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AUTOMATIC STARTER FOR CONTINUOUS CURRENT ELECTROMOTORS.

APPLICATION FILED MAR. 12, 1907.

913,437. Patented Feb. 23, 1909.

Fig. 1.

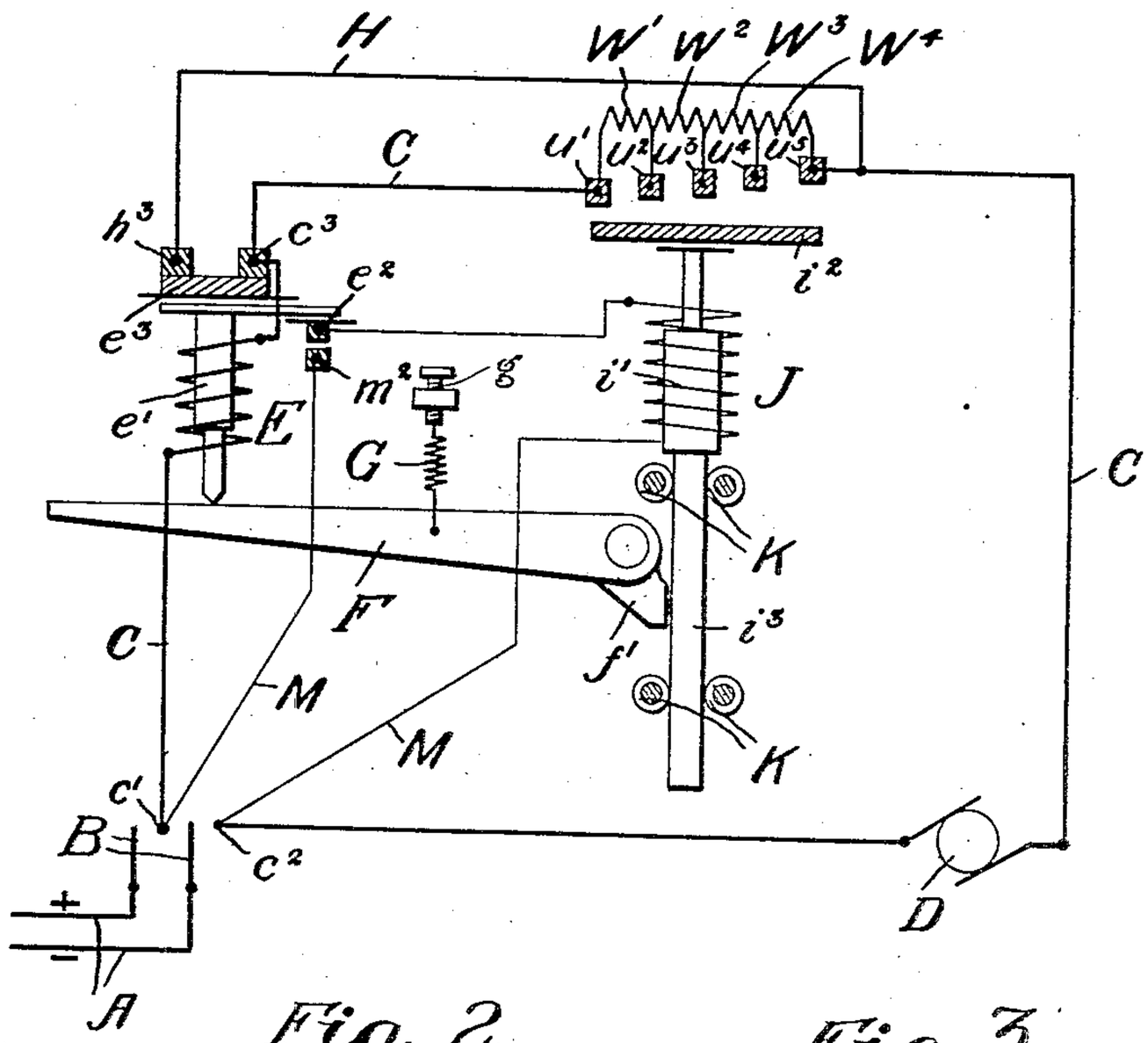


Fig. 2.

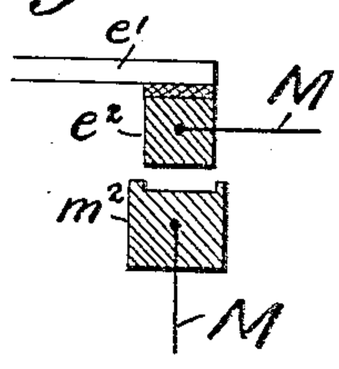
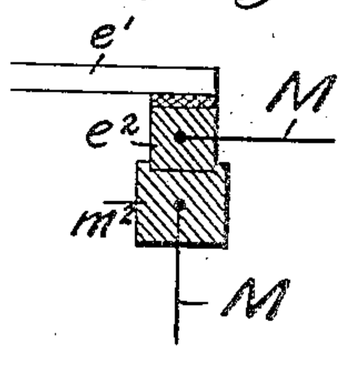


Fig. 3.



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UNITED STATES PATENT OFFICE.

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AUTOMATIC STARTER FOR CONTINUOUS-CURRENT ELECTROMOTORS.

No. 913,437. Specification of Letters Patent. Patented Feb. 23, 1909.

Application filed March 12, 1907. Serial No. 362,072.

To all whom it may concern:

Be it known that we, GUSTAV A. SCHOELLER, residing at 2 Gustavstrasse, Mülheim-on-the-Ruhr, Germany, and HERMANN SUNDHAUSEN, residing at 43 Rüttenscheiderstrasse, Essen-on-the-Ruhr, Germany, both subjects of the Emperor of Germany, have invented a certain new and useful Improvement in Automatic Starters for Continuous-Current Electromotors, of which the following is a specification.

The present invention relates to an automatic starter for direct-current electromotors.

An object of the invention is to provide a starter in which the current strength may be as high as desired and which may be regulated by changing the tension of a spring.

A further object is to provide a starter which insures the motor against overload without interrupting the running.

Other and further objects will appear in the following description and will be more particularly pointed out in the appended claims.

In the drawings:—Figure 1 is a diagrammatical view of the invention, the starter being in the position of rest. Fig. 2 is a view of the contacts in the solenoid circuit, said contacts being spaced apart, and Fig. 3 is a view of the solenoid-circuit contacts, closed.

A are the electric mains or line wires to which the armature or main circuit C of the electro-motor D can be connected through the medium of the switch B and the contacts c', c^2. In the armature or main circuit C the starting resistances W′, W², W³ and W⁴ and the maximum current operated means or a solenoid E are inserted. The armature e' of the solenoid E is provided with two contacts e^2 and e^3 which are insulated from each other and from the armature. A lever F, which is under the action of a spring G of regulable tension by the screw g tends to hold the armature e', of the solenoid in the position shown in the drawing in which the contact e^3 through connection of the contacts h^3 and c^3 acts as switch to connect to the armature or main circuit, a short circuit H extending parallel the starting resistances. In this position the armature e', the motor is, therefore, in cuit with the mains and the resistance is out.

J is the main starting solenoid which forms means for gradually cutting out the resistance. The armature i' of this solenoid carries a contact or switch i^2 which, when the armature moves, is successively brought into contact with the contacts u', u^2, u^3, u^4 and u^5 of the starting resistances, that is to say, it can successively short-circuit or cut out the several resistances. The armature i' carries an extension i^3, guided by rollers K, and its movement can be braked by means of a cam f' on the lever F. Two contacts m^2 and e^2 (Figs. 2 and 3) acting as a switch are inserted in the starting solenoid circuit M which is connected to the contacts c' and c^2 of the armature or main circuit, said solenoid circuit being in shunt with the latter circuit. As above mentioned, the contact e^2 is connected to the armature e' of the maximum current solenoid. The other contact e^2 is constructed and arranged in such a manner that, when the circuit is closed, the contact can move a little without leaving the contact m^2 (as for instance a spring-contact, a plunger-contact or a sliding contact). In that position of the armature e' which is shown in the drawing, the contacts m^2 and e^2 do not contact and the shunt circuit M is, therefore, open.

When the armature or main circuit C is connected to the mains by means of the switch B, the current passes from the contact c' through the coil of the maximum current solenoid or electro-magnet E, to the contact c^3, thence through the contacts e^3, h^3, the shunt circuit H and the armature of the motor D to the contact c^2. The motor is, therefore, connected to the mains without starting resistances. Due to the lack of a counter electro-motive force in the motor, the current strength in the armature circuit increases immediately after the motor is switched in. As soon as the current strength has reached the amount permissible for the running of the motor, that is to say, as soon as it has increased so much that the magnetic force acting on the armature e' of the solenoid E can overcome the resistance of the lever F, which is under the action of the spring G, the armature e' of the solenoid E is attracted against the action of the spring G. The shunt circuit H is then first disconnected from the armature circuit C so that the entire current must pass through

the starting resistances thus throwing the resistances in the main circuit. Furthermore, the cam f' of the lever F is pressed against the extension i^3 of the armature i' of the starting solenoid or electro-magnet J thereby preventing movement of the starting solenoid. At the same time, the contacts e^2, m^2 enter into contact with each other and close the shunt circuit M of the starting solenoid, which exerts a pull on its armature i', which, however, at first is not strong enough to overcome the braking action of the lever F. In the meantime, the motor has been set in motion. When the speed of rotation of the motor increases, the counter electro-motive force of the motor increases, while at the same time the current strength in the armature or main circuit decreases. The attracting force of the maximum current solenoid E decreases and the braking force of the lever F becomes correspondingly smaller. In spite of the decrease in current strength, the shunt circuit M remains closed because as aforesaid, the contact e^2 can move a short distance without coming out of contact with the contact m^2.

The upward movement of the armature e' is really practically equal to nothing, because, as soon as the attraction of the maximum solenoid E decreases, to become equal to the opposing pulling force of the spring G, the pressure or friction between the cam f' and the extension i^3 becomes equal to nothing. When the friction reaches a certain amount, the attraction of the starting solenoid J overcomes the braking action of the lever F and the armature i' commences to move and short-circuit the first step (W') of the starting resistance. The current strength in the armature or main circuit then immediately increases. This proceeding is repeated until all the starting resistances are short-circuited and the motor has obtained its normal speed. As the current strength has then been lowered to operating current strength and a new current shock does not any longer take place, the pressure, which the lever F effects on the armature e' due to the action of the spring G, overcomes the attraction of the maximum current solenoid and brings the contact e^3 of the armature into contact with the contacts h^3 and c^3, thereby connecting the circuit H to the armature circuit C. At the same time, the shunt circuit M of the starting solenoid is interrupted due to the removal of the contact e^2 from the contact m^2, (Figs. 2 and 3) and the cam f' of the lever F recedes from the armature i' which consequently drops down into its original position shown in the drawing. The current now takes the same course as immediately upon the switching in of the motor.

The above-described starter presents the advantage that the current strength for starting the motor can be selected as high as desired and can be regulated by changing the tension of the spring G. Moreover, the starter insures the motor against overload without effecting a stopping of the operation in case of overload, as is the case with lead safety fuses. As soon as the current strength, which increases due to overloading the motor, has reached the amount of the starting current strength, the maximum current solenoid again enters into operation and switches in the starting resistance in front of the armature of the motor. Simultaneously with this, the starting solenoid is switched in. When the overload has been removed, the speed of rotation of the motor is again automatically brought to its normal amount in the aforesaid manner through the short-circuiting or cutting out of the resistances. As the starting solenoid is without current after the starting of the motor has been effected and as the maximum current solenoid presents only a slight resistance, the starter uses only little energy and is, therefore, economical.

Having thus described our invention, what we claim as new therein and desire to secure by Letters Patent is:

1. In a starter for continuous current electro motors, the combination with the resistance, of a maximum current operated means throwing in the resistance, and means gradually cutting out the said resistance, and controlled by the maximum current operated means.

2. In a starter for continuous current electro motors, the combination with the resistances, of a shunt about the same, a maximum current solenoid controlling said shunt circuit, and a starting solenoid for cutting out the resistances, having its circuit closed by the maximum current solenoid.

3. In an automatic starter for continuous current electric motors, the combination with the main circuit and the resistances in the main circuit, of a shunt circuit about the resistances, a solenoid operated to cut out the shunt circuit upon a maximum current in the main circuit, a cut out for the resistances, a solenoid operating said cut out and in shunt with the main circuit, and connection between the main current solenoid and the shunt circuit of the other solenoid, to throw in the latter shunt circuit and operate the solenoid thereof.

4. In an automatic starter for continuous current electric motors, the combination with the resistance, of a shunt circuit about the same, and means operated by a maximum current, to first cut out the shunt circuit to throw in the resistance and then to gradually cut out the resistance.

5. In an automatic starter for continuous current electric motors, the combination with

the main circuit, and resistance therein, a shunt circuit about the resistance, of a maximum current solenoid constructed to cut out the shunt circuit to cause the full current to pass through the resistance, a starting solenoid, a circuit for the starting solenoid closed when the maximum current solenoid attracts its armature, and broken when the latter solenoid releases its armature, and means operated by the starting solenoid to cut out the resistance.

6. In an automatic starter for continuous current electric motors, the combination with the resistance, of a maximum current operated means throwing in the resistance, means for cutting out said resistance, operated by the maximum current operated means, and a brake for the means cutting out the resistance, controlled by the maximum current operated means.

7. In an automatic starter for continuous current electric motors, the combination with the main circuit and the resistance therein, of a maximum current solenoid, a starting solenoid controlled by the maximum current solenoid and cutting out the resistance, and a brake for the armature of the starting solenoid, controlled by the maximum current solenoid.

8. In an automatic starter for continuous current electric motors, the combination with the main circuit and the resistance therein, of a maximum current solenoid, a starting solenoid controlled by the maximum current solenoid and cutting out the resistance, a brake for the armature of the starting solenoid, controlled by the maximum current solenoid, and a shunt circuit about the resistance, closed by the maximum current solenoid when it is in its inoperative position.

The foregoing specification signed at Dusseldorf, Germany, this sixteenth day of February, 1907.

GUSTAV A. SCHOELLER.
HERMANN SUNDHAUSEN.

In presence of—
M. ENGELS,
ALFRED POHLMEYER.