened by the separation of said contact from said arm.

With the construction and arrangement of parts as thus far described the operation is as follows: The normal strength of the current in the line A is such that when the circuit is closed by the key C the armature D will move the bell-crank F so as to press the contact d against the arm H and separate the latter from the contact f. The armature will not, however, be drawn to the limit of its movement, as the counter-tension device E is so adjusted as to balance the attractive force of the magnet B before such complete movement is accomplished. In the initial position of parts the brake-shoe k is pressed against the arm G, so as to hold said arm from movement; but as soon as the arm H is separated from the contact f by the movement of the bell-crank F the electric circuit I will be broken, thereby releasing the armature j and permitting the spring j' to draw the brake-shoe out of contact with the arm G. The latter is thus free to swing upon its pivot, and as the spring l', acting through the medium of the arm H and bracket G', exerts a backward pull upon said arm G it will tend to move in the opposite direction from the movement of the bell-crank lever F. The movement of the lever F is, however, normally more than sufficient to separate the arm H from the contact f, and in this overmovement it will strike against the stop h on the arm G, thereby moving said arm forward. When the circuit in the line A is again opened by the key C, the magnet B will be deënergized, permitting the counter-tension device E to return the bell-crank lever F and arm H, the latter closing the circuit I and again applying the brake k. In the return movement of the lever F the counter tension device E will also exert its tension upon the arm G; but the return movement of this arm is temporarily arrested until the brake k can be set. As shown in Fig. 1, the means employed for retarding the backward movement of the arm G comprises a dash-pot p, which is so arranged that the forward movement of the arm will be free.

From the above description it will be understood that whenever there is an abnormal movement of the armature the arm G will be shifted forward in position and locked in this position of adjustment by the setting of the brake k. On the other hand, if the movement of the armature is less than normal as soon as the circuit I is opened the arm G will be slowly moved backward by the tension of the spring l'. The result is that the positions of the contact f and the stops g and h are changed in relation to the fixed parts of the mechanism, but remain in the same relation to each other and to the bell-crank F and arm H. When there has been an overmovement in the armature, this change in the position of parts will place a greater tension upon the springs l and l'. Thus when the magnet B is again energized its attractive force is resisted by a greater tension than in the previous operation. It will be understood that an increase of current in the line A passing through the magnet B will cause a greater amplitude of movement of the armature D and bell-crank lever F and that this overmovement will cause the arm G to be adjusted into a new position. In this new position a greater counter tension is exerted upon the armature, so that in succeeding operations substantially the same differential force will actuate the bell-crank lever F in moving it against the arm H and closing the sounder-circuit J. Should there be a further increase in the strength of current, the operation will be repeated and the arm G adjusted in still another position, where an even greater tension is exerted by the spring l. If, on the other hand, the current should diminish in strength, the result will be that the throw of the armature will not be sufficient to carry the arm H against the stop h, but will merely separate from the contact f, thus breaking the circuit I. This will release the brake k, and while the main circuit is still closed the arm G will move backward, being actuated by the spring l' and the dash-pot p, permitting a slow movement. Thus when the brake is again applied it will hold the arm G in a new position, where a lesser tension is exerted upon the bell-crank lever F and arm H. It is to be noted that the adjustment of the arm G in either direction does not break the contact between the contact d on the lever F and the arm H, so that the local electric circuit remains closed while the adjustment is being effected. In order to properly adjust the relative tension to be exerted upon the arm H and lever F by the counter-tension device E, the terminal ends of the latter are adjustably secured to said arm and lever. This connection, as shown in Fig. 4, comprises the collars l^3 and l^4, respectively sleeved upon the arm H and lever F and secured thereto by set-screws l^5. For certain uses it may be found desirable to dispense with the brake and to simply provide the armature with a retarding device, such as the dash-pot p (shown in Fig. 1) or the train of gearing, such as shown in Fig. 2. With such an arrangement the movement of the arm G being much slower than that of the armature it will be held from returning to its normal position until the main circuit is closed and a new adjustment is made.

My improvements are also adapted for use in connection with the duplex or multiplex telegraph systems, for which use I preferably employ the construction shown in Fig. 3. With this construction the arm G is connected with a segmental rack K, which meshes with a pinion M. The latter is secured to an arbor M′, which also carries the contact-arm M^2. N and N′ are two contacts arranged upon opposite sides of the contact-arm M^2 and secured to a rotary member, such as N^2, having the same axis of rotation as the arbor M′. The contact N is included in an electric circuit adapted when closed by the arm M^2 to throw into operation mechanism for rotating the member N^2 in the direction indicated by the arrow. The member N^2 is also provided with a contact-hand N^3, extending into proximity to a segmental series of contacts O, connected with a variable resistance or rheostat O′. The arrangement is such that the movement of the contact N^3 in the direction of the arrow will cause the throwing in of additional resistance. The motor and mechanism for rotating the member N^2 may be of any suitable construction, but as shown in Fig. 3 comprises a rock-arm q, pivoted upon the arbor M′ and at its free end connected to a movable core q' of the solenoid q^2. q^4 is a pawl pivoted to the arm q and adapted to engage with a ratchet-wheel q^5, connected to the rotary member N^2. The solenoid q^2 is included in a local electric circuit P, which also includes the contact N and movable contact-arm M^2. Q is an automatic circuit-breaker or pulsator also included in the circuit P, the arrangement being such that when the contact-arm M^2 bears against the contact N the circuit P will be closed, which will throw into action the pulsator Q, causing the circuit to be successively closed and broken. This will cause a reciprocating movement of the rock-arm q, which is first drawn downward by the magnetic pull on the core q^2 and is then returned by the spring q^6. The reciprocating movement of the arm q will cause the step-by-step actuation of the ratchet-wheel q^5 through the medium of the pawl q^4, and this in turn will rotate the member N^2 in the direction of the arrow. The contact N′ is included in a local electric circuit P′, which contains the solenoid similar to the solenoid q^2 and adapted to actuate the rock-arm and pawl for turning the ratchet-wheel q^5 in the opposite direction. In the operation of the apparatus above described the magnet B is included in the main circuit, as in the previously-described construction. The rheostat is connected with the differentially-wound relay, so that the movement of the contact N^3 in one direction will cut in additional resistance in the said relay-circuit, and the movement of said hand in the opposite direction will cut out resistance. Any alteration in the strength of the current in the main line will therefore alter the balance between the magnetic pull and the counter-tension device, which will shift the position of the armature and through the medium of the rack K and pinion M will move the contact-arm M^2. If the current in the main line is strengthened, the arm M^2 will be moved from its neutral position between the contacts N and N′ until it bears against the contact N. This will close the local circuit P, which will start into operation the pulsator Q and the step-by-step movement of the ratchet-wheel q^5, thereby imparting a rotary movement to the member N^2 in the same direction that the arm M^2 is moved. This of course will withdraw the contact N from said arm M^2; but if the strength of current in the main line is sufficient said arm M^2 will follow the movement of the contact N until the position is reached where the counter-tension device exactly balances the magnetic pull. The contact N will, however, continue this movement until separated from the arm M^2, whereupon the local electric circuit P is broken and the movement of the mechanism is arrested. In the movement of the rotary member N^2 the contact N^3 will traverse the series of contacts O, thereby cutting in additional resistance into the circuit of the differentially-wound relay, which will tend to neutralize the abnormal strength of current. Where the strength of the current in the main circuit is diminished, an opposite movement of the mechanism is produced which is brought about first by the contacting of arm M^2 with the contact N'. This will close the local circuit P' and throw into operation the mechanism for moving the member N^2 and contact N^3 in the reverse direction, thereby cutting out resistance from the relay-circuit until the proper balance is again established.

From the description of the two embodiments of my invention as above set forth it will be understood that it may be applied to various uses, and I deem it unnecessary to describe further modifications which might be made.

What I claim as my invention is—

1. The combination with an electromagnetic motor and a counter-tension device, of a circuit-closer connected for actuation to said motor and counter-tension device, and means operating upon a variation in the magnetic force acting upon said circuit-closer for effecting a proportional change in said counter-tension device, whereby substantially the same differential force is maintained in each of a series of adjustments.

2. The combination with an electromagnetic motor and a counter-tension device, of a circuit-closer connected for actuation with said motor and counter-tension device, and means operating upon a variation of the magnetic force acting upon said circuit-closer, for shifting the latter proportional in relation to said motor and counter-tension device whereby substantially the same differential force is exerted thereon in each of a series of positions of adjustment.

3. The combination with an electromagnetic motor adapted to vary the amplitude of its movement corresponding to variations in the strength of the operating-current, of a counter-tension device, a circuit-closer connected for actuation with said motor and counter-tension device and adapted to be operated by less than the normal movement thereof, and means operating upon an abnormal movement of said motor for shifting the position of said circuit-closer whereby the same differential force will be exerted thereon in each of a series of positions of adjustment for the purpose described.

4. The combination with an electromagnet and a pivotal armature therefor, of a circuit-closer comprising a movable contact connected to said armature, a coöperating contact, a pivotal arm to which said coöperating contact is connected having its axis of rotation coincident with that of said armature, means for temporarily holding said arm in different positions of adjustment, and means for releasing said arm upon the closing of said circuit-closer and for effecting an adjustment thereof while unlocked upon a variation in the movement of said armature.

5. The combination with an electromagnetic motor and a counter-tension device, of a circuit-closer connected for actuation with said motor and counter-tension device and adapted to be actuated by a fraction of the movement thereof, and means operable during the remainder of said movement for automatically adjusting the counter tension acting upon said circuit-closer relative to the magnetic pull exerted thereon.

6. The combination with an electromagnetic motor and a counter-tension device, of a circuit-closer connected for actuation with said motor and counter tension and adapted to be operated by a fraction of the movement thereof and means for automatically adjusting the counter tension acting upon said circuit-closer proportionately to the amplitude of the remainder of said movement.

7. The combination with an electromagnetic motor and a counter-tension device, of a circuit-closer connected for actuation with said motor and counter tension, and means operated while said circuit-closer is closed for adjusting said counter tension corresponding to variations in strength in the magnetic pull, said adjustment being maintained after said circuit-closer is opened.

8. The combination with an electromagnetic motor and a counter-tension device, of a circuit-closer connected for actuation with said motor and counter tension, being adapted to be closed by a fraction of the movement thereof and to remain closed during the remainder of said movement, and means operating during the interval of closure for automatically adjusting said counter tension proportionate to the amplitude of said remainder of the movement.

9. The combination with an electromagnetic motor and a counter-tension device, of a circuit-closer comprising a movable member adapted to be actuated by the differential force of said motor and counter tension, a coöperating contact a carrying member for yieldingly holding said coöperating contact said carrying member being under tension to move toward said movable contact, but held from movement during a fraction of the movement of the latter and until it has closed with said coöperating contact, means for releasing said carrying member when said contacts are closed to permit of an adjustment, and a stop for limiting said adjustment relative to said movable contact whereby an abnormal movement of the latter will effect a counter adjustment of said carrying member and said coöperating contact.

10. The combination with an electromagnet, a pivotal armature therefor, a pivotal member having a coincident axis of rotation and having stops between which said armature is adapted to play, a contact carried by said armature, a coöperating contact pivotally secured to said pivotal member, a third contact against which said coöperating contact is normally held fixedly secured to said

pivotal member and arranged between said stops, an electromagnetic lock for said pivotal member having its operating-circuit closed through said coöperating contact and third contact, a second electric circuit adapted to be closed through said movable contact and coöperating contact, and counter-tension means for said armature and pivotal member adapted when said electromagnet is deënergized to hold said armature against one of said stops and hold its contact separated from said coöperating contact; for the purpose described.

In testimony whereof I affix my signature in presence of two witnesses.

GEORGE W. GILLESPIE.

Witnesses:
CLARENCE G. BOWKER,
JAMES C. MILLER.