No. 608,013. Patented July 26, 1898.

I. E. STOREY.

REVERSING RHEOSTAT.

(Application filed Jan. 29, 1898.)

(No Model.) 3 Sheets—Sheet 1.

Fig. 1.

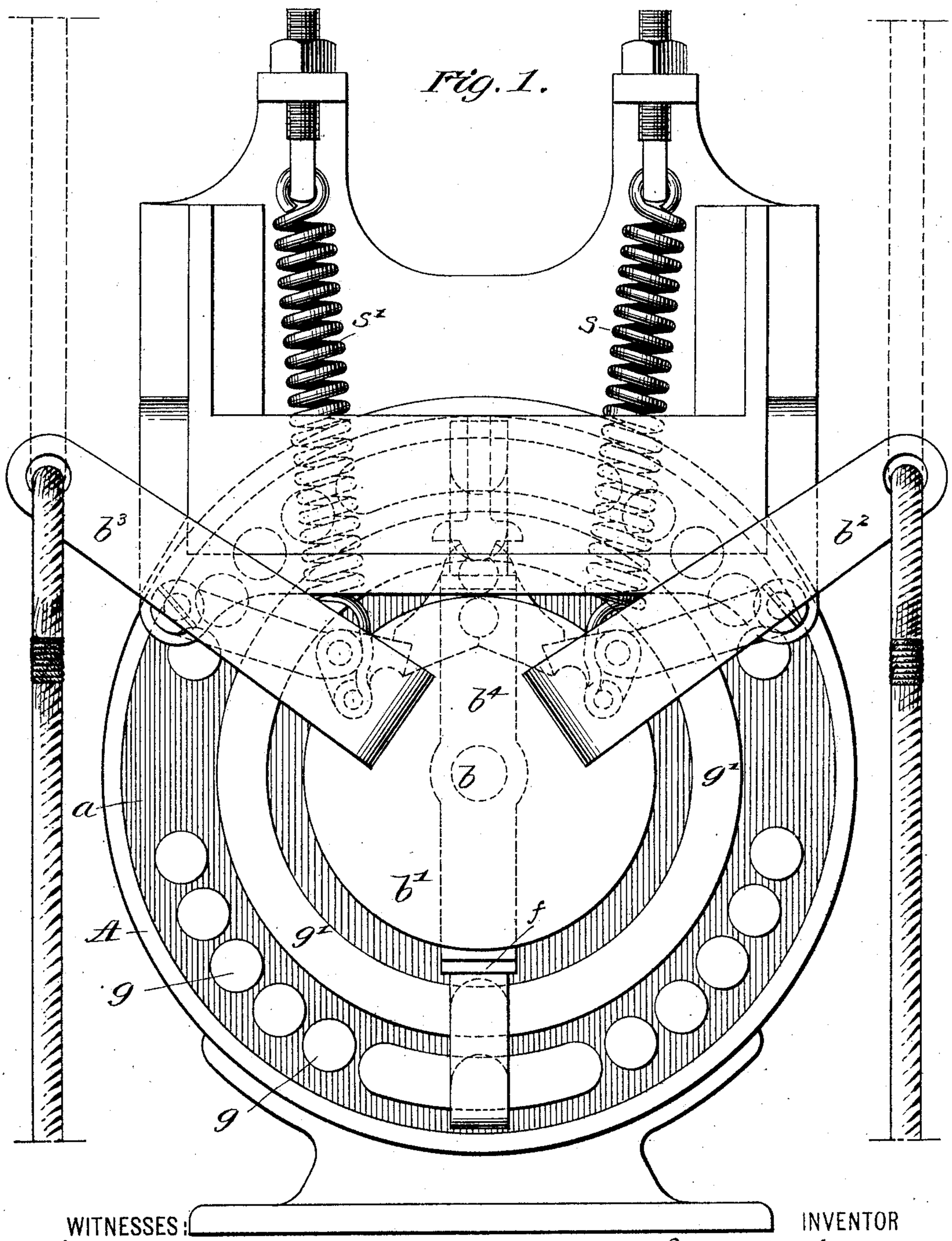

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Fig. 2.

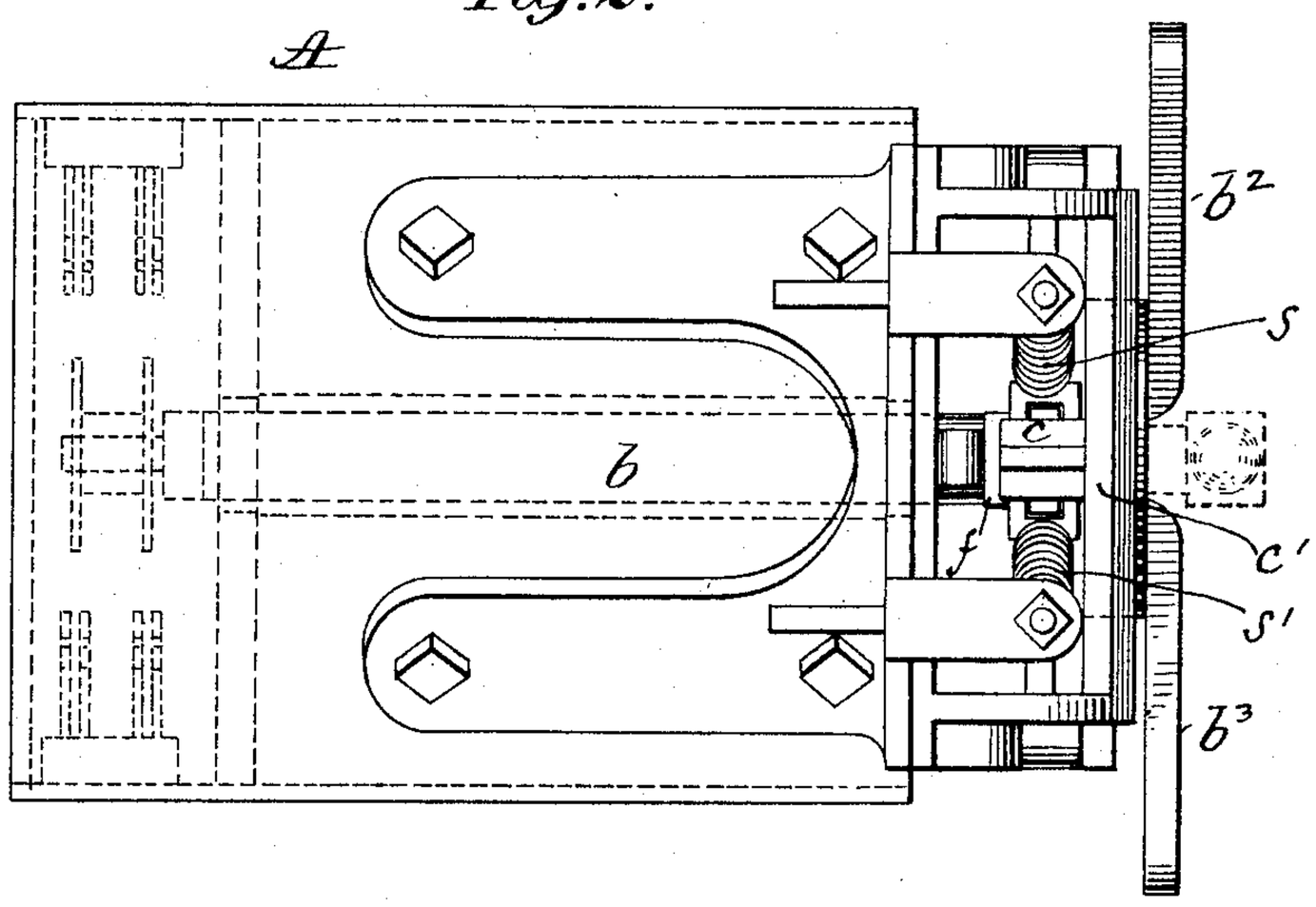

Fig. 3.

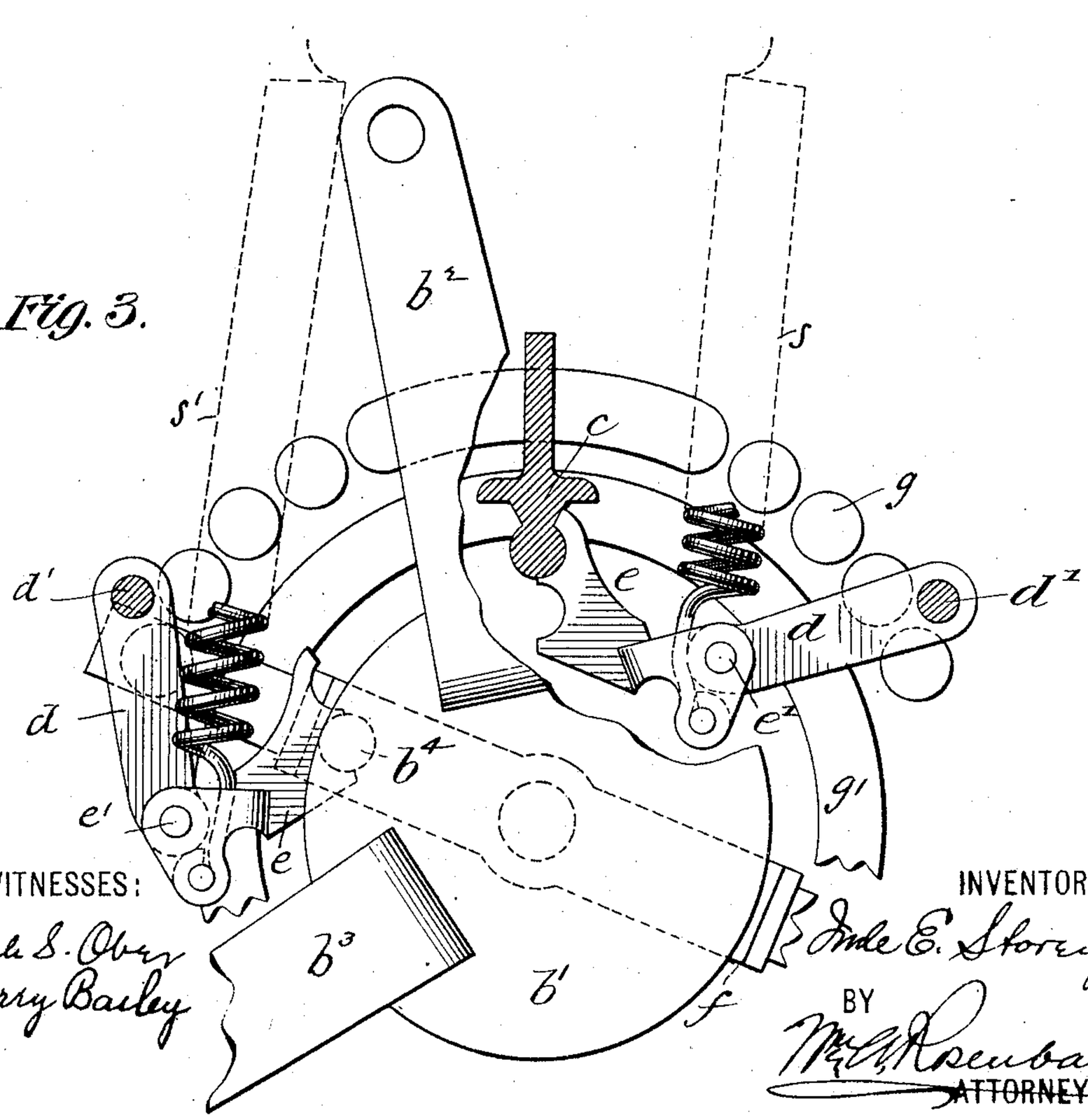

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Fig. 4.

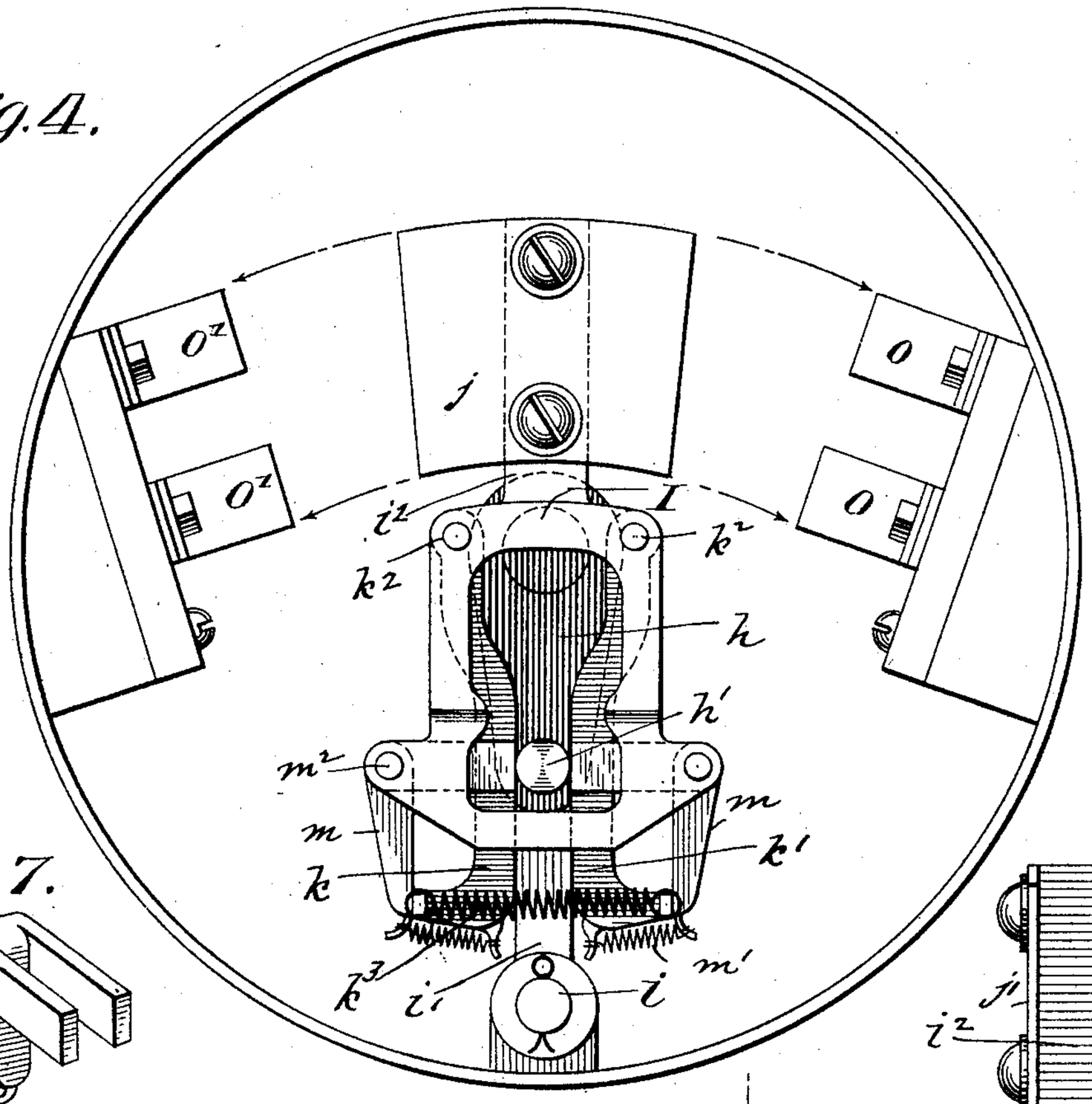


Fig. 7.

Fig. 6.

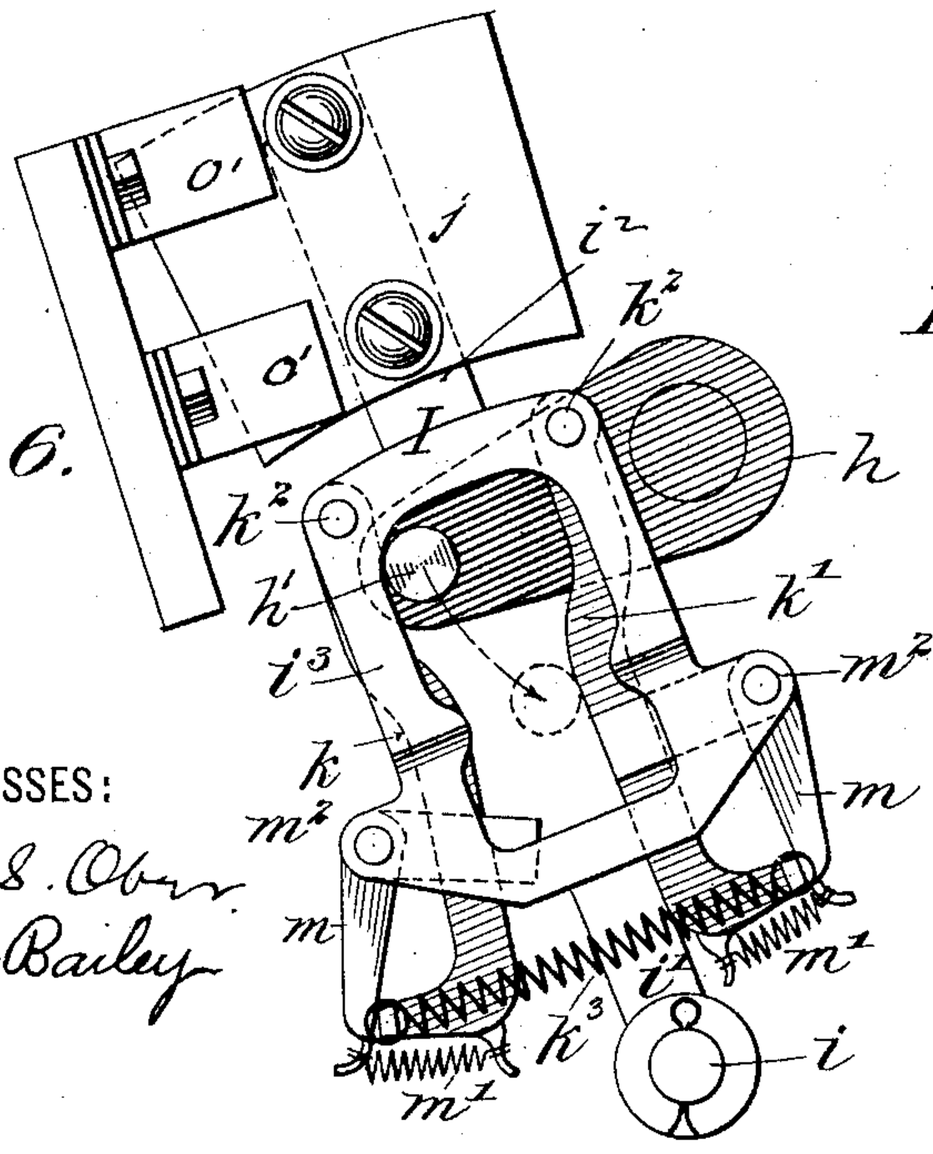
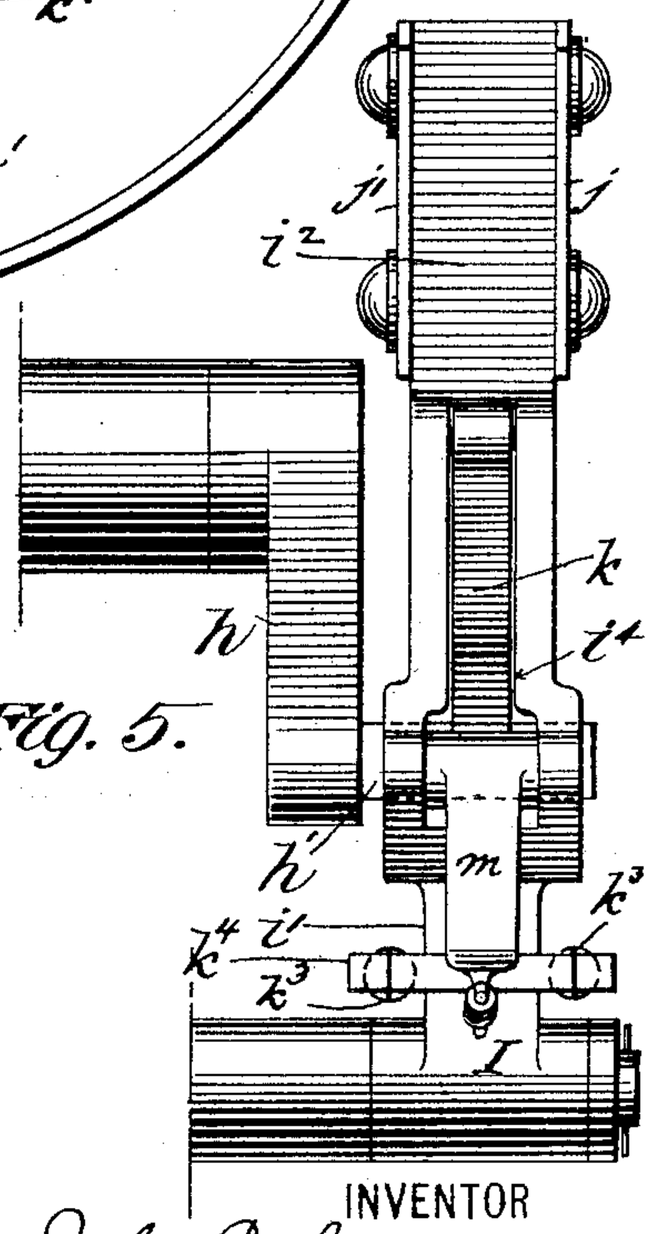


Fig. 5.



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IMLE E. STOREY, OF PHILADELPHIA, PENNSYLVANIA.

REVERSING-RHEOSTAT.

SPECIFICATION forming part of Letters Patent No. 608,013, dated July 26, 1898.

Application filed January 29, 1898. Serial No. 668,394. (No model.)

To all whom it may concern:

Be it known that I, IMLE E. STOREY, a citizen of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Reversing-Rheostats, of which the following is a full, clear, and exact description.

This invention relates to combined reversing switches and rheostats or starting-boxes for electric motors, the object being to provide a simple, compact, and efficient mechanical device whereby the amount of resistance in the circuit may be varied throughout the entire range of the rheostat, after closing the circuit, without destroying the integrity thereof. The switch is a reversing device that operates by moving the switch-arm from one side to the other of a median line, another object of the invention being to prevent the circuit-controlling arm, which moves quickly and independently when the circuit is broken, from jumping from the contacts on one side of the center to those on the other.

A still further object of my invention is to provide means for mechanically operating the starting-box from a distance, especially adapted for frequent short runs of the motor, such as in electric cranes, wherein the operator usually keeps his hand upon the controlling-lever while the motor is in operation, and of such construction that if the operating-lever is let go the controlling-arm of the rheostat will immediately and automatically return to the median position for stopping the motor.

The invention consists of certain mechanical devices which will be hereinafter fully described, and particularly pointed out in the claims.

In the accompanying drawings, Figure 1 is a front elevation of the rheostat, showing the resistance-contacts. Fig. 2 is a plan of the rheostat. Fig. 3 is a detail view of the operating mechanism of the rheostat when in one of the running positions. Fig. 4 is a rear elevation of the rheostat, showing the reversing-switch mechanism. Fig. 5 is a side view of the switch-arm and attached parts. Fig. 6 is a front view of the same, showing the switch closed; and Fig. 7 is a detail.

I will first describe the mechanism for automatically returning the controlling-arm of the rheostat to the normal position and bringing the motor to a stop in case the operator lets go of the operating handle or cord.

The resistance-coils (not shown) are contained within a cylindrical casing A, at each end of which is a head a of non-conducting material, such as slate. A shaft b, having bearings in these heads, extends beyond them and carries at one end a disk b', to which are rigidly secured two arms b^2 and b^3, set at equal angles on opposite sides of a vertical plane passing through the shaft. To the outer ends of these arms cords or other suitable handles may be attached for manipulation by the operator, a pull on one serving to start the motor in one direction, while a pull on the other will start it in the opposite direction. On the inner face of disk b' and located midway between the arms b^2 and b^3 and near the periphery of the disk is a cylindrical stud b^4, and standing directly above the normal position of this stud is a stop c, projecting inward from the fixed bracket c'. Behind the disk are arranged two sets of toggles, one on each side, each consisting of an arm d, pivoted at d', and another arm e, pivoted to the first at e' and having its bearing normally against the stop c and the stud b^4, it being shaped with semicylindrical seats to accurately fit against the two parts referred to. Springs s s' connect the joint of each toggle with a fixed part of the frame, as shown in Fig. 1, the arm e being offset and the spring attached to the offset portion immediately beneath the pivot-pin e', so that it may act in the same plane with the arms e and d. When both of the arms e are against the stops, the points e' are just below a straight line connecting d' and b^4, in which position they are held strongly by the springs, and the disk b' is correspondingly held in this its normal position. Now when either of the arms b^2 b^3 are pulled downward the stud b^4 is forced against the end of the corresponding arm e, causing this arm to leave the stop c and begin to close upon the arm d and assume the folded position shown to the left in Fig. 3. This motion stores power in the spring s', which will act to return the disk to its normal position by opening the arms of the toggle. When the arm e is thus carried away from stop c, the

other arm *e* remains unaffected against the stop. While a toggle is in the folded position described the resistance is out of circuit and the motor is running. In this position the operator holds the parts, and he is able to do so without great exertion, because the pull of the spring is comparatively light, it being nearly in line with the centers of the toggle. When the operator releases the handle, the spring opens the toggle to return the resistance-arm, in which motion a large part of the power of the spring is reserved for the end of the stroke or at the time when the members of the toggle are nearly in line with each other, at which time the most power is required, for then the resistance has been thrown into circuit and the switch-arm must be released from the grip of the contacts, as will be explained hereinafter.

Upon the shaft *b* immediately back of the parts described is a rheostat-controlling arm *f*, hung in the middle and carrying at each end two contacts, suitably insulated from each other. One of these is at the extreme end of the arm and bears against a row of resistance-terminals *g*, fixed in the slate head *a* near the edge, while the other is just inside of it and bears against a continuous metallic ring *g'*. Two sets of terminals *g* are shown, one above and the other below, this being a double-pole device. The middle terminal of each set *g* is elongated, as shown, so as to make no change in the resistance while the arm is traversing the beginning of one stroke and the ending of the other. At the opposite end of the box A the shaft *b* projects through the head and carries a crank *h*, having a crank-pin *h'* projecting outward. This crank actuates the reversing-switch and circuit-closer. Pivoted at the point *i* near the edge of the casing A is a switch-arm *l*, consisting of the two straight portions *i'* and i^2 and the loop i^3, the part i^2 carrying the two contact-blades *j* and *j'*. The sides of the loop are slotted, as shown at i^4, and in these slots levers *k k'* stand, being pivoted at the upper corners of the loop at k^2. The lower ends of these arms project below the loop and normally rest back to back against the straight part *i'* of the switch-arm, being held in this position by a pair of springs k^3, connecting them together. The lower extremities of these arms turn outward at right angles and carry cross-pieces k^4, between the extremities of which the springs k^3 are connected. The lower end of the slots i^4 are widened to receive a bell-crank lever *m*, one arm of which is bifurcated, as shown in Fig. 7, straddles the arm *k*, and projects into the loop. The other arm of this lever *m* bears against the cross-piece k^4, against which it is held by a small spring *m'*. The levers *m* are pivoted at m^2 to the sides of the loop, and their bifurcated arms normally stand in the same plane, tangent to the arc of movement of the crank-pin, with their ends facing each other, as shown in Fig. 4, and with the crank-pin standing between them. In this normal position also the adjacent faces of the arms *k* are standing flush with the ends of levers *m* and are exposed inside of the loop i^3. To the right and left of the lever *l* are located the contact-clips *o* and *o'*, respectively, with which the blades *j* and *j'* on the end of arm *l* engage to close the circuit and send current through the motor in one or the other direction.

The operation is as follows: Assume the apparatus to be in the normal position, (shown in Figs. 1 and 4,) in which position the resistance is all in circuit, but the circuit is open and the motor is not running. To start the motor, one or the other of levers b^2 b^3 is pulled downward slowly, causing one set of toggles to fold into the position shown at the left in Fig. 3 and the shaft *b* to be rotated. In the initial movement of the shaft the rheostat-arm *f* travels over the elongated contacts in the row of terminals *g* and makes no change in resistance of the circuit. At the same time the switch-arm *l* at the opposite end of the box is traveling from the intermediate position toward the clips *o'*. The switch-arm is given this motion by the crank-pin *h'*, which at the outset bears directly against the end of the bell-crank lever *m* and positively forces the switch-lever over. When the arc of movement of the crank-pin carries it off of the end of the bell-crank lever, the blades *j j'* have just entered the clips *o'*, and at about the same instant the rheostat-arm *f* touches the first rheostat-terminals above and below in the row *g* and begins to cut out the resistance. With the further motion of the shaft the arm *f* travels over the terminals *g* until it finally rests upon the last ones, as shown in Fig. 3, and accompanying this motion the crank-pin *h'* leaves the end of lever *m* and presses against the exposed arm *k*, causing it to fold into its slot, stretching the spring k^3 and allowing the crank-pin to bear directly against the side of the loop i^3, against which the crank continues until the pin reaches the upper corner of the loop, as shown in full lines in Fig. 6, at which time the blades *j j'* are firmly set in clips *o'*. The motor is now running with the resistance all out. The operator continues to hold the cord by which he rotates the shaft *b* until it is desired to stop or change the direction of rotation of the motor. To stop the motor, the operator releases the cord, whereupon spring *s'*, in which power has been stored, begins to act upon the toggle, gradually opening it and rotating shaft *b* backward. As the shaft rotates the crank-pin returns to its former position; but in its initial movement or while traveling from the point shown in full lines in Fig. 6 to the position shown in dotted lines it has no effect upon the switch-arm *l*; but during this time the rheostat-arm is being carried back and the resistance thrown into the circuit. When the rheostat-arm reaches the first terminals *g* again, the crank-pin reaches the position shown in dotted lines in Fig. 6,

and accompanying this movement of the crank-pin the arm *k* has been drawn back by springs k^3 to its normal position and has caused the bell-crank *m* on the same side to assume its normal position. In the further movement of the mechanism the switch-blades *j j'* must be removed from the grip of clips *o'* and carried with a quick movement to the intermediate position. (Shown in Fig. 4.) To release the blades of the switch requires considerable power; but this is furnished by the position of the toggles, which have now nearly opened, and the spring *s'* therefore acts with greater leverage upon disk *b'*. The crank-pin continues its motion, forces the arm *k'* into its slot, stretching the springs k^3, and tilting the bifurcated arm of lever *m* downward. When the crank-pin strikes the side of the loop i^3, it begins to release the blades *j j'* until at the moment when they are fully released and are ready to jump out of the clips the crank-pin *h'* has reached its normal position vertically below the shaft *b*, as shown in Fig. 4. In this position the pin is locked because the arm *e* of the toggle has been brought against the stop *c*. The moment the blades *j j'* are free and the crank-pin is in the position described the springs k^3, in which power has been stored, quickly jump the blades out of contact with the clips *o'* and force the arm *l* over toward its normal position, where it is positively stopped by the bifurcated end of the lever *m* on the left-hand side striking the crank-pin, and all vibration of the arm *l* is prevented by the return of lever *m* on the other side to its normal position against the opposite side of the crank-pin. Thus it will be seen that in breaking the circuit, either purposely or inadvertently, the switch-arm cannot jump from the contacts on one side to those on the other and thus create a spark or temporary reversal of the current. The function, then, of the levers *m* is twofold: first, to furnish an unyielding abutment for the crank-pin to insure the immediate movement of the switch-arm in closing the circuit, and, second, to furnish a stop or abutment to limit the movement of the switch-arm in opening the circuit. The function of the arms *k k'* and the springs k^3, it will be seen, is to cause the quick movement of the arm *l* on the breaking of the circuit and to tilt the bell-cranks on the opening stroke.

It will be observed that after the blades *j j'* are securely seated in the clips on either side the crank-pin has a motion indicated by its two positions in Fig. 6, during which the switch-arm *l* is not affected. This movement corresponds with the travel of the rheostat-arm *f* from the first to the last terminals in the row *g*, this providing for a variation of resistance in circuit through the entire range without moving the switch.

The described apparatus is particularly designed for controlling the motors of electric cranes, hoists, and similar apparatus where the runs of the motor are short and at frequent intervals. In operating such machinery it is customary for the operator to keep his hand upon the controller while the motor is in operation, but the danger that he might remove his hand from the controller and forget to stop the motor at the proper time always exists; but with my improved controller any such mistake on the part of the operator could not result in damage, because the moment the handle is released the apparatus automatically throws in resistance and stops the motor. It is obvious, however, that those features of the invention relating to the switch-arm may be used on a controller without the toggles and other automatic apparatus at the other end of the box. For ordinary work the simple crank handle or lever (indicated in dotted lines in Fig. 2) may be secured to the end of shaft *b* and moved positively in both directions by the operator, as will be readily understood.

I claim an advantage for my invention in the location of the various parts of the apparatus with respect to each other, the resistance-coils being located in the cylinder between the two slate heads *a* and surrounding the shaft, the latter operating the rheostat-terminals at one end and the reversing-switch at the other. This construction gives a very compact box, which for a given horse-power is much smaller than any other known to me.

Having thus described my invention, I claim—

1. In a motor-controller the combination of a rotary shaft carrying a crank-disk, an abutment on the disk, a toggle-lever bearing at one extremity against the abutment and pivoted at a fixed point at the other and a spring connected to the toggle-joint, substantially as described.

2. In a motor-controller, the combination of a rotary shaft carrying a crank-disk, an abutment on the disk, another abutment or stop, a toggle-lever normally bearing at one extremity against both abutments and pivoted at a fixed point at the other and a spring connected to the joint of the toggle, substantially as described.

3. In a motor-controller, the combination of a rotary shaft carrying a crank-disk, an abutment on the disk, another abutment or stop, two toggle-levers normally bearing at one extremity against opposite sides of the two abutments with their other extremities pivoted at a fixed point and springs connected to the joints of the toggles, snbstantially as described.

4. In a motor-controller, a rotary shaft carrying a crank, a switch-arm with which the crank engages, means for rotating the crank to release the switch-arm from its contacts and simultaneously store the power to move the arm after it is released.

5. In an apparatus of the character described, the combination with a suitable actuator, of a switch-arm adapted to be thrown

thereby into and out of contact with the terminals of an electric circuit the said switch-arm carrying thereon movable members affording rigid abutments for said actuator when moving in a direction to throw the switch, and yielding abutments therefor when moving in a direction to release the switch.

6. In apparatus of the character described, the combination with a suitable actuator, of a switch-arm adapted to be thrown thereby into and out of contact with the terminals of an electric circuit, the said switch-arm having movable members thereon serving as rigid abutments for said actuator when moving in a direction to close the switch and having means controlled by the return movement of said actuator whereby said abutments are displaced, as and for the purpose described.

7. In apparatus of the character described the combination with a suitable actuator, of a switch-arm adapted to be thrown thereby into and out of contact with the terminals of an electric circuit, the said switch-arm having movable members thereon presenting rigid abutments for said actuator when moving in a direction to close the switch, other movable members impinging against said abutments and located in the path of the return movement of said actuator whereby the said abutments may be displaced to permit the actuator to resume its former position, substantially as described.

8. In apparatus of the character described the combination with a suitable actuator, of a switch-arm adapted to be thrown thereby into and out of contact with the terminals of an electric circuit, the said switch-arm having movable members thereon presenting rigid abutments for said actuator when moving in a direction to close the switch, swinging levers also carried by said switch-arm impinging against said abutments and located in the path of the return movement of said actuator and springs adapted to be put under tension by said levers to move the switch-arm, substantially as described.

9. In apparatus of the character described, the combination with a suitable actuator, of a switch-arm adapted to be thrown into and out of contact with the terminals of an electric circuit, the said switch-arm carrying abutments normally contacting in opposite sides of said actuator and pivoted on tangent lines with relation to the arc of movement thereof, whereby the initial movement of said actuator serves to throw the switch, pivoted levers also carried by said switch-arm and movable by said actuator against the tension of springs after the switch has been thrown and connection between said abutments and said levers whereby the abutments may be displaced to permit the actuator to resume its normal position.

10. In apparatus of the character described the combination with a suitable actuator, of a switch-arm adapted to be thrown thereby into and out of contact with the terminals of an electric circuit, the said switch-arm having movable abutments contacting on opposite sides of said actuator whereby the switch-arm may be thrown in either direction to effect electric contact with said terminals, means providing for a certain range of movement of said actuator without disturbing the integrity of the switch-contact, levers carried by said switch-arm and located in the path of the return movement of said actuator and movable thereby against the tension of springs whereby power is stored to compel a quick "break," and suitable connection between said levers and said abutments, as and for the purpose described.

11. In apparatus of the character described, the combination with a suitable actuator, of a switch-arm adapted to be thrown into and out of contact with the terminals of an electric circuit the said switch-arm being normally held in locked relation with said actuator by movable abutments contacting on opposite sides thereof, the said abutments affording means whereby the switch-arm may be thrown in either direction to effect electric contact with said terminals by the initial movement of said actuator, and means carried by said switch-arm for displacing said abutments whereby the actuator may resume its former position, and means for reëstablishing the lock.

12. In apparatus of the character described the combination with a rocking shaft carrying a suitable actuator thereon, a switch controlled thereby, springs connected with and tending to hold said shaft in a state of rest at a median line, movable members carried by said switch-arm and normally abutting on opposite sides of said actuator whereby the switch-arm also is held in a state of rest in a median line, substantially as described.

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

IMLE E. STOREY.

Witnesses:
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RUPERT A. JENKS.