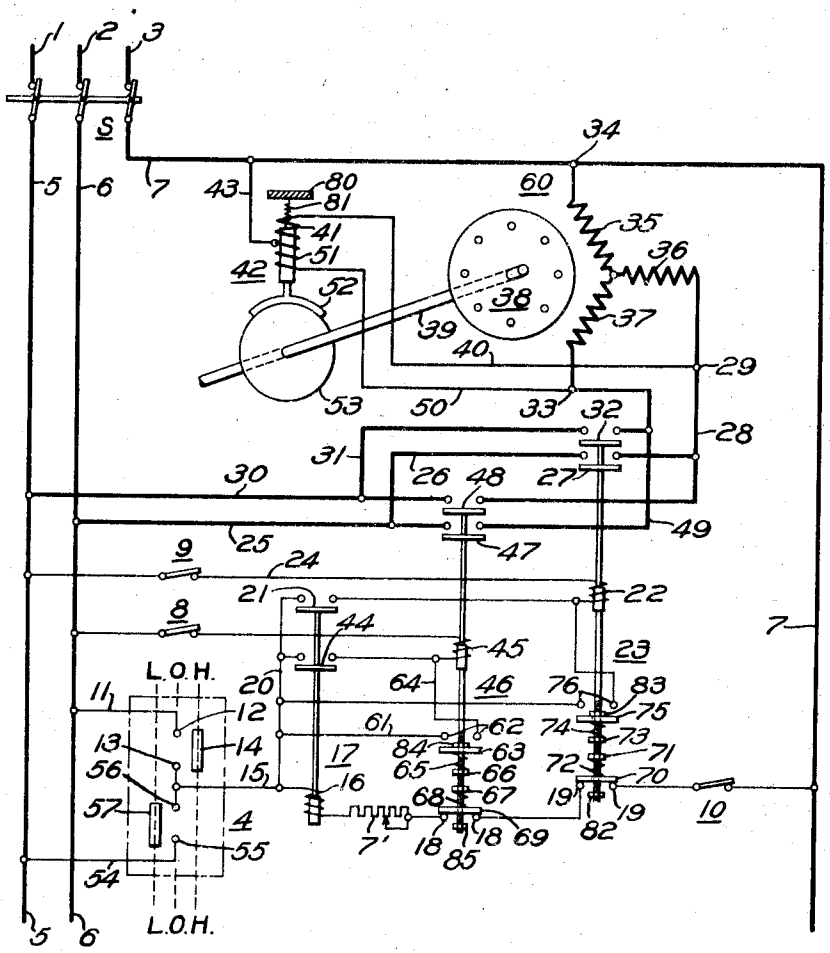
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REMOTE CONTROL OF THREE-PHASE MOTORS

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REMOTE CONTROL OF THREE-PHASE MOTORS

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My invention relates generally to control systems and more particularly to systems for selectively controlling the direction of operation of reversing motors.

An object of my invention, generally stated, is to provide for controlling the operation of a motor by a single control circuit and a single control relay.

A more specific object of my invention is to provide for utilizing a single conductor and a single control relay for controlling the operation of motor-reversing switches at a remote station.

With the devices heretofore utilized for remotely controlling a three-phase alternating-current motor, a plurality of control circuits and a plurality of control relays were necessary. When but one control circuit and one control relay were utilized in the control system, the control relay was connected ahead of the directional contactors for the motor and effected the operation of one or another of the directional contactors, depending upon the connection of the control circuit to one or another phase selected by a manually-operable controller. This latter system of the prior art has the serious defect that the circuit through the operating coil of the control relay is not interrupted by the movement of the manual controller to the "O" or neutral position but is maintained through the auxiliary contact members which must, for control purposes, of necessity, be provided on the directional contactors.

To minimize the dangers of the defect mentioned, resistors and reactors have heretofore been provided for the control relay, but such an arrangement increases the cost of the control system and, what is much more serious, does not insure that the directional contactor, that has been energized, will release its contact members when the manually-operable controller is moved to the "O" position.

As the system of control under discussion is generally utilized for hoisting equipment where, as a rule, the operator's station and the drive are not located permanently relative to each other, so that a hand brake to be actuated by the operator could not be used, there is great danger that the operator will lose all control over the motor as well as over the brake-lifting device if one of the directional contactors fails to open. But, even if the energized directional contactor operates properly, the control relay remains energized, thus causing an unnecessary consumption of energy.

A further and important object, therefore, of my invention is the provision of a simplified, inexpensive and reliable control system.

Other objects and advantages will become apparent from a study of the following specification, when considered in conjunction with the accompanying drawing, in which the single figure is a diagrammatic view of a control system for a hoisting motor embodying the principal features of my invention.

Referring more particularly to the drawing, 1, 2 and 3 designate the three-phase line conductors leading to a suitable source of alternating-current supply (not shown). The switch S is a manually-operable knife switch, which, when actuated to the position shown, supplies electrical energy to the load conductors 5, 6 and 7 and the control circuit.

In this particular installation, my invention is shown in combination with an induction motor 60 for driving hoisting equipment (not shown).

The directional contactors for controlling the direction of operation of the motor 60 are designated at 23 and 46, and 17 designates the single control relay for controlling the energization of the directional contactors. The control relay and, therefore, the directional contactors may be caused to operate by appropriate operation of the master or manually-operable controller 4.

The control circuit may be isolated from the remaining circuits by the manually-operable knife switch 10 which is connected in series-circuit relation to the control circuit. In a similar manner, the knife switches 8 and 9 control the energizing circuits for the directional contactors 23 and 46. During the operation of the motor 60, a magnetic brake-releasing mechanism 42 releases the brake drum 53, in a manner more specifically pointed out hereinafter.

Assuming that the switch S and the knife switches 8, 9 and 10 are in the positions shown in the drawing, and that the attendant desires to operate the motor in the hoisting direction, he actuates the controller 4 to the "H", or hoisting position, thereby establishing a circuit from the energized conductor 6, through the conductor 11, contact fingers 12 and 13—bridged by the contact segment 14 of the controller 4—conductor 15, actuating coil 16 of the control relay 17, adjustable resistor 7', contact fingers 18—bridged by the back contact member 69 of the directional contactor 46—contact fingers 19—bridged by the back contact member 70 of the directional contactor 23 and knife switch 10, to the energized conductor 7.

Operation of the control relay 17 establishes a circuit from the energized conductor 15, through conductor 20, contact members 21 of the control relay 17, actuating coil 22 of the directional contactor 23, conductor 24 and the knife switch 9, to the energized conductor 5. It will be observed that the operation of the control relay 17 also causes the contact members 44 to move to circuit-closing position. However, this operation can have no effect, since the terminals of the actuating coil 45 of the directional contactor 46 are both connected to the same conductor, namely conductor 6.

Since the actuating coil 22 is connected across the conductors 5 and 6, the directional contactor 23 will be operated to establish an energizing circuit for the motor 60 to effect its operation in the hoisting direction. This circuit may be traced from conductor 5, through conductors 30 and 31 and contact members 32 of the directional contactor 23, to the junction 33 and the primary winding 37 of the induction motor 60. The primary winding 36 is energized by a circuit from conductor 6, through conductors 25 and 26, contact members 27 of the directional contactor 23 and conductor 28, to the junction 29. Since the primary winding 35 of the motor is permanently connected to the energized conductor 7 at the junction 34, the energizing circuit for the primary windings of the induction motor is complete, and the motor will operate in the hoisting direction the instant the braking mechanism 42 releases the brake drum 53.

The energizing circuit for the brake-releasing mechanism 42 is established at the same instant the circuit for the primary windings of the induction motor is established. This circuit may be traced from the junctions 33 and 29, through conductors 50 and 40, the additively energized actuating coils 51 and 41 of the brake-releasing mechanism 42 and the conductor 43, to the energized conductor 7. The brake shoe 52 thus releases the brake drum 53, and the motor armature 38, through the shaft 39, drives the hoisting equipment (not shown).

To eliminate the possibility of the operator losing control of the motor by continued energization of the control relay 17, the directional contactor 23 is provided with a contact member 75 which is biased to a predetermined position by a spring 74, disposed intermediate the contact member 75, and an adjustable nut 73. The contact member 70 is biased to a circuit-closing position by a spring 72, disposed intermediate the adjustable nut 71, and the contact member 70.

The armature stem of the directional contactor 23 is provided with an adjustable nut 82 near its lower end. By an appropriate adjustment of the nuts 71, 73, 82 and 83, a definite sequence of cooperation between the contact fingers 19 and the contact member 70, relative to the cooperation of contact member 75 and the contact fingers 76, may be effected. The adjustment of the respective nuts is such that the operation of the directional contactor 23 establishes a holding circuit for the actuating coil 22, from the energized conductor 20, through contact fingers 76—bridged by the contact member 75—an instant prior to the interruption of the control circuit at the contact fingers 19. As the armature of the directional contactor 23 continues to move upwardly, the nut 82 engages the contact member 70, thereby interrupting the circuit for the control relay 17 at the contact fingers 19.

The control relay 17 is thus deenergized, and the contact members 21 and 44 move to open-circuit position. It is, therefore, obvious that movement of the controller 4 to the "O," or off, position will not fail to interrupt the energizing circuit for the actuating coil 22 of the directional contactor 23, and a positive control of the directional contactor 23 is thus provided for the attendant through the master controller 4. It is, of course, apparent that, when the controller is moved to the "O" position, the circuit for the motor, as well as for the brake-releasing mechanism 42, is interrupted, and the brake shoe 52 biased by the compression spring 81 intermediate the support 80 and the armature of the brake-releasing mechanism will lock the brake drum 53 in a fixed position.

If it be desired to operate the motor 60 in the lowering direction, the master controller 4 is moved to the "L" position, thereby establishing an energizing circuit for the conductor 20 from the energized conductor 5, through conductor 54, contact fingers 55 and 56—bridged by the controller segment 57 of the controller 4—and conductor 15, to conductor 20. The control relay 17 will thus be energized in the manner described hereinbefore in connection with the operation of the motor in the hoisting direction but, since con-

ductor 20 is now energized from conductor 5, the actuating coil 45 of the directional contactor 46 will be energized by a circuit extending from the energized conductor 5, through contact members 44 of the control relay 17, actuating coil 45 and knife switch 8, to the energized conductor 6.

As will be readily understood, the operation of the control relay in response to the movement of the master controller to the lowering position does not effect the operation of the directional contactor 23, since, in this instance, the terminals of its actuating coil are both connected to the same conductor, namely, conductor 5.

The mechanical construction of the directional contactor 46 is identical, in every detail, with the mechanical construction of the directional contactor 23 and, by an appropriate adjustment of the nuts 66 and 67, 84 and 85, the biasing effect of springs 65 and 68 may be varied, and the time of cooperation between the contact fingers 62 and the contact member 63, with reference to the time of cooperation of the contact fingers 18 with contact member 69, may be varied. The adjustment of the respective nuts mentioned is such that the holding circuit for actuating coil 45, through conductor 61, contact fingers 62, bridged by the contact member 63, and conductor 64, is established an instant prior to the interruption of the energizing circuit for the control relay 17 at the contact fingers 18. It is, of course, obvious that the operation of the contactor 46 establishes the motor circuit through contact members 47 and 48 and the conductors 28 and 49.

As the armature of the directional contactor 46 continues to move upwardly, the nut 85 engages the contact member 69, thus interrupting the energizing circuit for the coil 16 of the control relay 17. The contact members 21 and 44 are thus again moved to open-circuit position, and a positive control is thus provided for the directional contactors from the manually-operable controller 4.

Although I have shown and described certain specific embodiments of my invention, I am fully aware that many modifications thereof are possible. My invention, therefore, is not to be restricted except insofar as is necessitated by the prior art and by the spirit of the appended claims.

I claim as my invention:

1. A remote-control system for a reversing motor of the three-phase alternating-current type, in combination, a three-phase source of supply for the motor, a single control circuit connected to one of the phases, a manually-operable controller for selectively connecting the circuit to either of the other two phases, directional contactors for the motors, a pair of back-contact members on each directional contactor, one of the members of each pair being in series-circuit relation to the control circuit and being in circuit-closing position when the directional contactors are in an inactive position, holding circuits for each directional contactor controlled, respectively, by the other back-contact members, a single control relay connected in the control circuit for controlling the directional contactors, and means on each directional contactor for adjusting the relative position of the back-contact members on each directional contactor so that the holding circuit for each directional contactor, when operated, is established before the circuit for the control relay is interrupted.

2. A remote-control system for a reversing motor of the three-phase alternating-current type, in combination, a three-phase source of supply for the motor, a single control circuit connected to one of the phases, directional contactors for the motor, a control relay for controlling the operation of the directional contactors and a manually-operable controller for selectively connecting the circuit to either of the other phases to thereby control the operation of the directional contactors and control relay.

3. A remote-control system for a reversing motor of the three-phase alternating-current type, in combination, a three-phase source of supply for the motor, a single control circuit connected to one of the phases, a manually-operable controller for selectively connecting the circuit to either of the other phases, a pair of directional contactors, a control relay in said control circuit disposed to be energized by the manually-operable controller when moved to any one of its operative positions, said control relay being disposed to effect the operation of the one or the other of the directional contactors, depending upon the position of the manually-operable controller, and means associated with each directional contactor for maintaining its own energization and, immediately thereafter, the deenergization of the control relay.

4. In a motor-control system, in combination, a polyphase motor, a source of power for the motor, reversing switches for the motor, a master switch operable to a plurality of positions for controlling the operation of the reversing switches, control means responsive to the actuation of the master switch to predetermined operating positions for initially establishing energizing circuits for the reversing switches in accordance with the position of the controller, and means responsive to the operation of the reversing switches for establishing holding circuits for the reversing switches and for rendering the control means ineffective to further control the energizing circuits for the reversing switches.

5. In a motor-control system, in combination, a polyphase motor, a polyphase source of power for the motor, reversing switches for connecting the motor to the power source,

a single control circuit connected to one phase of the power source, a control relay disposed to be energized over the control circuit, a master switch operable to connect the control circuit to any of the other phases of the power source to effect the operation of the control relay, said control relay being disposed to effect the energization of the reversing switches in accordance with the phase of the power source to which the control circuit has been connected by the master switch, and means responsive to the operation of the reversing switches for successively establishing a holding circuit for the energized reversing switch directly through the master switch and deenergizing the control relay.

In testimony whereof, I have hereunto subscribed my name this 27th day of February, 1931.

HERBERT GAST.