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Geremia

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[54] **SAFETY CONTROL CIRCUIT**

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[52] **U.S. Cl.** ..... **317/135 R;** 307/113

[51] **Int. Cl.** **H01h 47/00**

[58] **Field of Search** ..... 317/135, 151; 307/113, 307/112; 192/131 R

[56] **References Cited**

UNITED STATES PATENTS

3,207,957	9/1965	Naylor	317/135 R
3,748,541	7/1973	Ginsberg	317/135 R
3,793,533	2/1974	Ginsberg	317/135 R

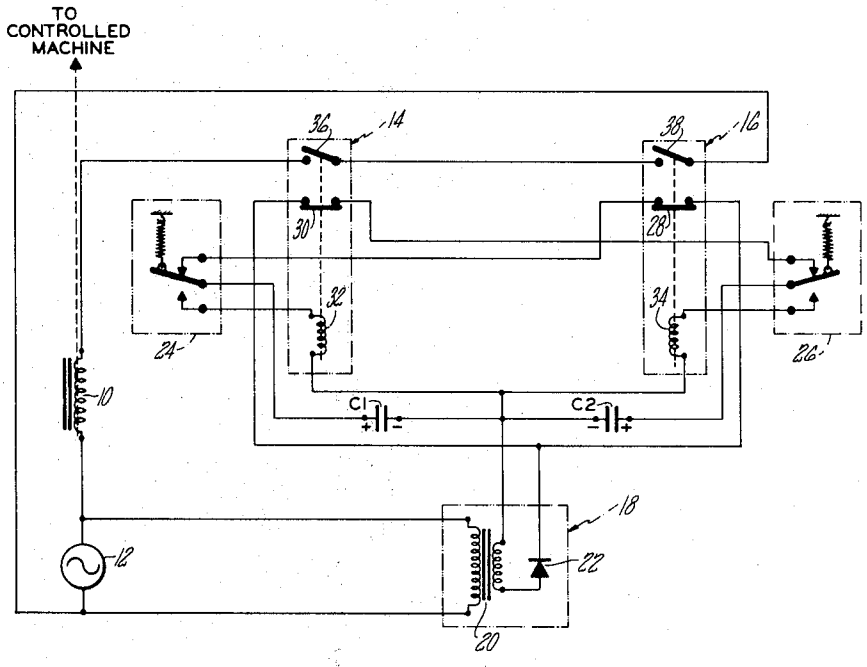
Primary Examiner—J. D. Miller

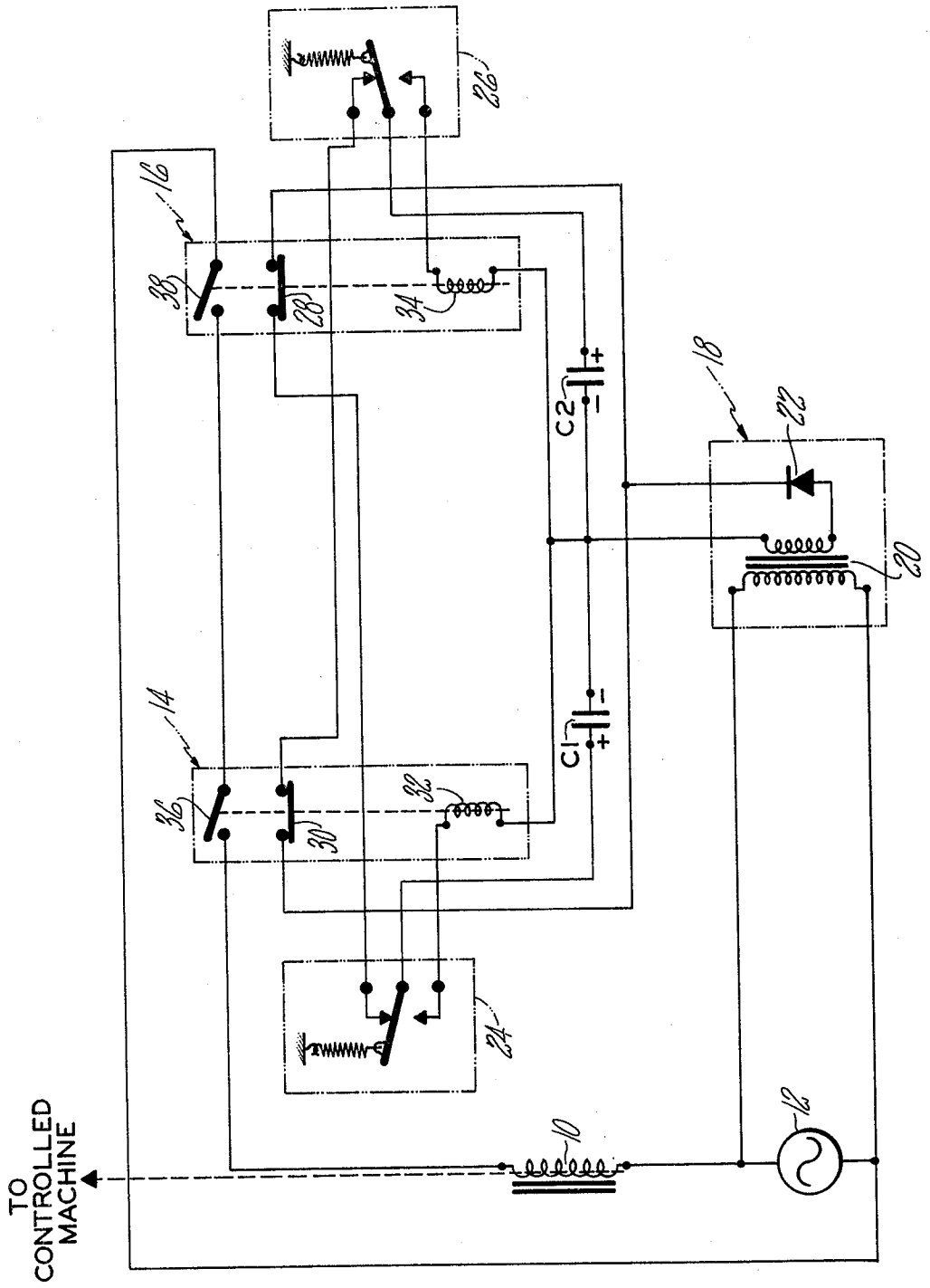
Assistant Examiner—Harry E. Moose, Jr.

[57] **ABSTRACT**

A safety control for power operated machines consisting of a two hand trip-two hand hold circuit which oversees energization of the machine. The circuit includes a pair of palm operated switches and a pair of relays having normally open contacts connected in series with a machine enabling solenoid and a source of current therefor. The palm switches control the discharge of associated capacitors through respective of the relay solenoids; simultaneous closing of both palm switches being required to energize the machine.

8 Claims, 2 Drawing Figures




TO CONTROLLED MACHINE
10
12
14
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24
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36
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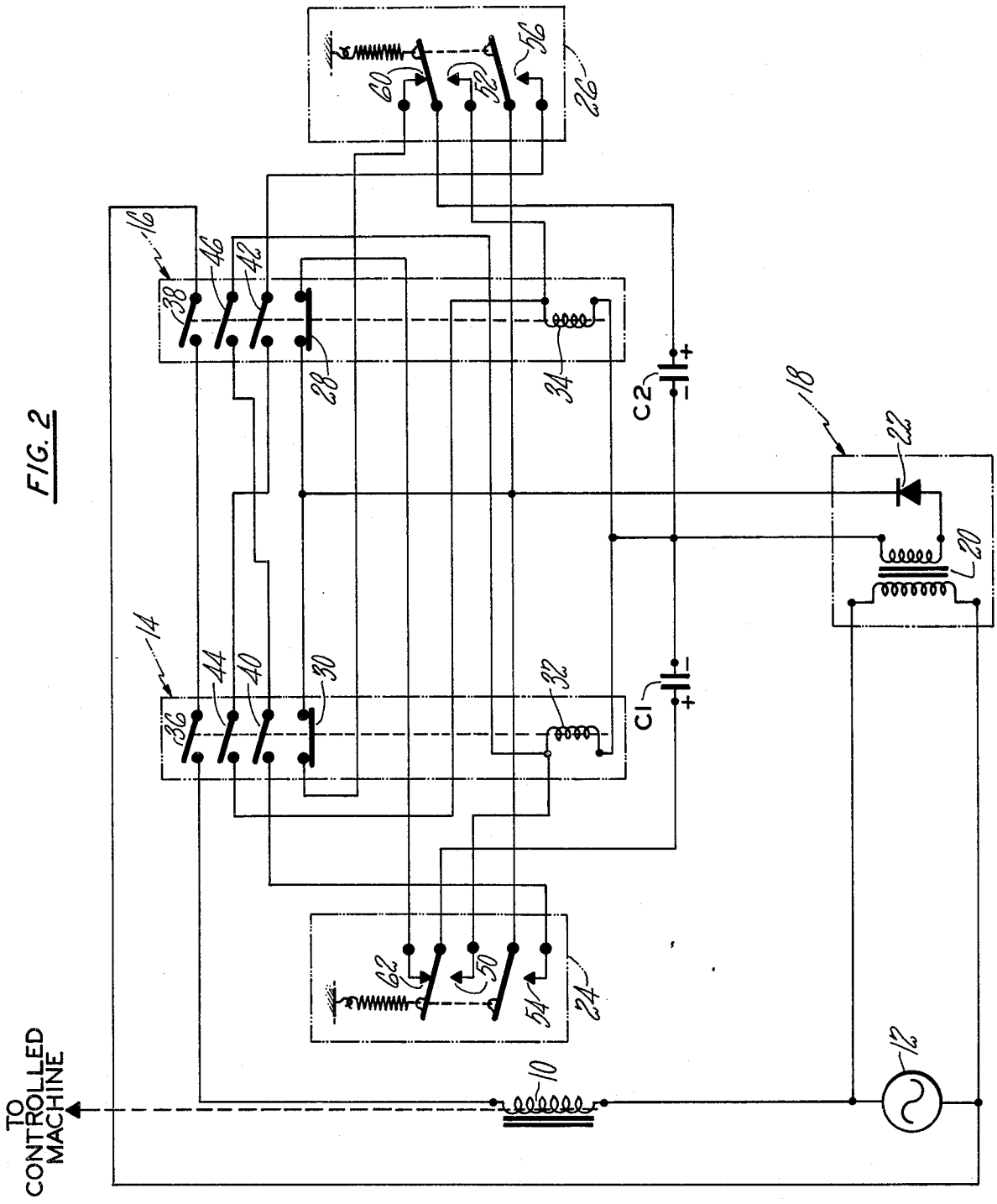
C1
C2

FIG. 1

FIG. 2


TO CONTROLLED MACHINE
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SAFETY CONTROL CIRCUIT

BACKGROUND OF THE INVENTION:

1. Field of the Invention

The present invention relates to enhancing the safety of operation of presses and other similar machine tools. More specifically, this invention is directed to a two hand trip-two hand hold control device for incorporation on a tool. Accordingly, the general objects of the present invention are to provide novel and improved methods and apparatus of such character.

2. Description of the Prior Art

It has long been recognized that equipment, such as punch presses and similar machines, must be provided with safety devices which will prevent operation of the apparatus unless both of the operator's hands are in a safe position. To this end, press and other machine tool starting circuits which theoretically require manipulation by both hands of the operator have long been known in the art. An example of such a prior art press control may be found in U.S. Pat. No. 2,594,520. Control circuits such as those of the referenced patent are intended to require that a pair of spatially displaced switches be simultaneously manually operated in order to activate the tool.

Unfortunately, due in part to the incentives of "piece work" payments, it has been prevalent practice for machine operators to devise ways to disable or otherwise circumvent safety control systems in such a manner that the operator will have at least one free hand to expedite the movement of work into and out of the machine. It is, accordingly, common to find that one of the control switches of a press or other tool has been fastened or held in the "run" position in some manner. By way of example, in the case of the control device of U.S. Pat. No. 2,594,520 one of the control switches can be fastened down whereby the operator can energize the press once employing one hand.

The passage of the Occupational Safety and Health Act of 1970, and similar state legislation, has emphasized the need for machine tool safety controls which prevent even a single operational cycle from being performed with one hand. Controls which meet this criteria have not previously been available.

SUMMARY OF THE INVENTION

The present invention overcomes the above briefly discussed and other deficiencies and disadvantages of the prior art by providing a two hand trip-two hand hold control device for machine tools and the like characterized by a novel and improved technique for preventing "tie down." In accordance with the present invention each of a pair of "palm" switches controls the discharge of a capacitor through an associated relay solenoid. The normally open contacts of the two relays are connected in series and control the application of power to the main control solenoid for the machine for which protection is intended. If either of the hand operated control switches is depressed its associated capacitor will discharge completely causing its relay to pulse. Accordingly, the tool can not be operated unless both "palm" buttons are simultaneously depressed. The capacitors can not be recharged until the control switches are returned to their initial position and thus, in addition to requiring simultaneous operation of the switches, the machine tool can not be cycled a second time unless both manually operated switches are released.

Also in accordance with the present invention, circuitry is provided which disables the main control solenoid if the contacts of one of the safety circuit relays should become welded in the closed position.

In accordance with a second embodiment of the invention, intended for use with tools having a comparatively long work cycle, the present invention requires that both manually operated control switches be held in the operated position through a complete cycle; i.e., the safety circuit relays will remain operated subsequent to discharge of the capacitors until either one or both "palm" switches are released. The machine tool will be deenergized so as to immediately return to its starting position if one or both of the manually operated switches is released prior to completion of a cycle and repetitive cycling, for example by tie down, is not possible since both "palm" switches must be released in order to start another cycle.

BRIEF DESCRIPTION OF THE DRAWING:

The present invention may be better understood and its numerous objects and advantages will become apparent to those skilled in the art by reference to the accompanying drawing wherein like reference numerals refer to like elements in the figures and in which:

FIG. **1** is a schematic diagram of a first embodiment of the present invention intended for use with a power press; and

FIG. **2** is a schematic diagram of a second embodiment of the invention intended for use with an air cylinder press.

DESCRIPTION OF THE PREFERRED EMBODIMENTS:

With reference now to FIG. **1**, a first embodiment of the invention intended for use with a power type press; i.e., a driven press or similar machine tool which has a short working cycle; is disclosed. An operational cycle of the tool with which the operator's safety circuit of FIG. **1** is associated is instituted by the energization of a main solenoid **10.** On most presses this solenoid momentarily operates an arm which couples the press to a flywheel. On some presses the main solenoid operates an air valve. Solenoid **10** is energized by the delivery of current thereto from an a.c. source **12** which may be the main 115 volt building power supply. In the manner to be described below, current is delivered to solenoid **10** via the normally open series connected contacts of a pair of control relays indicated generally at **14** and **16.**

Direct current power for operation of the safety circuit, including the solenoids of relays **14** and **16,** is derived from alternating current source **12** via a power supply indicated generally at **18.** Power supply **18** may, as shown, comprise merely a step-down transformer **20** and a diode **22.**

The safety circuit of the present invention comprises a pair of palm switches **24** and **26.** Switches **24** and **26** will be mounted on the press in such a manner that the operator will be required to operate the push button actuator of each switch with a separate hand. The contacts of switches **24** and **26** are spring loaded into the condition shown in FIG. **1** and each switch will immediately return to this condition when its associated actuator button is released. The safety circuit further

comprises a pair of capacitors C1 and C2 which cooperate with control relays **14** and **16** and palm switches **24** and **26.**

Capacitor C1 will be charged from d.c. power supply **18** via the normally closed contacts of switch **24** and a first pair of normally closed contacts **28** of control relay **16.** Similarly, capacitor C2 will be charged from source **18** via the normally closed contacts of switch **26** and a normally closed set of contacts **30** of control relay **14.** Capacitor C1 and C2 are normally in the charged condition with palm switches **24** and **26** unoperated. As each of switches **24** and **26** is depressed its normally open contacts will be closed and capacitors C1 and C2 will respectively be discharged through the solenoids **32** and **34** of respective control relays **14** and **16.** As noted above, a set of normally open contacts of relays **14** and **16,** respectively indicated at **36** and **38,** are connected in series with the main power solenoid **10.** As each palm switch is depressed its associated capacitor is discharged into its own relay coil holding the control relays closed for a period which is just long enough to complete a circuit from power source **12** through contacts **38** and **36** of the control relays and the main solenoid **10.** The solenoid **10** is thus energized and a single cycle of the controlled machine will result. Capacitors C1 and C2 are completely discharged by the closing of their respective palm switches; the energization of control relay solenoids **32** and **34** thus being in the form of a pulse. The time constants of the circuits comprising the capacitors and the control relay solenoids can, of course, be varied by varying the capacitance of capacitors C1 and C2 or by varying the impedance of the circuit including the relay coils.

The capacitors C1 and C2 can not recharge until the switches **24** and **26** are returned to the initial position. Thus, the present invention constitutes an anti tie down safety control for a machine tool or the like.

The present invention also encompasses a number of additional safety features. If transformer **20** fails, either in the open or short circuited condition, no power will be available for charging capacitors C1 and C2 and the safety circuit will be rendered inoperative thus disabling the controlled machine. Similarly, if diode **22** fails there will either be no power to the safety circuit or, if the diode should short circuit, the capacitors will not charge. If either of the capacitors fails the circuit will, of course, not operate. Similarly, if the coils of either of the control relays **14** and **16** open or short the safety circuit will be disabled. If either of contacts **36** or **38,** through which power for energizing the main solenoid **10** is delivered, should become welded in the closed position due to an overload, the associated pair of relay contacts **28** or **30** will remain open thereby preventing recharging of one of the capacitors thus again disabling the safety circuit and preventing operation of the controlled machine.

Referring now to FIG. **2,** a second embodiment of the present invention intended for use with machine tools having a longer work cycle than tools of the type with which the control of FIG. 1 would be employed is disclosed. The control circuit of FIG. **2** may, for example, be employed on a hydraulic press or air cylinder. As in the case of the FIG. **1** embodiment, the operational cycle of the tool is instituted by the energization of a main control solenoid **10.** Solenoid **10** will typically open an air valve which will operate an air cylinder or hydraulic actuator. Solenoid **10** is energized by the delivery of current thereto from a.c. source **12** via the normally open series connected contacts **36** and **38** of control relays **14** and **16.** Direct current for operation of the safety circuit, including the coils of relays **14** and **16,** is derived from the alternating current source **12** via power supply **18.**

In the FIG. **2** embodiment, for purposes which will be described below, control relays **14** and **16** are each respectively provided with two extra pairs of normally open contacts **40, 44** and **42, 46.** Also, the palm switches, in addition to being provided with the same set of contacts as discussed above in the description of FIG. **1,** are each provided with an additional pair of normally open contacts as indicated respectively at **54** and **56** for switches **24** and **26.**

The operation of the embodiment of FIG. **2** will now be described. Capacitor C1 will be charged from direct current source **18** via normally closed contact **62** of palm switch **24** and the normally closed contacts **28** of control relay **16.** Similarly, capacitor C2 will be charged from source **18** via the normally closed contacts **60** of palm switch **26** and the normally closed contacts **30** of control relay **14.** Capacitors C1 and C2 will be normally in the charged condition with palm switches **24** and **26** unenergized. As each of the palm switches is depressed its normally closed contacts will be switched and first normally open contacts, indicated respectively at **50** and **52,** will be closed. Capacitors C1 and C2 will accordingly be discharged respectively through the coils **32** and **34** of respective control relays **14** and **16.** As previously discussed, the normally open contacts **36** and **38** of the control relays are connected in series with the main power solenoid **10.** As each palm switch is depressed its associated capacitor is discharged into its own relay coil thus closing the relay. Thus, if both palm switches are simultaneously operated a circuit will be completed through the main power solenoid **10.**

The operation of palm switch **24** will additionally cause the closing of its second set normally open contacts **54** and, when capacitor C1 discharges through coil **32,** the normally open contacts **40** and **44** of control relay **14** will be closed. Similarly, operation of palm switch will cause closing of its second set of normally open contacts **56** and, through energization of the control relay **16,** will also cause the closing of the normally open contacts **42** and **46** of control relay **16.** Contacts **54** of palm switch **24,** contacts **40** of relay **14** and contacts **46** of relay **16,** when closed, complete a "holding" circuit for relay **14.** Similarly, contacts **56** of palm switch **26,** contacts **42** of relay **16** and contacts **44** of relay **14** complete a holding circuit for control relay **16.** Thus, if palm switches **24** and **26** are simultaneously operated, the control relays **14** and **16** will be latched in the energized position and current will be continuously delivered to the main power solenoid **10.**

As noted above, an air cylinder or hydraulic press differs from a power press, of the type which would be employed with the control circuit of FIG. **1,** in that the time cycle of operation is much slower. Thus, employing the control circuit of FIG. **2,** the time cycle is controlled by the operator by holding both palm switches depressed for a predetermined time. The release of one of the palm switches when the predetermined time has expired will interrupt the holding circuit of both of control relays **14** and **16.** For example, if palm switch **24** is released its contacts **54** will be opened thus opening

the hold-in circuit to coil **32** of control relay **14** which is established via contacts **40** of control relay **14.** Once relay **14** has been unlatched, contacts **44** of relay **14** will open the hold-in circuit for coil **34** of control relay **16.** Both palm switches must, of course, be released prior to starting another cycle. The normally closed contacts **30** of relay **14** control the charging of capacitor C2 through contact **60** of palm switch **26** and, similarly, contacts **28** of relay **16** control the charging of capacitor C1 through contact **62** of palm switch **24.** Thus, the capacitors C1 and C2 can not be recharged until both of the palm switches have been released.

Both of palm switches **24** and **26** must also, of course, be operated within the discharge time of capacitor C1 and C2 in order to cycle the controlled tool. This requires that normally open contacts **40** and **44** of control relay **14** and normally open contacts **42** and **46** of control relay **16** must close at the same time to complete the holding circuit for both control relays.

The tying down of one of palm switches **24** and **26** will not allow the recharging of the capacitor associated with that switch. The tying down of both palm switches with the press in the operated position will only extend the length of time the press is closed; i.e., the simultaneous tying down of both switches after an operational cycle has been installed will not result in a condition where the tool may be cycled a second time.

While preferred embodiments have been shown and described, various modifications and substitutions may be made thereto without departing from the spirit and scope of the invention. Accordingly, it is to be understood that the present invention has been described by way of illustration and not limitation.

What is claimed is:

1. A safety control circuit for a power operated machine comprising:

a machine enabling solenoid;

first hand operated control switch means, said first switch means establishing a normally closed electrical circuit and at least a first normally open electrical circuit;

second hand operated control switch means, said second switch means establishing a normally closed electrical circuit and at least a first normally open electrical circuit, said first and second switch means in part forming a two-hand tripping control for single operating cycles of the machine;

a pair of capacitors;

a source of direct charging current for said capacitors;

means connecting a first terminal of each of said capacitors to a first polarity terminal of said current source;

a first control relay, said first relay having a solenoid and at least first pairs of normally open and normally closed contacts;

a second control relay, said second relay having a solenoid and at least first pairs of normally open and normally closed contacts;

first conductor means connecting the second terminal of a first of said capacitors to the second polarity terminal of said current source, said first conductor means connecting the normally closed circuit of said first switch means and the normally closed contacts of said second relay in series whereby said first capacitor is normally charged;

second conductor means connecting the second terminal of the second of said capacitors to the second polarity terminal of said current source, said second conductor means connecting the normally closed circuit of said second switch means and the normally closed contacts of said first relay in series whereby said second capacitor is normally charged;

third conductor means connecting the normally open circuit of said first switch means and the solenoid of said first relay in series between said first capacitor second terminal and said current source first polarity terminal whereby operation of said first switch means will establish a path for the discharge of said first capacitor through said first relay solenoid;

fourth conductor means connecting the normally open circuit of said second switch means and the solenoid of said second relay in series between said second capacitor second terminal and said current source first polarity terminal whereby operation of said second switch means will establish a path for the discharge of said second capacitor through said second relay solenoid; and

fifth conductor means for connecting first pairs of normally open contacts of said first and second relays in series between a source of energizing current and said machine enabling solenoid whereby simultaneous operation of said first and second switches will cause discharge of said first and second capacitors respectively through said first and second relay solenoids to thereby cause simultaneous momentary closing of the normally open contacts of said relays to complete a current path through said machine enabling solenoid.

2. The apparatus of claim **1** wherein said first and second control relays each include:

a solenoid;

a first pair of normally open contacts;

a first pair of normally closed contacts; and

plunger means movable in response to energization of said solenoid, said plunger means mechanically coupling said normally open and closed contacts whereby the failure of said control relay with the normally open contacts closed will result in said normally closed contacts being held open and the charging current path for one of said capacitors being opened.

3. The apparatus of claim **1** wherein said switch means each include:

a palm operated single pole double throw switch, said switch being spring loaded in a first circuit establishing condition.

4. The apparatus of claim **2** wherein said switch means each include:

a palm operated single pole double throw switch, said switch being spring loaded in a first circuit establishing condition.

5. The apparatus of claim **1** further comprising:

latching circuit means for holding said first and second relay solenoids in the energized state subsequent to discharge of said capacitors.

6. The apparatus of claim **5** wherein said switch means each comprise:

a single pole double throw switch;

a normally open single pole single throw switch;

means biasing said double throw switch into a first circuit establishing condition;

means mechanically interconnecting said single and double throw switches for simultaneous operation; and

a palm operated actuator coupled to said interconnecting means.

7. The apparatus of claim **6** wherein said control relays each comprise:

a solenoid;

a first pair of normally closed contacts;

a first pair of normally open contacts;

at least second and third pairs of normally open contacts; and

plunger means movable in response to energization of said solenoid, said plunger means mechanically interconnecting said pairs of contacts.

8. The apparatus of claim **7** wherein said latching circuit means comprises:

means connecting said normally open first switch means single throw switch and second pairs of normally open contacts of said first and second control relays in series with said first control relay solenoid and said current source; and

means connecting said normally open second switch means single throw switch and third pair of normally open contacts of said first and second control relays in series with said second control relay solenoid and said current source.

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