

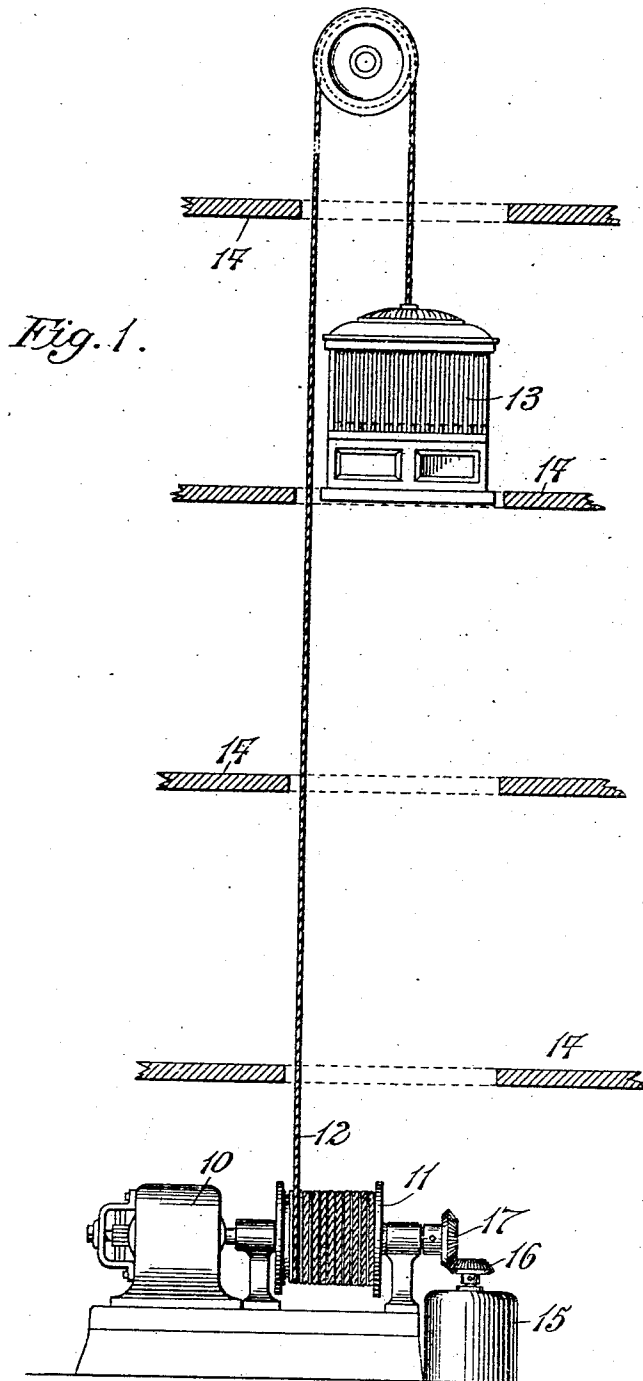
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A. E. HANDY.
AUTOMATIC MOTOR CONTROLLER.
APPLICATION FILED MAR. 31, 1909.

948,560.

Patented Feb. 8, 1910.

3 SHEETS—SHEET 1.



Witnesses:
Edward A. Bowland,
H. G. Butler,

Arthur E. Handy Inventor
His Attorney *Armstrong*

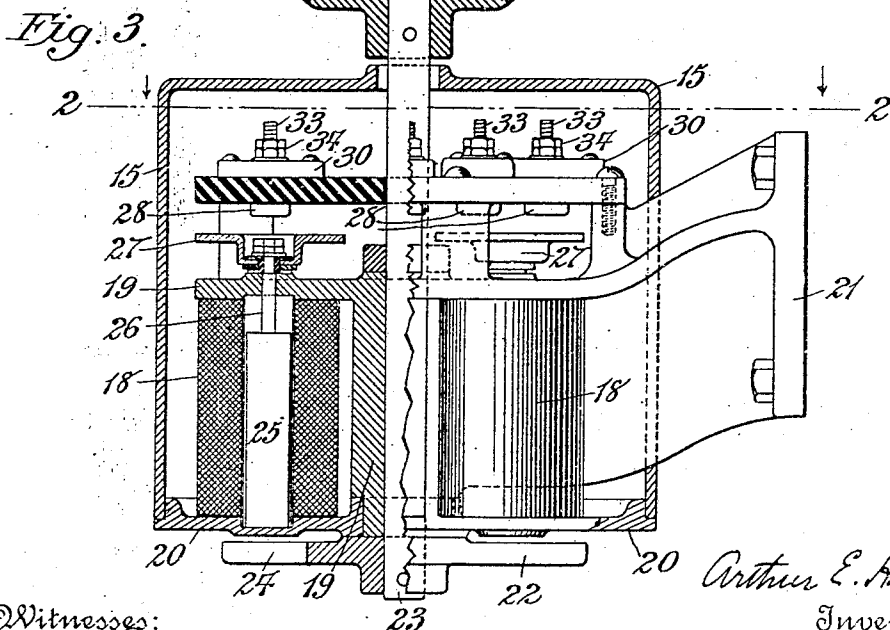
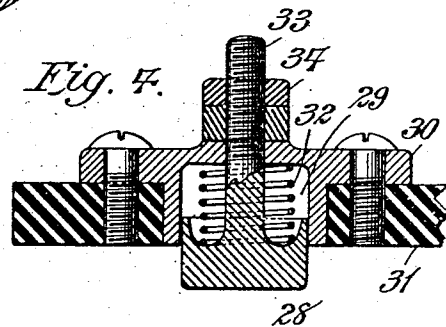
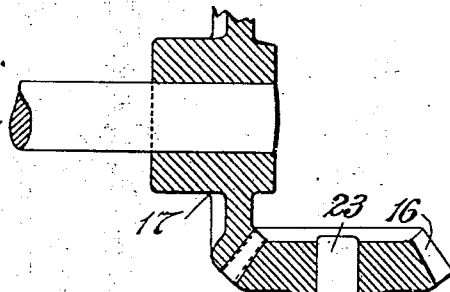
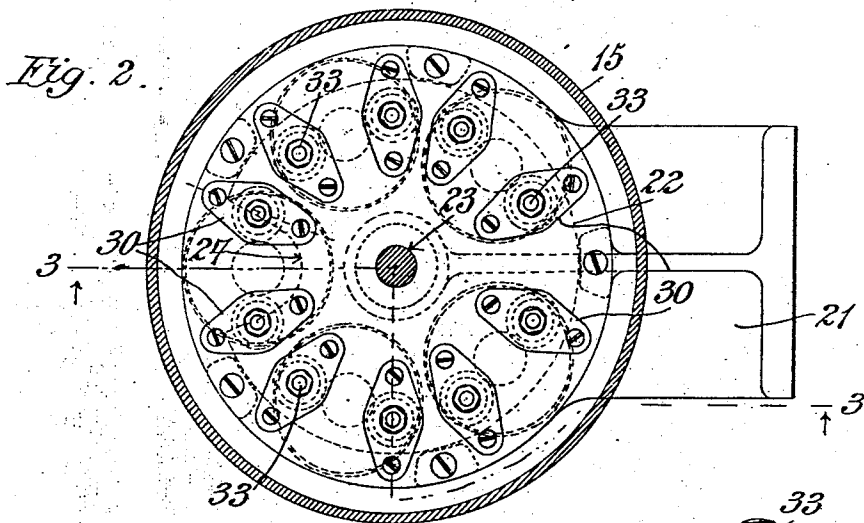
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W. A. Butler.

Arthur E. Handy
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Fig. 5.

The diagram illustrates an electrical circuit and a mechanical assembly. The circuit includes a battery (35, 36), a switch (48), a solenoid (37), a bell (41), and a relay (42). The mechanical assembly includes a solenoid (47) connected to a lever (46) with contacts (45, 44) and a complex contact assembly (43, 49, 22, 24, 23, 18, 33).

Witnesses:
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UNITED STATES PATENT OFFICE

ARTHUR E. HANDY, OF CRANSTON, RHODE ISLAND.

AUTOMATIC MOTOR-CONTROLLER.

948,560.

Specification of Letters Patent.

Patented Feb. 8, 1910.

Application filed March 31, 1909. Serial No. 486,988.

To all whom it may concern:

Be it known that I, ARTHUR E. HANDY, a citizen of the United States, residing in the town of Cranston, county of Providence, and State of Rhode Island, have invented a certain new and useful Improvement in Automatic Motor-Controllers, of which the following is a specification.

My present invention relates to improved apparatus for automatically changing the circuit conditions in electric motors.

When the starting circuit of an electric motor is first closed, the armature being at rest and opposing no counter-electro-motive force to the flow of current, it is essential that a certain amount of resistance should be in circuit with said armatures, to prevent excessive flow of current and consequent damage. As the armature takes on speed, however, counter-electro-motive force is created, and, in order that the requisite strength or amount of current may be maintained in the armature, the initial resistance must be gradually cut out of the circuit. Many devices have been proposed for accomplishing this end automatically in proportion as the electric motor speeds up; and my present invention, while belonging to this general class, covers and comprises a departure from former methods and structures employed for this purpose.

Certain illustrative forms of my preferred apparatus are shown in the accompanying drawings wherein—

Figure 1 shows the general arrangement of my device with relation to the principal elements of an electric elevator system, Fig. 2 is a horizontal section of an incased group of automatic switches, taken on the plane 2—2 of Fig. 3, Fig. 3 is a view in section on the plane 3—3 of Fig. 2 of the same group of automatic switches, showing the operative connection also illustrated in Fig. 1, Fig. 4 is a vertical sectional view in detail of one of the spring contacts, Fig. 5 is a diagram of circuits, Fig. 6 is a plan view of the rotary disk.

My invention involves a construction having the following advantages. The movable member which determines the operation of my controller is attached positively once for all to the motor itself or to some element positively connected thereto and moving therewith, and all necessity for adjustment to various loads is thus obviated, since the speed of the circuit controller is always pro-

portional to that of the motor; thus taking a longer time to cut out the armature resistance when the motor is heavily loaded and vice versa. Arcing and burning of contacts is avoided. A system of electro-magnetic switches is employed which is so arranged as to operate with a practically constant number of lines of force, arranged so that the successive action of any number of switches does not weaken the operating means for the others. A group of actuating coils is supplied so that by proper arrangement the disabling of one will not prevent successful use of the entire controller pending repairs, and so that a defective coil may be readily replaced in case of accident.

In Fig. 1 my improvement is shown applied to an electric elevator. This is one example of its use, but my invention covers the combinations claimed hereinafter, as applied to electric motors applied to any purpose.

The motor is shown at 10 in Figs. 1 and 6, and upon the armature shaft thereof is mounted the drum 11 over which passes the cable 12 whereby the elevator car 13 is supported.

At 14 are indicated the various floors.

The group of automatic switches which operate together to carry out the ends of my invention are placed within a casing 15, and the movable member whereby their proper operation is determined is positively connected, once for all, to the motor shaft by means of a beveled gear 16 meshing with a similar gear 17 on said shaft. Each automatic switch in the group is composed of a circuit changer affecting the motor circuits when appropriately moved and an actuating device for the circuit changer. These elements may take a great variety of forms without departing from my invention.

In the specific preferred form shown in Figs. 2, 3, 4, 5 and 6 the actuating devices consist of solenoids or hollow electro-magnets 18, set in a circle and supported by a two-part framework. One part of this frame, indicated by the numeral 19, is composed of iron or soft steel. It extends over the solenoids and forms a central core surrounded by them, which core is centrally bored. The part 20 of the supporting frame is a thin under plate of brass or other non-magnetic material. The casing 15 is carried by this lower plate. The supporting framework 19, 20, is in turn supported by an ap-

appropriate bracket 21 which passes through an opening in the side of the casing 15. In this preferred form described, the determining movable member positively connected to the movable member of the motor is a plate 22 made of iron or steel and arranged parallel and very close to the non-magnetic plate 20. This plate 22 is fixed to the lower end of a rotatable shaft 23 to the upper end of which is fixed the driven gear 16.

The plate 22 is cut out or notched deeply at one point, as shown at 24, (Figs. 3 and 6) and, as shown in dotted lines in Figs. 2 and 5, this notch is substantially as wide as one of the solenoids or magnets 18. The size and shape of this notch is not material to my invention, however, so long as it is calculated to cause a sufficient gap in the magnetic current of each solenoid in turn to effect the function described hereinafter. Each solenoid 18 has the usual movable core 25 which occupies the position shown in Fig. 3 when the solenoids are deenergized; and each core 25 carries a stem 26 projecting through the top of the solenoid and bearing a circuit-closing plate 27 insulated from said stem. The plate 27, is a part of the circuit-changing switch, and, when lifted by action of the solenoid, presses against a pair of conducting contact pieces 28 preferably constructed and arranged as shown in Fig. 4. There are two of these contact pieces over each plate 27.

As shown in Fig. 4, each contact piece 28 plays up and down in a cavity 29 on the under side of a metal plate 30 fixed to the insulating supporting plate 31. This plate 31 is supported directly above the tops of the solenoids 18. Within each cavity 29 is a spiral spring 32 surrounding a stem 33 on the contact piece 28 and tending to press said contact piece downward. Two nuts 34 on the end of the stem 33 serve at once to provide means of attachment for conducting wires and to limit the downward movement of the contact piece 28.

Referring now to the diagram shown in Fig. 5, the main line wires are shown at 35, 36. The field-magnet coils of the motor to be governed are shown at 37; the same being supplied with current over the branch wires 38, 39, and being preferably commanded by a switch indicated at 40. Ordinarily this field-magnet circuit is permanently closed. The armature (or preferred moving member) of the motor to be governed is shown at 41, being connected with the main line on one side by wire 42, and on the other, through the resistance coils 43 in series with each other, with one fixed contact 44 of the main motor-controlling switch. In the specific form shown this switch comprises two fixed contacts 44, 45, and a movable bridging contact piece 46, adapted to be lifted up against said fixed contacts by the solenoid 47,

when this last is energized. The fixed contact 45 is connected to the main line wire 35. One side of the coil on the solenoid 47 is connected to the wire 35 and the other side, through the primary controlling switch 48 which may be in an elevator car or elsewhere within easy reach of the operator, and, as illustrated, it is intended to typify any form of switch appropriate to the purposes had in view.

I have shown no means for reversing the motor, these being perfectly well known to those skilled in the art and needing no illustration in this connection.

It is to be noted that the two ends of each separate resistance coil 43 are connected respectively to the stems 33 of two contact pieces 28 directly over one plate 27 commanded by a solenoid 18. The coils of the solenoids 18 may be connected either in series or in multiple arc. In the form shown they are in series, being connected among themselves by wires 49 and current being brought to them when circuit is closed through the motor armature 41, by any appropriate means. In the form shown, one end of the series of solenoid coils is connected to the main line wire 36 by the conductor 50, while the other terminal is connected by the wire 51 to the "pig-tail" connection 52 fixed on the movable bridging piece 46.

The operation of the apparatus thus far described is as follows—When the motor is to be started, the field-magnet coils being already in circuit, the switch 48 is closed. This energizes the solenoid 47 which closes the armature circuit at 46, through the entire series of resistance coils 43, thus cutting down the initial current through the armature, as the motor begins to move. At the same time all the solenoids 18 are energized and a strong magnetic circuit is set up around each, including the magnetic portions 19 of the supporting frame and the plate 22 under the solenoids, which is, of course, rotating slowly at the same time as the motor armature, by which it is positively driven. At this time, the solenoid cores 25 all being in their lower position and the magnetic gap at their lower ends, next the plate 22, being smaller than that at their upper ends, these cores will remain in said lower position. But, as soon as the notch 24 comes under any one of the cores, a gap is created in the magnetic circuit under the corresponding solenoid, with the result that such core 25 will be at once drawn upward, until its plate 27 strikes the pair of contact pieces 28 directly above said plate, thus short-circuiting the particular resistance coil 43 whose terminals are connected to that pair of contact pieces 28. It will thus be seen that, immediately on closing the armature circuit, all of the coils 43 will be in circuit in series with each other and with the armature 41, and that, although

all of the solenoids 18 are simultaneously energized, they only act one by one in rotation, as the notch or gap 24 in the magnetic plate 22 is brought under said solenoids successively. This causes the successive short-circuiting of all the coils 43, until finally, after a predetermined travel of the armature 41 (by which time it has come up to full speed) the resistances are entirely short-circuited by the plates 27 and the armature receives the full voltage of the line. On the other hand, as soon as the armature circuit is broken to stop the motor, all of the solenoids 18 are deenergized and their cores all drop together, preparatory to a renewed operation. It will be seen that this mechanism will have the effect described in which ever direction the motor may be run, and in whatever position the plate 22 is found when the motor stops or starts. It may often occur, of course, that, when the motor stops, the gap 24 will be found directly beneath one of the solenoids. Under these circumstances, of course, that particular solenoid will act as soon as the motor circuit is established, but this does not interfere with the operation of my device, as I employ so many coils 43 that the absence of one of them at the start or by accident at any time will not injure the armature. This construction provides a magnetic system composed of radiating branch paths for the lines of force, which also pass through a common path at the central core 19.

The operation above described involves preservation of a total number of lines of magnetic force suffering very little fluctuation as the disk 22 revolves, and the moving members of the separate circuit changers are operated by a change in the distribution of lines of force in each solenoid separately, such lines being transferred to the top of each solenoid by reason of the increased magnetic resistance caused by the gap 24. This may be called transferring the magnetic balance. Thus each solenoid acts with continuing pressure to preserve a firm contact at the plate 27 carried by it.

It will be seen that I thus use a group of automatic switches whose operation is governed by a determining element which is positively and permanently connected to the moving part of the motor, whereby the cutting out of resistance, or other desired alteration in the motor circuit, is accomplished without the use of timed elements or parts needing adjustment.

Various changes may be made in the embodiment of my invention, and I do not limit myself to the details herein shown and described.

What I claim is—

1. In combination with an electric motor and the operating circuit thereof, a number of circuit-changers in said circuit, separate

electro-magnetic means arranged to operate said circuit changers individually by transfer of the magnetic balance in each, and means operated by said motor adapted to transfer the magnetic balance in each electro-magnetic means successively, substantially as described.

2. In combination with an electric motor and the operating circuit thereof, a number of circuit changers in said circuit, a separate solenoid for actuating each of said circuit changers, and means operated by said motor adapted to bring about a change in the distribution of lines of force in each solenoid successively for causing the same to operate its own circuit changer, substantially as described.

3. In combination with an electric motor and the operating circuit thereof, a number of circuit changers in said circuit, a separate solenoid for each circuit changer arranged to exert a positive pull upon the circuit-changer in one or the other direction according to the position of the lines of force in said solenoid, and means operated by said motor adapted to change the distribution of the lines of force in each solenoid successively for operating said circuit changers, substantially as described.

4. In combination with an electric motor and the operating circuit thereof, a number of circuit changers in said circuit, a group of solenoids for individually controlling said circuit changers, which solenoids are arranged to form branch magnetic circuits having a portion in common, a magnetic determining member adapted to move through the magnetic fields of all of said solenoids so as to successively transfer the magnetic balance in each without material fluctuation of their total magnetic flow, and means connected to said motor for operating said determining member, substantially as described.

5. In combination with an electric motor and the operating circuit thereof, a number of circuit changers in said circuit comprising each a solenoid core, a group of parallel solenoids surrounding said cores individually, a magnetic body having an interrupted portion adapted to move within the field of all of said solenoids, and means connected with said motor for so moving said body as to cause said interrupted portion to pass the end of each solenoid in succession, substantially as described.

6. In combination with an electric motor and the operating circuit thereof, a number of circuit changers in said circuit comprising each a vertically placed solenoid core, said cores being grouped around a central axis, solenoids surrounding said cores individually, a disk of magnetic material having a gap and adapted to revolve in a horizontal plane beneath all of said solenoids

within their magnetic field, and means connected to said motor for rotating said disk, substantially as described.

5 7. In combination with an electric motor and the operating circuit thereof, a number of circuit changers in said circuit, a separate electro-magnetic actuating device for each, means for closing circuit through the coils of all of said actuating devices simultaneously, and means operatively connected to
10 said motor for causing transfer of the magnetic balance in each of said devices successively, substantially as described.

15 8. In combination with an electric motor and the operating circuit thereof, a number of circuit changers in said circuit, a separate solenoid for actuating each circuit changer, a common magnetic circuit for all of said solenoids comprising a rotating portion having a gap at one point, and means operatively connected with said motor for moving said rotary portion, substantially as
20 described.

9. In combination with an electric motor and the operating circuit thereof, a number of circuit changers in said circuit, a separate solenoid for actuating each circuit changer,

a plate of magnetic material extending over one end of said solenoids, a magnetic core around which said solenoids are grouped, a
30 movable plate of magnetic material having a gap at one point and extending over the opposite end of said solenoids and means for rotating said plate, substantially as described.
35

10. In combination with an electric motor and the operating circuit thereof, a number of circuit changers in said circuit, a separate solenoid for actuating each circuit changer, a plate of magnetic material extending over
40 one end of said solenoids, a magnetic core around which said solenoids are grouped, a movable plate of magnetic material having a gap at one point and extending over the opposite end of said solenoids, a shaft extending through said core and fixed to said
45 plate, and an operative mechanical connection between said shaft and plate, substantially as described.

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