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SAFETY CONTROL CIRCUIT FOR ELECTRIC MOTOR DRIVEN MACHINERY

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FIG-1

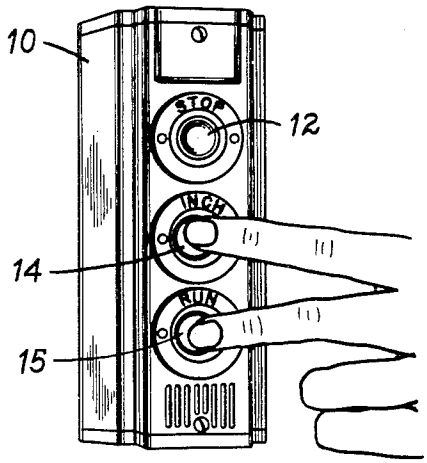


FIG-2

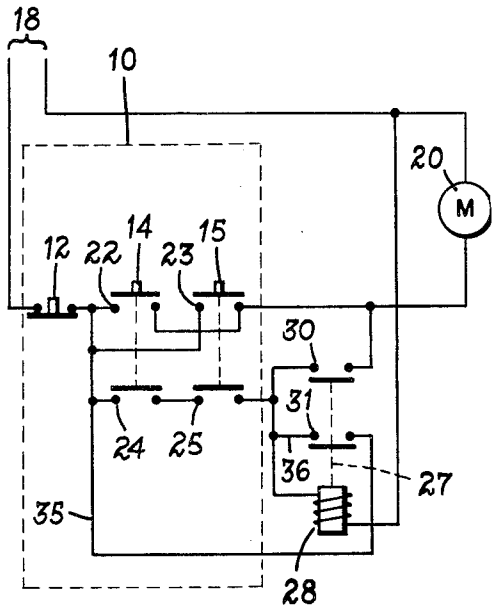
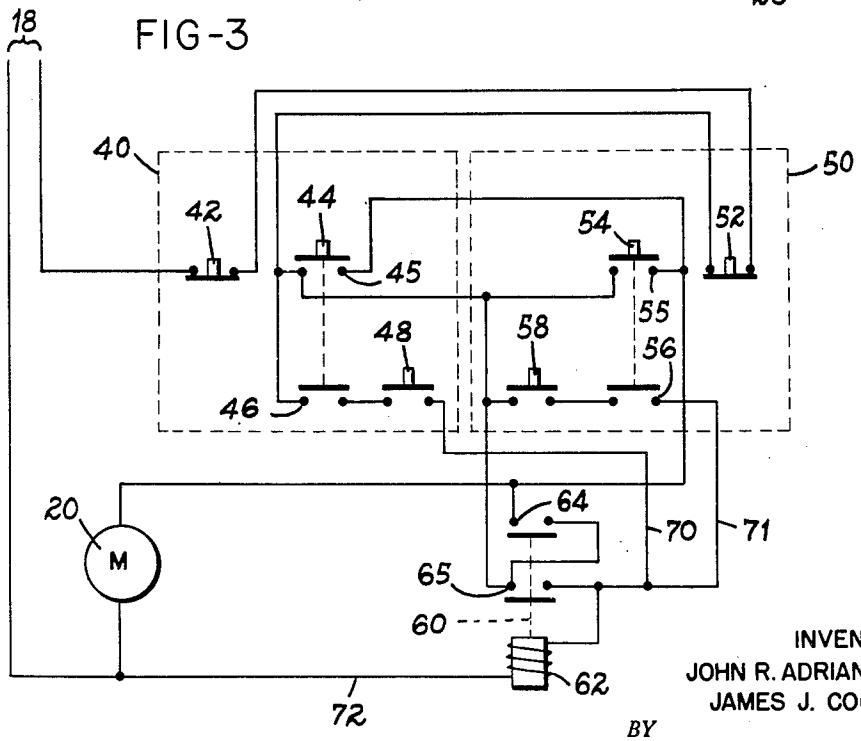


FIG-3



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SAFETY CONTROL CIRCUIT FOR ELECTRIC MOTOR DRIVEN MACHINERY

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2 Claims. (Cl. 318—443)

The present invention is hereby dedicated to the public in the interests of safety and may be used by anyone without payment of royalty thereon.

This invention relates to safety control circuits for electrical machinery.

In the operation of many large automatic electric machines, for example, printing presses, paper cutters, automatic lathes, milling machines, and the like, it is often customary to "jog" or "inch" the moving parts of the machine by punching an appropriate "jog" switch button with one hand while using the other hand to perform some cleaning or adjusting operations on or adjacent to these moving parts. Obviously, if the machine should accidentally begin its automatic operations at such a time, serious injury might be caused to the operator, and such an accident is quite possible if the operator inadvertantly punches the switch button which initiates the automatic regime.

Several systems have been suggested to prevent such accidents, among them the construction of "jog" and "run" buttons which are of different shapes or colors, and also the locating of these two buttons at different stations on the machine. Each of these systems has a disadvantage, namely, the buttons of different shapes or colors may not be correctly identified with their associated operations by one whose attention is distracted to something he is doing with his other hand, and the difference in location requires excess wiring and a consequent inconvenience of installation and operation.

In accordance with the present invention it is possible to provide a single station three element control for automatic machines which overcomes the aforementioned disadvantages and positively assures that the operator will not accidentally push the wrong switch button and set the machine on automatic operation when he merely intends to "jog" it.

It is accordingly a primary object of this invention to provide a control circuit for automatic electrically operated machines wherein a pair of identical switch buttons are located adjacent each other and wired in circuit with the machine so that pressing one of these switch buttons will "jog" or "inch" the machine as long as that button is held depressed, and wherein pressing of both buttons is required to initiate continued automatic operation of the machine.

Another object of the invention is to provide a control circuit for automatic electrically operated machines wherein continued closing of either one of a pair of switches will operate the machine only for the period during which that switch is maintained closed, and wherein closing of both switches will energize a holding relay in circuit with these switches and maintain operation of the machine after these switches have been opened.

A further object of this invention is to provide a control circuit for electrically operated machines wherein a plurality of control stations may govern the operation of the machine completely independently from each other, wherein each of these control stations requires pressing

of two switch buttons at the same station to set the machine in fully automatic operation, and wherein pressing of one button at any station or one button at each of several stations will allow the machine to operate only so long as those buttons are held depressed.

Other objects and advantages of the invention will be apparent from the following description, the accompanying drawing and the appended claims.

In the drawing—

Fig. 1 is a perspective view of a control box used in the present invention, showing the fingers of an operator about to set the machine into automatic operation;

Fig. 2 is a schematic wiring diagram of the control box of Fig. 1; and

Fig. 3 is a wiring diagram of a modified control circuit provided by this invention.

Referring to the drawing, which illustrates a preferred embodiment of the invention, Fig. 1 illustrates a control box **10** for electric machinery requiring a manually controlled "jog" or "inch" operation in addition to a fully automatic regime. One example of such machinery is a large printing press which has a drum normally rotated continuously by its electric drive motor, and in which it is desirable to have a control for turning the drum of the press through small increments while an operator cleans the drum. In such a typical installation it is common to have one switch button in the control box which will complete the circuit to the motor only when it is held closed, and this switch produces the "jogging" or "inching" of the machine. Another such switch, referred to as the "run" switch, is mounted in a control box and connected with a relay and holding circuit to lock the machine in its automatic regime when this other switch is pushed closed and released. The difficulties mentioned previously result from inadvertent confusion of these two switches.

This invention provides in the single control box **10** three push button type switches, two of which are normally urged open in a conventional manner by springs. In the particular embodiment shown in Fig. 1 the third control switch is shown at **12** as the stop switch, and it is of the single pole single throw type, normally closed, as seen in Fig. 2. While illustrated as the uppermost of the three switch elements in box **10**, it obviously could be located at any one of the three places on the box relative to the other switches. Switch **12** is opened when depressed to break the machine control circuit. The other two push button switches, indicated at **14** and **15**, are of the double pole single throw type as seen in Fig. 2, and are normally open.

The control circuit of Fig. 2 is arranged to govern the supply of electric current from a suitable source **18** to an electric motor **20** which drives the particular machine to be controlled. This motor may be any A. C. or D. C. single or polyphase type desired, and includes conventional controlling means for starting and stopping the motor. Box **10** is wired in the circuit of motor **20**, with the stop switch **12** connected in series with the motor and with the remainder of the control circuit so that opening of the stop switch results in breaking of the circuit and stopping of the motor.

Switches **14** and **15** have one set of contacts **22** and **23** respectively wired in parallel to each other, and their other contacts **24** and **25** are wired in series with each other with this series circuit being in turn wired in parallel with contacts **22** and **23**. A double pole relay switch indicated generally at **27**, and having an actuating coil **28** and a pair of contacts **30** and **31** respectively, is wired with contact **30** in series with contacts **24** and **25** of switches **14** and **15** respectively, and with contact **31** in parallel with contacts **24** and **25**, but in series with the other contact **30** of relay **27**. Coil **28** is initially ener-

gized by an activating circuit including both contacts 24 and 25 in series with the coil, this entire activating circuit being arranged in parallel with motor 20.

A holding or lock-in circuit is arranged to provide for continued actuation of coil 28 after switches 14 and 15 have been released, with resultant opening of contacts 24 and 25, and this holding circuit includes conductors 35 and 36 which by-pass all the contacts of switches 14 and 15 and complete the holding circuit through the relay contacts 30 and 31 as well as maintaining actuation of coil 28 upon opening of switches 14 and 15.

Analysis of the circuit of Fig. 2 shows that closing of either switch 14 or 15 alone will close the circuit to the motor as long as it is held closed but will not energize relay 27, since one or the other of poles 24 or 25 will be left open, and so the operator of the machine, when he wishes to "jog" or "inch" the machine need only be mindful that he use one finger to punch the switch, and whether he strikes the jog switch 14 or run switch 15, only the jogging action will result. To set the machine in "run" it is necessary to employ two fingers, and depress both switches 14 and 15 simultaneously, thus energizing relay 27 and completing the lock-in circuit. Of course, opening switch 12 at any time breaks the entire control circuit and stops motor 20.

Referring to Fig. 3, there is shown a modified circuit in accordance with this invention, wherein two control boxes 40 and 50, of the same three element type as box 10, are utilized at different stations on the machine to be controlled. Box 40 contains a stop switch 42, a double pole single throw jog switch 44 having contacts 45 and 46, and a single pole run switch 48. Likewise, box 50 contains stop switch 52, a double pole single throw jog switch 54 having contacts 55 and 56, and a single pole run switch 58. Both boxes are independently enabled to energize motor 20 for either jogging or automatic running operations, as well as to stop the motor, and require only a single relay.

This is accomplished by wiring stop switches 42 and 52 in series with the entire control circuit so that opening of either stop switch will break the entire motor control circuit. The jogging circuit is provided by wiring contacts 45 and 55 of switches 44 and 54 respectively in parallel with each other and in series with the stop switches and with motor 20, thus enabling the motor to be energized by depression of either one of these jog switches.

In order to initiate the automatic regime from either box 40 or box 50, a double pole relay switch indicated generally at 60 as having an actuating coil 62 and contacts 64 and 65, is connected into the motor control circuit so as to by-pass the jog and run switches of both boxes and complete a holding circuit which will maintain the operation of motor 20 after relay 60 is closed and the jog switches 44 and 54, together with run switches 48 and 58, are released. The circuit for energizing relay 60 includes conductors 70 or 71 and 72 which are wired as follows so as to energize coil 62 upon simultaneous depression of switches 44 and 48, or upon simultaneous depression of switches 54 and 58. The energizing circuit for box 40 includes contact 46 of jog switch 44, run switch 48, conductor 70, actuating coil 62 and conductor 72 all wired in series to each other, permitting energization of relay 60 when both switches 44 and 48 are depressed. Once relay 60 has thus been energized, the closing of contacts 64 and 65 of the relay completes a by-pass circuit which includes in series the two stop switches 42 and 52, contact 64, and motor 20, which is maintained by a holding circuit including contact 65 and actuating coil 62 in parallel with contact 64 and motor 20, so that the relay switch 60 is held closed when switches 44 and 48 are released and opened.

In the same fashion depression of both jog switch 54 and run switch 58 will complete an activating circuit through conductor 71, coil 62 and conductor 72 to energize relay 60, and upon subsequent release and opening of switches 54 and 58 the same holding and by-pass circuits as identified above will be completed.

It is believed obvious that more than two stations could be provided for each machine by employing three or more control boxes similar to boxes 40 and 50 and wiring each of these boxes relative to each other in the same fashion that boxes 40 and 50 are connected to each other. In all of the circuits contemplated by this invention, use of the basic principle of "one finger to jog, two fingers to run" is required, thus providing a simple, compact, and safe control over the machine. The only difference between the single box control of Fig. 2 and the plural box control of Fig. 3 is that only one switch on each box will jog the machine, whereas in the circuit of Fig. 2, either of the switches 14 or 15 will jog the machine when depressed. However, both circuits require that two switches be depressed in order to initiate the automatic regime of the machine.

While the forms of apparatus herein described constitute preferred embodiments of the invention, it is to be understood that the invention is not limited to these precise forms of apparatus, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. In a safety control circuit for an electric motor the combination of a pair of normally open double pole single throw switches arranged to be closed upon manual depression thereof, said switches being connected in parallel to each other through one set of contacts and in series with each other through the other set of contacts, said one set of contacts being connected in circuit with said motor to provide for actuation thereof upon depression of either said switch, a double pole normally open relay having an energizing coil, an energizing circuit for said relay including said other set of contacts and said coil wired in series with each other for energization of said coil upon depression of both said switches, circuit means for by-passing all said contacts of said pair of switches upon energization of said relay including both contacts of said relay connected in parallel with said switches, and a holding circuit for said relay including one contact of said relay connected in series with said coil to maintain energization of said coil upon opening of said switches.

2. In a safety control circuit for an electric motor drive, the combination of a plurality of control stations, each of said control stations having a normally closed stop switch, said stop switches being connected in series with each other and with the motor to provide for deactivation of the motor upon opening of any one thereof, each of said control stations also including a double pole single throw jog switch having one contact connected in a series circuit with said stop switches and the motor, said series circuit being in parallel with the comparable contacts on the remainder of said jog switches, a run switch in each said control station connected in series with the other contact of the jog switch at its respective said control station and in series with the motor, a single normally open relay switch, energizing circuit means including each of said other contacts and each of said run switches providing for closing of said relay upon simultaneous closing of both said run switch and said jog switch at any one of said control stations, by-pass circuit means including said relay arranged to close an energizing circuit to the motor in parallel with all of said run switches and said jog switches, and holding circuit means for said relay providing for continued energization of said relay following opening of the particular run switch and jog switch utilized to complete said energizing circuit.

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