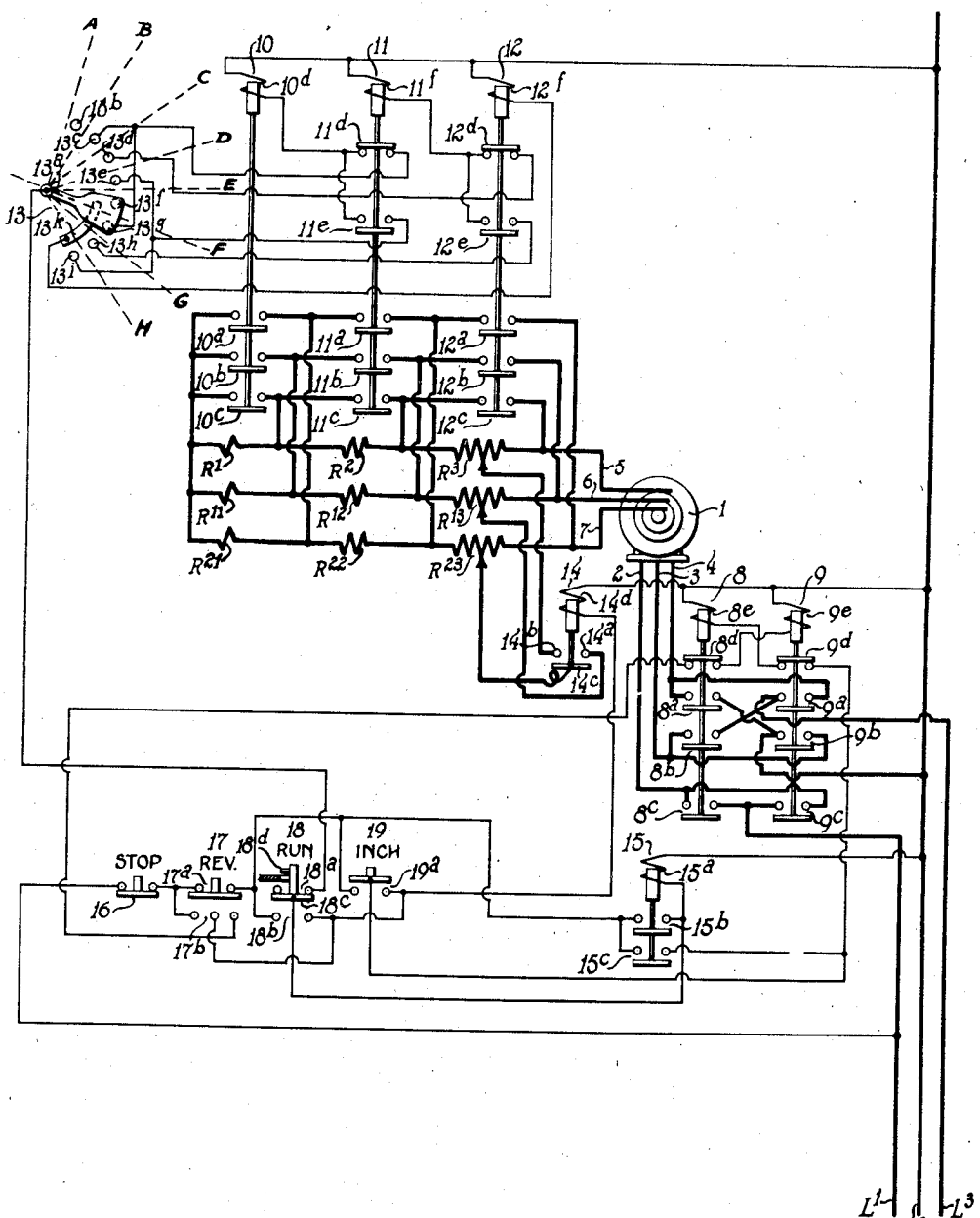
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MOTOR CONTROLLER

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MOTOR CONTROLLER

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This invention relates to controllers for electric motors.

It is particularly advantageous for printing press control where it is desired to operate the press at various pre-determined speeds and where the motor is to be controlled from a control station located conveniently to the press, while the control apparatus proper, which commutates the heavy motor current, is located near the motor, thereby conserving wiring.

An object of the invention is to provide a controller in which the motor may be started, stopped and reversed from suitable push button stations located at a distance from the motor.

Another object is to provide a controller in which the speed at which the motor operates may be set at a control station located conveniently to the push buttons.

Another object is to provide a controller of the aforementioned type affording a relatively large number of speeds with a minimum number of resistor steps and control switches therefor.

Another object is to provide a controller of the aforementioned type in which the torque of the motor may be temporarily increased to provide for starting or reverse rotation thereof.

Another object is to provide a controller, requiring a minimum of floor space near the press.

Other objects and advantages of the invention will hereinafter appear.

The accompanying drawing illustrates one embodiment of the invention.

A three phase slip ring type induction motor 1 having primary terminals 2, 3 and 4 and secondary terminals 5, 6 and 7, is shown as constituting the driving motor. The motor is supplied with power from the three phase power mains L^1, L^2 and L^3 through a pair of electromagnetic reversing switches 8 and 9 for forward and reverse operation, respectively. The switch 8 is equipped with normally open main contacts 8*a*, 8*b* and 8*c*, normally closed auxiliary contact 8*d* and an electromagnetic winding 8*e*, while the reversing switch 9 has normally open main contacts 9*a*, 9*b* and 9*c*, a normally closed auxiliary contact 9*d* and an electromagnetic winding 9*e*. The secondary terminals 5, 6 and 7 of the motor are connected to three sets of star connected resistors, the phase connected to the terminal 5 embraces the resistors R^1, R^2 and R^3, the phase connected to terminal 6 embraces the resistors R^{11}, R^{12} and R^{13}, while the phase connected to the terminal 7 embraces the resistors R^{21}, R^{22} and R^{23}. Corresponding resistors in the three phases are preferably of equal ohmic value, while the ratio of the ohmic value of successive steps of the resistors in each phase is preferably a geometric progression, that is the resistor R^2 has twice the ohmic value of the resistor R^1 and the resistor R^3 has twice the ohmic value of the resistor R^2. It is thus possible by properly combining the different steps of resistors to obtain a number of speed points for the motor which exceeds the number of steps of resistors in each phase. Thus in the present case with three steps of resistors per phase it is possible to get a total number of eight speed points, including the speed at which all of the resistance is short-circuited.

The resistors are controlled by electromagnetic switches 10, 11 and 12. The switch 10 has normally open main contacts 10*a*, 10*b* and 10*c* and an electromagnetic winding 10*d*. The switch 11 has normally open main contacts 11*a*, 11*b* and 11*c*, a normally closed auxiliary contact 11*d*, a normally open auxiliary contact 11*e* and an electromagnetic winding 11*f*. The switch 12 is equipped with normally open main contacts 12*a*, 12*b* and 12*c*, a normally closed auxiliary contact 12*d*, a normally open auxiliary contact 12*e* and an electromagnetic winding 12*f*.

A presettable manually operated speed controller 13 provides for control of the electromagnetic windings of switches 10, 11 and 12. The controller 13 is equipped with a pivoted contact lever 13*a* which is designed to engage contact buttons 13*b* to 13*i*, inclusive, and the concentric contact segment 13*k*, which latter extends over an arc including the contact buttons 13*g* to 13*i*, inclusive. The outer end of the lever 13*a* is so arranged that it

may bridge two contact buttons simultaneously.

The apparatus also includes an electromagnetic switch 14 having stationary contacts 14*a* and 14*b*, a bridging contact disc 14*c* which normally disengages said stationary contacts, and an electromagnetic operating winding 14*d*. Also there is included an electromagnetic relay 15 having a winding 15*a* and normally open contacts 15*b* and 15*c*, and on the press at a point convenient to the operator are mounted a series of push button switches as follows: a normally closed switch 16, a reversing switch 17 having normally closed contacts 17*a* and a normally open triple contact 17*b*, a running switch 18 having normally closed contacts 18*a* and normally open contacts 18*b* and an inch switch 19 having normally open contacts 19*a*. The running button is equipped with a pin 18*d*, which registers with a slot in the cover, so that the button may be partly depressed and upon turning locked in that position.

In practice the push buttons and the speed regulating controller 13 may be mounted together at a convenient point on the press.

The apparatus functions in the following manner: If it is desired to start the press and operate it at a certain speed corresponding to that position of the contact lever 13*a* in which it makes contact with the button 13*g*, the control lever 13*a* is moved to the corresponding speed position. In order to start the press the operator pushes the running button, thus bridging the normally open contacts 18*b* by the contact disk 18*c*. A current then flows from the line L^1 through the stop button and the reverse button over the left hand stationary contact 18*b*, contact disk 18*c*, winding 15*a*, to line L^2. Relay 15 is thus energized and closes its normally open contacts 15*b* and 15*c*. Thus a circuit is completed from line L^1 through the stop and reverse buttons, contacts 15*b* through winding 15*a* and line L^2. The relay 15 thus remains energized after the running button is released. A second circuit is closed from the reversing button through contact 15*c*, contact 9*d* and winding 8*e* to line L^2. This energizes switch 8 and said switch completes the circuit to the primary winding of the motor, one circuit extending from L^1 over contact 8*c*, to terminal 2 of the motor, the second extending from line L^2 over contact 8*a* to terminal 4 of the motor, while the third circuit extends from line L^3 over contact 8*b* to terminal 3 of the motor. Current thereupon also circulates through the secondary winding and resistance of the motor and the latter tends to start. The usual printing press, however, requires a starting torque of considerable magnitude, and this torque could not be exerted by the motor with all of the speed regulating resistance in circuit. To increase the torque of the motor sufficiently to start the press there is provided the torque switch 14 which functions as follows: As long as the button 18 is depressed a circuit is completed from line L^1 through the stop and reversing button, stationary contacts 18*b*, through winding 14*d* to line L^2. Thus switch 14 is energized, thereby closing its normally open contacts which are connected to three points of the star connected resistor, so that when the switch 14 is closed part of the speed regulating resistance is short-circuited, and the remaining resistance is sufficiently low to permit the motor to start. With the switch 14 closed the current in one phase of the secondary winding of the motor passes from terminal 5 through part of the resistance R^3 to the contact 14*b*. Current in a second phase passes from terminal 6 through part of resistance R^{13} to contact 14*a*, while current from the terminal 7 passes through part of the resistance R^{23}, through contact disk 14*c* so that when closed the contacts of switch 14 form the star or neutral point of the resistance remaining in circuit. The running button 18 is held in the depressed position by the operator until the press has started, whereupon he releases it. In the released position of the running button the switch 14 is again deenergized and all of the speed regulating resistance is reinserted in the secondary circuit of the motor. When the push button 18 returns to its normal position a circuit is completed from line L^1 through the stop and reversing button, contact 15*b*, contact disk 18*c* and normally closed contact 18*a* to lever 13*a*, through contact button 13*g*, through normally closed contact 11*d*, through winding 10*d* of switch 10 to line L^2. Another circuit is completed from contact 13*a*, through segment 13*k* and winding 12*f* to line L^2. Thus the switches 10 and 12 are energized, the switch 10 short-circuiting the resistance R^1, R^{11} and R^{21} while the switch 12 short-circuits the resistances R^3 R^{13}, and R^{23}. The motor is thus accelerated until its speed corresponds to the value of the resistance in circuit, which is now R^2, R^{12} and R^{22}, respectively.

If it is desired, after starting, to run the press at a slow speed independent of the setting of the regulator 13, the button 18, after it has been fully depressed and the press has started, is locked in its intermediate position, whereupon the motor continues to revolve with all speed regulating resistance in circuit.

If it is desired to increase the speed of the press, the lever 13*a* is moved to the next button 13*h*, thus interrupting the circuit through the coil 10*d* causing insertion of the resistances R^1, R^{11} and R^{21}, while the coil 11*f* is energized through the normally open contact 12*e* of switch 12, the latter contact being closed as switch 12 is energized. In the new position only the resistances R^1, R^{11} and R^{21} remain in the motor circuit. It will be seen that upon movement of the lever 13*a* in the reverse direction a greater amount of resist-

ance is inserted in the secondary circuit of the motor, thus decreasing its speed. The various switches 10, 11 and 12 are so interlocked that they will have to close and open in the desired order.

If it is desired to stop the motor the stop button is depressed. This opens the circuit through the coil 15*a*, thus deenergizing the switch 15, thereby opening the circuit and disconnecting the motor from the line. At the same time the circuit leading to controller 13 is opened so that any of the switches 10, 11 and 12 which may be in the closed position are also deenergized, thereby reinserting all resistance in the motor circuit.

If the motor is standing still and it is desired to merely move the press a short distance by temporarily energizing the motor, the inch button 19 is depressed. This closes the circuit from line L^1 through the stop and reverse buttons, through the inch button, through the winding of the switch 14 to line L^2. The switch 14 is thus energized and short-circuits part of the regulating resistance in the manner aforedescribed. At the same time a circuit is also completed through the contact disk of button 19 through contact 9*d*, winding 8*e* to line L^2. This energizes the switch 8 and connects the motor to the line, causing it to start. The motor will revolve only as long as the switch 19 is depressed. Release of said switch will cause the apparatus to immediately return to the off position, thereby stopping the motor.

It is sometimes desired to reverse the direction of rotation of the motor. This is accomplished by means of the reverse button 17. If this button is depressed the circuit through the normally closed contacts of switch 15 as well as the circuit to the run and inch buttons are opened, and a circuit is completed from line L^1 through the stop button, over contact 17*b*, through contact 8*d*, coil 9*e* to line L^2. This energizes the reversing primary switch and connects the motor terminals to lines L^1, L^2 and L^3, but with the terminals 3 and 4 reversed relative to the lines L^2 and L^3. A circuit is also completed from the center contact 17*b*, through coil 14*d* to line L^3, thus energizing the switch 14 and short-circuiting part of the regulating resistance in the manner aforedescribed to enable the motor to start up. Reverse connection of the motor is maintained only as long as the reversing button is depressed. As soon as it is released the switches 14 and 9 are deenergized and the controller returns to the off position.

It is obvious, that the reverse or inch push button or both may be omitted without departing from the spirit of my invention.

While I have shown only one push button of each type, in practice a multiplicity of buttons may be used in a manner well known and practiced in the art.

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

1. In a controller for alternating current motor, in combination, speed regulating resistances having ohmic values which vary in geometric progression with a ratio of two, electromagnetic switches for excluding said resistances in different groupings to provide for operation of the motor at different running speeds, a presettable control switch for said electromagnetic switches to afford selection of the running speed of the motor, and starting means for the motor including a push button switch to be depressed to effect starting and slow speed operation of the motor regardless of the setting of said presettable switch and to be returned to a given position to effect acceleration of the motor to the speed selected by said presettable switch.

2. In a controller for alternating current motors, in combination, speed regulating resistances having ohmic values which vary in geometric progression with a ratio of two, electromagnetic switches for excluding said resistances in different groupings to provide for operation of the motor at different running speeds, a presettable control switch for said electromagnetic switches to afford selection of the running speed of the motor, and starting means for the motor including a push button switch operable to effect starting and in one position slow speed operation of the motor regardless of the setting of said presettable switch and in another position operation at the preselected higher speed, said starting means further including means to effect in starting of the motor as aforedescribed exclusion of a given amount of said resistance to afford the motor a high starting torque.

3. In a controller for alternating current motors, in combination, speed regulating resistances having ohmic values which vary in geometric progression with a ratio of two, electromagnetic switches for excluding said resistances in different groupings to provide for operation of the motor at different running speeds, a presettable control switch for said electromagnetic switches to afford selection of the running speed of the motor, and starting means for the motor including an electromagnetic switch to exclude a given amount of said resistance for high torque in starting and further including a push button switch which in one position effects starting of the motor with said given amount of resistance excluded from circuit, and which has other positions wherein it is adapted to effect operation of the motor at slow speed, and operation of the motor at a higher speed which is determined by the setting of said presettable switch.

4. In a controller for alternating current motors, in combination, speed regulating resistances having ohmic values which vary in

geometric progression with a ratio of two, electromagnetic switches for excluding said resistances in different groupings to provide for operation of the motor at different running speeds, a presettable control switch for said electromagnetic switches to afford selection of the running speed of the motor, and starting means for the motor including an electromagnetic switch to exclude a given amount of said resistance for high torque starting and reverse operation and further including a push button switch which in one position effects starting of the motor with said given amount of resistance excluded from circuit, and which has other positions wherein it is adapted to effect operation of the motor at slow speed, and operation of the motor at a higher speed which is determined by the setting of said presettable switch, and reversing means including a second push button switch which effects reversal of the motor with said given amount of resistance excluded from circuit.

5. In a controller for alternating current motors, in combination, speed regulating resistances having ohmic values which vary in geometric progression with a ratio of two, electromagnetic switches for excluding said resistances in different groupings to provide for operation of the motor at different running speeds, a presettable control switch for said electromagnetic switches to afford selection of the running speed of the motor, and starting and reversing means for the motor including push button switches operable to effect starting, slow speed and reverse operation of the motor regardless of the setting of said presettable switch, one of said push button switches being further operable to effect starting of the motor for operation at the preselected higher speed, said starting and reversing means further including means to effect starting and reversing of the motor as aforedescribed exclusive of a given amount of said resistance to afford the motor a high starting and reversing torque.

6. In a controller for alternating current motors, in combination, an electromagnetic reversing switch for connecting the motor to the supply circuit for forward and reverse rotation, speed regulating resistances for its armature circuit having ohmic values which vary in geometric progression with a ratio of two, electromagnetic switches for excluding said resistances in different groupings to provide for operation of the motor at different running speeds, a presettable control switch for said last mentioned electromagnetic switches to afford selection of the running speed of the motor, a push button switch cooperating with said reversing switch and which in one position effects starting of the motor with forward rotation with a given amount of resistance excluded from the armature circuit and which has other positions wherein it effects operation of the motor at slow speed, and operation of the motor at a higher speed which is determined by the setting of said presettable switch, and a second push button switch cooperating with said reversing switch and which effects starting of the motor with reverse rotation and with a given amount of resistance excluded from the armature circuit.

In witness whereof I have hereunto subscribed my name.

EDWIN W. SEEGER.