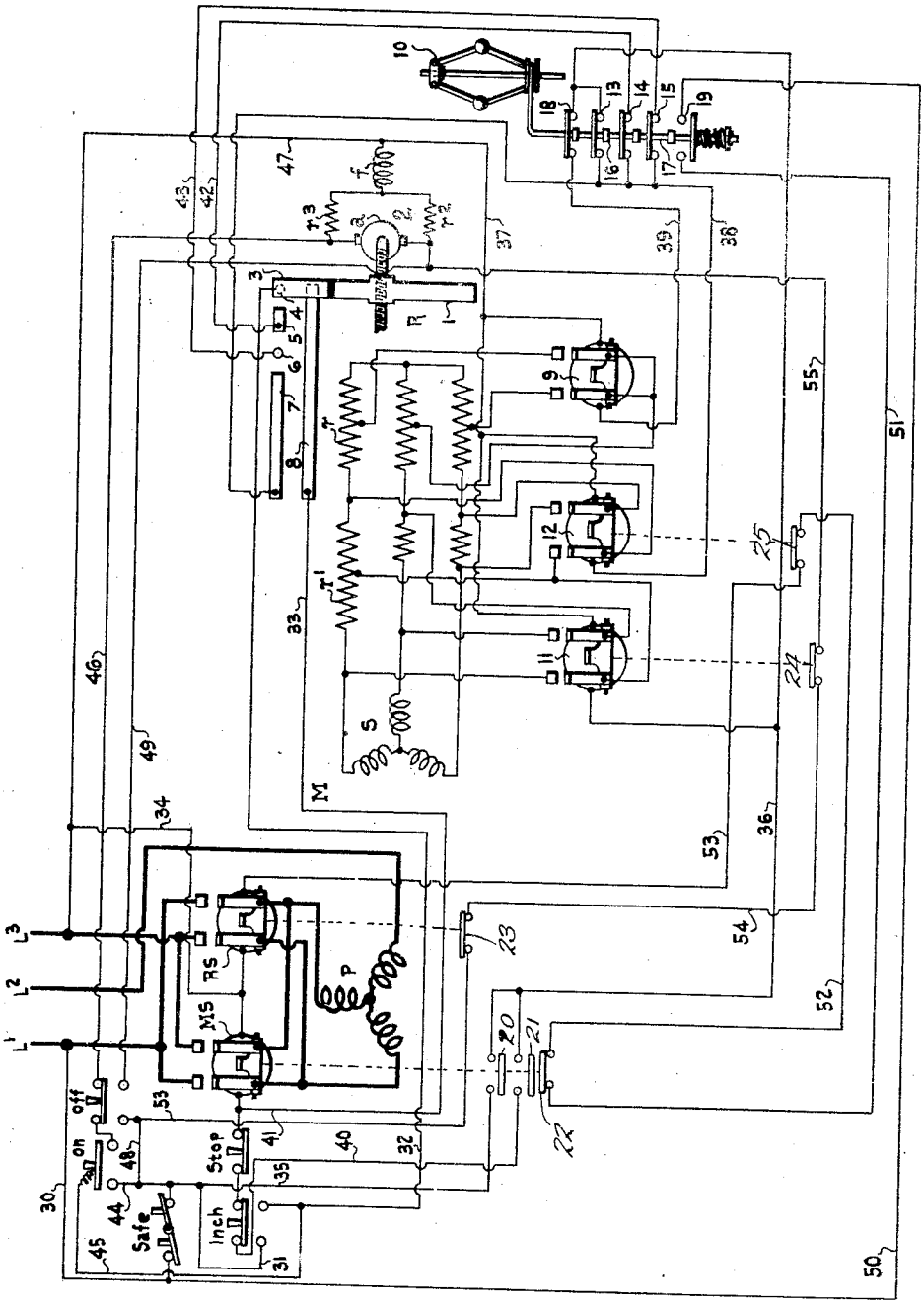
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MOTOR CONTROLLER

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MOTOR CONTROLLER

Application filed May 31, 1923. Serial No. 281,917.

This invention relates to improvements in motor controllers.

Controllers embodying the invention while not limited thereto, are especially advantageous for motors employed to drive printing presses.

An object of the invention is to provide a controller whereby a single motor may in some instances be advantageously employed in lieu of the customary two motor drive to afford operation of the press at the slow speeds desired for inching, etc., and at the higher speeds desired for printing.

Another object is to provide for such control by simple and efficient means.

Another object is to provide for operation at a number of different slow speeds selectively and for maintaining the motor speed in each instance substantially constant.

Another object is to provide for plugging of the motor and for restricting variation of the resistance of the motor circuit during plugging.

Other objects and advantages of the invention will hereinafter appear.

The accompanying drawing illustrates diagrammatically one embodiment of the invention which will now be described, it being understood that the invention may be embodied in other forms falling within the scope of the appended claims.

Referring to the drawing, there is illustrated therein a motor M to be controlled. This motor is illustrated as of a polyphase induction type having a primary P to be supplied from a three phase circuit L^1 L^2 L^3, and having a secondary S to be controlled through the medium of groups of resistances r, r^1, each group including resistance for each phase.

Resistance r is embodied in a rheostat R comprising a crosshead 1 to be operated by a pilot motor 2. As will be understood, the crosshead is movable by the pilot motor to exclude or include the resistance r according to the direction of operation of said pilot motor, and in like decrements or increments in the several phases of the motor circuit, for speed variation at will. The crosshead 1 has a portion 3 fixed thereto but insulated therefrom which is adapted to engage contacts 4, 5, 6 and 7 selectively according to the position of said crosshead and to bridge each of said contacts with a contact strip 8 engaged by portion 3 of the crosshead in all positions.

Resistance r also has associated therewith an electroresponsive switch adapted upon response to exclude a predetermined portion of said resistance for high torque starting. Switch 9, as will appear, is energized upon establishment of starting connections and is deenergized by means of a speed responsive device 10 immediately following starting to include all resistance r.

Resistance r^1 is independent of rheostat R, and as will be observed is not uniformly divided between the three phases, but as will appear, the illustrated arrangement of said resistance is not essential if control means other than that illustrated be provided. The control means illustrated comprises electroresponsive double pole switches 11 and 12 which jointly exclude all of said resistance and which individually short-circuit the resistance of but two phases. Switch 11 which is provided for plugging control only is arranged for response upon starting of the motor whereby the resistance r^1 is immediately reduced to those portions controlled by switch 12.

Switch 12 and that portion of resistance r^1 controlled thereby are provided to supplement the rheostat R for speed reduction and to maintain a substantially constant reduced speed. The switch 12 is under the control of the speed responsive device 10 which effects energization and deenergization of said switch under different speed conditions according to the setting of the rheostat crosshead. More particularly, when the rheostat R crosshead is in its extreme right hand position switch 12 is energized upon completion of the motor circuit subject to deenergization by the speed responsive device 10 if the motor speed increases above a given low value. If, on the other hand, the rheostat R is adjusted for engagement of its crosshead with contact 5 the device 10 is rendered effective to deenergize switch 12

only in case the motor speed exceeds a higher predetermined value, whereas with the rheostat adjusted for engagement of its crosshead with contact 6 the device 10 is rendered effective to deenergize switch 12 only at a still higher predetermined speed. As will be understood, opening of switch 12 tends to effect a decrease in the motor speed and thus under the control of device 10 it is caused to maintain the slow speed predetermined by the position of the rheostat crosshead.

The speed responsive device 10 as illustrated is of the flyball governor type to be operated by motor M, but it may in practice be of any other preferred type, as for example of the hydraulic type now commonly employed for operation of contacts in response to speed variations of the motor. The device illustrated is provided with contacts 13, 14 and 15 to control switch 12, all of said contacts normally bridging their respective stationary contacts and being adapted to be successively disengaged from their stationary contacts as the speed of the motor increases. The sequence of operation of these contacts is indicated by the spacings therefrom of their respective lifting parts 16 which may be assumed to be collars fixed to rod 17. Also, the device 10 comprises a contact 18 to control switch 9, said contact normally engaging its stationary contacts and being adapted to be disengaged therefrom to deenergize switch 9 upon initial response of device 10. Further, device 10 comprises a contact 19 controlling arrest of the motor after plugging, said contact being normally disengaged from its stationary contacts. As will appear, it is desired to have contact 19 engage its stationary contacts upon initial response of device 10 and to disengage its contacts only when the motor speed approximates zero value, and hence contact 19 is shown as resiliently supported on rod 17.

The primary of motor M is adapted to be connected to the supply circuit by a main switch MS, or alternatively by a reversing or plugging switch RS, both being electroresponsive, and said reversing switch being under the control of contact 19 of device 10. The arrangement is such that when reversing switch RS is energized for plugging it is maintained energized by the device 10 until the motor speed approximates zero value when contact 19 is disengaged from its stationary contacts to deenergize said switch to disconnect motor M from circuit.

A push button control station of conventional form is illustrated, said station comprising a "safe" switch, an "inch" switch, an "on" switch, an "off" switch, and a "stop" switch, all of which are so designated on the drawing. These switches, as will be understood, provide for all desired manual control of the instrumentalities heretofore described.

Certain of the electroresponsive switches heretofore described are preferably provided with interlocking contacts, and for simplicity of illustration such contacts are shown diagrammatically beneath the switches with which they are associated, certain of such contacts being normally engaged and others being normally disengaged. Thus, as will be understood, main switch MS has normally disengaged auxiliary contacts 20 and 21 and normally engaged auxiliary contacts 22, while reversing switch RS and switches 11 and 12 have normally engaged auxiliary contacts 23, 24 and 25, respectively.

Assuming rheostat R to be in the position illustrated to include in circuit all resistance r, depression of the inch button completes circuit from line L^1 by conductor 30 through the safe switch by conductor 31 through down contacts of the inch switch by conductor 32 to rheostat contact 3 and strip 8, by conductor 33 through the operating winding of main switch MS by conductor 34 to line L^3. Main switch MS is thus caused to respond to complete the motor circuit for slow speed operation and to effect energization of switches 9, 11 and 12. With the main switch closed circuit may be traced from the right hand side of the safe switch by conductor 35 through the main switch auxiliary contacts 20 by conductor 36 through the winding of switch 11 by conductor 37 to line L^3 and also from conductor 36 through the contact 13 of the speed responsive device 10 by conductor 38 through the winding of switch 12 to conductor 37 and line L^3. Thus switches 11 and 12 are energized to exclude all resistance r^1 from the secondary circuit of the motor. Also, with the main switch closed circuit may be traced from conductor 36 through the contact 18 of the speed responsive device 10 by conductor 39 through the winding of switch 9 to conductor 37 and line L^3 whereby said switch is energized to exclude a portion of resistance r for high torque starting.

Immediately after the motor is thus started the device 10 responds to disengage contact 18 from its stationary contact, thereby deenergizing switch 9 for inclusion of all resistance r for slow speed, and if the motor exceeds a predetermined slow speed the device 10 responds to disengage contact 13, thereby deenergizing switch 12. This provides for inclusion of a portion of resistance r^1 subject to removal thereof upon reduction of the motor speed and consequent operation of device 10 to reengage contact 13 with its stationary contacts.

While considering the control of switch 12 let it be assumed that the rheostat is adjusted for engagement of the crosshead with

contact 5. With such adjustment of the rheostat another energizing circuit for switch 12 may be traced from the right hand side of the safe switch by conductor 35 through the auxiliary contacts 20 and 21 of the main switch by conductor 40 through the up contacts of the inch switch and thence through the stop switch by conductors 41 and 33 to contact strip 8 and contact 5 of the rheostat by conductor 42 through contact 14 of the speed responsive device 10, and thence through the winding of switch 12 to line L^3, as already traced. As will be apparent, when switch 12 is provided with such a connection it is uneffected by operation of device 10 to disengage its contact 13 and remains energized until the motor attains a higher slow speed to cause device 10 to lift its contact 14. Further assuming the rheostat to be in a position to engage its cross-head with contact 6 another circuit for switch 12 may be traced from rheostat strip 8 to contact 6 by conductor 43 through contact 15 of device 10 to conductor 38 and thence to and through the winding of switch 12 as previously traced. With such connection it will be observed that the switch 12 is uneffected by operation of the device 10 to lift contact 14 and that switch 12 remains energized pending acceleration of the motor to cause response of device 10 to lift contact 15. Thus provision is made for utilizing the same switch to maintain constant speed of the motor for any one of a number of slow speed settings of the rheostat crosshead, and as will be apparent similar provision may be made for an increased number of slow speed settings. Also provision is made for maintaining switch 12 energized independently of device 10 when the rheostat crosshead is advanced to engage contact strip 7, for this strip is connected to conductor 38 and accordingly affords a shunt for contacts 13, 14 and 15 of device 10.

Assuming depression of the on switch circuit is completed from the right hand side of the safe switch by conductor 44 through the on switch by conductor 45 to conductor 32 and thence through the rheostat contacts 3 and 8 by conductors 33, 41 to and through the winding of main switch MS, as already traced. The motor M is thus connected to the supply circuit and at the same time a circuit is completed from conductor 44 through the on switch and the off switch by conductor 46 through the armature a of the pilot motor 2 in a downward direction, resistance r^2 and the series field f of said pilot motor by conductor 47 to line L^3, the armature a and resistance r^2 being shunted by a resistance r^3. The pilot motor is thus started for gradual exclusion of resistance r, the switches 9, 11 and 12 being energized as previously set forth, but the switch 9 being deenergized immediately after starting. Thus as will be understood any amount of the resistance r may be excluded for gradually bringing the motor M up to the desired speed, the on switch being released when the desired speed of the motor is attained.

Release of the on switch of course stops the pilot motor and interrupts the aforedescribed energizing circuit for main switch MS, but said main switch is maintained energized by a circuit through its auxiliary contacts. This circuit may be traced from the right hand side of the safe switch by conductor 35 through the auxiliary contacts 20 and 21 of said main switch by conductor 40 through the up contacts of the inch switch and stop switch, to and through the winding of the main switch, as heretofore traced.

If while the motor is in operation the off switch is depressed, circuit may be traced from the right hand side of the safe switch by conductor 48 through the down contacts of the off switch by conductor 49 through the armature a of the pilot motor in an upward direction thence through resistance r^3 and the field f to line L^3 whereupon the pilot motor is energized for reverse operation to increase the resistance in the motor circuit pending release of the off switch.

Stopping of the motor may be effected at any time by depressing the stop switch which as heretofore explained is in the maintaining circuit of the main switch MS and also in the energizing circuit of switch 12 whereby both switches are deenergized.

Main switch MS in opening deenergizes switch 11 and thus effects reinclusion of all resistance r^1 in the secondary circuit of the motor. Also, opening of the main switch effects completion of the energizing circuit of the reversing or plugging switch RS, said circuit extending from line L^1 by conductors 30 and 50 through the contact 19 of the speed responsive device 10 by conductor 51 through the normally closed auxiliary contacts 22 of the main switch by conductor 52 through the normally closed auxiliary contacts of switch 12 by conductor 53 through the winding of switch RS by conductor 34 to line L^3. Thus switch RS is caused to respond to reverse the power connections of the motor for plugging, switches 11 and 12 remaining open to include the resistance r^1 for the desired torque control during plugging.

Plugging action is continued until the motor approximates zero speed to cause the device 10 to release contact 19 which interrupts the energizing circuit of switch RS. Switch RS thereupon releases to disconnect motor M and to complete the circuit of pilot motor 2 for return of the crosshead to initial position. This circuit may be traced from the right hand side of the safe switch by conductors 48 and 53 through the normally closed auxiliary contacts 23 of switch RS by conductor 54 through the normally closed contacts 24 of switch 11 by conductor 55 to

and through the pilot motor to line L^3. In this connection it is to be noted that as the establishment of such circuit is dependent upon reopening of the switch RS and release of said switch is dependent upon reduction of the motor speed to approximately zero value the crosshead is insured against return movement during plugging, which is a very desirable provision in many instances.

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

1. The combination with an electric motor, of means to start said motor for operation at a relatively high speed, and means to restrict said motor at will to any one of a number of relatively low speeds and to maintain substantially constant low speeds, the latter means comprising a device responsive to variations in the motor speed and having a plurality of speed controlling elements and circuit connections therefor variable for selection of the motor speed to be established and maintained by the second mentioned means.

2. The combination with an electric motor, of means to start said motor for operation at a relatively high speed and speed reducing means for said motor including a device responsive to variations in the motor speed and having a plurality of speed controlling elements and circuit connections therefor variable by a part of the first mentioned means whereby the second mentioned means may be utilized to establish and maintain within limits any one of a number of slow speeds selectively.

3. The combination with an electric motor, of means to start said motor and means to restrict said motor at will to a relatively low speed when so started, the latter means comprising a relay to vary certain connections for the motor and a controlling device for said relay responsive to variations in the motor speed and having a plurality of sets of contacts to be selectively included in the control circuit of said relay to render the second mentioned means effective to establish and maintain different low speeds selectively.

4. The combination with an electric motor, of means to start said motor for operation at a relatively high speed and to effect plugging of said motor, said means including a speed responsive device through the medium of which plugging connections are maintained until the motor is reduced to substantially zero speed, and means including said speed responsive device to enable reduction of the running speed of the motor and variation of the reduced running speed at will.

5. The combination with an electric motor, of starting means therefor, a speed regulating rheostat for the motor providing for operation of the motor at different relatively high speeds, a resistance to be included in the motor circuit for a reduced speed of the motor, control means for the latter resistance whereby a reduced motor speed may be obtained at will and maintained substantially constant and plugging means for the motor comprising an additional resistance and the aforementioned resistance provided for speed reduction.

6. The combination with an electric motor, of means for starting the motor and regulating the speed thereof, said means comprising a power operated rheostat, and means for plugging the motor and for controlling said rheostat to effect its return to initial position but only upon termination of plugging, the last mentioned means including means whereby plugging is continued until the motor speed is reduced to substantially zero value.

7. The combination with an electric motor, of starting means therefor including a variable resistance and means for commutating said resistance to automatically maintain said motor at any one of a plurality of relatively low speeds, said starting means being operable to effect selection of such speeds, or to render said last mentioned means effective or ineffective at will.

8. The combination with an electric motor, of starting means therefor including a variable resistance providing a wide range of speed variation of said motor, and means for commutating said resistance to automatically maintain said motor at any one of a plurality of low speeds, said starting means affording push button control for starting said motor, for rendering said last mentioned means effective or ineffective at will, and for selecting the speed to be maintained by said last mentioned means.

9. The combination with an electric motor, of means to restrict said motor to low speed operation and to afford automatic regulation to maintain said motor at any one of a number of selected low speeds, and starting means for said motor operable to render said first mentioned means effective and to select the low speed to be maintained thereby or to render said first mentioned means ineffective whereby said motor may be operated at a relatively high speed.

10. The combination with an electric motor, of means to restrict said motor to low speed operation and to afford automatic regulation to maintain said motor at any one of a number of selected low speeds, and additional control means for said motor affording push button control for starting said motor for rendering said first mentioned means effective or ineffective at will and for selecting the speed to be maintained by said first mentioned means.

11. The combination with an electric motor, of means to restrict said motor to low speed operation and to afford automatic reg-

ulation to maintain said motor at any one of a number of selected low speeds, and additional control means for said motor to effect starting thereof and operation at either low speed under the influence of the first mentioned means, or high speed, said additional control means including a device movable at will to a position to render said first mentioned means effective to maintain a given low speed or to another position to render said first mentioned means effective to maintain a different low speed, or to another position to render said motor free from influence of said first mentioned means.

In witness whereof I have hereunto subscribed my name.

EDWIN W. SEEGER.