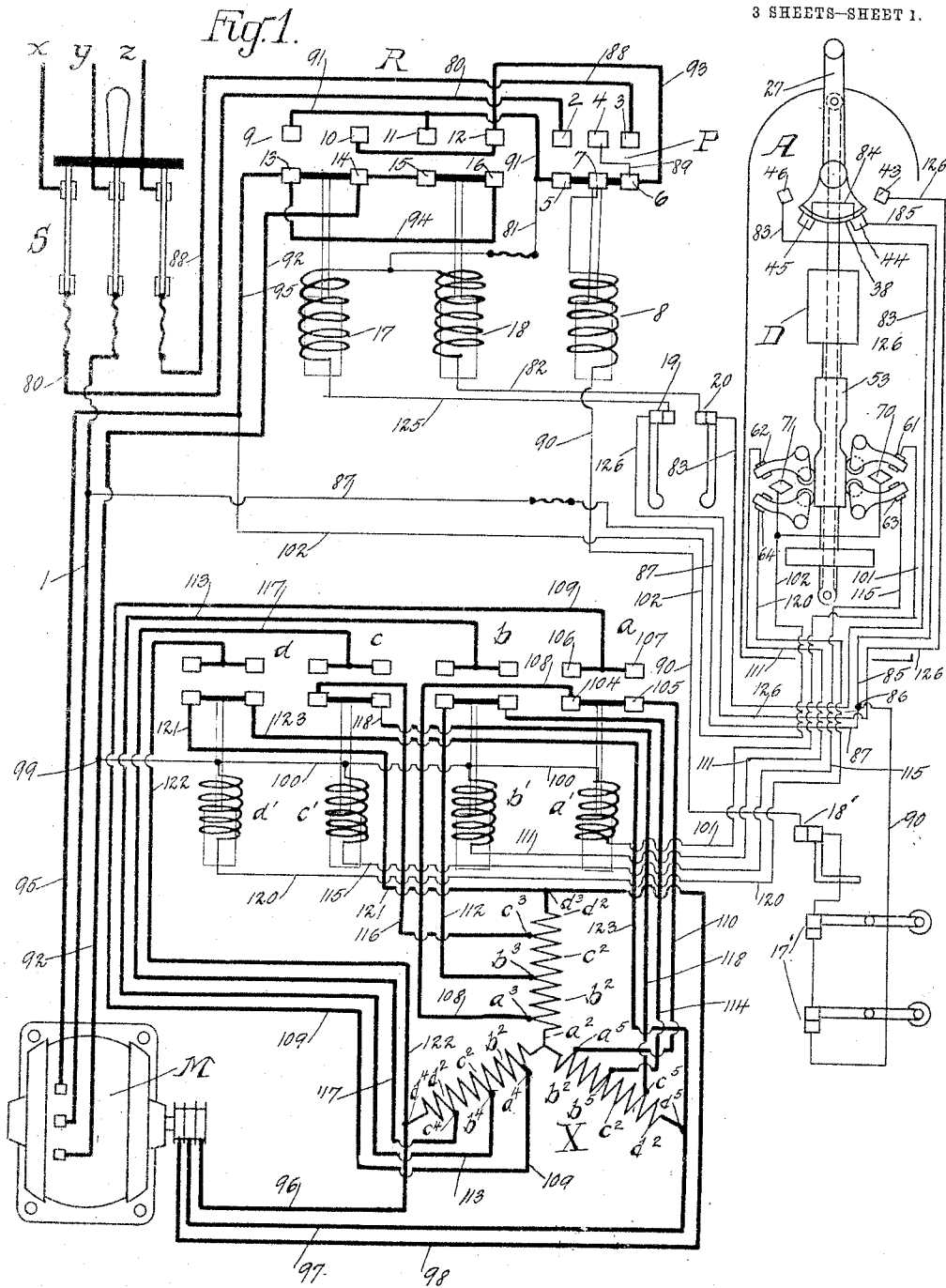


A. SUNDH.
ALTERNATING CURRENT ELEVATOR SYSTEM.
APPLICATION FILED OCT. 2, 1907.

986,243.

Patented Mar. 7, 1911.

3 SHEETS—SHEET 1.



Witnesses:

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3 SHEETS-SHEET 2.

Fig. 2.

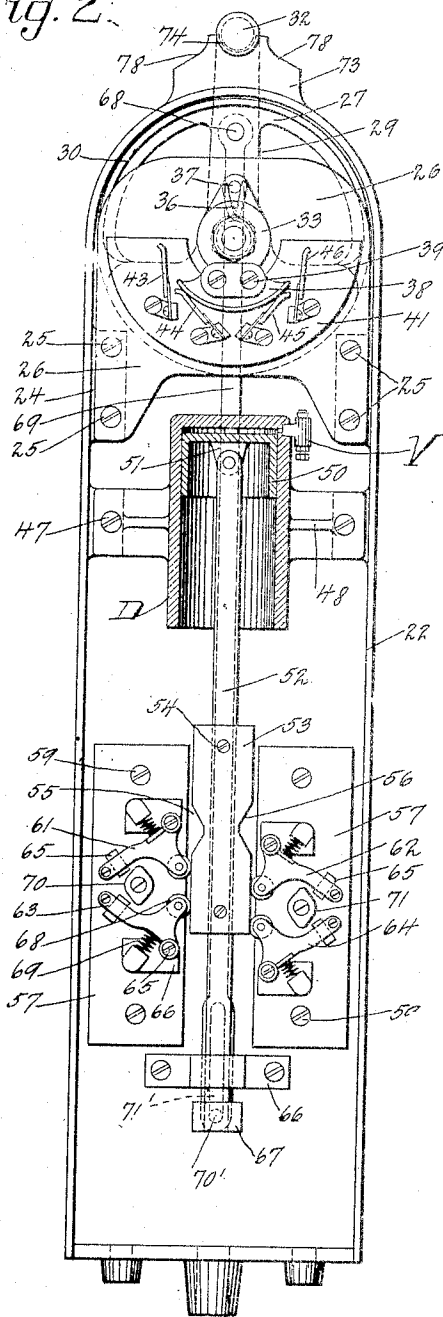
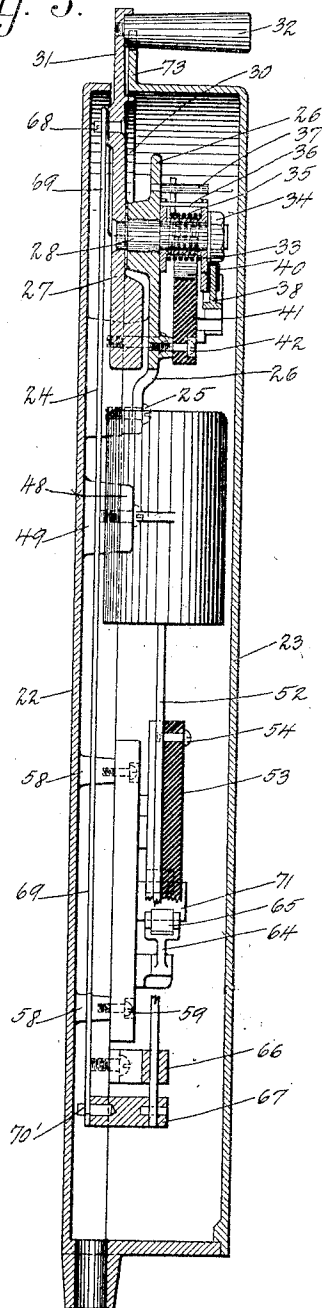


Fig. 3.



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3 SHEETS-SHEET 3.

Fig. 4.

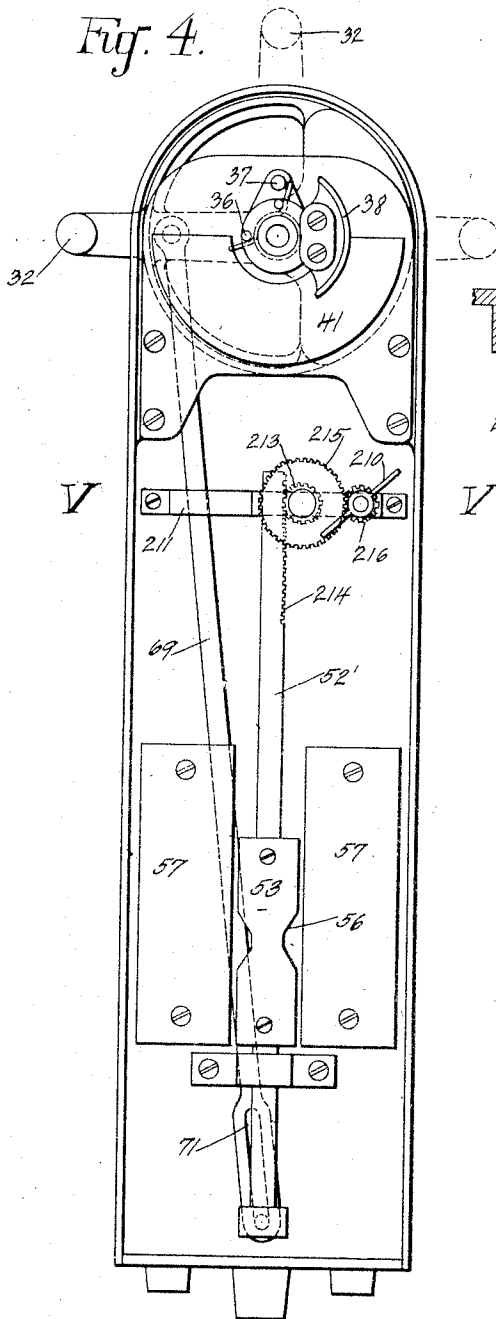


Fig. 5.

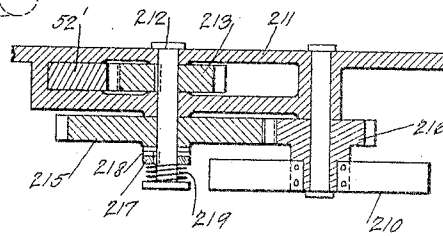


Fig. 6.

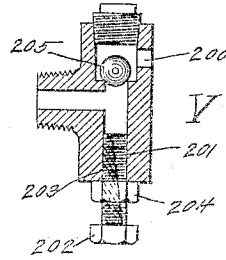
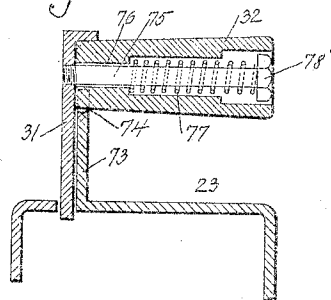


Fig. 7.



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UNITED STATES PATENT OFFICE.

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ALTERNATING-CURRENT ELEVATOR SYSTEM.

986,243.

Specification of Letters Patent.

Patented Mar. 7, 1911.

Application filed October 2, 1907. Serial No. 395,627.

To all whom it may concern:

Be it known that I, AUGUST SUNDH, a citizen of the United States, residing in Yonkers, in the county of Westchester and State of New York, have invented a new and useful Improvement in Alternating-Current Elevator Systems, of which the following is a specification.

My invention relates to alternating current elevator systems, and one of its objects is the provision of a simple and efficient control system for alternating current motors, which system shall be substantially noiseless in its operation.

Although my improved control system is particularly adapted to alternating current electric motors connected in elevator systems, it may have a general application.

More particularly it is one of the objects of my invention to provide means for automatically controlling the speed with which the motor controlling switch is operated.

A further object of the invention is the provision of means to automatically limit the speed of movement of a manual switch in one direction.

A further object is to provide a mechanical device releasable manually and movable automatically at a predetermined rate of speed to effect a predetermined acceleration of an electric motor.

Other objects of the invention will appear hereinafter, the novel combinations of elements being pointed out in the appended claims.

Referring to the accompanying drawings in which are shown constructions embodying my invention, Figure 1 is a diagrammatic view or wiring diagram of a motor with its circuits and switches as used in an elevator system; Fig. 2 is a front elevation partly in section of a switch with automatic retarding means; Fig. 3 is a sectional side elevation of the same; Fig. 4 is a view similar to Fig. 2 of a modification; Fig. 5 is a sectional view on an enlarged scale taken on the line V—V of Fig. 4; Fig. 6 is a detail view of the relief valve for the dash-pot; and Fig. 7 is a detail view of the switch handle.

In Fig. 1 is shown a motor and system of circuits adapted for use with a three-phase alternating current. It should be understood, however, that the switch hereinafter fully described may be used to control elec-

tric motors operated by other kinds of alternating current, intermittent current, or even direct current. The motor circuits in Fig. 1 are shown by heavy lines, and the controlling circuits by light lines. A main line switch S connects the motor M to the conductors x, y, z , leading from the source of supply. The middle pole or blade of the switch S is connected directly to the stator of the motor by the conductor 1, and the outside poles or blades are connected to the stator through the potential switch P and the reversing switch R. The potential switch P may be of any type desired, and in this instance is shown as comprising fixed contacts 2, 3 and 4 which are arranged to be engaged by the contacts 5, 6 and 7, respectively, which are carried by the core of the magnet 8. The reversing switch R comprises fixed contacts 9, 10 and 11, 12, arranged to be engaged by the contacts 13, 14 and 15, 16, respectively, which are carried by the cores of the magnets 17 and 18. The starting resistance in this instance is shown star-connected and in sections, and is designated by the reference character X. This resistance is connected in the rotor circuit by the conductors 96, 97 and 98. The several sections a^2, b^2, c^2, d^2 , are arranged to be successively short-circuited by the switch a, b, c, d , operated by the magnets a', b', c', d' , respectively. When the motor controlling apparatus is used in an elevator system the following automatic switches may be placed in the circuit of the potential switch magnet 8:—upper and lower limit switches 17' which effect a stopping of the motor when the car goes beyond its normal limits of travel; a slack cable switch 18' associated with the drum of the hoisting apparatus on which the hoisting and counterweight cables are wound; and switches necessitating the closing of the elevator well doors before the car can be started. In the circuits of the reversing switch magnets 17 and 18 may be placed the stop motion limit switches 19 and 20 which effect the stopping of the car at the normal limits of its travel. The operation of the aforesaid switches is well known in the art and detailed description is therefore unnecessary.

The arrangement of circuits and mechanism thus far referred to is old in the art and *per se* not of my invention.

The master switch or controlling switch A 112

which in an elevator system is usually located in the car, will now be described.

The casing (see Figs. 2 and 3) which incloses the switch mechanism comprises a back 22 and a removable front or cover 23. Within the casing and secured to or formed integral with the back 22 are lugs 24 to which is attached, for instance by means of screws 25, a bearing plate 26. Behind the plate 26 is a switch lever 27 having a pivot pin 28 rigidly secured thereto and extending forwardly through the plate 26 in which it is journaled. The portion of the lever 27 within the casing is in the form of a disk with portions of the upper half removed to form a half ring and a center web 29. The lower portion of the disk is solid and thicker than the upper portion so as to be weighted and tend to swing the lever automatically to central position when released. A similar circular flange 30 is formed on the upper part of the lever and fits loosely within the upper curved wall of the casing. A part 31 of the lever 27 extends upwardly through a slot in the casing and a handle 32 is connected to its upper end. The portion of the pivot pin 28 which extends forwardly beyond the plate 26 is of somewhat reduced diameter, and on this reduced portion is fitted a flange sleeve or spool 33 clamped in position by a nut 34. On this spool 33 is a coil spring 35 having its ends extending upwardly and bearing against opposite sides of a pin 36 secured to and extending between the flanges of the spool 33. The ends of the spring 35 also bear against opposite sides of the pin 37 secured to the stationary plate 26. A contact plate or bridging conductor 38 is secured to a downward extension of the front flange of the spool 33 by means of screws 39, for instance. This contact plate is, however, insulated from such extension by means of the interposed insulation 40. A plate or block of insulating material 41 approximately semi-circular in shape is secured to the stationary plate 26 by the screws 42. On the face of this plate are connected a plurality, in this instance four, flexible contacts 43, 44, 45 and 46 in such position as to be wiped by the arc-shaped contact plate 38 when the latter is rotated or oscillated. The lower contacts 44, 45 are electrically connected together by the conductor 84, as illustrated diagrammatically in Fig. 1.

The dash-pot D is located in the casing below the plate 26 and is secured in position by means of flanges 48 formed integral with the dash-pot cylinder, lugs 49 formed on the casing, and connecting screws 47. Connected to the piston 50 is a lug 51 to which is pivoted a depending rod 52 and cam plate 53 composed of vulcanite or other insulating material is attached to the rod 52 by any suitable means, as screws 54. This plate 53

has recesses 55 and 56 on opposite sides which form cam surfaces. Preferably these recesses are opposite each other, although such arrangement may be varied as desired. Contact carrying plates 57 are secured to lugs 58 extending from the back 22 of the casing by means of screws 59, the arrangement being such that the plates 57 occupy positions on opposite sides of the cam plate 53. Connected to the plates 57, but insulated therefrom, are four contact levers 61, 62, 63 and 64 similar in construction and each pivoted by means of the pivot screw 65 to a lug 66 secured to a plate 57. Each lever has a cam roller 68 bearing against the plate 53 and urged to such position by a coil spring 69. On opposite sides of the cam plate 53 are stationary contacts 70 and 71 secured to the plates 57 but insulated therefrom, and located between the levers 61, 63 and 62, 64, respectively, and in the path of movement with the contacts 65 carried by the lever. The rod 52 extends downwardly below the cam plate 53 through a slot in a stationary guide 66 secured to the casing, and to its lower end is attached a block 67. Connected to the switch lever 27 by a pivot pin 68 is a depending rod 69 which extends downwardly to the block 67. The lower end of this rod is provided with a slot 71' to receive the pin 70' in the block 67. The upper end of the dash-pot is provided with a relief valve V which may be such as illustrated in Fig. 6, and comprises an outlet 200, a restricted inlet 201, a ball check 205, an adjusting screw 202, and a locking nut 204. The opening through the tapered slot 203 in the bolt 202 may be restricted to any desired degree by adjusting the latter, which is then locked in position by the nut 204. The ball 205 remains seated during the downward movement of the dash-pot piston 50, the latter being thus retarded to an extent determined by the opening 203. The piston 50 may move freely in an upward direction, however, as in such an event the air above the piston may escape freely through the opening 200 past the check valve 205.

In the upper edge of the flange 73 which extends upwardly from the cover 23 of the casing is formed a recess 74 to receive the handle 32 and lock it in its central position. I prefer to use the type of handle shown in Fig. 7 where the bolt 75 rigid with the extension 31 of the lever 27 fits loosely in an opening 76 of the handle 32. This opening extends longitudinally through the handle and is enlarged for a portion of its length to receive the coil spring 77 which bears at its inner end against a circular shoulder formed by the differences in the diameter of the opening 76. The other end of this spring 77 bears against the head 78' of the bolt 75. The recess 76 is further enlarged at its outer end to accommodate the bolt head

78' and permit the handle to be pulled outwardly on the bolt beyond the flange 73. It will therefore be seen that when the handle 32 is in the position shown in Fig. 7 in the recess 74 the lever 27 cannot be moved from its central position, being obstructed by the flange 73. But when the handle 32 is grasped and pulled outwardly against the action of the spring 77 the inner end of such handle is pulled out of the recess 74 and away from the plane of the flange 73, so that thereafter the lever 27 may be moved freely in either direction. When the switch has been operated in either direction the handle does not need to be brought back to its central locked position to cut off the current and stop the motor, but may be brought up against either of the shoulders 78, from which position it may be moved back to again start the motor in the same direction as before. When, however, it is desired to reverse the motor the handle must be pulled out and moved to central position and then beyond to the reversed position. The handle 32 is moved to the left as viewed in Fig. 2, and the movable contact plate 38 will be brought into position to bridge the contacts 45 and 46. The rod 69 will at the same time be moved downwardly, its lower slotted end sliding along the pin 70 freely. Normally when the switch lever 27 is in central position the lower end of the rod 69 supports or holds the plate 53, rod 52 and piston 50 in their upper positions as illustrated in Fig. 2. Therefore when the lever 27 is rotated to the left and the rod 69 lowered, the piston and cam plate will be released. The cam plate and connected parts will therefore move downwardly by their own weight, this movement being retarded to any desired extent by the dash-pot. As the cam plate moves down, the cam roller 68 on the lever 61 is the first to ride into the recess 55. This permits the lever 61 to be moved by its spring to bring the contact 65 into engagement with the contact 70. The lever 62 next coöperates with the recess 56 to cause the contact 65 of said lever to engage the contact 71. The lever 61 is then lifted to disconnect the contacts 65 and 70 and the lever 63 is permitted to swing to bring its contact into engagement with the contact 70. Then the lever 62 is brought back to normal position and the contacts 65, 71 disconnected. The next step is the movement of the lever 64 to bring into engagement its contact and the contact 71. By this time the cam plate 53 has reached its lowermost position. The successive order of operation of the switches may be varied as desired, but in this instance the switch levers are shown in staggered relation and the cam recesses substantially opposite each other. When the controller handle is moved back toward central position the lower end

of the slot 71 immediately engages the pin 70' to positively lift the cam plate, piston and connecting parts, and during this operation the switches are closed and opened in the reverse order. This return operation 70 may be as rapid as desired, as the rod 69 now engages the pin 79 and lifts the cam plate by a positive movement and the relief valve of the dash-pot permits free escape of the air from the space above the piston 50. The controlling lever 27 will return automatically if moved to one of its limiting positions and then released, as the lower end of this lever is weighted. Furthermore, the nut 34 clamps the spool 33 rigidly with the pivot pin 28 so that when the lever 27 is moved to one side or the other the pin 36 will engage one of the ends of the coil spring 35 and place it under additional tension. It will therefore be seen that the switch mechanism includes the centering weight 85 and the centering spring for the actuating lever 27.

In Figs. 4 and 5 I have shown a modification of the retarding mechanism for the controller, in which the dash-pot is replaced by a fan 210 and connecting gearing. To a transfer supporting bar 211 secured within the casing is journaled a spindle 212 to which is keyed a pinion 213. The latter meshes with the rack 214 on the upper end of the rod 52' which carries the cam plate 53. The spindle 212 carries a gear wheel 215 mounted loosely thereon and geared to a pinion 216 to which the fan blades are secured. Feathered loosely on the spindle 212 is a small driving disk 217 having ratchet teeth 218 on its inner face which mesh with similar teeth on the gear wheel 215. A coil spring 219 holds the ratchet teeth yieldingly in engagement with each other, permitting a backward rotation of the spindle 212 independently of the gear wheel 215 but permitting a positive driving connection when the spindle is rotated in a forward direction. The fan will therefore act to retard the downward movement of the cam plate 53, but will not hinder a quick upward movement.

The operation of the control system will now be described.

The main line switch S being closed, the switch P is closed manually and thereafter held closed by the magnet 8 so long as the potential on the line remains above a predetermined limit and the circuit through the magnet 8 is not broken. This circuit may be traced as follows,—from the main conductor z through wire 88, contacts 3, 6, conductor 89, contacts 4, 7, magnet 8, conductor 90, switches 18', 17', to junction 86, and thence through conductors 87 and 1 to the main y . It will thus be seen that in the system illustrated a single phase current will flow through the magnet 8 to hold the switch

P closed. When the switch lever 27 is moved to the right, for example as viewed in Fig. 1, the movable contact 38 bridges the contacts 45, 46 and establishes a circuit through the reversing switch magnet 18. This circuit may be traced as follows,—from the main x through wire 80, contacts 2, 5, wire 81, magnet 18, wire 82, stop motion limit switch 20, wire 83, contacts 46, 38, 45, wire 84, contact 44, wire 85, to junction 86, and thence by wires 87 and 1 to main y . The magnet 18 being thus energized will move the contacts 15, 16 upwardly and establish a circuit through the stator of the motor as follows,—from the main x through wire 80, contacts 2, 5, wire 91, contacts 11, 15, wire 92 to the lower terminal of the motor, through the stator winding to the middle terminal, and through wire 1 to the main y . A circuit is also established from the main z through wire 88, contacts 3, 6, wire 93, contacts 12, 16, wires 94, 95 to the upper terminal of the motor, through the stator of the motor to the middle terminal, and through wire 1 to the main y . It should be observed that two of the main conductors are connected directly to the fixed contacts 2 and 3 of the potential switch P and the other main conductors connected directly to the motor. Therefore when the potential switch P is opened all current from the motor and the controlling apparatus is cut off. It will be observed that the three terminals of the rotor of the motor are connected by the wires 96, 97, 98 to the outer terminals, respectively, of the star-connected resistance X. As the controller lever 27 is moved farther to the right the contact plate 53 moves downwardly and permits the successive operation of the switch levers 61, 62, 63 and 64. The lever 61 operates first to close a circuit through the magnet winding a' as follows,—from the main x through wire 80, contacts 2, 5, wire 91, contacts 11, 15, wire 92 to junction 99, wire 100, magnet a' , wire 101, lever 61, contact 70, wires 102, 95, 94, contacts 16, 12, wire 93, contacts 6, 3, wire 88 to main z . The magnet a' being thus energized the contacts 104, 105 will be moved into engagement with the contacts 106, 107. This operation short-circuits the middle section a^2 of the resistance X by connecting the three terminals a^3 , a^4 , a^5 as follows,— a^3 is connected through the wire 108, contacts 104, 106 and wire 109 to a^4 , and a^5 is connected to wire 110, contacts 105, 107 and wire 109. The resistance x being thus reduced allows an increase of current through the rotor winding, and consequently increased speed of the motor. The lever 62 next operates to close a circuit through the magnet b' . This circuit is the same as that through the coil a' from the main x up to the wire 100 where it forms a parallel circuit to the magnet b' , wire 111, contact lever 62, contact 71 to the

wire 102, and from thence in common with the circuit through the magnet a' to the main z . The magnet b' being energized closes the switch b and this short-circuits the sections b^2 of the star-connected resistance by connecting the terminals b^3 , b^4 , b^5 through the wires 112, 113, 114, respectively, to the contacts of the switch b . The starting resistance is thus further reduced. The contact lever 63 next operates and closes a circuit through the magnet c' . This circuit is also in parallel with that of magnet a' from wire 100 to wire 102, as follows,—from wire 100 through magnet c' , wire 115, contact lever 63, contact 70 to wire 102. The magnet c' now closes the switch c and short-circuits the sections c^2 of the resistance by connecting the terminals c^3 , c^4 , c^5 through the wires 116, 117, 118, respectively, to the switch c . This reduces the resistance still further, permitting further acceleration of the motor. Lastly the contact lever 64 operates and closes a circuit through the magnet d' . This circuit is also in parallel with the circuits of magnets a' , b' , c' from wire 100 through magnet d' , wire 120, contact lever 64, contact 71 to wire 102. The magnet d' closes the switch d and thus connects the terminals d^3 , d^4 , d^5 with the switch d through the wires 121, 122, 123, respectively. This short-circuits the remaining portion of the resistance X, permitting the motor to run at full speed.

As before explained, when the succeeding switch lever is operated to closed position the preceding one is operated to open position such that when the cam plate 53 reaches the limit of its movement only the switch lever 64 is held in circuit closing position. This operation effects the successive deenergization of the magnets a' , b' , c' , and therefore only one magnet, viz. d' , consumes current while the motor is in operation and the switch d maintains all of the starting resistance X short-circuited. When the controller lever is moved back to central position the switch levers 61, 62, 63, 64, are operated in the reverse order, the magnet c' being first energized, then the magnet d' deenergized, the magnet b' energized, the magnet c' deenergized, the magnet a' energized, the magnet b' deenergized, and finally the magnet a' deenergized. By this operation the resistance X is gradually introduced back into the rotor circuit, after which the contacts 38 and 46 are separated to break the circuit through the reversing switch magnet 18 and thereby cut off the supply current to the motor which will then be stopped by the application of brake apparatus in any well known manner. When the controller lever is moved to the left the contact plate 38 bridges the contacts 43, 44, and closes a circuit through the magnets 17 of the reversing switch. This circuit is as

follows,—from main x through wire 80, contacts 2, 5, wire 81, magnet 17, wire 125, limit switch 19, wire 126, contacts 43, 38, 44, wires 85 and 87 to main y . The magnet 17 moves the contacts 13, 14 into engagement with the contacts 9, 10, respectively. This closes the circuits through the stator windings of the motor in a direction to reverse the rotation of the latter. The switch operated by the magnet 17 connects the wires 91 and 93 to the wires 95 and 92, respectively, while the switch operated by the magnet 18 connects the wires 91, 93 to the wires 92 and 95, respectively. The direction of the current through the stator windings is therefore reversed by the reversal of the movement of the controller lever.

It will be apparent from the above description that the motor may be started in either direction, depending upon the direction in which the controller lever is moved, and that the acceleration may be made as slow as desired, depending upon the speed with which the controller lever is moved to release the cam plate 53 and allow the same to operate the switch levers to effect the step by step cutting out of the starting resistance. But such acceleration cannot exceed a predetermined limit on account of the retarded movement of the cam plate 53 which is out of the control of the operator during normal operation. The movement of the cam plate 53 in the reverse direction, however, to insert the resistance may be made as quickly as desired, or the cam plate 53 may be brought back to its initial position slowly to effect a slowing down of the motor before stopping by the gradual reinsertion of the starting resistance. When the controller handle is let go the weight at the lower end of the lever 27 and the centering spring operate to automatically return the switch lever and the cam plate 53 to their initial positions. The flange 73 offers an obstruction to the movement of the handle 32 to central position or past central position and prevents the controller lever from being thrown over quickly and reversing the motor circuits before the motor has been slowed down sufficiently. The recesses 78 are in such position that when the handle 32 seats itself therein the cam plate 53 holds all the switch levers 61, 62, 63 and 64 in their open circuiting positions and the contact plate 38 is out of engagement with either of the contacts 43 or 46. In order to start the motor in the same direction as before, the handle may be simply returned to its outermost position. If the motor is to be reversed, however, the handle 32 must be pulled out against the spring 77 so that the obstruction formed by the flange 73 may be avoided.

Although I have shown the motor and controlling system applicable particularly

to elevators, it should be understood that the invention may have a general application. For instance, the automatically retarded manual controller is also adapted to control other forms of starting resistance, and other arrangements of circuits and connections might be used to effect the closing and opening of a series of circuits other than those used in connection with the starting resistance. I have shown two forms of retarding devices, and still others might be used. Obviously, those skilled in the art may make various changes in the details of construction of the switch mechanism and in the arrangements of parts without departing from the spirit and scope of my invention, and I desire therefore not to be limited to the precise construction and arrangement disclosed.

Having thus fully described my invention, what I claim and desire to have protected by Letters Patent of the United States is:—

1. In a motor control system, the combination with a motor, a sectional starting resistance, and accelerating relays, of a manually operable switch lever carrying a switch contact, stationary contacts cooperating therewith, a plurality of fixed and movable contacts in the circuits of the relay magnets, means for operating said movable contacts successively upon the operation of the switch lever, and a mechanical device for automatically retarding the operation of said means.

2. In a motor control system, the combination with a motor, a reversing switch, a sectional starting resistance, and accelerating relays, of a master switch comprising a lever movable from a central position in either direction, and controlling the circuits of the reversing switch magnets, means operable upon the movement of said lever in either direction to successively operate the relay magnets, a mechanical device operable to automatically limit the speed with which said means operates when the lever is moved from a central position, and permitting a quick movement of said means in the reverse direction.

3. In a controller, the combination with a switch lever, a contact carried thereby and a stationary contact in the path of movement of the lever contact, of a plurality of circuit controlling members, and automatically retarded means mechanically connected to the switch lever for successively operating said members when the lever has been moved.

4. In a controller, the combination with a switch lever, a contact carried thereby, and a cooperating stationary contact, of a plurality of stationary circuit controlling members, a device for successively operating said members, connections between the lever and said device permitting the device to op-

erate when the lever is moved, and means for automatically limiting the speed of operation of said devices.

5 In a controller, the combination with a switch lever movable in opposite directions from a vertical central position, of a depending rod pivoted to the lever above the lever pivot, a switch-operating device, and connections between said device and said
10 rod for holding the device inoperative while the switch lever is in central position.

6. In a controller, the combination with a manual actuating device, of electric switch mechanism, a lost-motion connection between said actuating device and said switch
15 mechanism, apparatus for automatically returning said actuating device from actuated to central position and serving also to hold said switch mechanism in its initial position, and means for retarding the automatic operation of said switch mechanism
20 when released by actuating said device.

7. In a controller for electric motors, the combination with a manual lever, of an electric switch operated directly thereby, centering mechanism to automatically return
25 said lever to or near initial or central position, an additional switch, a cam actuated by gravity to automatically operate said additional switch, a connection comprising a
30 pin-and-slot between said lever and said

cam to effect a release of the latter when the lever is moved from its initial position a predetermined distance and to positively lift said cam when the lever is returned, and
35 a retarding device out of the control of the operator to prevent the cam from descending beyond a predetermined rate of speed.

8. In a controller, the combination with a switch lever, of a contact carried thereby,
40 stationary contacts in position to be engaged by the first-named contact, an additional switch located below said lever, a device for operating said additional switch, means for normally holding said switch lever in a vertical position and automatically returning
45 it to such position when released after operation, a rod connected to said lever above its pivot, a lost-motion connection between said rod and said device permitting the operation of said device independently of the
50 lever when the latter is moved from its central position, and retarding mechanism located above said device and operatively connected thereto.

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

AUGUST SUNDH.

Witnesses:

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DAVID LARSON.