

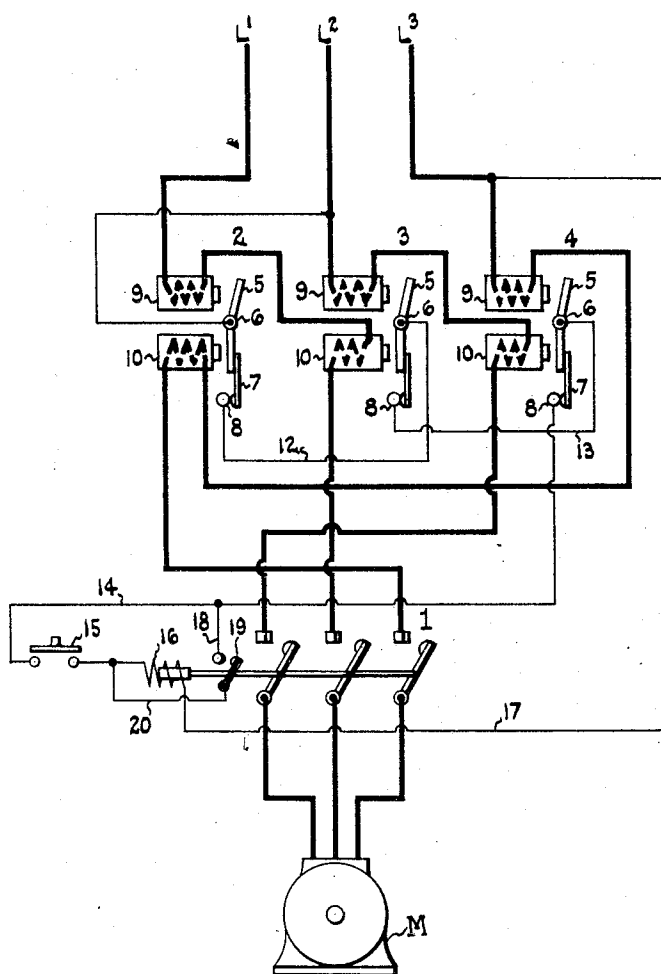
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LOW VOLTAGE PROTECTIVE MEANS

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LOW-VOLTAGE PROTECTIVE MEANS

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This invention relates to improvements in low voltage protective means for electric circuits.

5 An object of the invention is to provide improved protective means especially advantageous for phase failure protection of synchronous motors and rotary converters.

10 A further object is to provide simple and efficient protective means for the aforementioned and other uses which will reset automatically.

Other objects and advantages of the invention will hereinafter appear.

15 The accompanying drawing illustrates diagrammatically one embodiment of the invention which will now be described, it being understood that the embodiment illustrated is capable of various modifications and other uses falling within the scope of the appended claims.

20 Referring to the drawing, there is illustrated a motor M to be connected to a three phase alternating current circuit L^1 , L^2 , L^3 through a three pole electro-responsive main switch 1, said main switch being under the control of phase failure protective means hereinafter described.

25 The motor M may be assumed to be of the synchronous type and hence capable of operating single phase unless protected thereagainst. However, it is to be understood that the motor might be of other types.

30 The protective means includes three relays 2, 3 and 4 of like construction, each comprising an armature 5 pivoted at 6 and carrying at its lower end a contact 7 to engage a stationary contact 8, said armature being under the control of two electromagnets 9 and 10. The electromagnets 9 and 10 are arranged 40 with respect to the pivot of the armature to exert opposing pulls on said armature whereby electromagnet 10 tends to hold the contacts 7 and 8 in engagement while electromagnet 9 tends to disengage said contacts. 45 As illustrated the contacts 7 and 8 normally engage under the influence of gravity and hence the electromagnet 9 must overcome such bias of the movable contact and the opposing pull, if any, of electromagnet 10 in 50 order to disengage said contacts.

Each of relays 2, 3 and 4 has its windings 9 and 10 connected to different supply lines to be included in series with the motor and each relay is so designed as to remain closed pending failure of the phase in which its 55 winding 10 is connected or a given reduction in voltage. More particularly, relay 2 has its winding 9 connected to line L^1 and its winding 10 connected to line L^3 through winding 9 of relay 4, whereas relay 3 has its 60 winding 9 connected to line L^2 and its winding 10 connected to line L^1 through winding 9 of relay 2 and relay 4 has its winding 10 connected to line L^2 through winding 9 of relay 3, winding 9 of relay 4 being connected 65 to line L^3 as previously stated.

Thus assuming closure of main switch 1 and further assuming normal voltage of each phase, each relay will be held closed against 70 the pull of its respective winding 9 whereas failure of any phase will release the relay having its winding 10 connected therein and such relay will then open if the phase including its winding 9 is still supplied with a given 75 voltage either from the source of supply or from the motor when operating single phase. In other words, failure of one or two phases will insure operation of one or another of said relays and, as will appear, opening of 80 any one of the relays will effect opening of the main switch. Also as will appear, failure of all phases will effect opening of the main switch without dependence on operation of either relay provided the failure continues 85 until the motor stops.

Tracing the energizing circuit of the main switch 1, the same extends from line L^2 through relay 2 by conductor 12 through relay 3 by conductor 13 through relay 4 by conductor 14 through push button switch 15 90 when closed, to and through the winding 16 of main switch 1 by conductor 17 to line L^3 . Push button switch 15 thus serves to energize the main switch assuming closure of all relays, and the main switch upon responding 95 shunts the push button switch. This shunt may be traced from conductor 14 by conductor 18 through auxiliary contacts 19 of main switch 1 by conductor 20 to a point between push button switch 15 and the main switch 100

winding 16, and as will be apparent this shunt provides a maintaining circuit for the main switch inclusive of relays 2, 3 and 4 in series.

Thus as previously stated, opening of any relay will deenergize the main switch, whereas failure of all phases for a period sufficient to effect stopping of the motor will deenergize the main switch independently of the relays and the main switch in opening will interrupt its maintaining circuit. Accordingly the main switch upon opening will remain open pending depression of push button switch 15 but with the arrangement disclosed the relays upon opening will reclose automatically upon opening of the main switch for all relay windings will then be disconnected from circuit.

As will be understood, the relays may be designed and adjusted for the desired sensitivity of response upon phase failure, as for example immediate response when the current in the live phase attains 100% value, and as will further be understood, the relays may be modified to require manual resetting thereof if desired.

What I claim as new and desire to secure by Letters Patent is:

1. The combination with an electric circuit having at least three lines, of low voltage protective means therefor comprising a plurality of relays, each having windings subjecting the same to opposing pulls and each having its windings connected to different lines of said circuit.

2. The combination with an electric circuit having at least three lines, of low voltage protective means therefor comprising a plurality of relays, each biased to a given position and each having a holding winding connected to one of said lines and an operating winding connected to another of said lines.

3. The combination with an electric circuit having at least three lines, of low voltage protective means therefor comprising a switch controlling the continuity of said circuit and a plurality of relays responsive separately to effect opening of said switch, each of said relays having windings subjecting it to opposing pulls and each having its windings connected to different lines of said circuit.

4. The combination with an electric circuit having at least three lines, of low voltage protective means therefor comprising a plurality of relays, one for each of said lines, each of said relays having an operating winding and an opposing holding winding and each having its windings connected to different lines of said circuit with its operating winding in series with a holding winding of a second relay and its holding winding in series with the operating winding of a third relay.

5. The combination with an electric circuit having at least three wires to afford a plurality of phases, of means to insure interrup-

tion of said circuit upon failure of less than all phases thereof and comprising separate relays for the different phases, each of said relays having an operating winding included in one phase and an opposing holding winding connected in a different phase.

6. The combination with an electric circuit having at least three wires to afford a plurality of phases, of means to insure interruption of said circuit upon failure of less than all phases thereof, and comprising separate relays for the different phases, each of said relays having an operating winding and an opposing holding winding, and each having its windings connected in different phases with its operating winding in phase with the holding winding of a second relay and its holding winding in phase with the operating winding of a third relay.

7. In phase failure protective means for circuits having at least three wires to afford a plurality of phases, the combination with a main switch controlling the continuity of the several phases, of a plurality of relays separately responsive to effect opening of said main switch, each of said relays having an operating winding and an opposing holding winding connected in different phases.

8. In phase failure protective means for circuits having at least three wires to afford a plurality of phases, the combination with a main switch controlling the continuity of the several phases, of a plurality of relays separately responsive to effect opening of said main switch, each of said relays having an operating winding and an opposing holding winding connected in different phases with its operating winding in phase with a second relay and its holding winding in phase with the operating winding of a third relay.

In witness whereof, I have hereunto subscribed my name.

EDWIN W. SEEGER.

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