(No Model.)

H. H. BLADES.

AUTOMATIC ELECTRIC SWITCH.

No. 552,094. Patented Dec. 31, 1895.

Fig. 3.

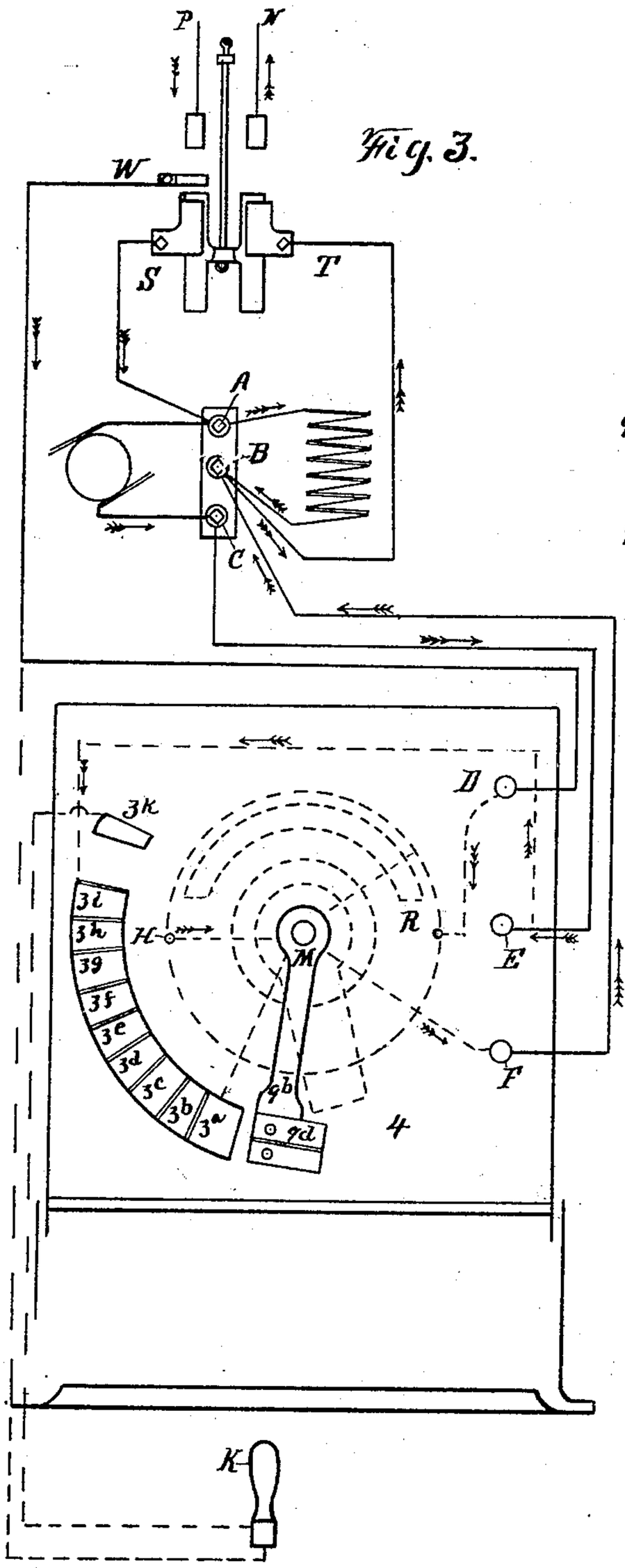
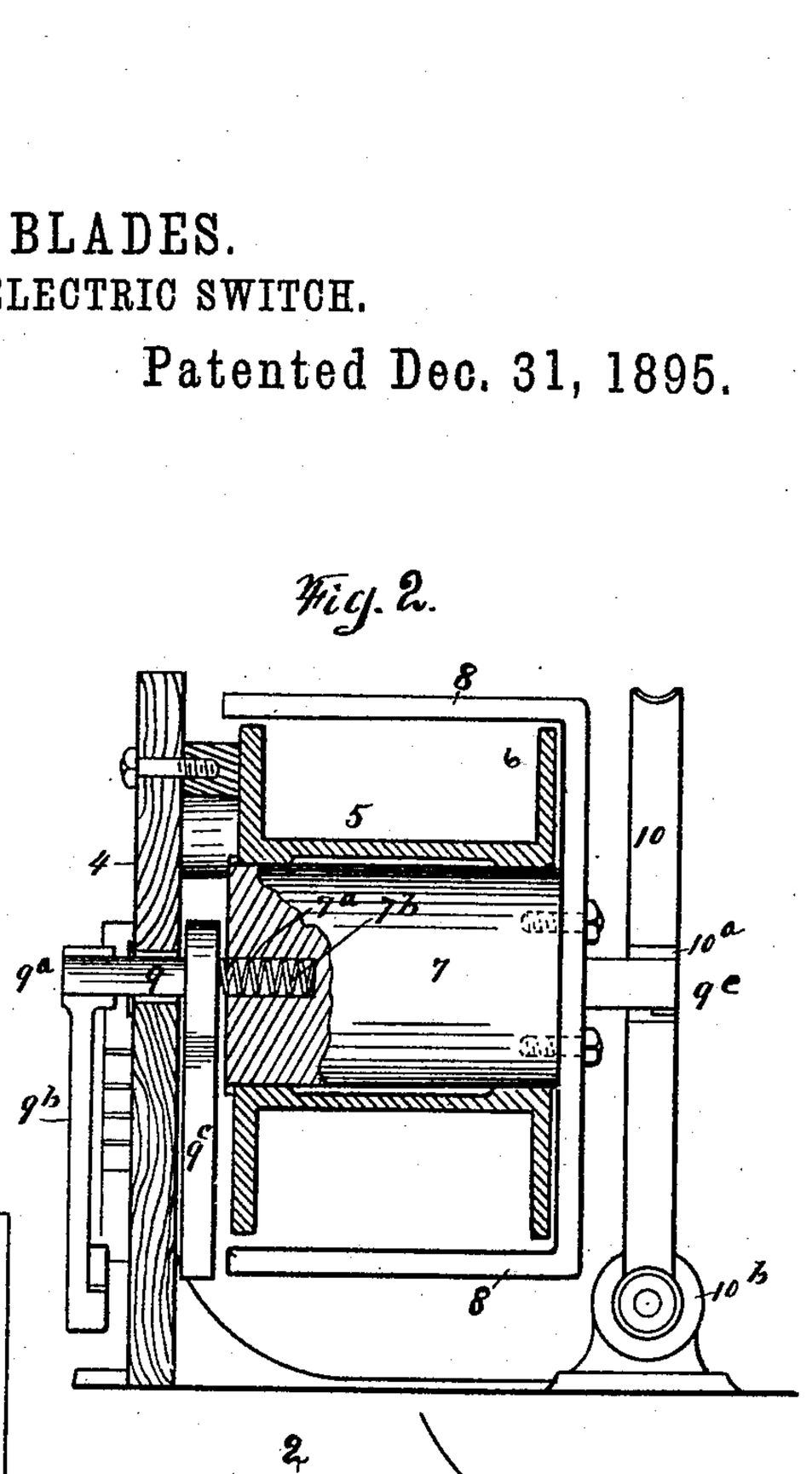


Fig. 2.



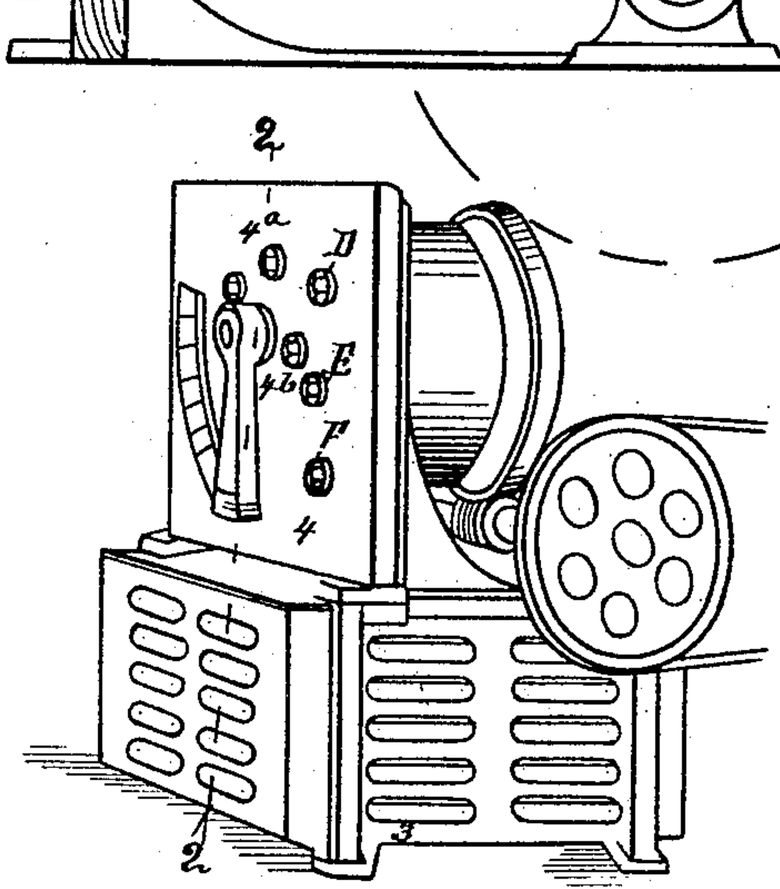


Fig. 1.

WITNESSES

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AUTOMATIC ELECTRIC SWITCH.

SPECIFICATION forming part of Letters Patent No. 552,094, dated December 31, 1895.

Application filed September 14, 1895. Serial No. 562,472. (No model.)

To all whom it may concern:

Be it known that I, HARRY H. BLADES, a citizen of the United States, residing at Detroit, county of Wayne, State of Michigan, have invented a certain new and useful Improvement in Automatic Electric Switches; and I declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it pertains to make and use the same, reference being had to the accompanying drawings, which form a part of this specification.

This invention relates to automatic electric switches, and has for its object a switch adapted to govern the admission of the electric current to the armature-circuit of an electric motor, and to gradually and automatically throw out of the circuit successive resistances until the resistances have been entirely thrown out and the current has a practically unimpeded passage to the motor. The invention pertains to the same subject-matter and is somewhat analogous to previous inventions for which patents have been granted to me—namely, Nos. 418,678, 457,338, 457,339, and 453,032. This invention is a development and improvement of the inventions described in said patents, and possesses certain features which are entirely novel.

This invention is intended to be used primarily with shunt or compound wound motors on constant-potential circuits, but it may be employed in other connections and under different conditions, and I do not wish to be limited in its application. This automatic switch is actuated by a small round belt driven directly by the motor-shaft or counter-shaft connected with the shaft of the motor. The round belt passes over a grooved pulley on a shaft mounted in bearings on the frame of the switch-box. Fastened to the shaft is a worm which meshes in and turns a worm-wheel. The worm-wheel is rigidly attached to the core of a stationary electromagnet, the coils of which are wound on a brass spool, the bore of which serves as a bearing for the revolving core and pole-piece. The core also has a slight longitudinal movement through the spool. The spool is firmly screwed to the back of the slate switchboard, the switch contacts and lever being on the other side. The shaft of the switch-lever extends through the switchboard, and securely fastened to it is an iron flange or arm, moving always with the switch-lever. When the electromagnet is not excited the lever and flange move entirely free. The end of the core of the magnet presents its surface close to the surface of the iron flange, but a coiled spring recessed in a cavity drilled in the core serves to keep the core and the flange entirely separate, while the electromagnet is not excited. When the electromagnet is excited, the core and pole-piece which surrounds the spool in the form of a cylindrical cup attract the flange and hold it in magnetic clutch. As the current is usually thrown "on" from a main-line snap-switch, it excites the electromagnet and the motor at the same time. As the armature of the motor begins to move, it turns the pulley very slowly, the worm-gear and the switch-lever which gradually passes from the first contact successively to the others until the resistance is entirely cut out of the armature-circuit and after the switch has reached its final position the worm-gear, core and pole-piece still continue to revolve with the shaft of the motor. The magnetism of the core and pole-piece is sufficient to hold the iron flange and lever in magnetic clutch, while in revolving they slide over the surface of the iron flange which is stationary when the lever has reached its final position. The work done by the belt is much increased when the lever has reached its final point, as it has not only to turn the worm-gearing, but to force the core and pole-piece to slide over the magnetically-excited flange. Sometimes the construction is varied so as to bring the worm-gearing to rest at the time that the lever reaches its final position. This is done by bringing the worm-wheel into very close mesh with the worm, thus offering considerable resistance, or further by adding a considerable weight to the worm-wheel, or by a light brake. In this case the small round belt would not turn with the shaft of the motor, but would remain stationary, the motor-shaft revolving within it. Under many circumstances it will be found desirable to operate the worm-gearing by hand by a crank fastened to the worm-shaft. Of course it will be understood that the rate of movement of the switch-lever is capable of being adjusted

to a wide range by changing the gearing. The preferable adjustment is one such that the movement is completed in from ten to twenty seconds. The armature-circuit is also preferably a closed circuit, and the switch-lever does not touch the contacts until the iron flange has been drawn into magnetic clutch. The switch-lever does not open or close the armature-circuit, but only short-circuits the resistances, and sparking and injury to the contacts is thus obviated.

It is important that one terminal of the electromagnet shall be connected with an isolated main-line contact, that is in circuit only when the main line is on. Such an isolated circuit is shown in the drawings at W. The other terminal of the main-line magnet may be connected with the corresponding terminals of the motor on the other side of the main switch. If both terminals of the electromagnet were connected with the terminals of the motor there would be a closed circuit through the electromagnet across the motor-armature, and as this armature generates considerable current before coming to rest, the switch-lever would be held in magnetic clutch for too long a time before dropping, instead of being instantly released to return to its initial position. The cylindrical or drum pole-piece serves as a shield for the coils of the electromagnet, and preserves them from injury in those places where injury is liable to occur. In some cases the cylindrical pole-piece might be dispensed with, and then the electromagnet would have the usual form of the solenoid with revolving armature only one end however serving to move the switch-lever. The weight of the switch-lever is usually sufficient to bring it back to its initial position, but a flat concentric spring may be attached to the center of the switch-lever for this purpose. When the current is interrupted the lever immediately drops whether its movement is completed or not. The coil-spring recessed in the center of the core of the electromagnet throws the switch-lever and the arm 9^e out of clutch and overcomes any residual magnetism that might tend to hold the arm.

In many kinds of work, such as elevator work, it is possible to "make" or "break" the main switch at any time without reference to the motor, as the switch-lever is always in a position of "safety," since it instantly returns to its starting-point with all the resistance in the armature-circuit.

While the invention is of great value as a matter of convenience in elevator and kindred work, it also saves a large item of expense, for in many places motors are allowed to run continually light, consuming considerable current, when by the use of this switch they might be started and stopped as required. As the invention is particularly applicable to special kinds of work, such as the running of hoists, pumps, cranes and elevators, it may also be used to advantage whenever the usual type of stationary motors are employed. The main snap-switch controlling the main circuit is usually controlled by a cord extending over pulleys. One pull of this cord is sufficient to start or stop the motor, while the operator may be at a considerable distance from the motor and starting-switch. It has not been thought necessary to indicate such an actuating-cord in the drawings.

The switch may be used with reversible motors by locating a duplicate set of resistance-contacts on the opposite side of the slate switchboard. As the motor reverses, it turns the worm and worm-wheel in the opposite direction, and consequently the switch-lever. The action of the switch then becomes exactly the same in both directions.

In the drawings, Figure 1 is a perspective of the switch and case of resistance-coils. Fig. 2 is a sectional elevation of the switch, taken in the plane passing from front to rear through the line 2 2 of Fig. 1. Fig. 3 is a diagram indicating the face of the switch, the snap-switch, and the wiring.

3 indicates a case of resistance-coils.

4 indicates a switchboard, preferably made of slate or some similar non-conducting material, provided with a central hole for the passage of a shaft for a switch-arm, and with other holes suitable for the binding-screws, binding-posts, &c. To the back of the plate 4 is held a spool 5, upon which is wound a solenoid 6. Within the central opening through the spool 5 is journaled a core 7, and to the core 7 is secured a pole-piece 8. The pole-piece 8 is cup-shaped or cylindrical, and entirely surrounding the solenoid. That edge of the cup which lies toward the plate 4 forms one magnetic pole, and the end of the core 7 forms another magnetic pole. In the core 7 is a central cavity 7^a. Concentric with the cavity is the shaft 9, which projects through the plate 4 and carries on its projecting end 9^a a switch-arm 9^b, arranged to sweep the resistance-terminals 3^a to 3^i, and to stop, while still in contact with the terminal 3^i, against a lamp-terminal 3^k.

The shaft 9 is arranged to slide for a limited distance through the bearing in the face 4, so that the arm 9^c, which is keyed to the shaft 9, can approach toward or recede from the pole-pieces 7 and 8. A spring-brush 9^d, on the end of the sweep 9^b, makes contact with the resistance-terminals in the movement just described.

Projecting from the rear of the core is a shaft 9^e, having keyed to it a worm-wheel 10, and this wheel is insulated from the shaft by an interposed insulating-bushing 10^a. The worm-wheel is driven from the motor by belting that will slip if the resistance is great. The belting is regulated to turn the pole-pieces so long as there is no serious obstacle interposed. Should the belt be tight enough and strong enough, as is usually the case, to continue to turn the pole-pieces after the sweep reaches the lamp-terminal, the switch is not

injured, as in that case the sweep and arm 9^c simply remain stationary.

In the cavity 7^a, surrounding the shaft 9, is a coiled spring 7^b, which bears against the bottom of the cavity and against the arm 9^c, and tends to force the arm away from the pole-pieces and the brushes 9^d out of contact with the resistance-terminals. The wiring (which will be explained) is such that as soon as the current is switched through the motor it passes through the solenoid 6, energizes the magnet, draws the arm 9^c against the pole-pieces and produces a magnetic clutch between the pole-pieces and the arm. At the same time the motor starts, the belt begins to rotate the poles and the arm and switch 9^b, throwing it gradually over the resistance-terminals until all but the last terminal has been passed and the resistance cut out. The arm stops against the lamp-terminal 3^k and shunts a circuit through the lamp K. So long as the lamp remains lighted it is an indication that the resistance in the armature-circuit of the motor is at a minimum.

The electric current from one side of the main switch S, passing to the binding-post A on the motor, branches, part going through the field-circuit, thence to a binding-post B, and by the wire BT to the terminal T on the other side of the main switch. The other branch of the current goes through the armature-circuit, thence to the binding-post C on the motor, then by the wire CE to the binding-post E on the switch, then by wire (shown by dotted lines) to the final point 3^l on the switch, then through all the resistances to the first point 3^a of the switch, then by a wire (shown by dotted lines) to the binding-post F, passing in its course through the shaft 9, to which also the switch-lever is connected. From this binding-post F the current passes by the wire FB to the binding-post B on the motor, thence by the wire BT to the other terminal T on the switch. When the lever is on the final point of the switch, the current passes directly through the lever to binding-post F. The wire runs from the isolated contact W, on the main switch, to the terminal R of the electromagnet. Thence the current passes through the coils of the magnet to the other terminal H, then by the dotted wire to the binding-post F, then by the wire FB to the binding-post B, then by the wire BT to the other terminal T of the main switch. The lamp-circuit, as shown, is a direct shunt between the isolated terminal W, on the main switch, and the terminal T, on the other side of the main switch. The lamp-contact 3^k is only "live" when it is touched by the lever.

To summarize some of the advantages of this switch: The quick instant return of the lever is an improvement over a switch in which the lever is governed by a dash-pot, as the oil in the dash-pot retards the lever several seconds, during which time it might be possible to damage the armature and commutator of the motor by making the main circuit. A stationary electromagnet is preferable to a movable magnet, as brushes and a commutating device are necessary in that case, in order to carry the current to the coils. A closed armature-circuit obviates all sparking and burning of the resistance-contact; the ease with which the switch may be made reversible, by simply duplicating the contacts on the opposite side; as a worm-gear is employed, it forms a lock on the switch which cannot be turned back except by turning the worm in the opposite direction; the drum cylindrical pole-piece serving as a shield for the magnet-coils; the drop of the lever from any point whether movement is completed or not; the spring, making certain the throw of the switch-lever out of clutch; the isolated contact on main switch preventing generating of current in the magnet by motor-armatures while slowing down; the instant return of the lever in case of a shut-down at the central station, or a break somewhere on the line; the novel form of the pole-piece making it possible for it to continually revolve and not to have to start at some fixed point as it would if irregularly shaped; the changing of the relative positions of flange and switch-lever on the common shaft, making it possible to adjust as desired the stopping-point of the lever, which is usually the final point on the switch.

What I claim is—

1. The combination with an electric motor, of a switch governing the admission of current to the motor, a solenoid electro magnet on an independent shunt circuit, said solenoid having a revolving armature adapted to engage and hold in magnetic clutch an iron flange attached to a switch lever, a series of resistances arranged to successively make contact with the said switch-lever, and means for automatically retracting the said switch lever to its initial position when the magnet is deenergized by the cessation of the current substantially as described.

2. The combination with a shunt wound electric motor on a constant potential circuit, of a switch governing the admission of current to the motor, a solenoid electro magnet on an independent shunt circuit, said solenoid having a revolving armature adapted to engage and hold in magnetic clutch, an iron flange attached to the switch levers, a series of resistances arranged to successively make contact with the said switch lever, and means for automatically retracting the said switch-lever to its initial position when the magnet is deenergized by the cessation of the current, substantially as described.

3. The combination with a shunt wound electric motor on a constant potential circuit, of a switch governing the admission of current to the armature circuit, said armature circuit being a continually closed circuit, a solenoid electro magnet on an independent shunt circuit, said solenoid having a revolving armature adapted to engage and hold in

magnetic clutch an iron flange attached to a switch lever, a series of resistances arranged to successively make contact with the said switch lever, and means for automatically retracting the said switch lever to its initial position, when the magnet is deenergized by the cessation of the current, substantially as described.

4. The combination with an electric motor, of a switch governing the admission of current to the motor, a solenoid electro magnet on an independent shunt circuit, said shunt circuit lying between one terminal of the motor on one side, and an isolated main line contact on the other, said solenoid having a revolving armature adapted to engage and hold in magnetic clutch an iron flange attached to a switch lever, a series of resistances arranged to successively make contact with the said switch-lever, and means for automatically retracting the said switch lever to its initial position when the magnet is deenergized by the cessation of the current, substantially as described.

5. The combination with a shunt wound electric motor on a constant potential circuit, of a switch governing the admission of current to the motor, a solenoid electro magnet on an independent shunt circuit, said shunt circuit lying between one terminal of the motor on one side, and an isolated main line contact on the other, said solenoid having a revolving armature adapted to engage and hold in magnetic clutch, an iron flange attached to a switch lever, a series of resistances arranged to successively make contact with the said switch lever, and means for automatically retracting the said switch-lever to its initial position when the magnet is deenergized by the cessation of the current, substantially as described.

6. The combination with a shunt wound electric motor on a constant potential circuit, of a switch governing the admission of current to the armature circuit, said armature circuit being a continually closed circuit, a solenoid electro magnet on an independent shunt circuit, said independent shunt circuit lying between one terminal of the motor on one side, and an isolated main line contact on the other, a solenoid electro magnet on an independent shunt circuit, said solenoid having a revolving armature adapted to engage and hold in magnetic clutch an iron flange attached to a switch lever, a series of resistances arranged to successively make contact with said switch lever, and means for automatically retracting the said switch lever to its initial position when the magnet is deenergized by the cessation of the current, substantially as described.

7. The combination with an electro motor, of a switch governing the admission of current to the motor, a solenoid electro magnet on an independent shunt circuit between the terminals of the motor, said solenoid having a revolving armature adapted to engage and hold in magnetic clutch an iron flange attached to a switch lever, a series of resistances arranged to successively make contact with the said switch lever and means for automatically retracting the said switch lever to its initial position when the magnet is deenergized by the cessation of the current, substantially as described.

8. The combination with a shunt wound electric motor on a constant potential circuit, of a switch governing the admission of current to the motor, a solenoid electro magnet on an independent shunt circuit between the terminals of the motor, said solenoid having a revolving armature adapted to engage and hold in magnetic clutch an iron flange attached to a switch lever, a series of resistances arranged to successively make contact with the said switch lever, and means for automatically retracting the said switch lever to its initial position when the magnet is deenergized by the cessation of the current, substantially as described.

9. The combination with a shunt wound electric motor on a constant potential circuit, of a switch governing the admission of current to the armature circuit, said armature circuit being a continually closed circuit, a solenoid electro magnet on an independent shunt circuit, said solenoid having a revolving armature adapted to engage and hold in magnetic clutch an iron flange attached to a switch lever, a series of resistances arranged to successively make contact with the said switch lever, and means for automatically retracting the said switch-lever to its initial position when the magnet is deenergized by the cessation of the current, substantially as described.

10. The combination with an electric motor, of a switch governing the admission of current to the motor, an electro magnet on an independent shunt circuit, said magnet having a revolving core and pole piece adapted to engage and hold in magnetic clutch an iron flange attached to a switch lever, a series of resistances arranged to successively make contact with the said switch lever, and means for automatically retracting the said switch-lever to its initial position when the magnet is deenergized by the cessation of said current, substantially as described.

11. The combination with an electric motor, of a switch governing the admission of current to the motor an electro magnet on an independent shunt circuit, said magnet having a revolving core and a cylindrical pole-piece adapted to engage and hold in magnetic clutch, an iron flange attached to a switch lever, a series of resistances arranged to successively make contact with the said switch lever, and means for automatically retracting the said switch lever to its initial position when the magnet is deenergized by the cessation of the current, substantially as described.

12. The combination with an electric motor,

of a switch governing the admission of current to the motor, an electro magnet on an independent shunt circuit, said magnet having a revolving core and cylindrical pole-piece shielding and inclosing the coils of said magnet, and being adapted to engage and hold in magnetic clutch, an iron flange attached to a switch lever, a series of resistances arranged to successively make contact with the said switch lever, and means for automatically retracting said switch lever to its initial position when the magnet is deenergized by the cessation of the current, substantially as described.

13. The combination with an electric motor, of a switch governing the admission of current to the motor, a stationary electro magnet on an independent shunt circuit, said magnet having a revolving core and pole piece adapted to engage and hold in magnetic clutch, an iron flange attached to a switch lever, a series of resistances arranged to successively make contact with the said switch lever, and means for automatically retracting the said switch lever to its initial position when the magnet is deenergized by the cessation of the current, substantially as described.

14. The combination with an electric motor, of a switch governing the admission of current to the motor, a stationary electro magnet on an independent shunt circuit, said magnet having a revolving core and pole piece cylindrical in form, and shielding and inclosing the coils of said magnet and adapted to engage and hold in magnetic clutch, an iron flange attached to a switch-lever, a series of resistances arranged to successively make contact with the said switch lever and means for automatically retracting the said switch lever to its initial position when the magnet is deenergized by the cessation of the current, substantially as described.

15. The combination with an electric motor, of a switch governing the admission of current to the motor, a stationary electro magnet on an independent shunt circuit, said shunt circuit lying between one terminal of the motor on one side, and an isolated main line contact on the other side, said magnet having a revolving core and pole piece adapted to engage and hold in magnetic clutch, an iron flange attached to a switch lever, a series of resistances arranged to successively make contact with the said switch lever, and means for automatically retracting the said switch lever to its initial position when the magnet is deenergized by the cessation of the current, substantially as described.

16. The combination with a shunt wound electric motor on a constant potential circuit, of a switch governing the admission of current to the armature circuit, said armature circuit being a continually closed circuit, a stationary electro magnet on an independent shunt circuit, said shunt circuit lying between one terminal of the motor on one side and an isolated main line contact on the other side, said magnet having a revolving core and pole piece adapted to engage and hold in magnetic clutch, an iron flange attached to a switch lever, a series of resistances arranged to successively make contact with said switch lever, and means for automatically retracting the said switch lever to its initial position when the magnet is deenergized by the cessation of the current, substantially as described.

17. The combination with an electric motor, of a switch governing the admission of current to the motor, a stationary electro magnet on an independent shunt circuit, between the terminals of the motor, said magnet having a revolving core and pole piece adapted to engage and hold in magnetic clutch, an iron flange attached to a switch-lever, a series of resistances arranged to successively make contact with said switch lever, and means for automatically retracting the said switch lever to its initial position when the magnet is deenergized by the cessation of the current, substantially as described.

18. The combination with a shunt wound electric motor on a constant potential circuit, of a switch governing the admission of current to the armature circuit, said armature circuit being a continually closed circuit, a stationary electro magnet on an independent shunt circuit between the terminals of the motor, said magnet having a revolving core and pole piece adapted to engage and hold in magnetic clutch an iron flange attached to a switch lever, a series of resistances arranged to successively make contact with said switch lever, and means for automatically retracting the said switch lever to its initial position when the magnet is deenergized by the cessation of the current, substantially as described.

19. The combination with an electric motor, of a switch governing the admission of current to the motor, a stationary electro magnet on an independent shunt circuit, said shunt circuit lying between one terminal of the motor on one side, and an isolated main line contact on the other side, said magnet having a revolving core and cylindrical pole piece shielding and inclosing the coils of said magnet and adapted to engage and hold in magnetic clutch, an iron flange attached to a switch lever, a series of resistances arranged to successively make contact with said switch lever, and means for automatically retracting the said switch lever to its initial position when the magnet is deenergized by the cessation of the current, substantially as described.

20. The combination with a shunt wound electric motor on a constant potential circuit, of a switch governing the admission of current to the armature circuit, said armature circuit being a continually closed circuit, a stationary electro magnet on an independent shunt circuit, said independent shunt circuit lying between one terminal of the motor on one side, and an isolated main line contact on the other

side, said magnet having a revolving core and a cylindrical pole piece shielding and inclosing the core of said magnet and being adapted to engage and hold in magnetic clutch, an iron flange attached to a switch lever, a series of resistances arranged to successively make contact with said switch lever, and means for automatically retracting the said switch lever to its initial position when the magnet is deenergized by the cessation of the current, substantially as described.

21. The combination with an electric motor, of a switch governing the admission of the current to the motor, an electro magnet on an independent shunt circuit between the terminals of the motor, said magnet having a revolving core and cylindrical pole piece shielding and inclosing the coils of said magnet, and being adapted to engage and hold in magnetic clutch, an iron flange attached to a switch lever, a series of resistances arranged to successively make contact with said switch lever, and means for automatically retracting the said switch lever to its initial position when the magnet is deenergized by the cessation of the current, substantially as described.

22. The combination with an electric motor, of a switch governing the admission of current to the motor, an electro magnet on an independent shunt circuit, said magnet having a revolving core and pole-piece adapted to engage and hold in magnetic clutch a metal flange attached to the switch lever, a series of resistances arranged to successively make contact with the said switch lever, a pulley, worm and worm-wheel connected with the motor shaft for revolving said core and pole piece, and means for automatically retracting said switch-lever to its initial position when the magnet is deenergized by the cessation of the current, substantially as described.

In testimony whereof I sign this specification in the presence of two witnesses.

HARRY H. BLADES.

Witnesses:
VIRGINIA M. CLOUGH,
F. CLOUGH.