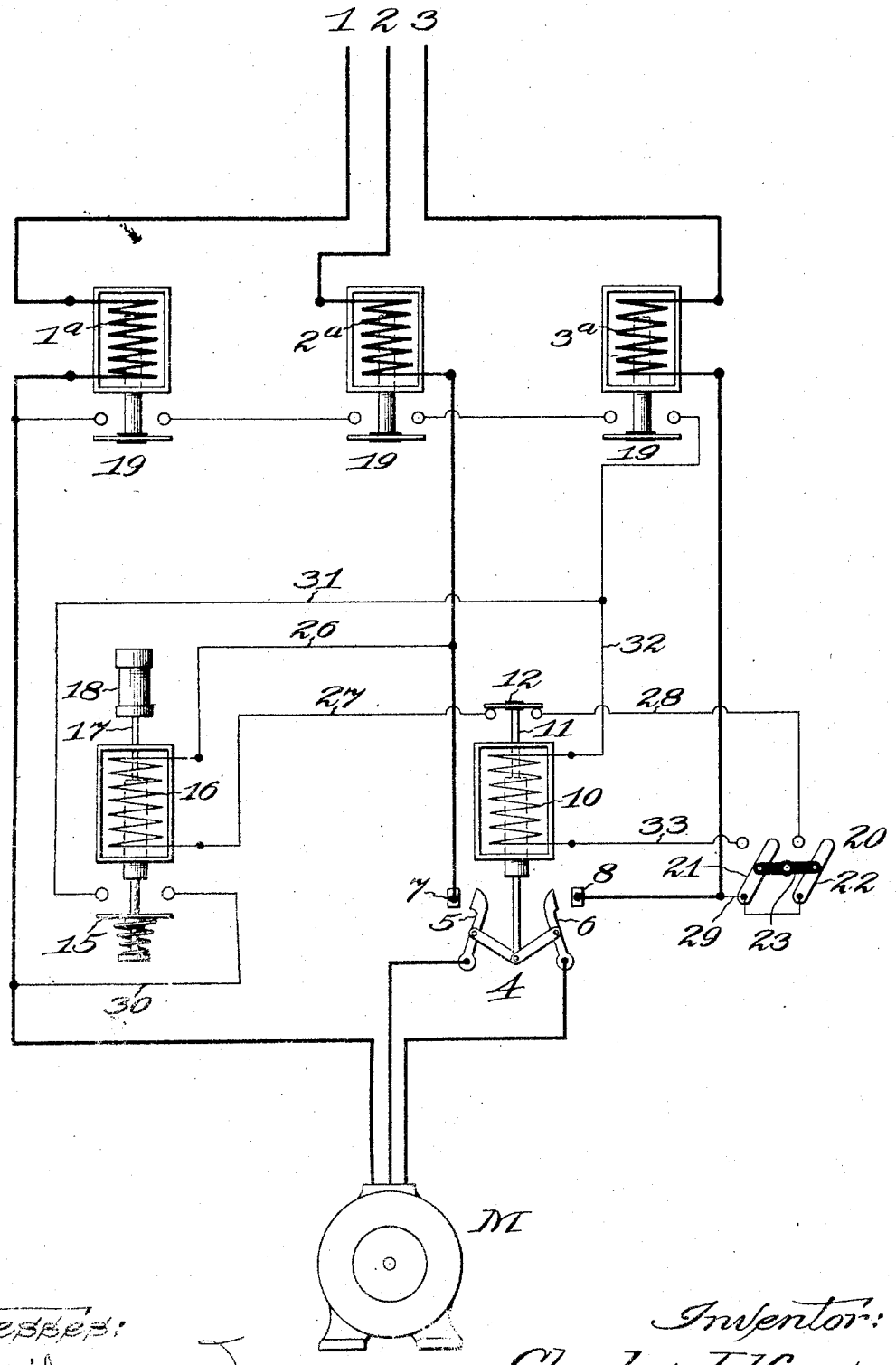
C. J. KRUSE.

CIRCUIT CONTROLLER.

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1,179,637. Patented Apr. 18, 1916.



Witnesses:
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UNITED STATES PATENT OFFICE.

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CIRCUIT-CONTROLLER.

1,179,637. Specification of Letters Patent. Patented Apr. 18, 1916.

Application filed January 5, 1911, Serial No. 600,857. Renewed August 12, 1911. Serial No. 643,784.

To all whom it may concern:

Be it known that I, CHARLES J. KRUSE, a citizen of the United States, residing at Cleveland, in the county of Cuyahoga and State of Ohio, 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.

One object of my invention is to provide a circuit controlling device that will open the circuit controlled thereby upon failure of voltage and which may be used for controlling polyphase alternating current circuits with the aforesaid result upon failure of voltage in any phase thereof.

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

In order to clearly and fully disclose the nature and characteristic features of my invention, I shall describe the motor controller diagrammatically illustrated in the accompanying drawing, said controller embodying my invention in one form. It should be understood, however, that my invention may assume other forms than that illustrated in the accompanying drawing and may be used in other relations.

I have shown in the accompanying drawing a three phase alternating current motor M adapted to be supplied with current from a three phase alternating current circuit, the lines of which I have designated 1, 2 and 3. I have omitted illustration of the main line switch and the fuses which are ordinarily used in practice. Supply line 1 is permanently connected to one terminal of the motor, while the supply lines 2 and 3 are adapted to be connected to the other two terminals of the motor by a main switch 4. In practice, the main switch 4 may assume any preferred form. As illustrated, it comprises two pivoted switch arms 5 and 6 having stationary contacts 7 and 8 respectively. The switch arm 5 is connected to the middle terminal of the motor, while its coöperating contact 7 is connected to supply line 2. The switch arm 6 is connected to the right hand terminal of the motor, while its coöperating contact 8 is connected to supply line 3. Accordingly, when the switch 4 is closed, circuit is completed through the motor and the motor will be set in operation. For operating the switch 4, I have provided a solenoid 10, the plunger of which carries at its upper end a tail rod 11 upon which is mounted an auxiliary switch 12. The switch 12 has coöperating contacts, which are engaged thereby when the solenoid 10 is deenergized and the switch 4 is open. Conversely, when the solenoid 10 is energized and the switch 4 is closed, the switch 12 is moved out of engagement with its stationary contacts.

The initial energizing circuit of the solenoid 10 is controlled by a switch 15. The switch 15 is provided with an operating solenoid 16. The plunger of the solenoid 16 has a tail rod 17 upon which the switch 15 is resiliently mounted in such a manner that said switch member will engage its contacts before the plunger of solenoid 16 has completed its stroke, and will remain in engagement with its stationary contacts for a time after the plunger of solenoid 16 commences to descend. Also, the plunger of the solenoid 16 is connected to a dash pot 18 for retarding its descent. With this particular form of switch a certain lapse of time is insured between the deënergization of the solenoid 16 and the opening of the switch 15. The purpose of this time arrangement will be hereinafter made apparent. It should be undestood, that any other preferred form of switch might be employed. As will be hereinafter more clearly set forth, when the switch 4 closes, it deënergizes the solenoid 16 of its control switch 15, therefore necessitating the establishment of a maintaining circuit for retaining said switch 4 in closed position. This retaining circuit is established in a manner hereinafter described by relay switches 19. The relay switches 19 are provided with operating windings 1^a, 2^a and 3^a respectively, each of said windings being connected in a different

phase of the supply circuit, preferably in series with the motor. In practice, the number of relay switches may be varied as desired, but I prefer to have one switch for each phase of the supply circuit. The windings 1^a, 2^a and 3^a are preferably so designed as to respond only when the motor circuit is closed and to become deënergized immediately upon failure of voltage in their corresponding phases of the supply circuit.

For controlling the energizing circuits of switches 4 and 15 to start and stop the motor, I have provided a switch 20. In practice, the switch 20 may assume any preferred form and may be adapted either for manual or automatic operation. As illustrated, the switch merely comprises two pivoted switch arms 21 and 22 provided with coöperating stationary contacts and connected by an insulating link 23 for causing movement thereof in unison.

I shall now describe the operation of the controller, at the same time clearly and fully setting forth the circuit connections therefor.

With the various switches in the position illustrated, the motor is disconnected from circuit. To start the motor it is necessary to move switch 20 to the left bringing the members 21 and 22 thereof into engagement with their coöperating contacts. When the switch 20 is so operated, circuit is completed from main line 2 by conductor 26 through the solenoid winding 16 by conductor 27 through the auxiliary switch 12 of main switch 4 by conductor 28 through the arm 22 of switch 20 by conductor 29 to supply line 3. Accordingly, solenoid 16 is connected across supply lines 2 and 3 and responds to close the switch 15. Closure of the switch 15 completes a circuit from supply line 1 by conductor 30 through said switch 15 by conductors 31 and 32 through the solenoid winding 10 of main switch 4 by conductor 33 through arm 21 of switch 20 by conductor 29 to supply line 3. The solenoid winding 10 being thus connected across supply lines 1 and 3 becomes energized and closes the switch 4. Closure of the switch 4 completes the motor circuit, as already set forth, thereby setting the motor in operation. As has been seen, the solenoid winding 16 and the solenoid winding 10 are connected across different phases of the supply circuit and must operate successively in order to close the motor circuit. Accordingly, the switches 4 and 15 cannot respond and the motor circuit cannot be completed unless normal voltage conditions prevail in all phases of the supply circuit. Hence, the danger of injuring the motor by attempting to close the circuit thereof while abnormally low voltage exists in any phase thereof is positively prevented.

Returning now to the operation of the controller, it will be seen that upon closure of switch 4, the auxiliary switch 12 thereof will be opened. As has been seen this auxiliary switch is connected in circuit with the solenoid winding 16 and hence, when the same is opened it will cause the deënergization of said solenoid winding 16. Thereupon the plunger of the solenoid 16 tends to drop, but is retarded in its descent by the dash pot 18. The switch 15 upon opening would deënergize the switch 4, causing the same to disconnect the motor from circuit. Accordingly, I arrange the windings of the relay switches 19 to respond immediately upon closure of the motor circuit to establish a maintaining circuit for the operating solenoid of switch 4. It is for the purpose of giving the relay switches 19 ample time to respond, that I provide the switch 15 with means for giving a time element, for, if no such time element was provided, the switch 15 might deënergize switch 4 before said relay switches 19 had responded. Upon all of the relay switches 19 responding, a circuit is completed from supply line 1 through all of said relay switches in series to conductor 32, thereby establishing a shunt circuit around the switch 15 for maintaining the operating solenoid of switch 4 energized. As has previously been set forth, the relay switches 19 are designed to open upon failure of voltage in their corresponding phases of the supply circuit and, obviously, when any one of the relay switches 19 does open, it interrupts the maintaining circuit of the operating solenoid of switch 4 causing said switch to open and interrupt the motor circuit. Thus the switch 4 will be deënergized upon failure of voltage in any phase of the supply circuit and cannot be reset until normal voltage is restored in every phase of the supply circuit.

Having thus described my invention what I claim as new and desire to secure by Letters Patent, is:

1. In a controlling device for polyphase alternating current circuits, in combination, electro-responsive means controlling the continuity of the several phases of the controlled circuit, a plurality of relays having operating windings in different phases of the controlled circuit and each being dependent for energization upon energization of said electro-responsive means and predetermined electrical conditions in its respective phase of the controlled circuit, a normally interrupted energizing circuit for said electro-responsive means independent of said relays, and connections whereby energization of said electro-responsive means to maintain the continuity of the controlled circuit is dependent upon energization of all of said relays.

2. In a controlling device for polyphase alternating current circuits, in combination, electro-responsive means controlling the continuity of the several phases of the controlled circuit, a plurality of relay switches having operating windings connected in all phases of the controlled circuit and each in a different phase thereof, whereby said relays are each dependent for energization upon energization of said electro-responsive means and predetermined electrical conditions in its respective phase of the controlled circuit, a normally open energizing circuit for said electro-responsive means independent of said relays and a maintaining circuit for said electro-responsive means through all of said relays in series whereby said circuit is interrupted upon deënergization of any one of said relays.

3. In a controller for polyphase alternating current circuits, in combination, electro-responsive means for completing the several phases of the circuit, a plurality of relays operating upon failure of voltage in any phase of the circuit to deënergize said electro-responsive means but under normal conditions establishing a maintaining circuit for said electro-responsive means, and means for initially energizing said electro-responsive means but ineffective to maintain the same energized.

4. In a controller for polyphase alternating current circuits, in combination, electro-responsive means for completing the several phases of the circuit, a plurality of relays operating upon failure of voltage in any phase of the circuit to deënergize said electro-responsive means but under normal conditions establishing a maintaining circuit for said electro-responsive means, and means for initially energizing said electro-responsive means but ineffective to maintain the same energized and ineffective to initially energize said electro-responsive means unless normal conditions prevail.

5. In a controller for polyphase alternating current circuits, in combination, electro-responsive means for completing the several phases of the circuit, a relay operable to initially energize said electro-responsive means but automatically interrupting the energizing circuit of said means after the lapse of a temporary period, and means for automatically establishing a maintaining circuit for said electro-responsive means but necessitating normal voltage conditions in all phases of the circuit prior thereto.

6. In a controller for polyphase alternating current circuits, in combination, electro-responsive means for completing the several phases of the circuit, a relay operable to initially energize said electro-responsive means but automatically interrupting the energizing circuit of said means after the lapse of a temporary period, and means for automatically establishing a maintaining circuit for said electro-responsive means but necessitating normal voltage conditions in all phases of the circuit prior thereto, said electro-responsive means and said relay being dependent for their joint operation on normal voltage conditions in all phases of the supply circuit.

7. In a controller for polyphase alternating current circuits, in combination, electro-responsive means for completing the several phases of the circuit, an electro-responsive relay for initially energizing said electro-responsive means, connections insuring the deënergization of said relay upon response of said electro-responsive means, a maintaining circuit for said electro-responsive means, a plurality of relays connected in series in said maintaining circuit and having operating windings connected in the several phases of the circuit to insure against the completion of said maintaining circuit while abnormal voltage conditions prevail in any phase and to interrupt said maintaining circuit upon the occurrence of abnormal voltage conditions in any phase.

8. In a controller for polyphase alternating current circuits, in combination, electro-responsive means for completing the several phases of the circuit, an electro-responsive relay for initially energizing said electro-responsive means, connections insuring the deënergization of said relay upon response of said electro-responsive means, a maintaining circuit for said electro-responsive means, a plurality of relays connected in series in said maintaining circuit and having operating windings connected in the several phases of the circuit to insure against the completion of said maintaining circuit while abnormal voltage conditions prevail in any phase and to interrupt said maintaining circuit upon the occurrence of abnormal voltage conditions in any phase, the operating windings of said electro-responsive means and said first mentioned relay being dependent for their energization upon normal voltage conditions in all phases of the supply circuit.

9. In a controller for polyphase alternating current circuits, in combination, a plurality of switch members for controlling the several phases of the controlled circuit, a single electro-responsive operating winding therefor, means for energizing said winding but only under predetermined electrical conditions in the controlled circuit and means for maintaining said winding energized under normal voltage conditions in the controlled circuit but insuring the deënergization of said winding upon an abnormal decrease in voltage in any phase of the controlled circuit.

10. In a circuit controlling device for polyphase alternating current circuits in combination, an electroresponsive main switch, means for energizing said main switch, but tending to automatically deënergize the same after a lapse of time, and means automatically operating upon closure of said switch to maintain the same energized independently of said first mentioned means but only upon normal conditions in all phases of the circuit.

11. In a circuit controlling device for polyphase alternating current circuits in combination, an electroresponsive main switch, means for energizing said main switch, but tending to automatically deënergize the same after a lapse of time, and means automatically operating upon closure of said switch to maintain the same energized independently of said first mentioned means but only upon normal conditions in all phases of the circuit, said second mentioned means causing deënergization of said switch upon failure of voltage in any phase of the circuit.

12. In a circuit controlling device, in combination, an electro-responsive main switch, means operating automatically upon closure of said main switch for establishing a maintaining circuit therefor, and automatic means for deënergizing said main switch within a predetermined period upon failure of said former means to operate.

13. In a circuit controlling device, in combination, an electro-responsive main switch means operating automatically upon closure of said switch for establishing a maintaining circuit therefor, said means being ineffective to establish the maintaining circuit while abnormal conditions exist, and means operating automatically to deënergize said main switch within a predetermined period upon failure of said first mentioned means to operate.

14. In a controlling device for electric circuits in combination, an electroresponsive main switch, a time relay switch tending to deënergize said main switch, and means for rendering said relay switch ineffective to deënergize said main switch while normal conditions prevail.

15. In a controlling device for polyphase alternating current circuits, in combination, an electroresponsive main switch, an electroresponsive control switch therefor, said switches being dependent for their energization upon all phases of the polyphase circuit and interlocked to necessitate energization thereof successively, said main switch when energized being adapted to deënergize said control switch, and a plurality of relay switches each connected in a different phase of the polyphase circuit, said relay switches being adapted to respond upon completion of the polyphase circuit to establish a maintaining circuit for said main switch and to interrupt said maintaining circuit upon failure of voltage in any phase of the circuit.

16. In a controlling device for polyphase alternating current circuits, in combination, an electroresponsive main switch, an electroresponsive control switch therefor, said switches being dependent for their energization upon all phases of the polyphase circuit and interlocked to necessitate energization thereof successively, said main switch when energized being adapted to deënergize said control switch, and a plurality of relay switches each connected in a different phase of the polyphase circuit, said relay switches being adapted to respond upon completion of the polyphase circuit to establish a maintaining circuit for said main switch and to interrupt said maintaining circuit upon failure of voltage in any phase of the circuit, said control switch maintaining the initial energizing circuit of said main switch complete for a temporary period after the same is deënergized.

17. A protective device for multiphase circuits having a main line switch for all phases, electromagnetic means respectively for each phase and operatively actuated by a no-current condition of its allotted phase, and means receiving its current from said multi-phase circuit whereby the operative actuation of either or all electromagnetic means aforesaid causes said switch to operate.

18. A protective device for multi-phase circuits having a main line switch for all phases, electromagnetic means respectively for each phase and operatively actuated by a no-current condition of its allotted phase, and means receiving its current from said multi-phase circuit whereby the operative actuation of either electromagnetic means aforesaid causes said switch to operate, said last aforesaid means including a plurality of contacts serially arranged in circuit.

19. A protective device for multi-phase circuits having a main line switch for all phases, electromagnetic means respectively for each phase and operatively actuated by a no-current condition of its allotted phase, and means receiving its current from said multi-phase circuit, whereby the operative actuation of either or all electromagnetic means aforesaid causes said switch to operate, said last aforesaid means including a plurality of contacts, serially arranged in circuit, and a plunger for each electromagnetic means.

20. A protective device for multi-phase circuits having a main line switch for all phases, electromagnetic means respectively for each phase and operatively actuated by

a no-current condition of its allotted phase, and means receiving its current from said multi-phase circuit whereby the operative actuation of either or all electromagnetic means aforesaid causes said switch to operate, said last aforesaid means including a plurality of contacts serially arranged in circuit, and a plunger for each electromagnetic means, said plungers also controlling the circuit conditions of said last aforesaid pairs of contacts.

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

CHARLES J. KRUSE.

Witnesses:
LOUISE SCHEIDEGGER,
CHARLES F. MORGAN.