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CIRCUIT CONTROLLER.

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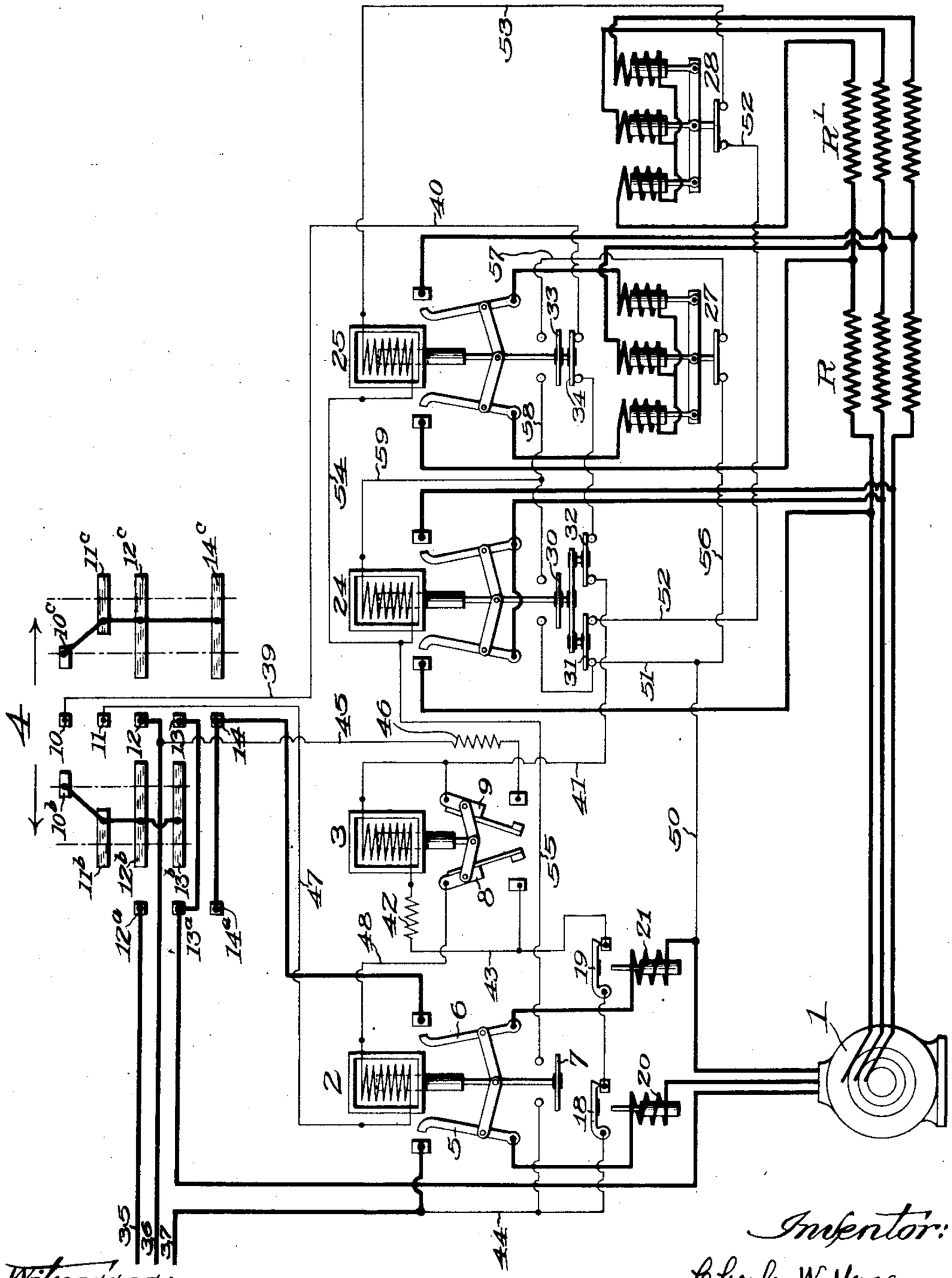
997,224.

Patented July 4, 1911.



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CIRCUIT-CONTROLLER.

997,224. Specification of Letters Patent. **Patented July 4, 1911.**

Application filed November 4, 1909. Serial No. 526,186.

To all whom it may concern:

Be it known that I, CHARLES W. YERGER, a citizen of the United States, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented new and useful Improvements in Circuit-Controllers, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawing, forming a part of this specification.

My invention relates to improvements in circuit controlling devices.

Broadly, it is the object of my invention to provide a circuit controlling device, particularly adapted for alternating current circuits, which will open upon the occurrence of abnormal conditions in the circuit controlled thereby and which will remain open until the same is intentionally reclosed. It should be understood, however, that my invention is equally applicable to circuit controlling devices for direct current circuits.

Various other objects and advantages of my invention will be hereinafter set forth.

For the purpose of more fully disclosing the characteristic features of my invention, I shall described the embodiment thereof diagrammatically illustrated in the accompanying drawing.

For the purpose of illustration, I have shown the device arranged to control the circuit of an alternating current slip ring motor 1. It should be understood, however, that my invention is not limited to this particular application thereof. The device illustrated includes an electroresponsive main switch 2, an auxiliary or relay switch 3 and a master switch 4. The main switch 2 is provided with two contact members 5 and 6, each connected in one phase of the primary circuit of the motor 1. The main switch 2 is also provided with an auxiliary switch contact 7 for a purpose hereinafter set forth. The auxiliary or relay switch 3 is provided with two contact members 8 and 9. The contact member 8, as will be hereinafter set forth, is connected in circuit with the operating winding of the main switch 2 while the contact member 9 is adapted to complete a maintaining circuit for its operating winding. In practice, the master switch may be of any preferred construction according to the functions which it is required to perform.

As illustrated, the master switch comprises a series of contact fingers 10, 11, 12, 13 and 14, a series of contact fingers 12^a, 13^a and 14^a, and two sets of contact segments arranged to be moved simultaneously in either direction into engagement with said sets of contact fingers. The segments of the left hand set I shall designate as 10^b, 11^b, 12^b and 13^b, and those of the right hand set as 10^c, 11^c, 12^c and 14^c. The segments of each set are electrically connected to one another. The master switch illustrated is arranged to control the circuits of both the main switch 2 and the relay switch 3, and also the direction of operation of the motor in a manner to be hereinafter set forth.

For protecting the motor against abnormal conditions in the primary circuit thereof, I have shown overload switches 18 and 19 provided with operating solenoids 20 and 21 respectively, which are connected in different phases of the primary circuit of the motor. Of course, the number of overload switches may be varied as desired. The overload switches, as will be hereinafter more fully set forth, are adapted, upon responding, to cause the deënergization of the relay switch 3, which, in turn, causes the deenergization of the main switch. The overload switches may be arranged to also directly deënergize the main switch in addition to the relay switch if desired.

In the secondary circuit of the motor are connected two sets of resistances R and R′, each set containing a plurality of sections of resistance, one for each phase of the secondary circuit. The sets of resistances R and R′ are arranged to be controlled by electroresponsive resistance switches 24 and 25 respectively. Each of the switches 24 and 25, when closed, shortcircuits its corresponding set of resistances. For preventing too rapid removal of resistances from the secondary circuit, I have shown relay switches 27 and 28 arranged to control the operating windings of the resistance switches 24 and 25 respectively. Each of the relay switches is provided with a plurality of operating windings connected in different phases of the secondary circuit. The resistance switch 24 is provided with auxiliary switches 30, 31 and 32. These auxiliary switches are so arranged that when the switch 24 is open, the auxiliary switches 31 and 32 are closed while the switch 30 is open. Upon closure

of the switch 24, the auxiliary switch 30 is closed and the other two auxiliary switches are open. In practice, switch 30 would be arranged to close prior to the opening of switches 31 and 32. The resistance switch 25 is provided with auxiliary switches 33 and 34. These auxiliary switches are so arranged that when the resistance switch 25 is open, the switch 34 will be closed and the switch 33 open, and when the switch 25 is closed, the switch 33 will be closed and the switch 34 opened.

I shall now describe the operation of the controller illustrated, at the same time setting forth the circuit connections therefor, assuming that current is supplied from a three phase alternating current supply circuit having main lines 35, 36 and 37. To close the primary circuit, it is necessary to move the master switch in one direction or the other according to the direction in which it is desired to operate the motor 1. Assume that the master switch is moved to bring the left hand set of contact segments into engagement with the right hand series of contact fingers, and the right hand set of segments into engagement with the left hand set of contact fingers. Circuit will first be closed from main line 36 of the alternating current supply circuit to contact finger 12, thence to contact segment 12^b and contact segment 10^b to contact finger 10, by conductors 39 and 40, through the auxiliary switches 34 and 32 of resistance switches 25 and 24 respectively, by conductor 41, through the operating winding of relay switch 3, through a protective resistance 42 by conductor 43, through the overload switches 19 and 18, by conductor 44 to main line 37. The operating winding of the relay switch 3 is thereby connected across one phase of the supply circuit and will respond to close the contact members 8 and 9. Closure of the contact member 9 completes a circuit from main line 36 by conductor 45, through resistance 46 and switch 9, and thence through its operating winding to main line 37 as already traced. The resistance 46 is so designed as to further protect the operating winding of switch 3 after the same has responded. Initial movement of the master switch, therefore, causes the relay switch to respond and to establish a maintaining circuit for its operating winding independent of the master controller. To cause the main switch to respond, it is necessary to move the master switch another step in the same direction to cause the contact segment 11^b to engage the contact finger 11. This movement of the master switch disengages the contact 10^b from the contact finger 10, thereby opening the initial energizing circuit of the relay switch. Movement of the master switch to the position just mentioned, completes a circuit as already traced, to contact segment 12^b, thence to contact segment 11^b and contact finger 11, by conductor 47, through the operating winding of main switch 2, by conductor 48 through the contact member 8 of the relay switch 3, to conductor 43, and thence to main line 37, as already traced. This conects the operating winding of the main switch 2 across one phase of the supply circuit, thereby causing said switch to respond. Closure of the main switch under these conditions connects the primary of the motor to the supply circuit in the following manner: Contact member 5 of switch 2 connects main line 37 to the middle terminal of the motor, contact member 6 and the master switch connect main line 35 to the right hand terminal of the motor, while the left hand terminal of the motor is connected through the master switch to main line 36. The motor is thus started with all of the resistance connected in the secondary circuit thereof. However, upon closure of main switch 2, the auxiliary switch 7 thereof completes a circuit from main line 35 through the master switch and contact member 6 of main switch 2, by conductors 50 and 51, through auxiliary switch 31 of resistance switch 24, by conductor 52, through the relay switch 28, by conductor 53, through the operating winding of resistance switch 25, by conductors 54 and 55 through the auxiliary switch 7, of main switch 2, and thence by conductor 44 to main line 37. This causes the switch 25 to respond, subject to the action of the relay switch 28, to shortcircuit the resistance sections R′ from the motor circuit. Upon closure of resistance switch 25, the auxiliary switch 33 operated thereby completes a circuit from conductor 50, by conductor 56, through the relay switch 27, by conductor 57, through the auxiliary switch 33 of resistance switch 25, by conductors 58 and 59, through the operating winding of resistance switch 24, to conductor 55. This connects the operating winding of resistance switch 24 in parallel to the operating winding of resistance switch 25, thereby causing the resistance switch 24 to respond, subject to the action of the relay switch 27, to shortcircuit resistance R. Upon closure of switch 24, the auxiliary switch 31 is opened, thereby deënergizing switch 25.

With the arrangement thus described, it will be seen that the main line switch controls the operation of the resistance switches, and, therefore, the resistance switches cannot operate until the main switch is closed. Conversely opening of the main switch, or more specifically, opening of the auxiliary switch 7 thereof, will cause deënergization of the resistance switches. This arrangement establishes an electrical interlock between the main switch and the resistance switches. It has previously been explained

that the initial energizing circuit of the relay switch is completed through the auxiliary switches 34 and 32 of resistance switches 25 and 24 respectively, which auxiliary switches are open when their corresponding resistance switches are closed. Consequently, these auxiliary switches form an electrical interlock, which prevents energization of the relay switch, unless the resistance switches are both open. It has further been explained that the circuit of the operating winding of resistance switch 25 is completed through the auxiliary switch 31 of resistance switch 24, which auxiliary switch is opened upon closure of said resistance switch 24. This auxiliary switch, therefore, forms another electrical interlock necessitating deënergization of the resistance switch 24 prior to energization of the resistance switch 25. The purpose of these interlocks will be apparent to anyone skilled in the art, and, briefly stated, is to insure operation of the switches in a definite sequence; or, in other words, to prevent any of the switches responding out of turn, thereby endangering the motor. All of the switches having now responded, it will be seen that the motor will be brought up to normal speed. If, now, at any time, while the motor is in operation, an overload occurs in any phase of the primary circuit, one of the overload switches will respond, thereby interrupting the maintaining circuit of the relay switch 3, which thereupon opens and in turn opens the circuit of the operating winding of the main switch 2. Main switch 2 is consequently deënergized, and, in turn, disconnects the motor from circuit and simultaneously deënergizes the resistance switch 24. Of course, upon opening of the motor circuit, the overload switches would be deënergized and return to closed position. It has been previously explained, however, that upon movement of the master switch to energize the main switch, the energizing circuit of the relay switch 3 is opened, and, consequently, reclosure of the overload switches cannot cause reënergization of the relay switch 3. Consequently, both the relay switch 3 and the main switch 2 will remain open until the master switch is returned to bring the contact segment 10^b into engagement with the contact finger 10, whereupon the relay switch 3 will again respond. In moving the master switch 4 to this position, the same opens the energizing circuit of the main switch 2, and, consequently, said main switch cannot be energized until the master switch is again operated to bring the contact segment 11^b into engagement with the contact finger 11, which, as before explained, opens the energizing circuit of the relay switch 3. It will thus be apparent that after the main switch has been tripped by the overload devices, the master switch may be brought back to initial position without again reënergizing the main switch, or it may be operated to energize the main switch as desired. Not only will the overload devices operate to deënergize the relay switch 3, but said relay switch 3 will also be deenergized upon failure of voltage. Thus the motor will be fully protected both upon overloads and failure of voltage. Upon movement of the master controller in the opposite direction, the several switches operate in the same manner as previously described. However, the circuit connections of the primary of the motor are changed. Under these conditions the left hand terminal of the motor is connected through the master switch to main line 35, while the right hand terminal is connected to main line 36. These connections cause the motor to operate in an opposite direction to that previously set forth.

Having thus described my invention, what I desire to secure by Letters Patent, is:—

1. In a circuit controller, in combination, an automatic switch, a second automatic switch adapted upon opening to cause said first mentioned switch to open, a master controller movable to one position to cause the second switch to close and movable to another position to cause the first switch to close, said second switch being incapable of closing when the said master controller is in said second position.

2. In a circuit controller, the combination with an electroresponsive main switch, of an electroresponsive auxiliary switch adapted, when deënergized, to cause deënergization of said main switch, an overload switch adapted to respond to deënergize said auxiliary switch, and circuit connections for preventing reënergization of said auxiliary switch upon return of the overload switch to normal position.

3. In a circuit controller, in combination, an electroresponsive switch, a second electroresponsive switch responsive only when said first mentioned switch is closed and adapted to be deënergized when said first mentioned switch is open and a master switch movable first to one position to cause said first mentioned switch to respond and then to another position to cause said second mentioned switch to respond, said first mentioned switch being unresponsive when said master switch is in said second position.

4. In a circuit controller, the combination with an electroresponsive main switch, of an electroresponsive auxiliary switch adapted, when deënergized, to cause deënergization of said main switch, and an overload switch adapted to cause deënergization of said auxiliary switch, said auxiliary switch being adapted to maintain its own operating winding deënergized after the return of said overload switch to normal position.

5. In a circuit controller, in combination, an electroresponsive main switch, an electroresponsive auxiliary switch adapted, when deënergized, to cause deënergization of said main switch, and a master switch separately controlling both of said electroresponsive switches, and adapted, upon energizing said main switch, to render said auxiliary switch ineffective to respond after it has once been deënergized.

6. In a circuit controller, in combination, an electroresponsive main switch, an electroresponsive auxiliary switch connected in circuit with the operating winding of said main switch, and a master switch movable into different positions to successively energize said auxiliary switch and said main switch, and, upon energizing said main switch, to render said auxiliary switch ineffective to respond after it has once been deënergized.

7. In a circuit controller, in combination, an electroresponsive main switch, an electroresponsive auxiliary switch in circuit with the operating winding of said main switch, said auxiliary switch, upon responding, being adapted to establish a maintaining circuit for its operating winding, and a master switch for successively energizing said auxiliary switch and said main switch, and adapted, upon energizing said main switch, to open the energizing circuit of said auxiliary switch.

8. In a circuit controller, in combination, an electroresponsive main switch, an electroresponsive auxiliary switch adapted, when deënergized, to cause deënergization of said main switch, a master switch for successively energizing said auxiliary switch and said main switch, and adapted, upon energizing said main switch, to render said auxiliary switch ineffective to respond after it has once been deënergized, and means responsive to abnormal conditions in the circuit controlled by said main switch for deënergizing said auxiliary switch.

9. In a circuit controller, in combination, an electroresponsive main switch, an electroresponsive auxiliary switch adapted, when deënergized, to cause deënergization of said main switch, an overload switch adapted to respond to deënergize said auxiliary switch, and a master switch controlling said main switch and said auxiliary switch and adapted, upon energizing said main switch, to render said auxiliary switch ineffective to again respond after the overload switch returns to normal position.

10. In a circuit controller, in combination, an electroresponsive main switch, an electroresponsive auxiliary switch adapted, when deënergized, to cause deënergization of said main switch, said auxiliary switch being adapted, upon responding, to establish a maintaining circuit for its operating winding, a master switch arranged to open the energizing circuit of said auxiliary switch upon energizing said main switch, and an overload switch connected in the maintaining circuit of said auxiliary switch.

11. In a controller for alternating current motors, in combination, an electroresponsive main switch for controlling the primary circuit of the motor, electroresponsive accelerating switches for the motor, means necessitating operation of the main switch and accelerating switches in definite sequence, an electroresponsive auxiliary switch adapted, when deënergized, to cause deënergization of said main switch, a master switch controlling said main switch and said auxiliary switch and adapted, upon energizing said main switch, to render said auxiliary switch ineffective to respond after it has once been deënergized, and means responsive to abnormal conditions in the motor circuit to deënergize said main switch.

12. In a controller for alternating current motors, in combination, an electroresponsive main switch for controlling the primary circuit of the motor, electroresponsive accelerating switches for the motor arranged to be deënergized upon deënergization of said main switch, an electroresponsive auxiliary switch adapted, when deënergized, to cause deënergization of said main switch, a master switch controlling said main switch and auxiliary switch and adapted, upon energizing said main switch, to render said auxiliary switch ineffective to respond after it has once been deënergized, and an overload switch responsive to abnormal conditions in the motor circuit for causing deënergization of said auxiliary switch.

13. In a circuit controller, in combination, an automatic main switch, a no-voltage device adapted when deënergized to cause said main switch to open, said main switch being capable of closing only when said no-voltage device is energized and a master controller movable first to one position to energize said no-voltage device and then to another position to cause said main switch to operate, said no-voltage device being unresponsive upon restoration of voltage while said master controller is in position to cause operation of said main switch.

In witness whereof, I have hereunto subscribed my name in the presence of two witnesses.

CHARLES W. YERGER.

Witnesses:
WALTER C. KENNEDY,
FRANK H. HUBBARD.