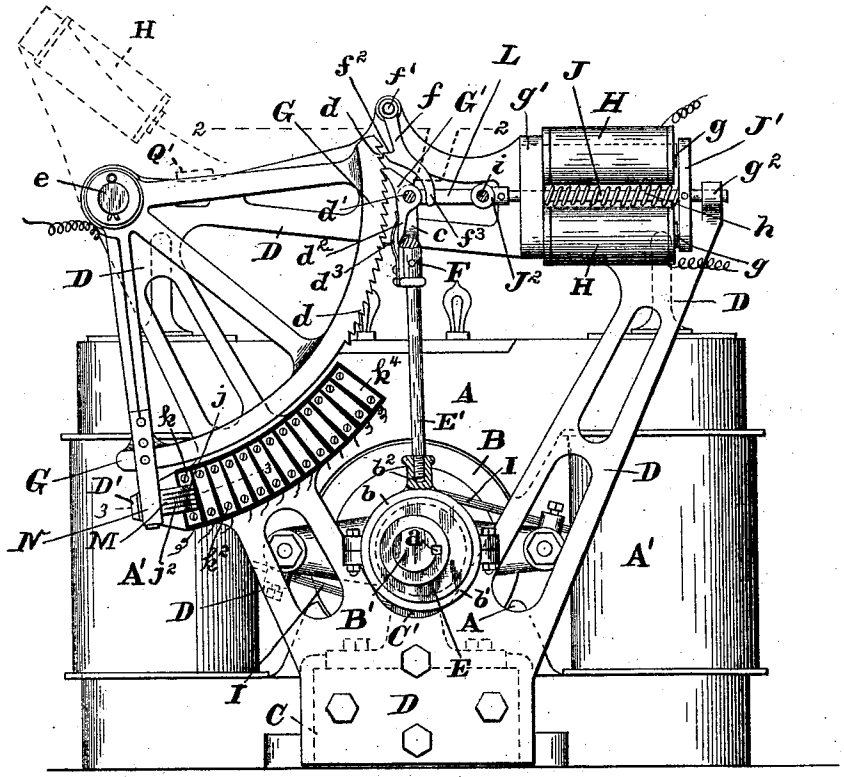
(No Model.) 2 Sheets—Sheet 1.

G. H. WHITTINGHAM.

AUTOMATIC DEVICE FOR REMOVING RESISTANCE IN STARTING ELECTRIC MOTORS AND REPLACING SAME.

No. 518,906. Patented Apr. 24, 1894.

Fig. 1.



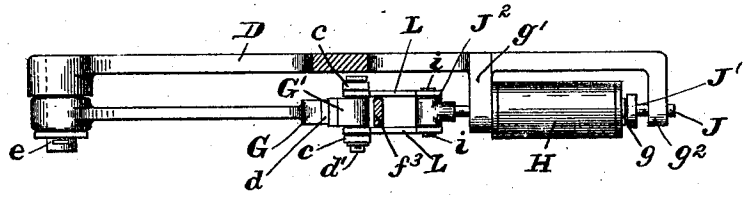


Fig. 2.

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(No Model.) 2 Sheets—Sheet 2.

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Fig. 3.

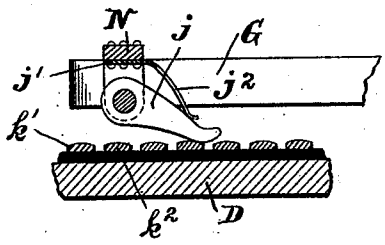
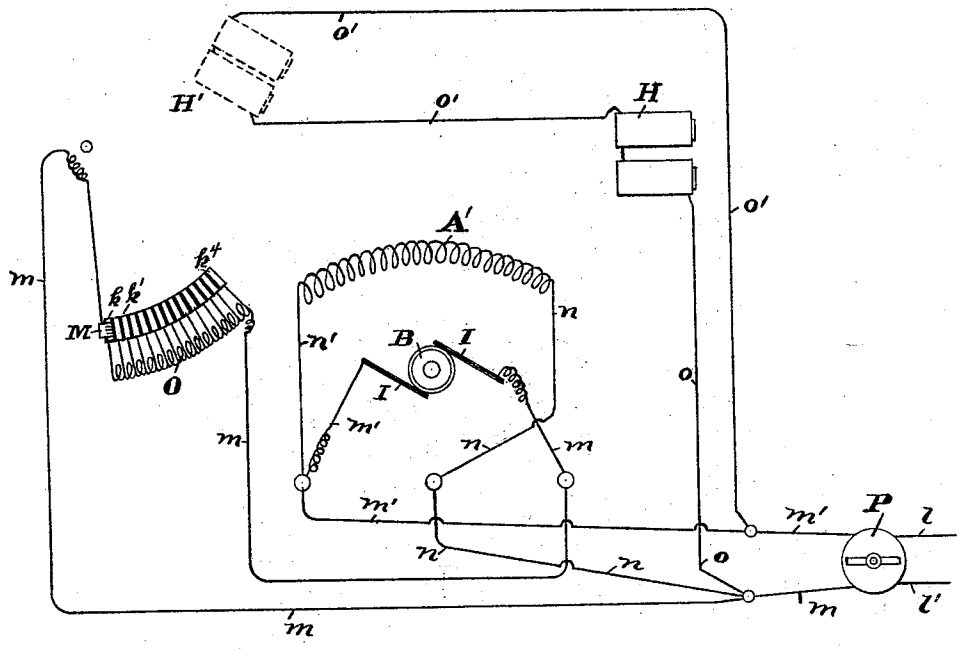


Fig. 4.



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UNITED STATES PATENT OFFICE.

GEORGE H. WHITTINGHAM, OF BALTIMORE, MARYLAND, ASSIGNOR TO THE AUTOMATIC SWITCH COMPANY OF BALTIMORE CITY, OF MARYLAND.

AUTOMATIC DEVICE FOR REMOVING RESISTANCE IN STARTING ELECTRIC MOTORS AND REPLACING SAME.

SPECIFICATION forming part of Letters Patent No. 518,906, dated April 24, 1894.

Application filed April 4, 1893. Serial No. 469,032. (No model.)

To all whom it may concern:

Be it known that I, GEORGE H. WHITTINGHAM, a citizen of the United States, residing at Baltimore, in the State of Maryland, have invented certain new and useful Improvements in Automatic Devices for Removing Resistance in Starting Electric Motors and Replacing the Same, of which the following is a specification.

This invention relates to an automatic starting device for electric motors and has for its object to gradually reduce the resistance in the armature circuit of the motor automatically when the current is turned on and the motor starting by cutting out the coils of resistance one after the other from that of the greatest resistance to that of the least resistance, and maintaining it in this position during the running of the motor, so that when the circuit through the motor is first completed to start the motor the current will meet with the greatest resistance and when the motor is fully running there will be the least resistance to the passage of the current. This is done to prevent the burning out of the armature of the motor when starting. When the current is shut-off this device operates to automatically replace the resistance in the circuit in readiness to be started again. By my invention the power for operating the resistance-controlling device is obtained from the motor itself.

In order to make the improvements clearly understood I have shown in the accompanying drawings means for carrying the same into practical effect, without however intending to limit my invention to this particular construction, for the invention as broadly conceived by me and as defined in my claims, may be embodied in many other forms.

In the drawings—Figure 1 shows an end view of a motor provided with my improved automatic resistance controlling device. Fig. 2 is a horizontal section of the device taken on the line 2—2 of Fig. 1. Fig. 3 is a section through the resistance plates taken on line 3—3 of Fig. 1. Fig. 4 shows a diagram of the circuits.

The letter, A, designates the field-magnets of the motor and A′, the coils thereof.

B, designates the armature and B′, the armature-shaft which is journaled in bearings, C′, on the base, C, of the motor.

A suitable upwardly-projecting frame-work, D, is bolted to the outside of the bearing-block, C′ and base, C, at the commutator end of the motor. Mounted on this frame-work, D, is a segment-shaped ratchet bar, G; a holding pawl, *f;* and electro-magnets, H, all hereinafter referred to.

I, designates the commutator brushes.

In the present instance the commutator end of the armature shaft, B′, is extended beyond the outside of the bearing-block C′, and has mounted thereon an eccentric, E, fastened by a key, *a;* around this eccentric is a split eccentric strap comprising two parts, *b*, *b′*, held together by suitable bolts, b^3. The upper half, *b*, of the eccentric strap has a threaded socket, b^2, to receive one end of an eccentric rod, E′, on the other end of which is mounted a yoke, F, having two arms, *c*. The ratchet pawl, G′, is pivoted on a pin, *d′*, between the said arms, *c*, and its free end engages the teeth, *d*, of the segment-shaped ratchet bar, G, connected with a hub which is pivoted on a stud, *e*, fixed to the upwardly-extending frame, D. The ratchet teeth, *d*, extend along only a portion of the length of the bar, G, and the remainder has a smooth surface. The ratchet-pawl previously referred to, has a depending arm, d^2, which engages the free end of a leaf-spring, d^3, attached to the yoke, F, the function of this spring is to keep the pawl in engagement with the teeth of the ratchet-bar, G. A holding pawl, *f*, pivoted on a stud, *f′*, also on the frame D, has a hook end, f^2, to also engage the teeth, *d*, of the segment ratchet bar, G. This pawl has a depending arm, f^3, to engage the ratchet pawl, G′, for a purpose hereinafter described. A pair of electro-magnets, H, have position on the frame, D, opposite the segment-ratchet bar, G, one end of each magnet core, *g*, being fastened in a rib or flange, *g′*, extending across the fixed ends of the magnets, said flange, *g′*, being integral with the frame, D. A longitudinally-movable rod, J, passes between the electro-magnets and one end extends through the flange, *g′*, which forms one bearing therefor. This extending end of the rod, J, is provided with a head, J^2, having a lateral hole which receives a cross-

pin, *i*. A pair of link-plates, L, one at each side of the head, J^2, have one end pivoted on the pin, *i*, and the other on the pin, *d'*, between the ratchet-pawl, G', and the arms, *c*, of the yoke, F. An additional bearing, g^2, on the frame, D, is provided for the other end of the rod, J. An armature, J', is fixed on the rod, J, between its bearings, *g'*, g^2, and extends crosswise of the same and coacts with the electro-magnets, H. A spiral-spring, *h*, around the rod, J, is interposed between the flange, *g'*, and armature, J', and serves to keep the armature normally away from the magnets, H. It will be seen that when the magnets, H, are not energized the armature, J', will not only be away from the magnets but the ratchet-pawl, G', and holding pawl, *f*, will be disengaged from the teeth of the ratchet-bar, G, which is thereby allowed to fall against a suitable stop, D', on the frame D. A contact-shoe, M, made up of a series of plates, *j*, adjacent to one another is pivoted on an arm, N, attached to the segment-shaped bar, G, but insulated therefrom. A plate, *j'*, of spring material, has one edge fixed to the said pivot-arm, N, and its other edge slitted to form a series of spring tangs, j^2, each of which bears on a corresponding plate, *j*, of the contact shoe, M. A series of contact plates, *k*, *k'*, k^2, &c., insulated from each other are respectively connected with a resistance coil, O. These contact plates are mounted on the frame, D, on an arc described from the pivot stud, *e*, and are successively engaged by the contact-shoe, M, which however, is always in engagement with one of them.

The operation is as follows:—When the motor is connected with the line, *l*, *l'*, by moving the switch, P, the current will flow along the line, *m*, through the shoe, M, resistance coil, O, armature, B, then along the line, *m'*, back to the switch; the current will also flow from line, *m*, along line, *n*, coil, A', of field-magnet and then return to line, *m'*, along line, *n'*; another portion of the current from main line, *m*, will flow along line, *o*, to electro-magnets, H, and then return along line, *o'*, to line, *m'*. The current by flowing as just stated will energize the field magnets and armature of the motor and at same time the electro magnets, H, which will attract and move the armature, J', against the action of the spring, *h*, whereby the pawls, G', and *f*, are brought into engagement with the teeth of the ratchet bar, G. Now as the current has also gone to the field-magnets and armature, the latter will be caused to rotate with its shaft, imparting motion to the eccentric which in turn reciprocates the eccentric-rod and pawl, G', which latter lifts the ratchet bar, G, one tooth at a time until the smooth surface of the ratchet bar reaches the said pawl whereupon the upward movement ceases; the holding pawl, *f*, coacting with and holding the bar elevated as the ratchet pawl, G', retracts. By this intermittent upward movement the shoe, M, connected with the ratchet bar, G, is moved over the contact plates of the resistance coil, beginning with the one of greatest resistance and gradually diminishing until the last plate is reached where there is practically no resistance. When the shoe, M, has reached this last plate, k^4, the pawl, G', simultaneously reaches the smooth surface on the ratchet bar, G, and consequently will not lift the bar any higher. When the shoe, M, has reached this last plate, k^4,—the point of lowest resistance—the said circuit is maintained thereat during the run of the motor. It will now be seen that when the current is shut off by the switch, P, the field-magnets, armature and electro-magnets will become inert, and consequently the pawls, G', and *f*, be disengaged from the ratchet bar, G, which will then fall and the shoe, M, again brought into contact with the plate, *k*, indicating the greatest resistance of the coil, whereupon the apparatus is in readiness for again starting the motor. It is obvious that a second pair of electro-magnets, H', indicated by broken lines in Figs. 1 and 4, could be placed in the circuit with the electro-magnets, H, and energized simultaneously therewith; this second pair of magnets would also be mounted on the frame, D, and would attract an armature Q', in broken lines, rigid on one arm of the ratchet bar, G, so that when the pawl, G', has raised the ratchet bar, G, as high as it can and is in engagement with the tooth adjoining the smooth surface; the magnet, H', will elevate the bar slightly higher to prevent the pawl hammering up against the said last tooth, but allow it to play freely on the smooth surface of the ratchet bar. It will also be seen that instead of connecting the starting and stopping mechanism as here shown, it could be driven independently, that is—a small motor could be employed and an independent circuit for this auxiliary motor and the electro-magnets, H, used, but said circuit made simultaneous with the one through the main motor which latter circuit passes only through the shoe, M, and resistance coil, O, of the starting mechanism. The two are in other respects independent of one another. It will be further observed that the two could be connected up mechanically, as for instance by a belt from the motor driving a shaft on which the eccentric is mounted and the electro-magnets suitably connected in the line circuit as it leaves the switch.

It will now be seen that the main object of my invention is to provide an automatic device for cutting out gradually the resistance to the current flowing to the motor when the same is turned on, so that when the motor is fully running there will be practically no resistance to the passage of the current, and when the current is shut-off to again introduce the said resistance automatically in readiness for again starting. By this means of controlling the flow of the current, the motor will always be governed by its load, that is—when the load is heavy the resistance

will slowly and gradually be cut out or diminished until the full speed and power is obtained, the motor starting up slowly, but when the load is light the motor will start up fast and the resistance rapidly cut-out or diminished thus allowing the motor to speed up quickly.

Having described my invention, I claim—

1. In an automatic starting device for electric motors, the combination of a motor; a resistance in series with the armature when starting the motor; a contact shoe engaging the resistance; and a direct mechanical connection between the armature and the contact shoe, whereby each revolution of the armature imparts to the contact shoe a positive movement and gradually cuts out the resistance from the armature circuit and maintains said circuit at the point of lowest resistance during the run of the motor.

2. The combination of a motor; a resistance coil in electrical connection with the armature; a movable contact device in circuit with said coil; a pawl and ratchet operated by the motor armature and adapted to impart to the contact device a limited movement in the direction which reduces the resistance of the armature circuit; and means for disengaging the pawl and ratchet when the supply of electricity is cut off.

3. In an automatic starting device for electric motors, the combination of a motor; a resistance in series with the armature when starting the motor; a contact shoe engaging the resistance; a direct mechanical connection between the armature and the contact shoe which is operative in the direction of cutting out the resistance from the armature-circuit, whereby said circuit is maintained at the point of lowest resistance during the run of the motor; and further means whereby the cessation of the current disengages the said mechanical connection and allows the contact shoe to return to its original position where the highest resistance is replaced, for the purpose set forth.

4. In an automatic starting device for electric motors, the combination of the field magnets; the armature; a resistance coil in series with the armature; a series of contact plates connected with the said coil; a movable ratchet bar; a contact shoe connected with said bar and movable over said contact plates; a ratchet pawl actuated by the armature; and means for causing the ratchet pawl to engage said ratchet bar and impart to it an intermittent movement only in the direction which reduces the resistance of the armature circuit, for the purpose set forth.

5. In a resistance controlling device for electric motors, the combination of the field-magnets; the armature; a resistance coil; a series of contact-plates each connected with the said coil; a movable ratchet bar; a contact-shoe connected with the said ratchet bar and moving over the contact plates successively; said field-magnets, armature, resistance coil and contact shoe all being connected with a line circuit; a reciprocating ratchet pawl to engage the said ratchet bar and impart an intermittent movement to it and the contact shoe; and means to disengage the pawl from the ratchet bar when the motor circuit is broken to allow the ratchet bar and contact shoe to return to their normal position.

6. In a resistance controlling device for electric motors, the combination of the field-magnets; the armature; the armature shaft; a resistance coil; a series of contact plates each connected with the said coil; a contact shoe to engage the said plates and in circuit with the resistance coil, field-magnets, armature and line circuit; a movable ratchet bar; a ratchet pawl to engage the ratchet bar and impart an intermittent movement to it and to the contact shoe; an eccentric on the armature shaft to reciprocate the ratchet pawl; a spring to co-act with the ratchet pawl and keep it away from the ratchet bar; and an electro-magnet energized simultaneously with the field-magnets and armature to co-act with the said ratchet pawl and place it into engagement with the ratchet bar against the action of the spring.

7. In a resistance controlling device for electric motors, the combination of the field-magnets; the armature; the armature shaft; a resistance coil; a series of contact plates each connected with the resistance coil; a contact shoe to engage the said plates and in circuit with the resistance coil, field-magnets, armature and line circuit; a movable segment-shaped ratchet bar; a ratchet pawl to engage the ratchet bar and impart an intermittent movement to it and to the contact shoe; an eccentric on the armature shaft to reciprocate the ratchet pawl; a spring to co-act with the ratchet pawl and keep it away from the ratchet bar; an electro-magnet energized simultaneously with the field-magnets and armature to co-act with the said ratchet pawl and place it into engagement with the ratchet bar against the action of the spring; and a holding pawl to engage the ratchet bar but like the ratchet pawl dependent upon said electro-magnets and spring.

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

GEORGE H. WHITTINGHAM.

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