No. 706,126. Patented Aug. 5, 1902.

A. SUNDH.

ELECTRIC CONTROLLING APPARATUS FOR ELEVATORS.

(Application filed Jan. 31, 1902.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.

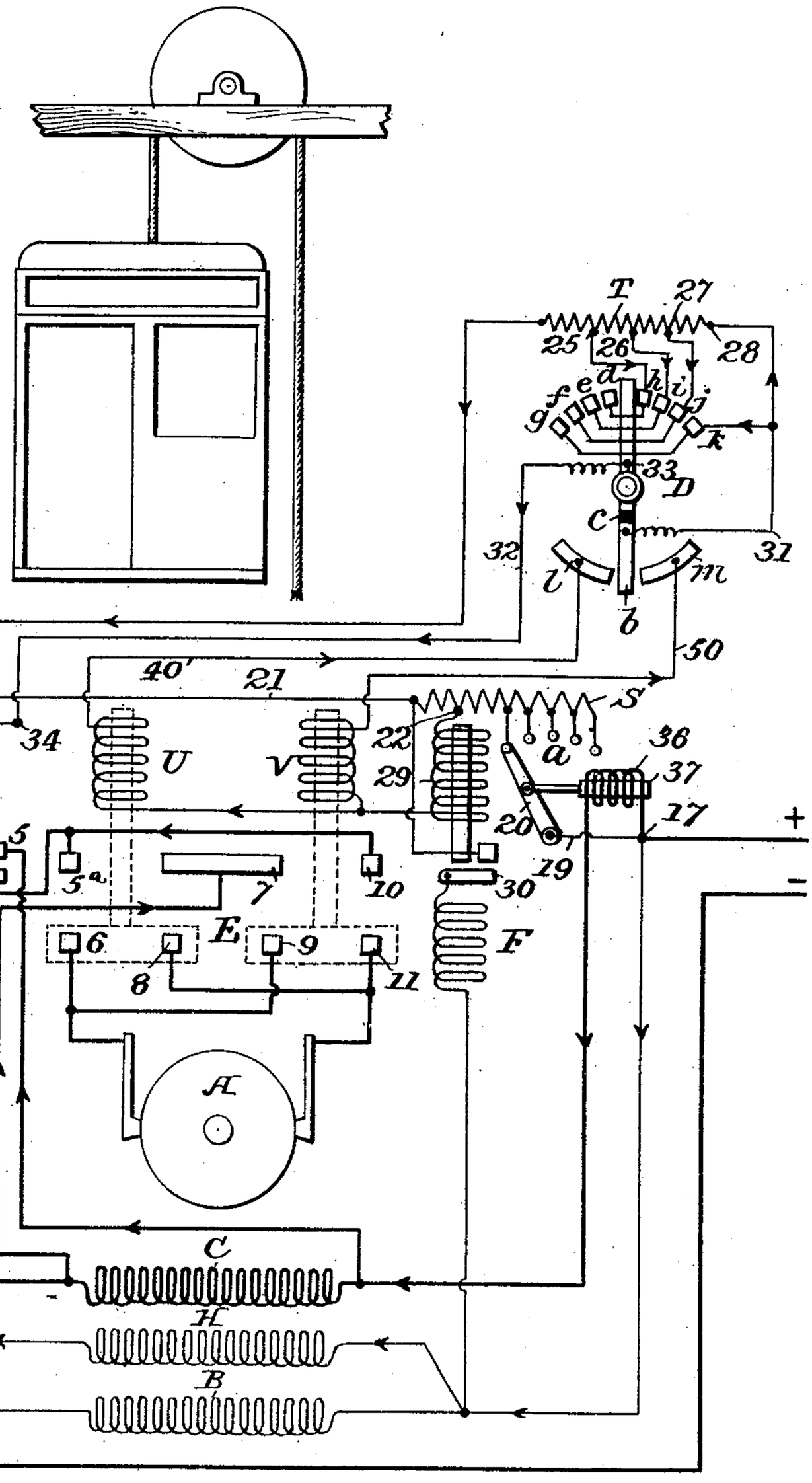

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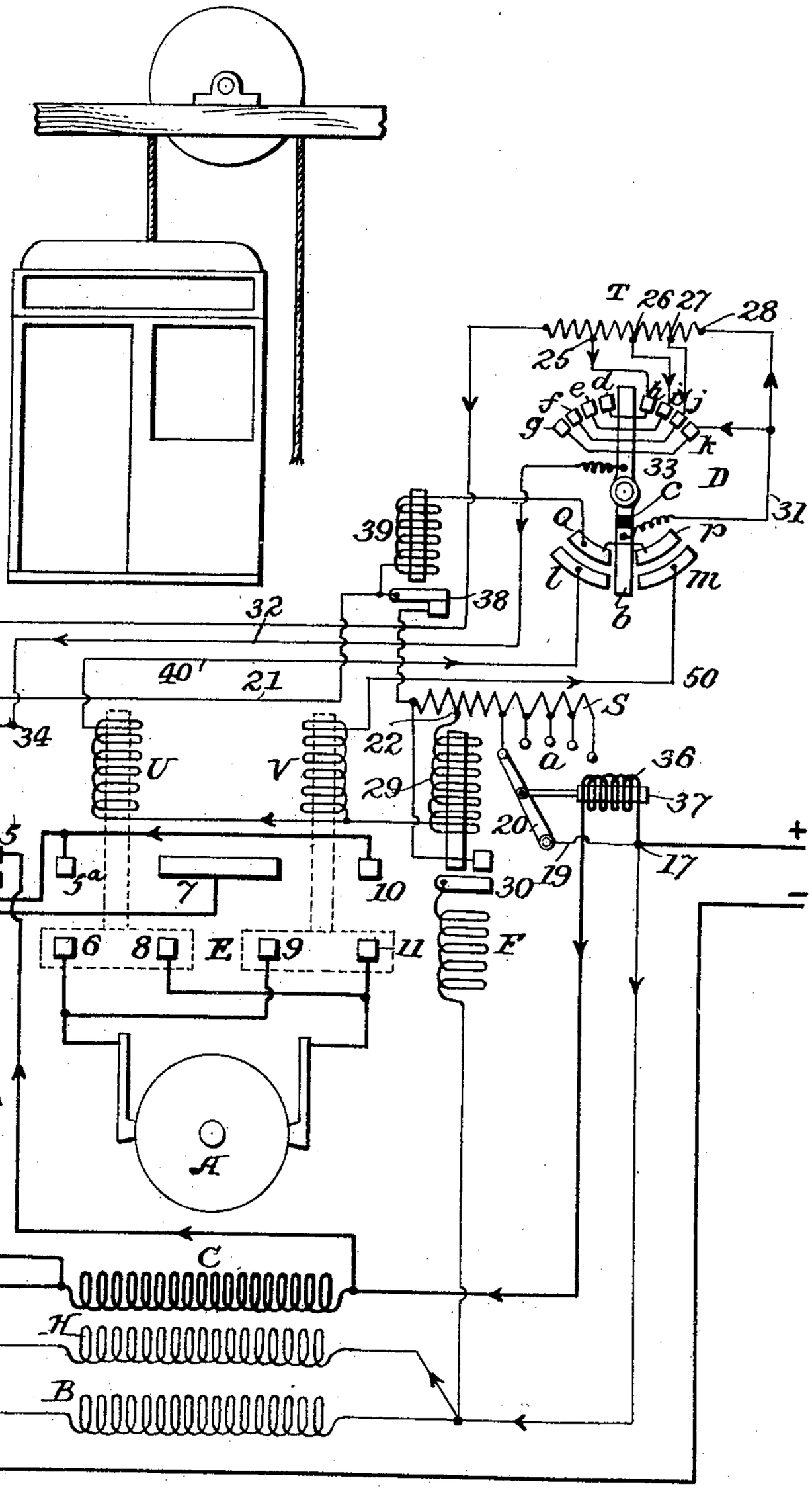
Fig. 2.



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UNITED STATES PATENT OFFICE.

AUGUST SUNDH, OF YONKERS, NEW YORK, ASSIGNOR TO OTIS ELEVATOR COMPANY, OF EAST ORANGE, NEW JERSEY, A CORPORATION OF NEW JERSEY.

ELECTRIC CONTROLLING APPARATUS FOR ELEVATORS.

SPECIFICATION forming part of Letters Patent No. 706,126, dated August 5, 1902.

Application filed January 31, 1902. Serial No. 92,038. (No model.)

To all whom it may concern:

Be it known that I, AUGUST SUNDH, a citizen of the United States, residing at Yonkers, in the county of Westchester and State of New York, have invented certain new and useful Improvements in Electric Controlling Apparatus for Elevators, of which the following is a specification.

My invention relates to the control of motors in general, but more particularly to the electrical control thereof, and it is applicable to any form of motor control, whether for cranes, railway-cars, elevators, hoists, &c., or the many classes of machinery operated by electric motors.

In the operation of dynamo-electric machines as electric motors on high-potential circuits it is obviously undesirable that the controlling-circuits, including the controlling devices, should be of substantially the same high potential as the line, and one of the objects of my invention is to secure a low potential in the controlling-circuits of the machine.

Controlling apparatus has heretofore been devised in which the operation of the controlling devices is dependent upon variations of potential in the circuits including them, and another object of my invention is to bring the operation of devices of this character under greater control of the operator.

My invention comprises means for accomplishing these objects, having the general mode of operation and construction and arrangement substantially as hereinafter more fully described in the accompanying specification and drawings, in which—

Figure 1 is a diagrammatic representation of circuits and apparatus embodying means for carrying out my invention, and Fig. 2 is a diagrammatic representation embodying a modified form of my invention.

Referring to the drawings, A represents a dynamo-electric machine, shown in this instance as an electric motor, which may be of any type suitable for the duty which it has to perform. I have illustrated a compound-wound motor provided with a shunt field-winding B and a series field C, with means for starting, stopping, and reversing the motor and means for varying its speed.

A motor of the character I have chosen as illustrative of the application of my invention is particularly suitable for the operation of elevators, hoists, cranes, and the like where it is usual to provide means for controlling the motor from a distance, as from the stations or landings or from the car, and D represents a controlling-switch, shown in this instance as a hand-switch for controlling the starting, stopping, and reversing of the motor. The switch D may be placed on the car or in any desired position relative to the motor, and I have simply shown this controlling-switch diagrammatically, with the controlling-circuits connecting it with a reversing-switch E, and starting and speed-regulating means, shown as a series of electrically-operated contacts 1 2 3 4 5, controlling a resistance R and certain of the motor-circuits.

My invention depends, primarily, on the principle that by making electric connection to a resistance connected in shunt to an electric circuit and then varying the position of the point or points of connection on the resistance any difference of potential from zero to nearly a maximum may be obtained at the terminals connected to the resistance. The same end may be attained by connecting to the resistance at a fixed point or points and then varying the resistance.

In the diagrams the positive and negative mains are represented by plus and minus signs, and in order to start the motor with the apparatus shown one or the other of the relays U or V, controlling the reversing-switch E, must be energized, the relay U closing contacts 5^a 6 7 8 and connecting the motor-circuits in such manner as to cause rotation of the armature in one direction, while the relay V closes contacts 7, 9, 10, and 11 and causes rotation of the armature in a reverse direction.

With the circuits in the diagrams the motor cannot start unless some of the motor-circuits are closed at one or more of the contacts 1 2 3 4 5, controlled by suitable means, as electromagnets 12 13 14 15 16, which in

this instance are arranged to operate on different potentials, and any desired adjustment of these magnets may be made.

In the present instance the magnets are connected in parallel and are adjusted so that they will be operated one after another in their numerical order from 12 to 16, the magnet 12 becoming sufficiently energized at the lowest desired potential to actuate the contacts 1, while magnet 16 is the last to become energized upon the highest desired potential. Any desired number of magnets and contacts controlled thereby may be used, I having shown but five of each as a convenient number illustrative of my invention.

Assuming that relay U has been energized and that magnet 12 has closed its contacts 1 and the brake is removed from the apparatus by means of a suitable brake-magnet F, then the circuits of the motor will be closed as follows: from the positive main through series field C, from thence to contact 7 of reversing-switch E, to contact 8, and through the armature of the motor to contact 6 of the reversing-switch, from thence through contact 5^a of said switch to resistance R, and to the negative main through contacts 1, the shunt field-winding B of the motor being at the same time energized by the closure of contacts 1. It is ordinarily desirable to operate with a low potential in the circuits of such controlling devices as the relays U and V of the reversing-switch E, the magnets 12 to 16, inclusive, of the controlling-switch D, and the brake-magnet F, and in order to obtain this low potential in such circuits I connect a resistance S in shunt across the mains between suitable points, as 17 18. As shown, this resistance S is variable, and the means for varying it and the reasons for doing so will hereinafter appear. The circuit of the shunt resistance S starts from the point 17, includes wire 19 and arm 20, arranged to be moved over a series of contacts *a*, connected to resistance S, and thence the circuit passes by wire 21 to the negative main at the point 18.

It is obvious that by connecting a wire to resistance S, as at the point 22, the difference of potential between said wire and either main is less than that between the mains themselves, so by connecting the terminals of an auxiliary electric circuit to a point on the resistance S, as at 22, and to another point on or near the negative main, for instance, as at 23, the potential of this auxiliary circuit is lower than that of the main line, and the potential of said auxiliary circuit may be varied by moving the point of connection 22 from place to place on resistance S or by varying the resistance, as shown, by means of suitable contacts *a* and arm 20.

In the diagrams the switch D and relays U and V are in a circuit derived from a shunt including the resistance S across the line between the points 17 and 18, this derived circuit, including the switch D and relays U and V, being connected between any suitable points, as 22 and 23. The derived circuit referred to also, as shown, includes a resistance T, and means are provided for connecting another circuit, including magnets 12 to 16, to different points on the resistance T. The circuit including the magnets 12 to 16 is connected in shunt from any suitable point, as 24, preferably adjacent the negative main, to the switch D, the operation of which serves to connect the circuit of the magnets to different points 25 26 27 28 on the resistance T. With this arrangement the electric potential of the circuit including the magnets 12 to 16 will be less than that of the derived circuit including the relays U and V, while the potential of the circuit including said magnets will be varied according to the connection of such circuit to resistance T.

The switch D may be of any suitable character for the purposes intended. As shown, it consists of a pivoted arm *b*, the two portions of which are insulated from each other, as at *c*, and one portion of the arm is adapted to be moved over series of contacts *d e f g* and *h i j k*, connected to each other and to the resistance T at the points 25 26 27 28, it being understood that any desired number of contacts may be used in connection with the resistance T, several only being shown for the sake of simplicity.

A circuit is led from the point 22 on resistance S through a magnet 29, controlling contacts 30 in the circuit of brake-magnet F, connected in such manner as to become energized to lift the brake when contacts 30 are closed, and the circuit referred to passes from magnet 29 to relays U and V, connected in parallel, and from thence by wires 40 and 50 to contacts *l* and *m*, with which one portion of the switch-arm *b* is adapted to make contact. From that portion of the switch-arm *b* which makes contact with contacts *l* and *m* connection is made by wire 31 to resistance T at the point 28, and connection is made by wire 32 from a point 33 on that portion of the switch-arm which sweeps over the contacts connected to resistance T through magnets 12 to 16, inclusive, to the point 24.

The farther the arm *b* is turned to the left or the right over the contacts with which it is adapted to make contact the greater will be the electric potential of the circuit including the magnets 12 to 16, inclusive. In other words, the difference of potential between the points 24 and 34 on the circuit of said magnets will increase as the arm *b* is moved farther from its central position to the right or left. At the same time that the arm *b* is moved as described, in one direction or the other, circuit will be made through one or the other of the relays U V, through contact *l* or *m*, wire 31, to resistance T, and by wire 35 to the negative main, so that practically simultaneously with the closure of one side or the other of the reversing-switch E the magnets 12 to 16 will begin to operate and first close the circuit of the shunt-field B,

then cut out an extra field H, (which may be a resistance arranged in shunt across the brushes of the machine which is used for starting and for slowing down the stopping hereinafter to be described,) then short-circuit the armature-resistance by degrees for starting, and, finally, short-circuit the series field-winding, at which time the motor has come up to speed.

The closure of contacts 1 establishes the circuit of the shunt-field B. The opening of contacts 2 cuts out the extra shunt-field or shunt resistance H, as the case may be. The closure of contacts 3 4 short-circuits the armature resistance R, and the closure of contacts 5^a short-circuits the series field C. Energizing-magnet 29 closes contacts 30 and completes the circuit of brake-magnet F to remove the brake on starting.

As the operating potential for magnets 12 to 16 is gradually reduced on stopping and the circuit is finally broken at the switch D, the extra field or shunt resistance H is thrown into circuit, thereby reducing the speed of the motor before stopping.

To prevent the operator from sending more than a safe current through the armature, the armature-circuit is run through a coil 36, and the core 37 thereof is connected to the arm 20 and arranged to be drawn in when the current is excessive, thereby including more of the resistance S in the shunt across the mains and reducing the difference of potential between points 22 and 23, which reduces proportionately the difference of potential between the points 24 and 34 which operates magnets 12 to 16.

One of the great advantages of my system is here apparent, for no matter what the voltage on the main line may be a constant voltage may be obtained in the operating-circuit by suitably varying the resistance S. Any desired number of gradations of voltage may be obtained in the circuit leading from the switch D and including magnets 12 to 16, so that the operator has more control of the motor-circuits than in other systems, as he is able to cut in or out the extra shunt field or resistance, the series field, and the armature-resistance at will, subject only to the automatic safety device 36, which prevents the operator from sending more than a safe amount of current through the armature.

In the diagram of Fig. 2 a modification of the apparatus is shown by means of which the shunt-circuit, including resistance S, connected across the mains, is normally broken, and is arranged to be energized only when it is desired to start the motor. In the diagram of Fig. 1 it will be seen that the shunt, including the resistance S, is continually taking current even when the motor is at rest, and as this is a wasteful arrangement it is preferable to provide means for breaking said shunt-circuit when the motor is at rest, and also for breaking the said circuit after the motor has started, as it is not necessary that the shunt-circuit across the mains should be completed while the motor is in operation. Any suitable means may be provided for accomplishing this end; but, as shown, contacts 38 are provided in the circuit of resistance S, controlled by a magnet 39, connected in circuit between contacts *o p* on the switch D and the negative main, these additional contacts *o p* being arranged on the switch D in such manner that when the switch-arm *b* is in a central position the magnet 39 is deënergized; but when it is moved to the right or left magnet 39 becomes energized and opens its contacts 38, which are normally closed, thereby breaking the shunt-circuit, including resistance S, when the motor starts. One or the other of the relays U V remains energized after the motor starts, even although the shunt-circuit, including the resistance S, is broken, because they remain in circuit with the resistance T and wire 35, connected to the negative main.

The operation of the apparatus shown in Fig. 2 is precisely like that of the apparatus shown in Fig. 1, and need not further be described.

It will thus be seen that according to my invention there are controlling means for the motor deriving their energy from the same source which supplies the motor or from the same supply-line, while means are provided for varying the power of said controlling means for doing work without varying the power of the source or of the line. It will also be seen that there are at least two controlling devices in circuit with each other, as shown, there being more than two such devices as embodied in the magnets of the reversing-switch and the magnets 12 to 16, inclusive, and means are provided for varying the potential of some of said devices, as the magnets 12 to 16, without varying that of the others.

Without limiting myself to the precise construction and arrangement of parts shown, what I claim as my invention is—

1. The combination with a motor and its supply-line, of a controlling-circuit of lower potential than the line derived from a shunt to said line, substantially as described.

2. The combination with a motor and its supply-line, of a controlling-circuit of lower potential than the line derived from a shunt to said line, and means for varying the potential of said controlling-circuit, substantially as described.

3. The combination with a motor and its supply-line, of a shunt to the line, a controlling-circuit derived therefrom, and means for varying the electric potential of said controlling-circuit in accordance with the current on the line, substantially as described.

4. The combination with a motor and its supply-line, of a controlling-circuit of lower potential than the line deriving its energy from said supply-line, and means for varying the power of said controlling-circuit for doing

work without varying that of the line, substantially as described.

5. The combination with an electric motor and its supply-line, of a controlling-circuit of lower potential than the line deriving its energy from said supply-line, and means for varying the electric potential of said controlling-circuit without varying that of the line, substantially as described.

6. The combination with a motor and its supply-line, of a controlling-circuit for the motor deriving its energy from said line, and means for increasing the electric potential of the controlling-circuit without increasing that of the line, substantially as described.

7. The combination with a motor and its supply-line, of a controlling-circuit deriving its energy from said line, and means for varying at will the difference of potential between the terminals of said controlling-circuit, substantially as described.

8. The combination with a motor and its supply-line, of a shunt-circuit across the line, a controlling-circuit derived from said shunt-circuit, and means for varying the difference of potential between the terminals of said controlling-circuit, substantially as described.

9. The combination with a motor and its supply-line, of a shunt-circuit across the line, a controlling-circuit derived from said shunt-circuit, and means for varying the difference of potential between the terminals of said controlling-circuit in accordance with variations of the current on the line, substantially as described.

10. The combination with a motor and its supply-line, of a controlling-circuit derived from said line, means for varying the electric potential in said controlling-circuit, and means for regulating the variations of said potential, substantially as described.

11. The combination with a motor and its supply-line, of a controlling-circuit derived from said line, means for varying the electric potential in said controlling-circuit, and means for regulating the variations of said potential in accordance with the current on the line, substantially as described.

12. The combination with a motor and its supply-line, of a shunt across the line, a circuit derived therefrom, means for varying the potential in said circuit, and means for regulating the variations of said potential, substantially as described.

13. The combination with a motor and its supply-line, of a shunt-circuit across the line, a controlling-circuit derived therefrom, and means for varying the electric potential of said controlling-circuit, substantially as described.

14. The combination with a motor and its supply-line, of a shunt-circuit across the line, a controlling-circuit derived therefrom, and means for varying the electric potential of said controlling-circuit without varying that of the line, substantially as described.

15. The combination with a motor and its supply-line, of a shunt-circuit across the line, a controlling-circuit derived therefrom, and means for maintaining a constant electric potential in said controlling-circuit, substantially as described.

16. The combination with a motor and its supply-line, of a shunt-circuit across the line, a controlling-circuit derived from said shunt-circuit, another controlling-circuit derived from said controlling-circuit, and means for varying the electric potential of said controlling-circuits, substantially as described.

17. The combination with a motor and its supply-line, of a shunt-circuit across the line, a controlling-circuit derived from said shunt-circuit, another controlling-circuit derived from said controlling-circuit, and means for varying the electric potential of each of said controlling-circuits, substantially as described.

18. The combination with a motor and its supply-line, of a shunt across the line including resistance, a controlling-circuit shunting a portion of said resistance and itself including resistance, and another controlling-circuit shunting the resistance in said controlling-circuit, substantially as described.

19. The combination with a motor and its supply-line, of a shunt across the line including variable resistance, a controlling-circuit shunting a portion of said resistance and itself including resistance, and another controlling-circuit shunting the resistance in said controlling-circuit, substantially as described.

20. The combination with a motor and its supply-line, of a shunt across the line including resistance, a controlling-circuit shunting a portion of said resistance and itself including resistance, another controlling-circuit in shunt to said controlling-circuit, and means for connecting said other circuit to different points on the resistance in said controlling-circuit, substantially as described.

21. The combination with a motor and its supply-line, of a shunt across the line, a circuit derived from said shunt and including resistance, a controlling-circuit connected in shunt to said derived circuit, and means for connecting said controlling-circuit to different points on said resistance, substantially as described.

22. The combination with a motor and its supply-line, of a shunt across the line, a circuit derived from said shunt, a controlling-circuit in shunt to said derived circuit, and means for connecting said controlling-circuit to different points on said derived circuit, substantially as described.

23. The combination with a motor and its supply-line, of a shunt across the line including a resistance, means for varying said resistance in accordance with the current on the line, a circuit derived from said shunt and shunting a portion of said variable resistance, a controlling-circuit in shunt to said derived circuit, and means for connecting said controlling-circuit to different points on said derived circuit, substantially as described.

24. The combination with a motor and the main line, of a shunt across the line including a variable resistance, means for varying said resistance in accordance with variations of current on the line, a circuit derived from said shunt and shunted across said variable resistance and itself including a resistance, a controlling-circuit in shunt to said derived circuit, and means for connecting said controlling-circuit to different points on the resistance in said derived circuit, substantially as described.

25. In an apparatus for controlling elevators, the combination with a motor and its supply-line, of a shunt across the line, a circuit derived therefrom including means for operating a motor-reversing switch, and another circuit in shunt to said derived circuit and including means for controlling the starting and stopping of the motor, substantially as described.

26. In an apparatus for controlling elevators, the combination with a motor and its supply-line, of a shunt across the line, a circuit derived therefrom including means for operating a motor-reversing switch, another circuit in shunt to said derived circuit and including means for controlling the starting and stopping of the motor, and means for varying the potential in said other circuit in shunt to said derived circuit, substantially as described.

27. In an apparatus for controlling elevators, the combination with a motor and its supply-line, of a shunt across the line, a circuit derived therefrom including means for operating a motor-reversing switch, another circuit in shunt to said derived circuit and including means for controlling the starting and stopping of the motor, and means for connecting said other circuit to different points on said derived circuit, substantially as described.

28. The combination with a motor and its supply-line, of a shunt across the line, a circuit derived from said shunt, a controlling-circuit in shunt to said derived circuit and including means for controlling armature resistance, means for connecting said controlling-circuit to different points on said derived circuit, and means for preventing the cutting out of said armature resistance too quickly on starting the motor with an excess of current on the line, substantially as described.

29. The combination with a motor and its supply-line, of a shunt across the line, a circuit derived from said shunt, a controlling-circuit in shunt to said derived circuit, means for varying the electric potential of said controlling-circuit, and means for regulating the variations of potential of said controlling-circuit, substantially as described.

30. The combination with a motor, and its armature-circuit, of a motor-controlling circuit, and an electromagnet for varying the electric potential of said controlling-circuit by means of the current in the armature-circuit, substantially as described.

31. The combination with a motor, and its main circuit, of a controlling-circuit in shunt to said main circuit, and means operated by the current in the main circuit for varying the electric potential of the shunt-circuit, substantially as described.

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

AUGUST SUNDH.

Witnesses:
H. R. MARSDEN,
W. H. BRADY.