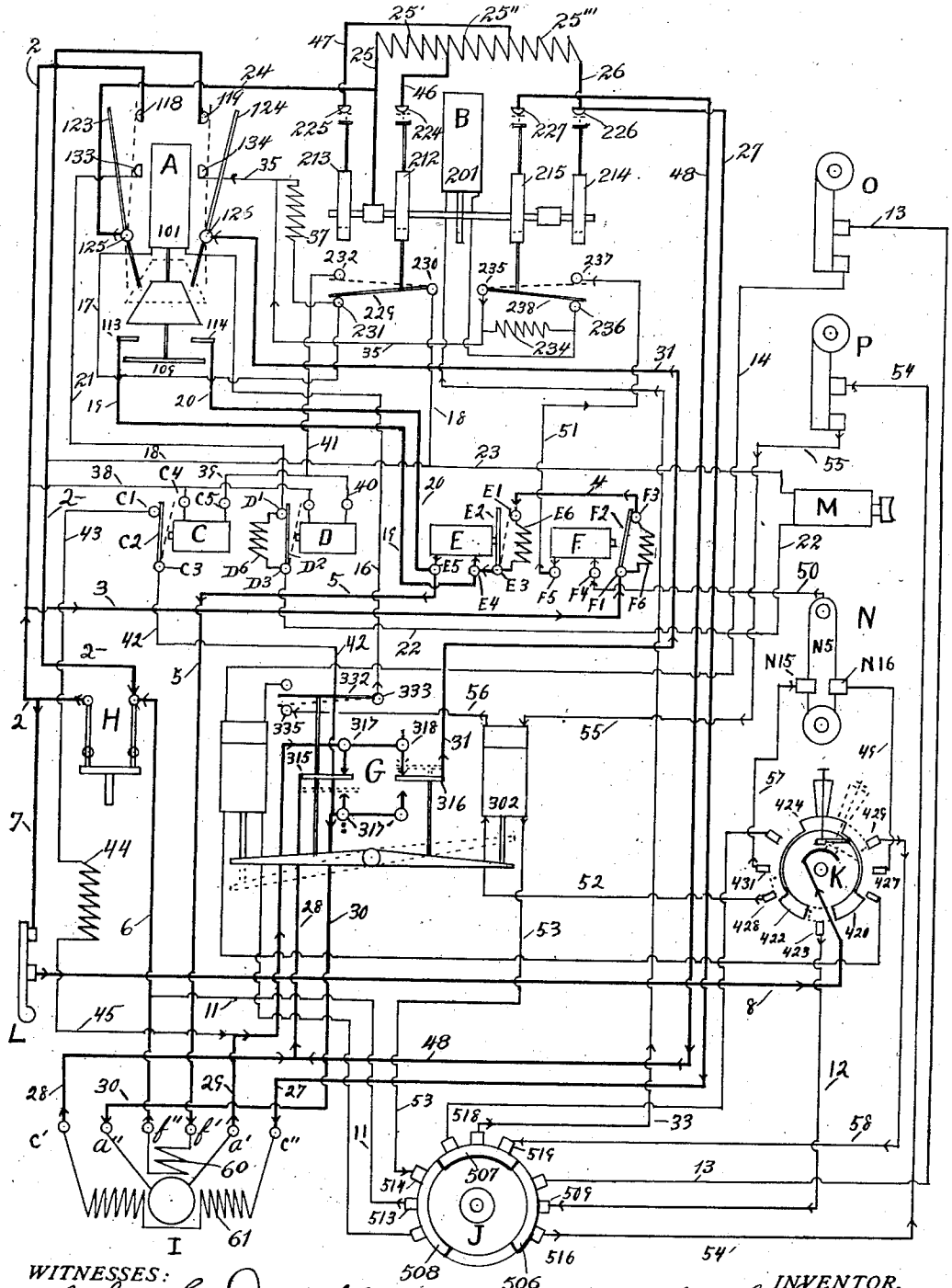
J. C. SMITH.

MOTOR CONTROL SYSTEM.

APPLICATION FILED JULY 31, 1911.

1,048,432. Patented Dec. 24, 1912.



WITNESSES:

John. G. Daeuble

Chas. Sauer

INVENTOR.

John C. Smith

BY

W. B. Mumell

ATTORNEY.

UNITED STATES PATENT OFFICE.

JOHN C. SMITH, OF LOUISVILLE, KENTUCKY.

MOTOR-CONTROL SYSTEM.

1,048,432. Specification of Letters Patent. Patented Dec. 24, 1912.

Application filed July 31, 1911. Serial No. 641,590.

To all whom it may concern:

Be it known that I, JOHN C. SMITH, a citizen of the United States, and residing at Louisville, in the county of Jefferson and State of Kentucky, have invented new and useful Improvements in Motor-Control Systems, of which the following is a specification.

This invention relates to the controlling of electric motors, and one of the objects is the provision of efficient means for securing a dynamic braking of the motor.

When current is cut off from the motor there is an induced current through the armature, in the opposite direction to the line current, if the field magnets are excited this will exert a retarding effect on the motor. This invention contemplates taking full advantage of the induced current in the armature by having the field magnets constantly excited. I accomplish this by having the shunt-field winding of the motor constantly connected to the line, or source of current supply.

After current is cut off from the motor the momentum of the load will drive the armature as a generator, the armature turning freely if the circuit is open, but if the armature is short circuited the retarding, or braking effect, will be so great as to bring the motor to a sudden stop. To regulate the braking effect resistances of the proper ohmage may be inserted in the circuit across the armature terminals.

With the foregoing and other objects in view, this invention consists of the novel construction of apparatus, and arrangement of circuits to be hereinafter referred to, and illustrated in the accompanying drawing, which forms a part of this specification, in which is set forth an embodiment of the invention, but it is to be understood that changes, variations and modifications may be resorted to that come within the scope of the claims appended hereunto.

The drawing is a diagrammatic view, or wiring plan, of the invention as applied to a motor for operating an elevator, showing in full lines the position in which the switches stand when the elevator is at rest, and in dotted lines the position assumed when the elevator is "going down." The circuits shown are illustrated and described in my copending application No. 636,825, filed July 5, 1911.

Referring to the drawing I indicates a compound-wound motor, the shunt-field winding of which is connected direct to the line, or source of current supply. The circuit being from the wall switch H by conductors 2 and 3 to the post F^1 on the switch F, through the lever F^2 to post F^3, by conductor 4 to contact post E^1, on the switch E, through resistance E^6 to post E^3, to post E^4, through the magnet coil to binding post E^5, thence by conductor 5 to motor terminal f', through the shunt-field winding 60 of the motor to terminal f'', thence by conductor 6 to the wall switch H. It will be seen that line current is supplied to the shunt-field and no provision is made to open, or short circuit it.

Provision is made to short circuit the resistance E^6 as follows; from the binding post E^4 a conductor 19 leads to a contact 113 on the main switch A, and from contact 114 conductor 20 leads to the binding post E^5. As the main switch A closes a contact piece 109 bridges the contacts 113—114, this short circuits the magnet coil of switch E, the lever E^2 drops and closes contact on the post E^1, the current will then flow through the lever E^2 and the shunt-field will receive full line current; this happens before the main switch closes so that the shunt-field is fully excited when current is given to the armature. The field magnet being excited when current is given to the armature, the motor speeds up quicker than if the lag in the field had first to be overcome. A dynamic braking circuit across the armature terminals, may be traced from the terminal a'', by conductors 30 and 42 to post C^3 on the switch C, through the lever C^2 to post C^1, by conductor 43 to and through resistance 44, thence by conductors 45 and 29 to terminal a'. This circuit is opened and closed by the switch C, the circuit operating the switch C may be traced from the wall switch H by conductors 2 and 38 to binding post C^4, by conductors 39 and 41 to contact post 232, through switch lever 229, when in position, to post 230, thence by conductors 18 and 2— to the wall switch H. From the foregoing it will be seen that the switch C is energized by the shifting of the switch lever 229 by the accelerating switch B. When the switch C is energized it attracts the lever C^2, thus opening the dynamic braking circuit. The dy-

namic braking circuit is not opened until the accelerating switch B starts to operate, this is an advantage in starting with a load that would drive the armature, before it receives sufficient current to overcome the torque caused by the load.

It will be observed that there are two resistance coils in the shunt-field circuit, E^6 regulating the amount of current necessary to secure the proper braking effect, as described, and F^6 to weaken the field for speeding up the motor, after the method well known in the art. The two coils are necessary because the amount of resistance required varies in each case. The resistance E^6 is cut in, and out, of circuit by the switch E as previously described, the resistance F^6 is cut in, and out, by the switch F, the circuit operating which is adapted to be closed by a manually operated switch K in the elevator car, the closing of the circuit being controlled by the accelerating switch B through medium of the switch lever 234, the object being to prevent the operation of switch F until the accelerating switch has completed its cycle of operations. A slow down switch N is included in the circuit from the switch K, that operates the switch F. Two conductors lead from the car switch K to the slow down switch, one from each side of the switch K. Conductor 49 leading from contact 427 on the "upside" to contact N^{16}, this being the circuit when the car is going up. Conductor 57 leading from contact 431 to contact N^{16}, this being the circuit when the car is going down. From the slow down switch a conductor 50 leads to the speeding up switch F. It will be observed that the shifting of the arm N^5 will open one of the circuits from the car switch to the speeding switch at N^{15} or N^{16}, and that the speeding switch cannot again be operated, on that circuit until the lever N^5 is restored, although it may be operated over the other circuit. The slow down switch is carried on the elevator car and the lever N^5 is shifted by stationary guides on the elevator supports, as described in my copending application No. 641,591, filed July 31, 1911.

The direction in which the armature rotates is governed by the direction of the current therethrough and this is controlled by a manually operated switch, this switch may be placed in any convenient location, but when the motor is used in connection with an elevator it is placed in the elevator car. The reversing switch is well known in the art and may be of any desired construction, though preferably I make use of that shown, and described in my copending application No. 636,825 filed July 5, 1911. The manually operated switch may be of any desired construction, in which a contactor is adapted to be brought into contact with a series of contacts, when shifted in either direction from a normal position of rest. Referring to the drawing, current is given to the switch K from the wall switch H by conductors 2 and 7, slack cable switch L and conductor 8. Moving the switch K to the right (the down direction) will bring the elevation 422 into contact with the contact finger 428, giving current to the reversing switch, the circuit to, and through, the down solenoid 302, thence by conductor 53 to contact finger 514 on auto limit switch J, from contact finger 513 thereon by conductors 11 and 6 to the wall switch H. This will set the reversing switch G, and the pilot-switch lever 332 in the position shown by the dotted lines, all other parts remaining as shown in full lines. Further movement of the switch K will bring elevation 420 into contact with contact finger 423, this will give current to the main switch A, the circuit being to, and through the auto-limit switch J thence by conductor 54 to the lower limit switch P thence to, and through, a locking coil on the solenoid 302, thence to contact 335, through pilot-switch lever 332, thence to, and through, the coil 101 of the main switch A, thence to, and through pilot-switch lever 229, by conductors 18 and 2— to wall switch H. This closes the main switch A, the parts assuming the position shown in dotted lines. As the main switch closes the contactor 109 bridges contacts 113—114 closing the shunt around the switch E, as previously explained. Further movement of the switch K will bring elevation 424 into contact with contact finger 429, this will give current to the accelerating switch B, as follows, from contact finger 429 by conductor 58 to contact 519 on the auto-limit switch J, from contact 518 thereon by conductor 33 to, and through pilot-lever 238 to post 235, thence by conductor 35 to, and through the main switch A, and conductor 2— to wall switch H. The movement of the accelerating switch shifts the pilot-switch lever 229, bringing it into contact with post 232, closing the circuit through switch C, as previously described. The accelerating switch also shifts the pilot lever 238, giving current to one side of switch F by conductors 51 and 35 to the main switch A, current being given to the other side of switch F by a further movement of the switch K bringing the elevation 422 into contact with the contact finger 431, the circuit being from contact 431 by conductor 57 to contact N^{15} on the slow-down switch N, through the lever N^5, thence by conductor 50 to the switch F.

Current is given to the main switch A from the wall switch H by conductor 2 to contact 111, and through lever 123 to points 125 and 133; and from points 126 and 134

through lever 124 to contact 119, thence by conductor 2— to the wall switch H. With the closing of the main switch current is given to the brake magnet M as follows, from point 133, on the main switch, by conductor 21, switch lever D^2, conductor 22 to and through the brake magnet, thence by conductors 23, 18 and 2— to wall switch H. The shifting of the pilot switch lever 229, by the accelerating switch member 212, closes a circuit from the wall switch H by conductors 2 and 38 to, and through, the coil of switch D, thence by conductors 40 and 41, lever 229, conductors 18 and 2— to the wall switch H; this energizes the switch D causing it to attract the lever D^2 cutting the resistance D^6 into the brake-magnet circuit, protecting it from over load. With the closing of the main switch current is given to the series field and armature of the motor as follows, from point 125, on the main switch, by conductors 24 and 25 to and through the resistance coils 25′—25″ and 25‴, thence by conductors 26 and 27 to motor terminals c'', through series field 61 to terminal c', by conductor 28 to 313 on reversing switch G through 317′, by conductor 30 to motor terminal a'', through armature 62 to terminal a', thence by conductor 29 to and through 317—318 to 316 on reversing switch G, thence by conductor 31 to 126 on the main switch A; this starts the motor at slow speed.

The accelerating switch B may be of any suitable construction, in which a plurality of members are adapted to operate *seriatim* to cut resistances in and out of circuit, the first and last members being adapted to shift pilot-switch levers. Members 212—213 and 214, of the accelerating switch B contact with the points 224—225 and 226 successively cutting the resistances 25′—25″ and 25‴ out of the series field and armature circuit; member 215 contacts with point 227 cutting out the series field entirely, the armature circuit then being from 125 on the main switch A by conductor 24 to and through the accelerating switch to point 227 thence by conductors 48 and 28 to 315 on the reversing switch G, through 317′ thence by conductor 30 to motor terminal a'', through armature 62 to terminal a', thence by conductor 29 to the reversing switch G, thence by conductor 31 to point 126 on the main switch A. The motor will now be running at about half speed. As the first member 212 of the accelerating switch moves it shifts the pilot-switch lever 229, breaking contact at 231 and making it at 232, opening the operating circuit of the main switch, previously described, at 231 would allow the main switch to "drop out," but that the main switch had closed a secondary or holding circuit from contact 231 through resistance 37 to point 134. As the last member 215 of the accelerating switch moves it shifts the pilot-switch lever 238, breaking contact at 236 and making it at 237. Breaking contact at 236 cuts resistance 234 into the circuit of the solenoid, 201, that operates the accelerating switch, protecting it from overloads. Closing the contact at 237 gives current to one side of the speeding-up switch F by conductor 51. The speeding-up switch may now be energized by the movement of the manual switch K, as previously explained, energization of the switch F causes it to attract lever F^2 cutting resistance F^6 into the shunt field circuit weakening it and speeding the motor up. The auto-limit switch J belongs to a class, well known in the art and needing no extended description, that is located on, or in proximity to, the motor and is adapted to be connected therewith and driven thereby in such relation to the travel of the elevator car, that contactors, included in various of the operating circuits, and bearing on contact segments carried by the switch will run off the ends of the segments in predetermined sequence opening the circuits therethrough and stopping the car at the upper and lower landings independent of the operator.

O and P indicate respectively, upper and lower limit switches included in the circuits from the manual switch K that lead through the locking coils of the reversing switch to the operating solenoid of the main switch A.

L indicates a slack cable switch included in the circuit from the wall switch to the manual switch.

M indicates the brake magnet.

These safety devices being well known in the art need no extended description, as any construction may be used, they forming no element of this invention.

Having described my invention so that any one skilled in the art pertaining thereto may make and use the same, I claim;—

1. In a motor control system, the combination with an electric motor, of a circuit including the shunt field winding thereof, a plurality of resistances, the source of current supply, a second circuit including the armature and series field windings, a switch for closing said second circuit, means controlled by said switch for short circuiting one of said resistances, and means manually controlled for short circuiting the other of said resistances.

2. In a motor control system, the combination with an electric motor, of a permanently closed circuit including the shunt field and a plurality of resistances, a second circuit including the armature and series field and a plurality of resistances, a switch for closing said second circuit, a switch for short circuiting the resistance in said second circuit, means operable by the first mentioned switch for short circuiting one of the first

mentioned resistances, and means controlled by said second switch for short circuiting another of said first mentioned resistances.

3. In motor control apparatus, the combination with an electric motor, of a main switch, an accelerating switch, a circuit across the armature terminals of the motor, a permanently closed circuit including the shunt field and a resistance, means operable by the closing of the main switch to short circuit said resistance, and means operable by the action of the accelerating switch to control the circuit across the armature terminals.

4. In motor control apparatus, the combination with an electric motor, of a main switch, an accelerating switch, a braking circuit across the armature terminals of the motor, a permanently closed circuit including the shunt field and a plurality of resistances, means operable by the closing of the main switch to short circuit one of said resistances, means operable by the action of the accelerating switch to control said braking circuit, and other means operable by the action of the accelerating switch to control the short circuiting of another of said resistances.

5. In motor control apparatus, the combination with an electric motor, of a main switch, an accelerating switch comprising a plurality of members operating *seriatim*, a braking circuit across the armature terminals, a permanently closed circuit including the shunt field and a plurality of resistances, means operable by the closing of the main switch to short circuit one of said resistances, means operable by the first of said accelerating switch members to control the brake circuit, and means operable by the last of said members to control another of said resistances.

6. In a motor control system, the combination with an electric motor, of a main switch, a permanently closed circuit including the shunt field, a resistance and an electric switch, said switch adapted when deenergized to short circuit said resistance, and means operable by the main switch to deënergize said switch.

7. In a motor control apparatus, the combination with an electric motor, of a main switch, an accelerating switch, a braking circuit across the armature terminals, an electric switch adapted to open said circuit, means operable by the accelerating switch to energize said electric switch, a permanently closed circuit including the shunt field, a resistance, and an electric switch adapted to short circuit said resistance, and means operable by the main switch to deenergize said electric switch.

8. In a system of motor control, the combination with an electric motor, of a main switch, a permanently closed circuit including the shunt field, a resistance and the coil of an electro-magnetic switch, said switch adapted when deënergized to short circuit said resistance, an open shunt around said coil, and means for closing said shunt thereby short circuiting said coil and deënergizing the switch.

9. In a motor control system, the combination with an electric motor, of a permanently closed circuit including the shunt field winding, a resistance, and the coil of an electro-magnetic switch, an open shunt around said coil, a second circuit including the armature and source of current supply, a switch for closing said second circuit, and means controlled by said switch for closing said shunt thereby short circuiting said coil and deënergizing said electro-magnetic switch.

10. In a system of motor control, a motor, the shunt field winding thereof, a resistance and the coil of an electro-magnetic switch being connected in series, an open shunt around said resistance, an open shunt around the coil, said switch adapted to close the shunt around the resistance, and means for closing the shunt around the coil thereby deënergizing said switch.

JOHN C. SMITH.

Witnesses:
W. B. MUNNELL,
WM. J. SAUER.