S. H. KEEFER.

MOTOR CONTROLLING APPARATUS.

APPLICATION FILED APR. 14, 1910.

967,782.

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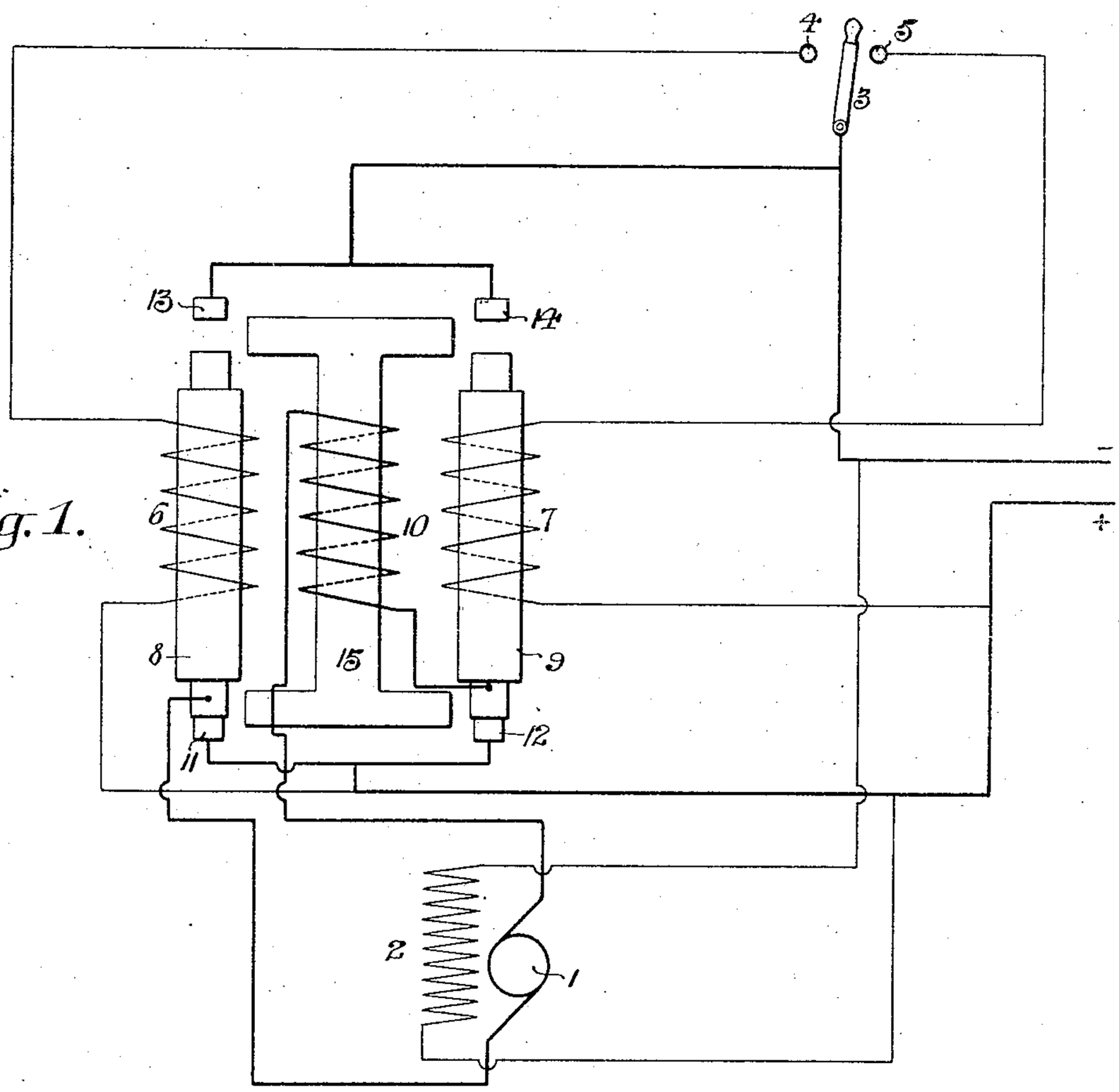


Fig. 1.

Fig. 2.

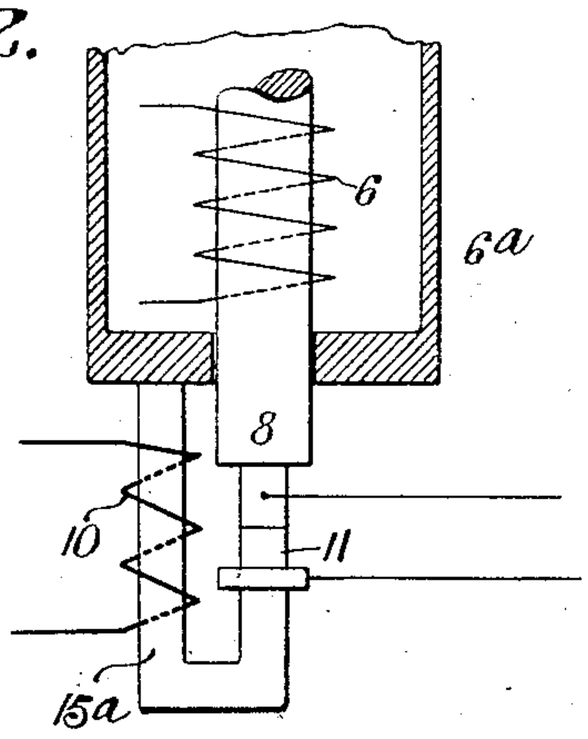
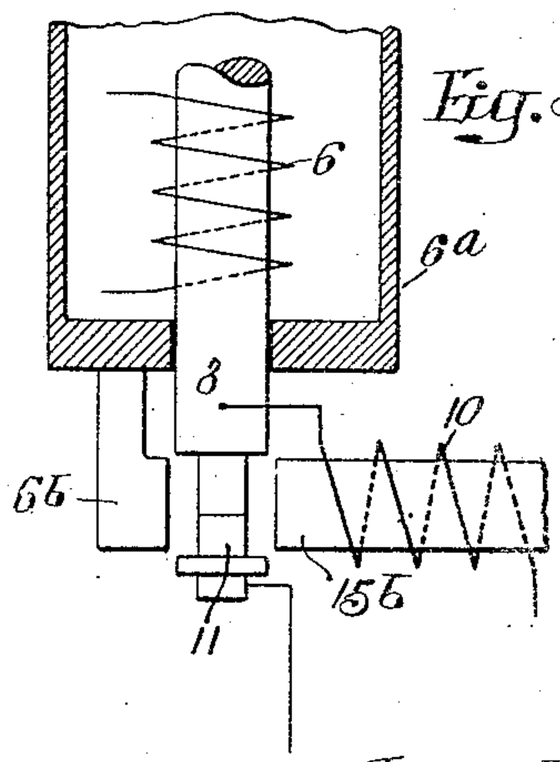


Fig. 3.



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UNITED STATES PATENT OFFICE.

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MOTOR-CONTROLLING APPARATUS.

967,782. Specification of Letters Patent. Patented Aug. 16, 1910.

Application filed April 14, 1910. Serial No. 555,340.

To all whom it may concern:

Be it known that I, SAMUEL H. KEEFER, a citizen of the United States, residing in Plainfield, county of Union, State of New Jersey, have invented certain Improvements in Motor-Controlling Apparatus, of which the following is a specification.

One object of my invention is to provide a novel and relatively simple as well as efficient combination of apparatus, particularly designed for the control of reversing motors, which shall prevent current being delivered to the motor after it has once been cut off from the same until the speed and consequently the counter E. M. F. has fallen to a predetermined low point.

Another object of my invention is to provide a novel form of magnetically operated motor reversing switch whose construction shall be such that even though the pilot switch controlling the energization of the solenoids of said reversing switch is so operated as to supply current to one of them, it shall not be possible for said reversing switch to operate to deliver current to the motor until the counter E. M. F. of said motor has fallen to a predetermined low point.

I further desire to provide a magnetically actuated reversing switch with a blow-out magnet so arranged and constructed that said magnet, in addition to its regular functions, shall be capable of acting to produce a magnetic flux opposing operation of the switch under certain conditions.

These objects and other advantageous ends I secure as hereinafter set forth, reference being had to the accompanying drawings, in which;—

Figure 1, is a diagrammatic view illustrating a motor controlling system having its parts arranged according to my invention, and Figs. 2 and 3, are fragmentary vertical sections, partly diagrammatic, illustrating the detail construction of a portion of a reversing switch designed in accordance with my invention.

In the above drawings, 1 is the armature and 2 is the field winding of the electric motor whose starting, stopping, and direction of rotation are to be controlled; these operations being governed by means of a pilot switch 3 which has two contacts 4 and 5.

The reverse-controlling switch of the motor includes two solenoid windings 6 and 7, respectively operative upon cores 8 and 9; one terminal of the motor armature 1 being connected to the core 8 and the other terminal being connected to the core 9 through the winding 10 of the blow-out magnet. The cores 8 and 9 are in the present instance designed to be longitudinally movable under the action of their windings, though under normal conditions, the lower end of the core 8 engages the contact 11, while the lower end of the core 9 similarly engages the contact 12. When the winding 6 is energized, the core 8 is moved upwardly into engagement with a contact 13 and under similar conditions the core 9 is moved into engagement with a contact 14. The two upper contacts 13 and 14 are connected together and to one of the current supply mains, while the contacts 11 and 12 are similarly connected to each other and to the second current supply main. The fixed core 15 of the blow-out magnet is provided with a cross member or an equivalent construction at each of its ends, so that it has a pole piece respectively adjacent the planes or areas of engagement of the core 8 with the contacts 11 and 13 and of the core 9 with the contacts 12 and 14. The arrangement is such that if the motor circuit be broken between any of these various pairs of contacts, the magnetic flux set up by the blow-out magnet acts in the well known manner to extinguish the arc formed.

The windings 6 and 7 of the two solenoids are both connected together at one end and to one of the current supply mains, while their opposite ends are respectively connected to the terminals 4 and 5 of the pilot switch. The placing of the core of the blow-out magnet with relation to the cores 8 and 9 of the solenoids, is such that if the winding 6, for example, be energized by moving the handle of the pilot switch into engagement with the contact 4, while current is flowing through the winding 10 of said blow-out magnet, the flux set up by this latter in its core and in the core 8, results in said latter core being held in its lower position in engagement with the contact 11, until the flow of current in the blow-out magnet winding has fallen to a predetermined low point. I utilize this characteristic of the apparatus to prevent injury to the motor as hereafter noted, and in starting said motor, the energization of the

winding 6 will move the core 8 into engagement with the contact 13, thus permitting current to flow from one of the current supply mains to the contact 12, core 9, blow-out magnet winding 10, motor armature 1, core 8, contact 13, and thence to the second current supply main; it being understood that the circuit of the field magnet winding of the motor was previously closed. If now, the handle of the pilot switch 3 be moved out of engagement with the contact 4, the consequent deënergization of the winding 6 permits the core 8 to drop into engagement with the contact 11, thus short-circuiting the motor armature through the blow-out magnet winding 10, with the result that the said armature is shortly brought to rest by reason of the braking effect of the current generated. If, however, the handle of the pilot switch be moved directly from the contact 4 into engagement with the contact 5, the winding 7 is immediately energized and tends to raise its core 9 which would result in a reversal of the motor. Such sudden reversal of the current supply would be almost certain to injure, if not destroy the motor, but, owing to the fact that the blow-out magnet is energized by the dynamic or braking current which flows almost immediately after the core 8 has engaged the contact 11, the flux produced by the said magnet holds the core 9 from moving. Such retarding or holding action is maintained until the speed of the motor, and consequently its counter E. M. F. has so far fallen that the reversal of the current flow in the motor armature would not be injurious, and when this point has been reached, the effect of the winding 7 overcomes the effect produced by the blow-out magnet 10, thereby raising the core 9 and causing its upper end to engage the contact 14. Such engagement then permits current to flow to the armature of the motor in a direction the reverse of that hitherto noted, and thus reverse its direction of rotation.

The arrangement and design of the various parts is such that when the winding 10 is energized and either of the cores 8 or 9 is in its raised position, the flux produced by said winding tends to maintain it raised, or if it be in its lower position said flux tends similarly to maintain it in this position. Further when the machine 1—2 is operating as a motor and current is passing through the winding 10, neither of the cores 8 nor 9 moves under the action of the flux set up by said current flow and since both of the cores are necessarily in their lower positions before current generated by the armature 1 can flow through the winding 10, such current flow does not act to raise the cores, but tends rather to maintain them in their lower positions.

It is obvious that the actual arrangement of the pole pieces of the blow-out magnet for accomplishing the above desired end may be very widely varied without departing from my invention, and in Figs. 2 and 3, I have shown two of such variations. In the first of these figures the solenoid having the winding 6 is illustrated as provided with an iron casing, in the lower part of which is supported a core 15^a for the reception of the winding 10; this core having its lower end turned upwardly so as to provide the contact 11. When the winding 10 is energized, the magnetic flux passes through the core 15^a, the core 8, and a portion of the iron casing 6^a of the winding 6, and thereby retards movement of the core 8 or altogether prevents such movement until current in said winding 10 has fallen to a predetermined point or ceases altogether.

In the form of magnet shown in Fig. 3, the contact 11 is supported in any suitable manner, and the pole piece 15^b of the blow out magnet winding 10 is so arranged as to terminate on one side of the plane of the contact between the core 8 and the fixed contact 11. An auxiliary pole piece 6^b projects downwardly from the solenoid casing 6^a on the other side of the core 8 and contact 11, so as to be directly opposite the pole piece 15^b, with the result that, as before, the winding 10 sets up such a flux between the pole pieces 15^b and 6^b that the movement of the core 8 is retarded or altogether prevented, even though the solenoid winding 6 be energized, until the current flowing in the armature 1 has fallen to the desired safe, low point.

As will be obvious to those skilled in the art, there are a number of ways in which the blow-out magnet 15 may be made effective in retarding the action of the cores 8 and 9 or in positively preventing such action for a predetermined period in order to accomplish the desired result, for by varying the proportions and arrangement of the various windings, 6, 7, and 10, these latter may be made to re-act on each other in different ways. In any case, however, the movement of the cores 8 and 9 to connect the motor with the current supply mains, is prevented or retarded by direct magnetic action, in contra-distinction to a forcibly acting mechanical device such as is described and claimed in my application for Patent No. 526,932, filed November 8, 1909, or to the electro-mechanical means described and claimed in my application for Patent No. 526,931, filed November 8, 1909, according to which the circuits of the windings 6 and 7 are kept open until such time as it is safe for the motor to be supplied with current.

I claim;—

1. A system including a motor; a reversing switch therefor including two solenoids; means for controlling the energization of said solenoids; and a winding having a core

placed to magnetically act on the movable members of said solenoids to prevent movement thereof when the motor is running, until the counter E. M. F. of said motor has fallen to a predetermined amount.

2. A system including a motor; electromagnetic reversing means therefor including a solenoid; contacts governed by the movable member of the solenoid; and a blow out magnet for extinguishing arcs formed between said contacts; said blow out magnet being placed to magnetically coöperate with the movable member of the solenoid to retard operation of the same until the counter E. M. F. of the motor has a predetermined value.

3. A system including a motor; electromagnetic reversing means therefor including two solenoids; a plurality of sets of contacts controlled by said solenoids; and a blow-out magnet for extinguishing the arcs formed between the contacts; said blow out magnet also coöperating with the movable elements of the solenoids to retard action thereof under predetermined conditions until the counter E. M. F. of the motor has fallen a predetermined amount.

4. A system including a motor; electromagnetic reversing means therefor including two solenoids; a plurality of sets of contacts governed by said solenoids; with a blowout magnet connected in circuit with the armature of the motor and operative on all of the contacts; said magnet and solenoids being constructed to mutually coöperate to prevent operation of the movable solenoid members until the counter E. M. F. of the motor falls to a predetermined amount.

5. The combination of a solenoid having a movable core; a contact carried thereby; a fixed contact placed to coöperate with said core-carried contact; with a blow-out magnet placed to extinguish the arcs formed at said contacts; said blow-out magnet being capable of co-acting with the core to retard movement thereof.

6. The combination of a solenoid having a case and a core, both of magnetic material; a pair of contacts governed by said core; and a winding placed to coöperate with the solenoid winding so as to retard action of the core under predetermined conditions; said winding including in its magnetic circuit the core and case of the solenoid.

7. The combination of a solenoid having a case and a core both of magnetic material; a pair of contacts placed to be governed by the core of the solenoid; a pole piece connected to the case of the solenoid and extending adjacent to the point of engagement of the contacts; with a magnet placed to set up a flux in the space between the contacts when these are separated, and also capable of coöperating with the pole pieces and the case of the solenoid to prevent movement of the core under predetermined conditions.

8. A system including a motor; a reversing switch therefor including two solenoids having substantially parallel cores; means for governing the action of said solenoids; and a magnet having pole pieces extending adjacent said cores in position to magnetically act thereon to prevent their movement when the motor is operating as a generator until the counter E. M. F. of said motor has fallen to a predetermined amount.

9. A system including a motor; a reversing switch therefor including a pair of electro-magnetic devices; and a single winding mounted between said devices provided with laterally projecting pole pieces placed to cooperate with said devices to prevent their action when the motor is operating as a generator until its counter E. M. F. has fallen to a predetermined amount.

In testimony whereof, I have signed my name to this specification, in the presence of two subscribing witnesses.

SAMUEL H. KEEFER.

Witnesses:
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J. T. MACMURRAY.