

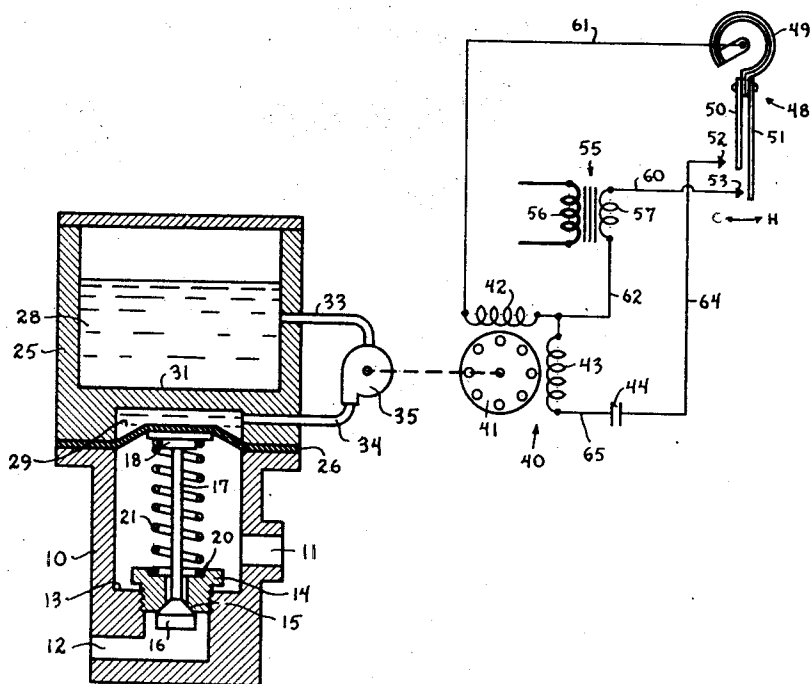
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MOTOR CONTROL CIRCUIT

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MOTOR CONTROL CIRCUIT

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The present invention relates to an improved motor control circuit and more particularly to one in which the controlling switch is a condition responsive switch.

In many cases in the condition controlling art, it is necessary to have a motor started upon the attainment of one condition and stopped upon the attainment of a second condition. The differential between starting and stopping of the motor is necessary to prevent excessive starting and stopping of the motor when the controlling condition is at approximately the desired value. One particular example of this practise is the case in which a hydraulic motor is used to position a temperature regulating device such as a valve. In such an arrangement, a spring usually biases the regulating device to one position and a hydraulic motor upon continuous operation of its associated pump is adapted to hold the device in another position. As soon as the motor associated with the pump is stopped, the biasing means is able to return the device to its biased position. It is desirable to use for the control of the motor driven pump a switch having a certain amount of differential to prevent excessive starting and stopping of the pump. In order to obtain this operation, it has been customary in the past to provide a relay or some similar auxiliary device which upon the establishment of one circuit insures the continued operation of the motor after that circuit has been broken until either a second circuit is broken or another circuit is made. The present invention is particularly concerned with a motor control circuit of the type in which the controlling switch is a condition responsive switch having two pairs of sequentially engageable contacts.

An object of the present invention is to provide a motor control system wherein a motor employing two starting windings is employed, the motor being capable of running on only one winding as a single phase motor after it has come up to speed and in which the motor is controlled by a condition responsive switch having two pairs of sequentially engageable contacts, one winding being energized under the control of the first to be engaged of said pairs of contacts and the other winding under the control of the last to be engaged of the pairs of contacts.

A further object of the present invention is to provide such a system in which one winding of the motor is the main winding and the second winding a condenser winding, the condenser winding being controlled by the one of said pairs

of contacts and the main winding by the other of said pairs of contacts.

A further object of the present invention is to provide such a system in which the controlling switch is a condition responsive switch.

A still further object of the invention is to provide such an arrangement wherein the motor is used to operate the pump of a hydraulically operated condition controlling device.

Other objects of the invention will be apparent from a consideration of the accompanying specification, claims and drawing.

In the single figure of the drawing, the motor control system is shown in connection with the control of a hydraulically actuated valve which may be employed for regulating the flow of a temperature changing fluid such as steam. This valve comprises a valve body 10 having inlet and outlet passages 11 and 12, respectively. Extending through the interior of the valve is a separate wall 13 into which is threaded an apertured plug 14 having a valve seat 15. Seated on the valve seat 15 is a valve 16 which has secured thereto a stem 17. Stem 17 is provided with a spring retaining collar 18 at its upper end. The plug 14 has a recess 20 in its upper face. A spring 21 seats at its lower end in the recess 20 and engages at its upper end the collar 18. The spring 21 serves to bias the valve 16 to its closed position in which it is in engagement with the valve seat 15. Secured to the valve body 10 is the hydraulic fluid housing 25. The housing 25 and the valve body 10 may be secured together by any suitable fastening means (not shown). Located between the housing 25 and the valve body 10 is a diaphragm 26 which is adapted to bear against the collar 18. The housing 25 contains two chambers for the hydraulic fluid. The first and largest of these chambers is the chamber 28 which chamber constitutes a reservoir for the hydraulic fluid. In the lower portion of the housing 28 is a second chamber 29 which is the motor chamber. The diaphragm 26 forms the lower wall of this chamber. The chambers 28 and 29 are separated by partition wall 31, being connected together by the pipes 33 and 34 and the centrifugal pump 35. The pump serves to pump the fluid from the upper chamber into the lower chamber through pipes 33 and 34 to open the valve against the action of spring 21. The pressure created by the pump serves to maintain the valve open as long as the pump is in operation. As soon as the pump 35 is stopped, the spring 21 is able to force the fluid in chamber 29 through the pump back into the reservoir 28 sufficiently

to enable closure of valve 16. The portion of the apparatus described so far does not, of itself, form a part of the present invention but is of importance only in its cooperation with the other elements of the system.

The pump 35 is driven by a motor generally designated by the reference numeral 40. This motor comprises a squirrel cage rotor 41 and a pair of field windings 42 and 43. A condenser 44 is connected in series with field winding 43 so that the current flowing through field winding 43 is displaced in phase with respect to that flowing through winding 42. The result is that the field windings 42 and 43 provide a shifting field to give a starting torque to the rotor 51. After the motor 41 has attained its running speed, the winding 43 may be disconnected inasmuch as the motor is able to continue to run as a single phase motor on only winding 42.

A thermostat 48 controls energization of the motor. This thermostat comprises a bimetal element 49 to which is secured contact blades 50 and 51. These blades are sequentially engageable with contacts 52 and 53. The spacing of blades 50 and 51 from contacts 52 and 53 is such that upon movement of blades 50 and 51 in the direction of the contacts, engagement is first effected between blade 51 and contact 53 and then between blade 50 and contact 52. It is to be understood that upon the blades moving in the opposite direction, blade 50 will be the first to disengage from its contact 52. In the illustrated form of the thermostat, the bimetallic element is so disposed that the blades 50 and 51 are moved to the left upon a temperature drop and to the right upon temperature rise although the bimetallic element may be disposed to provide the opposite action where preferable. While a thermostat has been shown as the controlling switch, it is to be understood that this switch may be actuated in accordance with any other desired controlling condition such as relative humidity, effective temperature, or pressure depending upon the nature of the control system.

A step-down transformer 55 provides low voltage power for operation of the control system. This transformer comprises a line voltage primary 56 adapted to be connected to any suitable source of power (not shown). The transformer also comprises a low voltage secondary 57.

Operation of system

The various elements of the system are shown in the position which they assume when the temperature adjacent bimetallic element 49 is sufficiently high to cause disengagement of both switch blades 50 and 51 from their respective contacts. Let it be assumed now that the temperature falls causing engagement of switch blade 51 with contact 53. As a result of this the following circuit will be established to the main winding 42. From the upper end of secondary 57 through conductor 60, contact 53, switch blade 51, bimetallic element 49, conductor 61, main winding 42 and conductor 62 to the lower terminal of secondary 57. The establishment of this circuit does not result in rotation of the rotor since the motor cannot start from the state of rest when only one of the windings are energized. The result is that nothing happens until the temperature falls sufficiently farther to cause engagement of switch blade 50 with contact 52. When this happens the following circuit is established to the condenser winding 43. From the upper end of secondary 57 through

conductor 60, contact 53, switch blade 51, switch blade 50, contact 52, conductor 64, condenser 44, conductor 65, field winding 43, and conductor 62 to the other terminal of secondary 57. Both windings of the motor will now be energized and since the current flowing through winding 43 must pass through condenser 44, the current flowing through this winding is displaced in phase with respect to that flowing through winding 42. The motor does, accordingly, now have a starting torque and is able to start rotating the pump 35. As soon as the motor has attained running speed, it is able to run when only winding 42 is energized.

The operation of motor 41 causes the pump 35 to drive fluid from the upper chamber 28 into the lower chamber 29 to cause valve 16 to be moved to open position. It is understood that the valve is used for the control of temperature changing apparatus. Thus the valve may be used as a pilot valve of a diaphragm gas valve controlling the flow of gas to the furnace. In any event, the opening of valve 16 is used to produce some action to increase the temperature of the region in which thermostat 48 is located. After the valve has been opened for a period of time, the temperature will rise sufficiently to cause disengagement of blade 50 from contact 52. This will interrupt the energization of starting winding 43, the energization of which is dependent upon engagement of both switch blades 50 and 51 with their respective contacts. The interruption in the energization of winding 43 does not terminate operation of the motor however since the motor is able to continue running on winding 42. The result is that valve 16 remains in open position despite the disengagement of switch blade 50 and contact 52. This relation continues until switch blade 51 disengages contact 53. Thereafter the motor is completely deenergized so that the operation of the pump is stopped. The spring 21 is now able to force the excess fluid in chamber 29 out through the pump 35 back into the upper chamber 28 so as to move valve 16 to closed position.

It will be seen that with the arrangement of the present invention, it is possible to employ a thermostat having sequentially engageable contacts to control a motor in such a manner that a differential is provided between the starting and stopping thereof without the interposition of any special switching device. It will further be seen that this control system results in an extremely simple and inexpensive motor control system particularly applicable for use with hydraulic controls.

While the specific embodiment of the invention has been shown for purposes of illustration, it is to be understood that the invention is limited only by the scope of the appended claims.

I claim as my invention:

1. In combination, a condition controlling device, a motor for operating said device, said motor having two windings and means for displacing in phase the current through one of said windings and said motor being capable of running on one winding as a single phase motor after it has been started, a switch responsive to a condition indicative of the need for operation of said device, said switch having two sequentially engaging pairs of contacts, an energizing circuit for one of said motor windings controlled by one of said pairs of contacts, and an energizing circuit for the other winding controlled by the other pair of contacts whereby said condition con-

trolling device is not placed in operation until both sets of contacts are made and continues running until both sets of contacts are separated.

2. In a motor controlling circuit, a motor having a main winding and a condenser winding and being capable of running on said main winding alone after it has been started, a controlling switch having two sequentially engaging pairs of contacts, an energizing circuit for said main winding controlled by the first pair of said contacts to engage, an energizing circuit for said condenser winding controlled by the second pair of said contacts to engage, a condition-controlling device operated by said motor, and means responsive to a condition for operating said switch, said means operating said switch to engage said pairs of contacts sequentially upon a variation in said condition indicative of the need for operation of said device, and said means operating said switch to open said pairs of contacts in reverse sequence upon a change in said condition indicative that the need for operation of said device no longer exists.

3. In combination, a condition controlling device, an electrical motor for operating said device, said motor having two windings and being adapted for continuous operation with one or both of said windings energized but requiring energization of both windings to start, switch means having two sequentially engaging pairs of contacts, an energizing circuit for one of said windings controlled by one of said pairs of contacts, an energizing circuit for the other of said wind-

ings controlled by the other of said pairs of contacts, and means responsive to a condition indicative of the need for operation of said device for actuating said switch means, said condition-responsive means actuating said switch means to close said pairs of contacts in succession as the condition changes in one direction, and to open said pairs of contacts in succession as the condition changes in the opposite direction.

4. A temperature control system, comprising in combination, temperature changing means, an electrical motor for controlling the operation of said temperature changing means, said motor having two windings and being adapted for continuous operation with one or both of said windings energized but requiring energization of both windings to start, switch means having two sequentially engaging pairs of contacts, an energizing circuit for one of said windings controlled by one of said pairs of contacts, an energizing circuit for the other of said windings controlled by the other of said pairs of contacts, and thermostatic means responsive to a temperature indicative of the need for operation of said temperature changing means for actuating said switch means, said thermostatic means actuating said switch means to close said pairs of contacts in succession as said indicative temperature changes in one direction, and to open said pairs of contacts in succession as said indicative temperature changes in the opposite direction.

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