Nov. 29, 1960 H. L. RAYMOND 2,962,633

DUAL PUSH BUTTON CONTROL SYSTEM

Filed June 24, 1955

Fig. 1.

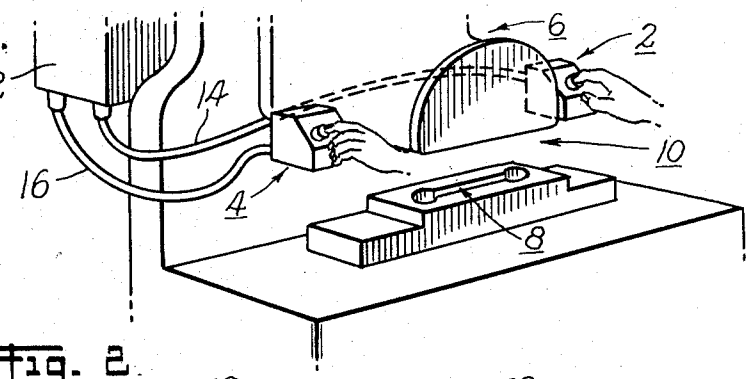


Fig. 2.

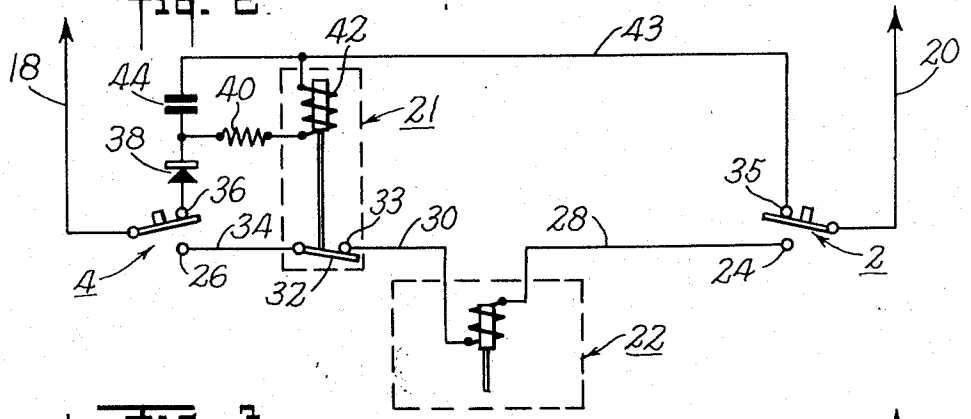
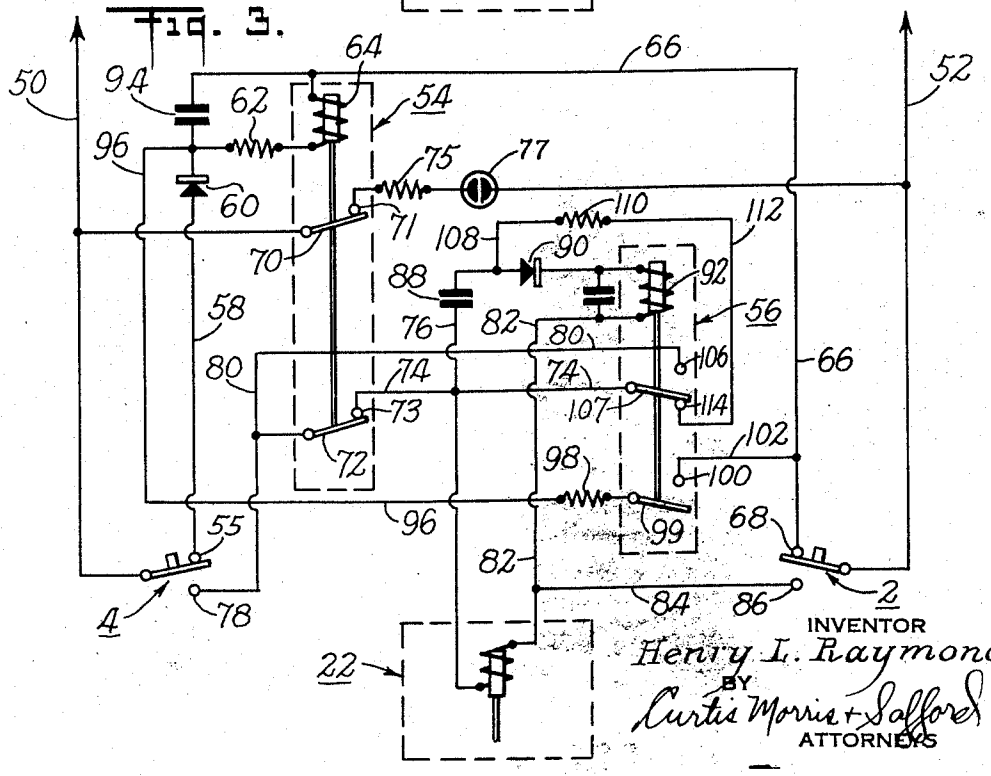


Fig. 3.



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DUAL PUSH BUTTON CONTROL SYSTEM

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9 Claims. (Cl. 317—135)

This invention relates to an electrical control system for the dual push button operation of machine tools.

An object of this invention is to provide an electrical system for the dual push button operation of a machine which will require that the operator in order to start the machine must depress simultaneously or within a brief interval each push button.

A better understanding of the invention, together with a full appreciation of its many advantages, will best be gained in the following detailed description given in connection with the accompanying drawings in which:

Figure 1 is a perspective view of a typical machine tool showing the location of push buttons;

Figure 2 is a circuit drawing of the basic push button control system; and

Figure 3 is a circuit drawing of a modified dual push button control system.

Referring now to Figure 1, the dual push buttons generally indicated at 2 and 4 are shown on machine 6 and are so arranged that the operator must clear his hands from the work 8 and away from the travel 10 of the operating part of the machine in order to press the buttons. The push buttons 2 and 4 are located on the machine convenient to the operator. Figure 1 generally depicts this invention as attached to a machine where control box 12, control wires 14 and 16 and push buttons 2 and 4 show the general arrangement of the control system. Leading from the top of the control box 12 are control wires, not shown, which lead to the main contactor or pneumatic relay which actuates the machine. The main contactor or pneumatic relay (see Figs. 2 and 3) is generally indicated by power device 22.

Figures 2 and 3 illustrate two arrangements of the control system.

Referring particularly to Figure 2, one embodiment of a safety control system incorporating the present invention is illustrated as comprising a source of power, usually at 110 volts A.C., shown as conductors 18 and 20 from a power house. The circuit diagram in Figure 2 illustrates the position of the devices when power is applied to leads 18 and 20 but before the push buttons 2 and 4 have been pressed to start the machine. Each push button 2 and 4 as illustrated constitutes the movable pole of a single pole double throw switch normally biased to one position and manually operable to another position. The system illustrated in Figure 2 comprises two push buttons, 2 and 4, and switches operated thereby, a time delay relay 21 and a power device 22. These elements of the electrical system are arranged in series across power lines 18 and 20 so that power device 22 will be energized when the circuit is complete. More specifically the circuit comprises push button switch 2, contact 24, wire 28, power device 22, wire 30, contact 33, safety switch 32 of relay 21, wire 34, contact 26 and push button switch 4. In the operation of this circuit push buttons 2 and 4 are closed against their respective contacts 24 and 26 completing the electrical circuit through power device 22, this energizes power device

22 and thereby starts machine 6. The single pole double throw switches or push buttons 2 and 4 are permanently biased in one position but are manually operable to the other position, which may be hereinafter referred to as the normally closed and normally opened positions respectively. The circuit through the push buttons to the power device is complete only so long as safety switch 32 remains closed against contact 33 and push buttons 2 and 4 are held against contacts 24 and 26 respectively.

It can be seen from Figure 2 that time delay relay 21 is normally energized directly from the power line through normally closed contacts 35 and 36 when the push buttons 2 and 4 are in their biased position. The power thus flows through the solenoid coil energizing of relay 21. Figure 2 shows the position of safety switch 32 when time delay relay 21 is energized as above described. In energizing relay 21, the current flows through rectifier 38, resistor 40 to D.C. solenoid 42 and thence to the switch operated by push button 2 by wire 43 and contact 35.

When either push button 2 or 4 is depressed to close the normally open circuit at 24 and 26 to energize power device 22, the circuit supply power to solenoid 42 of relay 21 is opened and the solenoid 42 would no longer be energized except for the energy stored in condenser 44 which continues to supply, for a short time through resistance 40, D.C. solenoid 42. This arrangement of rectifier 38, resistance 40, solenoid 42 and condenser 44 forms a time delay circuit which continues to energize solenoid 42 holding safety switch 32 of relay 21 closed for a short time after the power from the line to relay 21 is interrupted. In the present embodiment resistance and capacitor values were selected to give approximately one-half second time delay.

In the operation of this circuit if push buttons 2 and 4 are pressed at the same time the circuit through power device 22 is complete and the timing cycle of relay 21 commences. Since the power to device 22 is supplied for a full half-second before switch 32 opens interrupting the supply of power, device 22 will be energized and machine 6 will be started.

If however, push buttons 2 and 4 are depressed one after the other the timing cycle of relay 21 will begin at the moment the first button is pressed, interrupting the supply of power to solenoid 42, while device 22 will not begin to be energized unless the second button is pressed to complete the circuit through device 22 before the expiration of the time delay of relay 21.

Accordingly, if the delay between the pressing of push buttons 2 and 4 exceeds the time delay cycle set for the operation of relay 21, power device 22 will not be energized because safety switch 32 will open and the circuit through device 22 will not be complete. Further whatever time delay occurs between the pressing of the first and second push buttons, this time will in effect have to be subtracted from the time delay cycle of relay 21 in order to determine the time current quantity of power to device 22. Therefore if there is delay between depressing one push button and the pressing of the other there may not be a sufficient quantity of current fully to energize device 22 and machine 6 will not start.

If push button 2 has been permanently jammed to the "start" position, power device 22 will not operate upon the pressing of push button 4 because safety switch 32 will be open, its short time delay having previously expired. The operation of the time delay relay 21 requires that push buttons 2 and 4 be pressed simultaneously or in rapid sequence and released each time before beginning another cycle.

In the circuit illustrated in Figure 2 the capacitor and resistor have been selected so that the maximum length of time for current to flow through power device 22 is

approximately one-half second. If this is not long enough for the solenoid in power device 22 to become energized then the machine will not operate; similarly if the power device must remain energized for a brief time to permit the complete transfer of energy to the working part of the machine, an operation for a shorter time will be only partially effective. While the time delay of solenoid 42, in Figure 2, may be extended by changing the value of capacitor 44 and resistance 40 there is a practical limit to such modification.

Referring now to the circuit illustrated in Figure 3 there is shown one method by which this time may be extended so that power device 22 will be fully energized and remain so energized sufficiently long so that the transfer of energy may effectively be completed.

The circuit shown in Figure 3 shows the devices before the operator presses push buttons 2 and 4 and with power supplied to lead lines 50 and 52. A first time delay relay 54 is thereby normally energized and a second time delay relay 56 is normally deenergized. First relay 54 is energized from line 50 through push button contact point 55, control wire 58, rectifier 60 and resistor 62, solenoid 64, control wire 66, push button contact 68 to line 52. First and second line switches 70 and 72 close against contacts 71 and 73 of first time delay relay 54 when relay 54 is energized thereby supplying power through switch 70 and contact 71 to resistor 75 and lighting indicating lamp 77. The indicating lamp shows visible evidence that the system is reset and ready to operate power device 22 after push buttons 2 and 4 are pressed.

If push buttons 2 and 4 are pressed simultaneously or substantially so the electrical circuit to power device 22 is complete through contact point 78, control wire 80, second line switch 72, control wires 74 and 76 to power device 22 and through control wires 82 and 84 to contact 86 and line 52.

By pressing either push button 2 or 4 the circuit through solenoid 64 of first relay 54 is opened initiating the timing cycle. If within the period of time delay afforded by first relay 54 the circuit to power device 22 is complete through second line switch 72 the power device will be energized and operate, but once first relay 54 times-out, second line switch 72 opens and the circuit through second line switch 72 and contact 73 no longer supplies current to the power device.

The practical impossibility in pushing push buttons 2 and 4 simultaneously presents a serious problem when power device 22 requires more time to be energized than the one-half second or less provided by first relay 54. The time delay between the sequence operation of the push buttons must be subtracted from the effective time in which current will flow to power device 22, because the time delay of first relay 54 is measured from the beginning of the time either push button 2 or 4 is pressed. Therefore in the case of a large time-current demand for power device 22, it is possible that the timing circuit through second line switch 72 will open before power device 22 is fully energized thereby preventing the effective operation of the machine.

The modified circuit illustrated in Figure 3 is arranged to compensate for the time delay in the sequence operation when push buttons 2 and 4 are pressed. I have shown above how the circuit in Figure 3 is similar to the circuit in Figure 2 and I have discussed one phase of the operation of the circuit illustrated in Figure 3.

The circuit set forth in Figure 3 permits a greater time delay between the sequence operation of push buttons 2 and 4 without reducing the effective current flow to power device 22. This is accomplished by a dual time-delay system, one time delay means to limit the time within which both push buttons must be pressed, a second time delay means which accurately times the flow of current to power device 22 so as to assure its operation and yet limits the flow of current to power device 22 so that only a single operation is possible.

Referring again to Figure 3 it is seen that with push buttons 2 and 4 closed against normally opened contacts 86 and 78, power is applied to power device 22 through second line switch 72 but first relay 54 immediately begins to time-out. Power to second time delay relay 56 is supplied through second line switch 72, contact 73, wire 74, wire 76 to condenser 88, rectifier 90 through solenoid 92, to wires 82, 84 and contact 86 to line 52. As second relay 56 picks up first relay 54 drops out almost at once because the circulating current through resistor 62 and condenser 94 is short circuited by wire 96, resistor 98, through first control switch 99, contact 100, wires 102, and 66 to condenser 94, thereby causing relay 54 to drop out. Power is supplied to solenoid 92 of second relay 56 by the circuit through push button contact 78, wire 80, contact 106, second control switch 107, wires 74 and 76 to condenser 88 and rectifier 90. As relay 56 remains energized, power is supplied to power device 22 by circuit from push button contact 78, through wire 80, contact 106, second control switch 107, wires 74 and 76 to power device 22, through wires 82 and 84 to push button contact 86.

Flow of current to solenoid 92 begins to decrease as condenser 88 becomes charged and when the current through solenoid 92 becomes too small to effectively energize the solenoid, second relay 56 will drop out thereby opening the circuit at second control switch 107. Condenser 88 is short circuited through wire 108, resistor 110, wire 112, contact 114 second control switch 107, wires 74 and 76 thereby discharging condenser and preparing it for another time cycle. Second control switch 107 of second relay 56 is a double throw switch so arranged as to complete the shorting circuit to contact 114 when second relay is deenergized and said second control switch is in a normally closed position. When second time delay relay 56 is deenergized, second control switch 107 is in a normally open position with respect to a path parallel to second line switch 72. In order to assure the complete time sequence operation of the entire circuit shown in Figure 3 push buttons 2 and 4 must continuously be pressed, if either push button is released the main circuit is opened and the sequencing operation of relays 54 and 56 is interrupted. Further, after the cycle is complete both push buttons must be released in order to energize relay 54, which is also shown by the visual indicator neon light 77. When this light glows the push buttons may again be pressed for another operation of the machine.

The above description is intended to be illustrative of the invention. Various changes in the circuit described may occur to those skilled in the art and these may be without departing from the spirit and scope of the invention as set forth.

I claim:

1. A safety control system in an electric circuit of an electric starting device for operating a machine through a single cycle only which control system protects both hands of the machine operator and comprises power lines, a first branch circuit having a relay winding, a second branch circuit having a safety switch operated by the relay winding in the first branch circuit and an electric responsive device for initiating operation of the machine, a pair of manually operable current control devices each connected to one of the power lines and the devices being spaced so that both hands must be used to operate the control devices substantially simultaneously, each current control device having a current directing means biased to connect the first branch circuit between the power lines to normally energize the relay winding therein and close the safety switch in the second branch circuit, each current control device being operable by the presence of a hand of the operator to disconnect the first

branch circuit from its power line and connect the latter to the second branch circuit, and a timing device connected to delay the opening of the safety switch for a predetermined time after the first branch circuit is opened by either of the pair of control devices operated by the presence of a hand and less than the time required for the machine to operate through a cycle whereby operation of the machine is initiated only when the second branch circuit is energized by the presence of both hands on the current control devices, the safety switch is opened to de-energize the second branch before the machine completes a cycle and the safety switch is closed only when both hands are removed from the current control devices.

2. A safety control system in an electric circuit for an electric responsive device to operate a machine cyclically which protects both hands of the machine operator comprising power lines, a first branch circuit having a relay winding and an electric time control for delaying de-energization of the winding for a predetermined period of time after the branch circuit is opened, a second independent branch circuit having a safety switch operated by the relay winding in the first branch and an electric responsive device for initiating operation of the machine connected in series with the safety switch, a pair of manually operable single-pole, double-throw switches, each having its pole connected to one of the power lines, respectively, and so spaced that both hands must be used to operate the switches simultaneously, the poles of the switches being biased to connect the first branch circuit between the power lines to normally energize the relay winding therein and close the safety switch in the second branch circuit, each of the single-pole, double-throw switches being operable by one hand of the operator to disconnect its power line from the first branch and connect it to the second branch circuit whereby both control switches must be manually operated within the predetermined time period of the electric time control in the first branch circuit to initiate operation of the machine and the safety switch in the second branch circuit is opened at the end of said predetermined period of time to limit operation of the machine through a single cycle.

3. In an electric safety control system for a power operated machine which requires the use of both hands of the attendant during operation of the machine comprising an electric responsive device for controlling operation of the machine, a source of electric power having a pair of conductors, an electric branch circuit for connecting the electric responsive device between the conductors of the source of power, said circuit including a pair of switches each comprising normally engaged contacts and other contacts engaged when the switch is manually operated to close the circuit to the electric responsive device, each switch being connected to one side of the power line, a safety switch in said branch circuit connected in series with the electric responsive device between said pair of switches, a direct current relay for closing the safety switch, a second branch circuit having a rectifier for connecting the relay between the conductors of the electric power source when the contacts of the pair of switches are normally engaged, a timing device for opening the closed safety switch after a period of time less than required for the machine to operate through a cycle comprising the coil of said relay and a resistance condenser system in said second branch to delay opening of said safety switch a predetermined period of time after manual operation of one and both of said manually operated switches, a control switch in parallel with said safety switch, means responsive to the closing of said branch circuit to the electric responsive device for closing said control switch, a second timing device for opening said control switch after a predetermined period of time and said second timing device being responsive to and initiated by actuation of said control switch.

4. An electric control system for insuring the safe operation of a cyclically operated machine which is inherently dangerous to the hands of the attendant comprising an electrically responsive device for controlling operation of the machine through a cycle, a source of power, a switch operating means, an electric circuit comprising a first branch for connecting said source of power to the electric responsive device and a second branch arranged in parallel with said first branch for connecting the source of power to the switch operating means, a safety switch in said first branch connected for operation to closed position by the switch operating means in the second branch, a pair of two position switches having contacts normally engaged to energize the second branch and other contacts engaged when the switches are manually operated to de-energize the second branch and energize the first branch, a timing delay means in the second branch to maintain the switch operating means energized and thereby hold said safety switch closed for a predetermined period of time after said second branch is de-energized, a second switch connected in parallel with said safety switch in the first branch for connecting said source of power to the electric responsive device of said machine, switch operating means to close and to open said second switch, said switch operating means being connected to the first branch for energization therewith, and an electrically operated timing means connected to the first branch and the switch operating means to delay the opening of said second switch for a predetermined period of time after the safety switch is opened.

5. A control system comprising, a power device, an indicating lamp, two push button switches, each switch having contacts normally engaged to complete one circuit and a contact engaged when the switch is manually operated to complete another circuit, two time delay relays each having a D.C. solenoid and two separate contactors, conductors connecting one of said relays in one branch circuit, a first time delay system connected in said one branch circuit to operate with the time delay relay therein, said system comprising a rectifier, condenser and resistor, conductors connecting the other relay in another branch circuit, a second time delay system connected in said other branch circuit to operate with the time delay relay therein, said second system comprising two condensers and a rectifier, a contactor of said one relay being connected to control the power device and lamp, respectively, a shorting resistance for each of the first and second time delay relays, and said shorting resistances being connected to be operated in reverse order by the separate contactors of the second relay.

6. A safety control system for a power operated machine which insures the removal of the hands of the attendant during operation of the machine including a power supply, a control circuit and a device to be operated, said control circuit comprising two push button switches with each having one normally open and one normally closed contact, a first and second relay each having a D.C. solenoid and a first and second contactor, a first time delay system to operate with said first relay, said system comprising a rectifier, condenser and resistor, a second time delay system to operate with said second relay, said second system comprising two condensers and a rectifier, an indicating lamp in series with the first contacter of said first relay and connected to said power supply to signal when the control circuit is ready for operation, said normally closed contacts of said push button switches being connected in series with said solenoid of said first relay whereby said relay is normally energized, said normally open contacts of said push button switches being connected in series with the second contacter of the first relay, and said power operated device and said first contacter of said second relay being connected in parallel with the second contacter of the first relay whereby said power operated device can be fully energized when contacts of said first relay are opened, and said second time delay system operating to

open the first contact of the second relay after the time period of said system has expired to open the circuit to the power operated device.

7. A safety control system for a power operated machine comprising a first single-pole double-throw switch having a pole normally engaging one contact and manually operable to engage a second contact, a second single-pole double-throw switch having a pole normally engaging one contact and manually operable into engagement with a second contact, an electric power operated device for controlling operation of the machine, a safety switch having normally open contacts and a solenoid operable when energized to close the contacts, power lines connected to the poles of the first and second single-pole double-throw switches, a branch circuit having conductors connecting the safety switch solenoid to the normally engaged contacts of the pair of single-pole double-throw switches to complete a circuit through the solenoid to hold the safety switch in closed position, a branch circuit connecting the safety switch and electrically operated power device in series between the second mentioned contacts of the pair of single-pole double-throw switches to complete a circuit through the power device when the poles of both switches are manually operated into engagement with the second contacts, electrically operated time delay means for delaying the opening of the safety switch for a predetermined period of time after the pole piece of either single-pole double-throw switch is manually operated to open the branch circuit, said electrically operated time delay means being connected across said power line in series with said first and second switches so that said series circuit across said power line is completed when the poles of said first and second single-pole double-throw switches are in the normal engaged position with the first mentioned contacts and said time delay means is energized thereby holding said safety switch

closed, relay means interconnected with said first time delay means and said power lines comprising a second interrupting switch connected in parallel with the safety switch in the second mentioned branch circuit for energizing the power device, a solenoid for operating the second interrupting switch to closed position and connected in the second mentioned branch circuit for energization therewith, and a second electrical time delay means connected to delay the de-energization of the solenoid and opening of the second interrupting switch for a predetermined period of time after the safety switch opens.

8. A control system as claimed in claim 7 in further combination with a second relay means operated by the safety switch solenoid, an indicating light arranged in a circuit controlled by the relay means so that said indicating light will unfailingly show when power is on and also when said first time delay means is energized whereby the control system is ready to operate.

9. A control system as claimed in claim 7 in which said second time delay means includes a condenser, rectifier and D.C. solenoid connected for energization by closure of a circuit through the power device.

References Cited in the file of this patent

UNITED STATES PATENTS

2,067,413	Plaisted	Jan. 12, 1937
2,322,560	Beck	June 22, 1943
2,465,794	Fereday	Mar. 29, 1949
2,541,577	Dornbos	Feb. 13, 1951
2,579,595	McLane	Dec. 25, 1951
2,669,686	Riche	Feb. 16, 1954
2,705,297	Koch	Mar. 29, 1955
2,753,493	Saives	July 3, 1956

FOREIGN PATENTS

727,772	Germany	Nov. 12, 1942