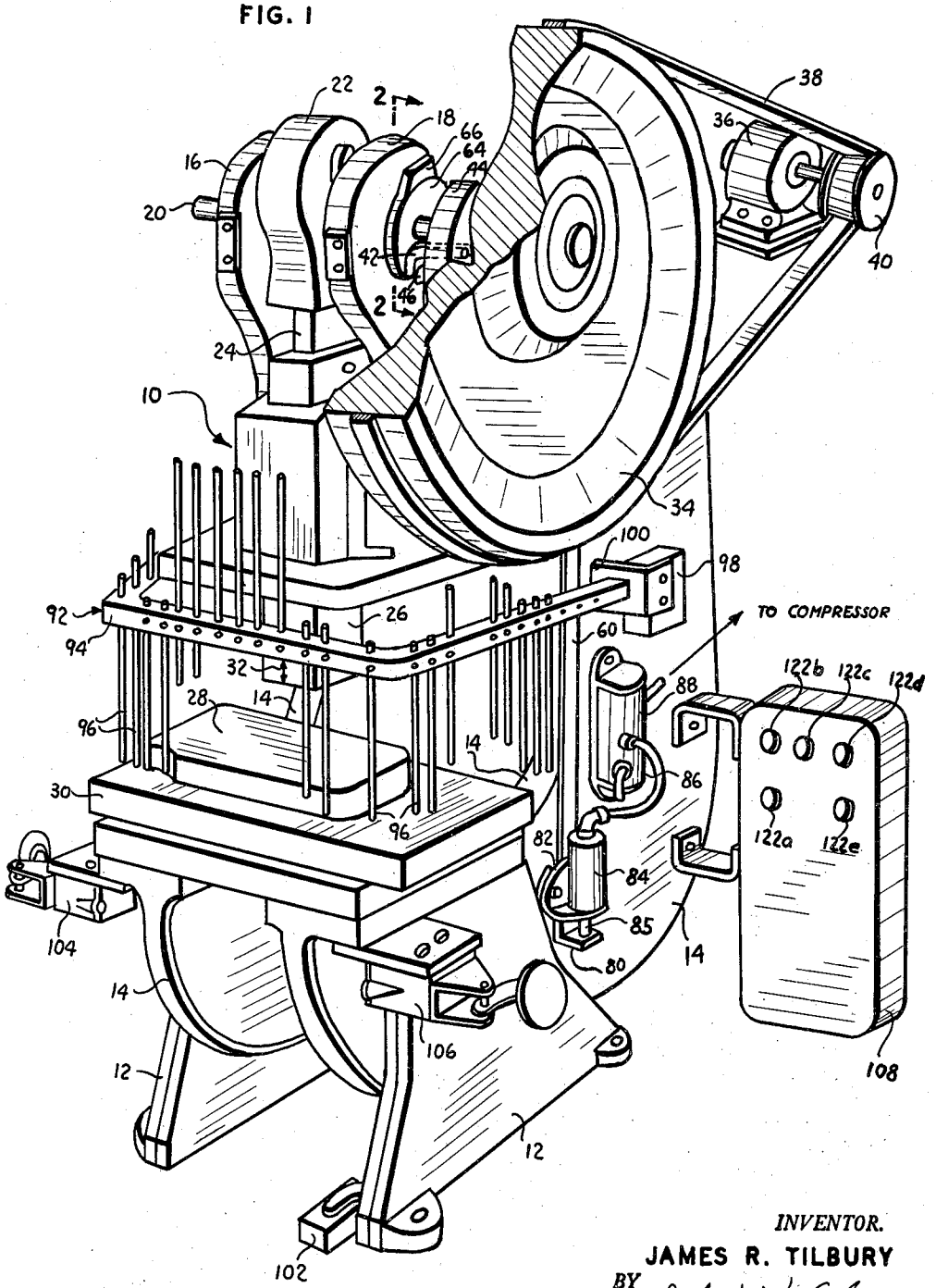
Sept. 10, 1963 J. R. TILBURY 3,103,270

TIME DELAY SAFETY INTERLOCK FOR MACHINES

Filed Sept. 4, 1959 2 Sheets-Sheet 1

FIG. 1

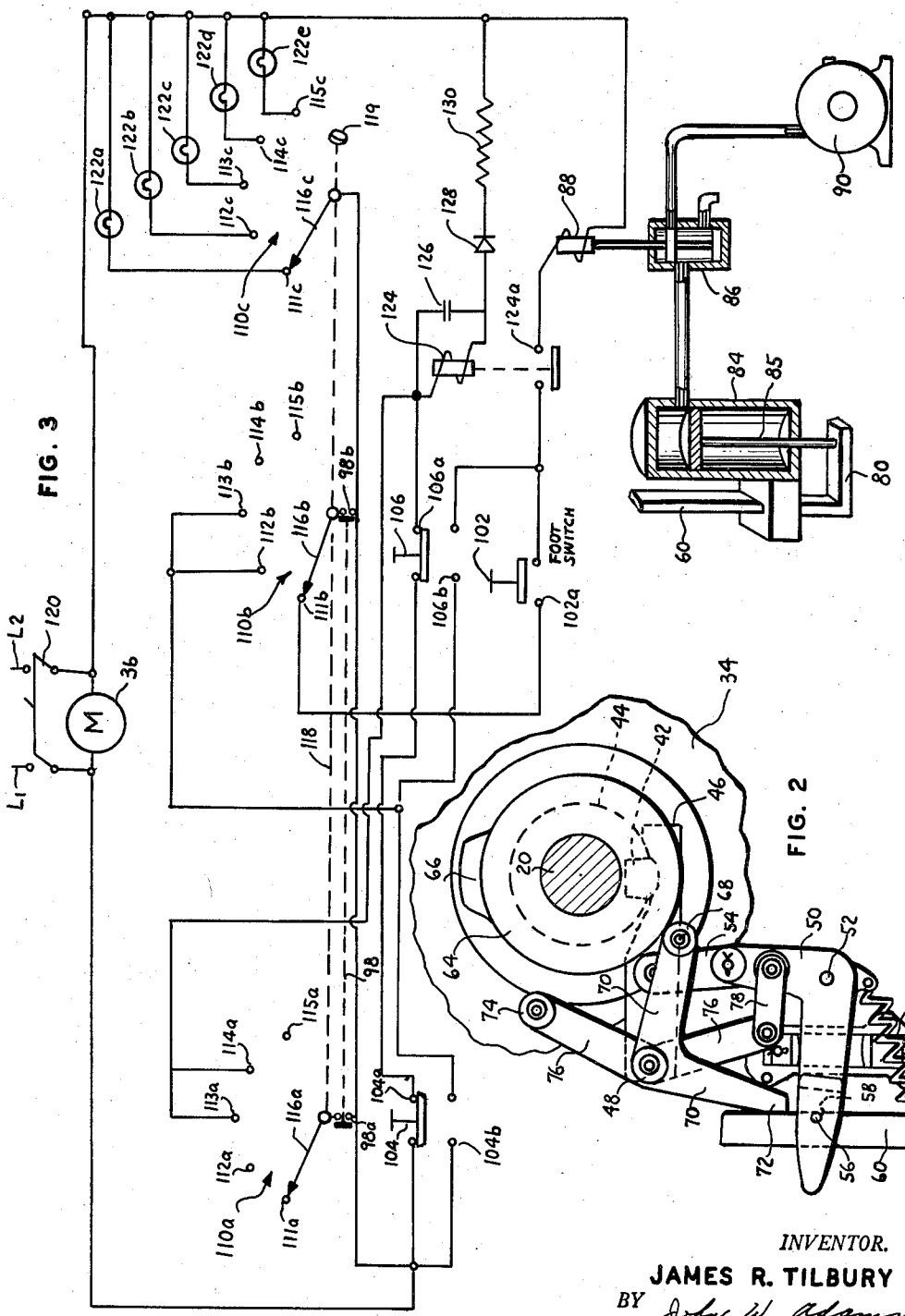


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TIME DELAY SAFETY INTERLOCK FOR MACHINES

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TIME DELAY SAFETY INTERLOCK FOR MACHINES

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6 Claims. (Cl. 192—131)

This invention relates generally to protective equipment for machinery, and pertains more particularly to a time delay safety interlock which may be selectively manipulated into the particular position best suiting the operating conditions expected to be encountered.

In the present day operation of punch presses, paper shears, plastic molders and the like, it has become almost mandatory that adequate safeguards be adopted for the proper protection of operating personnel. Both the character and degree of safety needed will vary from machine to machine and from job to job. Accordingly, the invention has for one object the provision of a safety interlock system that can be readily adjusted for conditions at hand. More specifically, it is an aim of the present invention to provide a control that is accessible to only qualified supervisory personnel and in which the desired goals cannot be readily circumvented by the operator of the machine. In other words the system forming the subject matter of this invention is intended to safeguard the operator and is designed to do so in a highly effective and versatile manner even though the nature of the demands thereon may vary rather widely.

Another object of the invention is to provide a system of the foregoing character that will be comparatively inexpensive to manufacture and which is not apt to get out of order readily.

Yet another object is to provide a safety interlock for machines that will be exceptionally reliable and which possesses certain inherent "fail safe" features.

A still further object is to provide an interlock system that may be quickly installed on a variety of different type of machines and which lends itself well to association with existing mechanical safety devices.

Other objects will be in part obvious and in part pointed out more in detail hereinafter.

The invention accordingly consists in the features of construction, combination of elements and arrangement of parts which will be exemplified in the construction hereafter set forth and the scope of the application which will be indicated in the appended claims.

In the drawings:

FIGURE 1 is a perspective view of a clutch operated press serving as a general illustration of one type of machine where my interlock system will find utility;

FIGURE 2 is a sectional view taken in the direction of line 2—2 of FIGURE 1 in order to show to better advantage a typical trip clutch mechanism which can also be used with presses equipped with my interlock arrangement, and

FIGURE 3 is a schematic view depicting generally the circuitry utilized in the practicing of the invention, but including portions of the machine exemplified in FIGURE 1 so that the viewer may better orient the electrical features with the mechanical details.

Referring now in detail to FIGURE 1, a conventional press has been denoted in its entirety by the reference numeral 10. Actually the specific details of the press 10 are not important to an understanding of the invention, especially since my time delay safety interlock may be employed with presses of different types and for that matter with other classes of machines where an electric control of the contemplated character may be desirable. However, to illustrate the utility and versatility possessed

by the electrical control subsequently to be described, it will be advantageous at this time to point out that the press structure includes legs 12 and a generally C-shaped, centrally divided frame 14. The upper end of the frame 14 is provided with a pair of bearings at 16, 18 which journal a crankshaft 20. Encircling the crankshaft eccentric is a throw 22 attached to a connecting rod 24 which in turn carries a ram 26. The ram 26, of course, cooperates with a bolster plate 28 anchored to the bed 30 of the press 10 the ram traversing a reciprocal path denoted by the double-headed arrow 32.

Free to rotate on one end of the crankshaft 20 is a flywheel 34. The flywheel 34 is driven by an electric motor 36 via a belt 38 entrained about the periphery of the flywheel 34 and a pulley 40 on the motor 36.

To effect engagement of the crankshaft 20 with the flywheel 34 a pin clutch mechanism is utilized, parts of which appear in both FIGURES 1 and 2. Accordingly, the flywheel 34, or a strike plate associated therewith, is provided with one or more holes or notches for the reception of one end of a clutch pin or bolt 42 slidably carried in a drive collar 44 affixed to the crankshaft 20. As is usual, the clutch bolt 42 is spring biased toward engagement with the flywheel 34, but is normally maintained in a retracted position by a clutch finger 46 provided on pin 48. For the purpose of disengaging the clutch finger 46 from the latch bolt 42, there is a bell crank 50 pivotally carried on a pin 52, the bell crank being articulatively connected to the clutch finger 46 via a link 54.

A latch pin 56 is carried by the other arm of the bell crank 50 and is engageable in a notch 58 at the upper end of an actuating bar 60. The role played by the bar 60 will be dealt with in more detail hereinafter when describing the manner in which it is moved downwardly to effect a release of the clutch bolt 42. A coil spring 62 normally pulls the upper end of the bar 60 against the pin 56 to maintain engagement thereof.

A cam ring 64, which may be a part of the collar 44, is attached to the crankshaft 20 so as to rotate in unison with said collar 44. Mounted on this ring 64 is a cam 66 for engaging a roller 68 at one end of the bell crank 70 pivotally carried on the previously mentioned pin 48, the other end 72 being disposed so as to kick the bar 60 out of its latched relationship with the pin 56. This allows finger 46 to return to its pictured position and thereby cause retraction of the clutch bolt 42. To assure return of the finger 46 to its depicted position, even if spring 62 should break, positive return of the finger 46 is assured by reason of a roller 74 mounted at the upper end of an obtuse bell crank 76 also pivotally supported on the pin 48. Through the agency of a horizontal link 78 connected to the lower end of the bell crank 76, it will be seen that if the roller 74 is struck by the cam 66, the bell crank 76 is rocked in a direction to force the finger 46 upwardly and thereby cause retraction of the clutch bolt 42.

The manner in which the actuating bar 60 is pulled downwardly to disengage the clutch finger 46 from the spring biased bolt 42 will now be described. From FIGURES 1 and 3 it will be perceived that the lower end of the bar 60 is provided with a laterally extending portion 80, thereby imparting an L-shaped configuration to the actuating bar. The bar 60 is constrained for vertical sliding motion by a suitable guide at 82.

Through the agency of an operating cylinder 84 having a piston rod 85 therein, with its projecting end aligned with the laterally extending portion 80, the bar 60 can be forced downwardly when compressed air is admitted to the upper end of the cylinder 84. The air fed to the cylinder 84 is controlled by a solenoid valve having a valve portion 86 and a solenoid portion 88. The valve 86

may receive air under pressure from a suitable source such as a compressor **90**.

Before describing the circuitry constituting my time delay safety interlock, reference will be made to a detachable guard **92** unit comprising a U-shaped frame **94** and a plurality of vertical rods or fingers **96**. One end of the frame **94** is engageable with a guard switch **98** fixedly mounted to a bracket **100** projecting from the visible side of the frame **14**, there being a similar bracket **100** on the other or concealed side of said frame.

Also, it is contemplated that a foot switch **102** be associated with the press **10**. Still further, a pair of hand switches **104**, **106** are attached on either side of the press. Attention is also directed to a control box **108** attached to the right side of the press structure **10**, as can be seen in FIGURE 1. The parts played by these various switches and the control box will become clearer during the succeeding description of the circuitry displayed in FIGURE 3.

Referring now to FIGURE 3 where my time delay safety interlock is diagrammed, it will first be explained that the control box **108** contains several selector switch levels which are mechanically ganged together for operation in unison. As schematically presented a selector switch unit **110** has been illustrated including three switch levels generally indicated by the reference numerals **110***a*, **110***b* and **110***c*, each level having five stationary contacts **111**, **112**, **113**, **114** and **115** and a rotatable switch arm **116** for selectively engaging each set of said contacts. In the drawing these contacts and arms have been distinguished from each other by the suffix *a*, *b* and *c* in accordance with the use of these letters for indicating the switch levels **110***a*, **110***b* and **110***c*. The switch arms **116***a*, **116***b* and **116***c* may be mechanically coupled together by a shaft **118** denoted by a succession of horizontal dashes. A manipulating knob **119** permits the shaft **118** to be rotated into a desired angular position.

Alternating current is supplied to the switch levels **110***a*, **110***b* and **110***c* via power lines L_1 and L_2 and a double pole switch **120**, this same switch furnishing power to the previously mentioned flywheel motor **36**. Thus, when the switch **120** is closed, a potential is immediately applied to each switch arm **116***a*, **116***b* and **116***c*.

It will be pointed out at this time that a plurality of indicating lamps **122***a*, **122***b*, **122***c*, **122***d* and **122***e* are connected to the various contacts **111***c*, **112***c*, **113***c*, **114***c* and **115***c* of the switch level **110***c*. These lamps are contained in the control box along with the switch unit **110**. The lamps of course signify the particular position in which the switch arms **116***a*, **116***b* and **116***c* have been placed, it being remembered that these switch arms are operated in unison by the shaft **118** through the agency of the knob **119**. What happens at each switch setting will become clearer as the description progresses. However, it will be manifest that the lamps **122** provide a visual indication of the relative position of the switch arms **116** whenever my system is in operation.

At this time attention is drawn to the fact that the hand switches **104**, **106** have an inactuated position in which their respective contacts **104***a* and **106***a* are bridged and an actuated position in which their contacts **104***b* and **106***b* are bridged. In other words the contacts **104***a*, **106***a* are normally closed, whereas contacts **104***b*, **106***b* are normally open.

In series with the contacts **104***a*, **106***a* is a relay **124** equipped with normally open contacts **124***a* which are in turn in series with the solenoid **88** operatively associated to the valve **86**. The relay **124** is of the slow release or slow drop out variety by reason of a capacitor **126** shunting same. Through the medium of a diode **128** the power to the relay **124** is rectified so that a D.-C. potential is applied thereacross. The circuit through the diode is completed to line L_2 through a limiting resistor **130**.

Reference has already been made to the guard switch. It will be seen from FIGURE 3 that this switch **98** is provided with two sets of contacts **98***a* and **98***b*, both of which are closed when the guard **92** is in place on the press **10**. From the circuit diagram it will be observed that the contacts **98***a* are connected to switch arm **116***a* of the switch level **110***a* and to L_1, and that when the switch **98** is closed an electrical path is established directly to the relay **124** if switch arm **116***a* is on contacts **113***a* or **114***a*. The other contacts **98***b*, however, are connected to the contact arm **116***b* of switch level **110***b* as well as to L_1.

Having in mind the mechanical construction pictured in FIGURES 1 and 2 and the circuit arrangement depicted in FIGURE 3, it is believed that a complete understanding of my invention may now be had from a typical description of its operation. Since the switch arms **116***a*, **116***b* and **116***c* have been illustrated in engagement with contacts **111***a*, **111***b* and **111***c*, respectively, this switch positioning will serve as a starting point for the operational description. Such a switch positioning is designed for "Foot" operation, because with the line switch **120** closed and the motor **36** running, electric power is immediately supplied to the relay **124** by way of the normally closed contacts **104***a* and **106***a* of the hand switches **104** and **106**. It will be appreciated that no hand actuation of these switches **104**, **106** is intended when the foot switch **102** is to be used.

With power supplied to the relay via the contacts **104***a* and **106***a*, as above outlined, this relay picks up owing to the continued electrical path furnished by the diode **128** and resistor **130**. Such action closes the contacts **124***a*, thereby conditioning the solenoid **88** for operation when the foot switch **102** is closed.

Closure of the switch **102** completes a circuit from line L_1 through guard switch contacts **98***b*, the switch arm **116***b*, the contacts **102***a*, the contacts **124***a* and the solenoid **88** to line L_2. Operation of the solenoid **88** opens the valve **86** to admit air to the cylinder **84**, thus causing piston **85** to move downwardly carrying with it the actuating bar **60**.

Without going into considerable detail, especially since some description has already been given regarding the clutch mechanism, it will be seen that the clutch finger **46** (FIGURE 2) will be forced downwardly to permit the clutch bolt **42** to advance under its spring bias into engagement with the flywheel **34**. This of course causes rotation of the crankshaft **20** and the ram **26** moves downwardly to effect the desired fabrication.

Even though the operator may keep the foot switch **102** closed, the cam **66** will thereafter strike the roller **74** so as to move the bell crank **76** counter-clockwise as viewed in FIGURE 2 to cause the bell crank **50** to withdraw its pin **56** from the notch **58** on the bar **60**. Concomitantly with this happening is the return of the clutch finger **46** to its depicted position with the consequence that the clutch bolt **42** is retracted from the flywheel **34**. If automatic or continuous reciprocation of the ram **26** is desired, the cam **66** can be removed as with subsequently to be described automatic types of operation.

Inasmuch as the lamp **122***a* is in circuit with the contact **111***c* of the switch level **110***c* during the foregoing sequence of events, it will be understood that this lamp **122***a* is the only lamp energized at the moment. In this way a tell-tale indication is provided, it being planned that the control box **108** be provided with a suitable legend indicating that the switch unit **110** housed therewithin has been positioned for "Foot" operation.

It will be now assumed that the switch arms **116***a*, **116***b* and **116***c* have been rotated by the knob **119** into respective engagement with contacts **112***a*, **112***b* and **112***c*. Owing to the fact that contact **112***b* is in circuit with contacts **98***b* of the guard switch **98**, it is imperative that the guard **92** be installed so that said contacts **98***b* will be closed. This type of operation will be termed "Right hand non-automatic" operation.

What occurs with this switch setting is that the relay

124 will be energized via the contacts 104*a* and 106*a* just as with the above-described "Foot" operation. The hand switch 104, that is, the switch normally actuated by the operator's left hand and contact 104*b*, is effectively by-passed or shunted through contacts 98*b*, the switch arm 116*b* and contact 112*b*. The contacts 98*b* must be closed by the guard 92 being in place.

This conditions the circuitry of FIGURE 3 so that only the switch 106 need be actuated. Separation of the contacts 106*a* immediately interrupts the circuit to the relay 124, but due to its slow drop out characteristic derived from the action of the capacitor 126, the relay contacts 124*a* remain momentarily closed. Continued actuation of the hand switch 106 quickly closes the contacts 106*b* whereby current can now flow through these contacts 106*b* via the aforenoted path which includes guard switch contacts 98*b*, the switch arm 116*b*, and contact 112*b*. The delay provided by the capacitor 126 is purposely of such short time duration that the operator will not have time to shift his hand from the switch 106 to a point beneath the ram 26 without the relay 124 dropping out. It will be appreciated that the relay contacts 124*a* must close in order to energize the solenoid 88 to open the valve 86, all as described in conjunction with the "Foot" operation given hereinbefore. Inasmuch as the capacitor 126 will soon discharge to a level where the relay 124 will not be held in a picked up condition, the relay contacts 124*a* will quickly open so that the solenoid 88 will not become energized. Thus, only one downward stroke of the ram 26 will occur. The occurrence of only one ram stroke is doubly assured if the cam 66 is employed. Since the switch arm 116*c* during the "Right hand non-automatic" is in engagement with contact 112*c*, it will be appreciated that lamp 122*b* is lighted during this phase.

Assuming now that the switch arms 116*a*, 116*b* and 116*c* are advanced to the contacts 113*a*, 113*b* and 113*c* respectively, of the switch unit 110, what will be called "Right hand automatic" operation is made possible. Since contacts 112*b* and 113*b* of the switch level 110*b* are in effect commoned, contacts 98*b* are again included in the circuit. Additionally, though, contacts 98*a* are included because these contacts are connected to contact 113*a* of switch level 110*a*. Therefore, unlike the "Right hand non-automatic" operation we now have established a conductive path through the switch arm 116*a* and the contacts 98*a* where the relay 124 will remain energized. Under this "Right hand automatic" scheme, it is only necessary to actuate the right hand switch 106 at any time, and the solenoid 88 will thereby be energized through contacts 98*b*, switch arm 116*b*, contact 113*b*, contacts 106*b* and contacts 124*a*. Furthermore, continued depression or actuation of the switch 106 will cause the ram 26 to reciprocate in a repeated or continuous fashion if cam 66 has been removed.

During the "Right hand automatic" operation, the lamp 122*c* will be energized, thereby signifying the type of operation that has been selected.

Next to be dealt with is what will be termed "Two hand automatic" operation. In this instance, the switch arms 116*a*, 116*b* and 116*c* are engaged with the contacts 114*a*, 114*b* and 114*c*, respectively. The relay 124 will remain picked up if guard switch contacts 98*a* are closed, as in the "Right hand automatic" operation. We now have a situation where both hand switches 104 and 106 must be actuated before a circuit is completed to the solenoid 88. The only electrical route possible is through the contacts 104*b* and 106*b*, which of course are bridged when both switches 104 and 106 are actuated. Otherwise, the operation is the same as with the one hand operation described immediately above. Because the switch arm 116*c* is at this time in engagement with contact 114*c* lamp 122*d* is energized.

A fifth type of operation is envisaged which will be referred to as "Two hand non-automatic" operation. The guard switch 98 is not at this time utilized. It is not needed because if either hand is removed from the switches 104 and 106 once their actuation has been initiated, the relay 124 will release before an opportunity is had for the operator to move his hand sufficiently so as to place it within the danger zone.

Assuming, though, that the operator follows through with his intended complete actuation of the hand switches 104, 106, then an electrical circuit is established through the contacts 104*b*, 106*b* and 124*a* to the solenoid 88 with the result that the valve 86 is opened and air is thus admitted to the operating cylinder 84.

However, only one stroke of the ram 26 has a chance to occur if things are functioning according to plan, for actuation of the hand switches 104, 106 breaks the circuit to the relay 124 since the contacts 104*a*, 106*a* open under these circumstances. Because the switch arm 116*c* is during this period engaged with the contact 115*c*, the lamp 122*e* will be energized to indicate the type of controlled operation that may take place.

To sum up the types of operation possible with my time delay safety interlock they are at this time repeated below in the order they have been presented:

(1) Foot
(2) Right hand non-automatic
(3) Right hand automatic
(4) Two hand automatic
(5) Two hand non-automatic

It will of course be appreciated that the control box 108 will normally be kept locked, thereby preventing unauthorized access to the switch unit 110 enclosed therewithin. In this way the machine equipped with my system of safety interlocking may be set by responsible and informed supervisory personnel for the type of operation that will afford the maximum degree of protection for the particular work performing operation to be undertaken.

As many changes could be made in the above construction and many apparently widely different embodiments of the invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the language used in the following claims is intended to cover all of the generic and specific features of the invention herein described and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

What is claimed:

1. A time delay safety interlock system for machines comprising a slow release relay having normally open contacts for conditioning operation of the machine with which the interlock system is associated when said relay has been energized to close said contacts, a pair of hand switches each provided with normally closed contacts in series circuit with said relay via which energization thereof may be effected and also provided with normally open contacts in series circuit with said relay contacts for providing electric power when closed to said relay contacts to then effect operation of said machine, and including switch means for selectively by-passing the normally closed contacts of said hand switches to provide two hand automatic operation of said machine.

2. A time delay safety interlock system for machines comprising a slow release relay having normally open contacts for conditioning operation of the machine with which the interlock system is associated when said relay has been energized to close said contacts, a pair of hand switches each provided with normally closed contacts in series circuit with said relay via which energization thereof may be effected and also provided with normally open contacts in series circuit with said relay contacts for providing elec-

tric power when closed to said relay contacts to then effect operation of said machine, switch means for selectively by-passing the normally open contacts of one of said hand switches to provide one hand operation of said machine, and switch means for selectively by-passing the normally closed contacts of said hand switches to provide two hand automatic operation of said machine when the switch means for by-passing the normally open contacts of said one of said hand switches is not utilized and to provide one hand automatic operation when said switch means for by-passing the normally open contacts of said hand switches is utilized.

3. A time delay safety interlock system for machines comprising a slow release relay having normally open contacts for conditioning operation of the machine with which the interlock system is associated when said relay has been energized to close said contacts, a pair of hand switches each provided with normally closed contacts in series circuit with said relay via which energization thereof may be effected and also provided with normally open contacts in series circuit with said relay contacts for providing electric power when closed to said relay contacts to then effect operation of said machine, selective switch means for selectively by-passing the normally open contacts of one of said hand switches to provide one hand operation of said machine, and guard actuated contacts in series with said selective switch means, said guard actuated contacts requiring closing in order to accomplish the by-passing of the normally open contacts of said hand switches.

4. A time delay safety interlock system in accordance with claim 2 including guard actuated contacts in series with the respective switch means which selectively by-pass the normally closed contacts of said hand switches, said guard contacts requiring closing in order to accomplish the by-passing of the normally closed contacts of said hand switches.

5. A time delay safety interlock system for machines comprising a relay having normally open contacts for conditioning operation of the machine with which the interlock system is associated when said relay has been energized to close said contacts, a capacitor shunting said relay to impart a slow drop out characteristic thereto, means for impressing a D.-C. potential across said relay, a pair of hand switches having normally closed contacts in circuit with said relay and said D.-C. potential means and normally open contacts in circuit with the normally open contacts of said relay, a guard switch having first and second sets of normally open contacts both of which sets are closed when a guard device has been properly positioned on said machine, a foot switch having normally open contacts, selector switch means having a first contact position for connecting the contacts of said foot switch in parallel with the normally open contacts of said hand switches, said selector switch means having a second contact position for by-passing the normally open contacts of one of said hand switches, said selector switch means having a third contact position for by-passing the normally open contacts of said one hand switch and also for causing energization of said relay, said selector switch means having a fourth contact position for causing energization of said relay, and said selector switch means having a fifth position in which no by-passing occurs and in which said relay remains de-energized, said first and second guard contacts being arranged in series with said selector means.

6. A time delay safety interlock system in accordance with claim 5 including a lamp for each of said five positions and said selector switch means including respective contact means for each of said five positions for energizing each lamp in accordance with the particular position of said selector switch means.

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