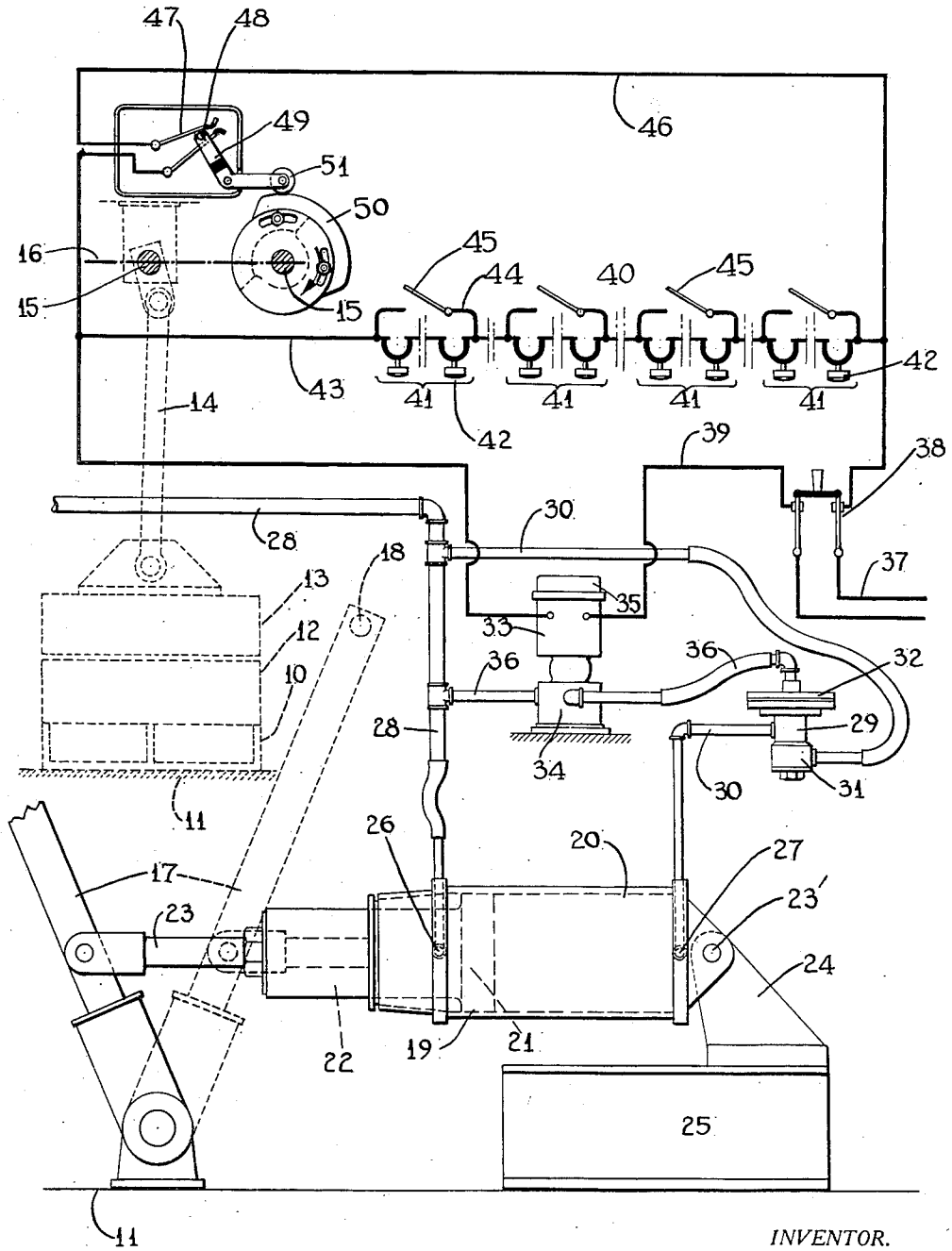
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DIE PRESS SAFETY SYSTEM

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DIE PRESS SAFETY SYSTEM

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The system and method of control of presses of my invention has especial application to die presses. In the art of die presses, accidents to the hands and limbs of operatives very frequently occur. The hands or limbs are caught between dies or other parts of the machine on its down stroke. In continuously operating presses this is occasioned mainly in instances where the operative does not remove his hands quickly enough in the act of feeding and otherwise attending the press. In intermittently operating presses hand started, and particularly those in connection with which there are employed a number of operatives, the press is sometimes started by one of the operators before another has completed the attention he is giving the work on the machine. But while it is the special aim of this invention to relieve these conditions and assure safety to the operatives of such presses, my invention has a wider scope still in its possible applicability to any machines having working cycles and parts which analogously endanger the limbs of their operatives.

Numerous systems and methods have heretofore been proposed to remedy these conditions. None of them, so far as I am aware, have been completely effective. Some have been mechanical and some electrical. The most common in intermittently operating presses has been the location of the control lever or control button of the electrical control circuit at a distance so remote from the dies as to require the operator to remove his hands or himself from each of the dies in order to reach the control.

Another device has been that of duplex control in which two control elements have been provided, one for operation by each hand of an operative, whereby neither hand is available during control of the press for engagement with the machine or the work.

Yet with these and other safeguards, accidents have continued due, among others, to situations like the following. Power control devices of the presses at times stopped in the "on" position, thereby continuing operation of the press expected by the operative to terminate at the end of the stroke. Operatives, sometimes carelessly and sometimes in an endeavor to save time, operated dual control devices, both by one hand, and at the other times blocked off one of the controls to avoid the necessity of using both. The two operatives, once the press was started, if the control system was such as to permit it to continue, removed their hands from the control devices and gave attention to work on the machine before the completion of the down stroke, while there was still danger that the hands projected between the dies or other parts of the machine the same might result in injury. As a general rule, control once instituted has been automatic for the completion of at least one full stroke of the machine, and with control handles or push buttons, as the case may be, the same might readily be released after initial actuation. This operation has been favored because it permitted, more leisurely, picking up and presenting of the work for the succeeding operation. The objects of my invention have especially to do with the meeting of these situations.

More general objects of my invention are the attainment of a perfect safety system in which not only the special situation is met, but each and every other situation of danger to the operative is eliminated, the efficient combination of manual control by the operative and automatic control by the press, and the achievement of an efficient, simple and inexpensive safety system for large power presses embodying servomotor control of the power cut on and cut off devices.

The single figure of the drawing is a diagrammatic showing of the system, some parts being represented schematically, and others in elevation consequently the dimensions of the various parts in the drawing are disproportionate to their true dimensions.

In this showing the press and the dies are subordinated to the enlargement and clarification of the general diagram of the system. For the most part, the press is indicated in dotted lines. 10 is its bed located on foundation 11, 12 and 13 are the lower and upper dies, respectively, 14 the connecting rods, 15 the crank shaft, and 16 the axis of the crank shaft. A power cut on and cut off device is diagrammatically represented by the showing of the pivoted lever 17 of the form usually employed to actuate the power cut on and cut off device. The lever is usually pivoted to the frame of the press or its foundation 11 and provided at its upper end with pull handle 18, by means of which it may be oscillated from the dotted line off position to the full line on position.

According to my system I provide a servomotor 19 to actuate this lever. This is a fluid pressure servomotor comprising a cylinder 20 containing piston 21 having an enlarged piston rod 22 projecting forwardly and provided with a reduced end 23 pivotally connected with the lever 17. The opposite end of the cylinder 20 is pivotally connected at 23', to a bracket 24' on the base block 25 mounted on the foundation 11 or some part of the press.

The particular fluid pressure motor disclosed is a compressed air motor. It is provided with ports 26 and 27 at its front and rear ends, before and behind the piston 21. Each is connected to the source of compressed air supply 28. Port 26 is directly connected thereto, whereby the front of the piston 21 is normally exposed to fluid pressure and the piston biased therefore rearwardly,

thereby biasing control lever 17 of the power cut on and cut off device to its rearward dotted line off position. The rear port 27 is indirectly connected to the source 28 through a fluid pressure relay valve 29 by way of a conduit 30 including the valve. The details of this valve are not shown. Suffice it to say that it comprises a valve per se 31 which when opened, admits fluid pressure to the rear of piston 21, and which, when closed, cuts fluid pressure therefrom and exhausts the rear end of cylinder 21 to atmosphere. It is of a well known type. The valve 31 is actuated by diaphragm motor 32.

Motor 32 receives its fluid pressure under control of an electro-pneumatic valve 33 comprising a valve per se, 34 and an electro-magnet 35. When the electro-magnet 35 is energized, valve 34 is opened to admit fluid pressure by way of conduit 36 connecting it to the diaphragm motor 32 and when magnet 35 is de-energized, valve 34 closes off the motor 32 from the source 28 and opens motor 32 to atmosphere, thereby closing valve 31.

Circuit of electro-magnet 35 is controlled from a source of electric power 37 as applied through line switch 38 over conductors 39. Two control means are provided. One 40 is manual. It comprises a plurality of pairs 41 of push buttons 42 arranged individually in series in a circuit 43 adapted to complete the connection of electro-magnet 35 to source 37 by way of conductor 39. The contacts of each pair are spread so far apart that they cannot be spanned by one hand, but require to be reached one by each hand in order simultaneously to operate them. Moreover, they are placed at points requiring the removal of hands and limbs of the operator beyond all danger regions of the dies and other parts of the press to be avoided by the operator in the working stroke. Each pair 41 of contacts 42 is provided with a by-pass 44 which is normally opened but is adapted to be closed on special occasions by switch 45, thus cutting out the pair and permitting the series circuit 43, 39 to be completed without the particular pair or pairs cut out. This is to provide for cases of variation of the number of operatives, since each pair of contacts 41 provides for control by one operative, and it is required that a pair be provided for each operative to secure safety for all as well as for each.

The other of the means for completing the connection of the control electro-magnet 35 to the source of power 37 is a circuit 46 in parallel to the circuit 43 of the pairs of contacts 41 in series. Circuit 46 is normally opened at spring contacts 47, but is adapted to be closed by the projection of pin 48 between the adjacent ends of contacts 47. Pin 48 is a pin of conducting material carried at the end of and insulated from the body of a bell crank lever 49. This lever is actuated by a cam 50 mounted upon and angularly adjustable about the axis 16 of the main crank shaft 15 of the press. Follower 51 on the opposite end of lever 49 from the pin 48 rides on cam 50 and as the main crank shaft 15 of the press revolves, rides onto and off of cam 50 to open and close the circuit 46. The angular adjustment of cam 50 asures that circuit 46 is open substantially at the extreme upper end of the upward stroke of the press, remains open as follower 51 rides on cam 50 during substantially the entire down stroke of the press, and as the press moves into the extreme of its down stroke, the follower 51 rides off of cam 50 and closes circuit 46 in parallel with and independently of the push bottons 42 of the pairs 41.

To operate the system one closes the switch 38 while the press is idle and the crank shaft substantially at the extreme of its upward stroke, substantially 180° from the position shown. Each operative, as he finishes his attention to the work on the machine, removes both hands from the work and assumes a body position enabling him to reach both buttons 42 of the pair 41 assigned to him. By reason of the electrical control, the buttons may be arranged at any points on or near the machine most convenient for the efficient movement of the particular operative to whom assigned. Each operative presses down the buttons assigned to him. When the last of the operatives has so pressed the buttons 42 assigned to him, and not until the last has so pressed them, can the circuit 39, 43 of electro-magnet 35 be completed. The instant it is completed, valve 34 is opened, throwing fluid pressure from source 28 by conduit 36 upon diaphragm motor 32 and opening valve 31, thereby throwing fluid pressure by conduit 30 upon the rear of the piston 21 to servo-motor 20. Immediately the piston 21 is operated to the full line position shown the press starts its downward stroke toward the dotted line position shown.

At no time until the press reaches substantially the lower extreme of its downward movement, and the dies or other parts of the presses are so close together as to preclude placement of hands or limbs between them, can any hand of any operator be removed from his push button 42 without stopping the press. The press control circuit 46 continues open at contacts 47 until the dies or other parts 12, 13 are so close together as to preclude the entry of the hands or limbs of an operator between. When they have reached a position so close together, however, pin 48 electrically connects contacts 47 and the press control circuit 46 supplants the operatives control circuit 39, 43, whereupon the operatives may freely release their hold on push buttons 42 and the press will continue to the end of its downward stroke and to the end of its upward stroke without further attention from the operator. During this portion of the cycle, cam follower 51 has rolled off of the cam 50 and remains off until the press reaches the extreme of its upward stroke. At this instant it rolls again onto the cam 50, contacts 47 are electrically separated, magnet 35 is de-energized, and valve 31 is opened to exhaust fluid pressure from motor 20 and throw the lever 17 from the full line on position to the dotted line off position. Through the adjustment of cam 50 in angular position and in angular extent, either by changing cams or by using duplex cam members which can be angularly adjusted relatively, as is well known to change the length of operation of the cam, the closure and opening of contacts 47 may be adjusted with respect to the end of the downward and the end of the upward stroke with great nicety.

Thus are the ends and aims of my invention achieved.

It has been found that there is ample time during the upstroke for operatives to move new work toward the press and to feed it in without undue loss of time between press strokes. The rate of operation of presses with this system installed is quite as high as that of presses in which it has not been installed, and workmen are free to move work toward the press after the danger

period of approach to the approaching parts of the machine has passed.

If at any time electric power goes off, by reason of the normal bias of piston 21 towards the off position by the connection of its front end to the source of fluid pressure 28, the press is stopped immediately. It can only be started again by manual operation. Such connection to fluid pressure also eliminates necessity for powerful springs and attendant wear and possible breakage, or the need for double action fluid pressure control.

The generic spirit of the invention should govern the scope of its claims independently of the circumstantial terminology used therein, in view of the substantial contribution over the prior art and the unavoidable evolution of modification and improvement.

What I claim is:

1. A safety system for power presses comprising a fluid actuated servo motor biased to inactive position, a differential pressure arrangement to actuate said motor, electrical means arranged to initiate said pressure means, a plurality of spaced switches in series circuit, arranged to energize said means, and a lock-in circuit arranged to maintain said electrical means energized during the extreme approach motion of the dies and during the retrograde motion of the dies only and independently of said manual means.

2. A safety system for power presses comprising a fluid actuated servo motor biased to inactive position, a differential pressure arrangement to actuate said motor, electrical means arranged to initiate said pressure means, a plurality of spaced switches in series circuit, arranged to energize said means, and a lock-in circuit arranged to maintain said electrical means energized during the extreme approach motion of the dies and during the retrograde motion of the dies only, said lock-in circuit only becoming operative due to the continued simultaneous actuation of said series switches throughout the approach die movement up to their extreme approach motion.

3. A safety system for presses comprising a pneumatically operated power control device, electrical means to control said device and parallel control circuits for said means, one of said circuits including a plurality of spaced switches in series circuit arranged to initiate said means upon simultaneous actuation thereof and to continue the energization thereof during the major approach motion of said press upon said continued actuation thereof, said other circuit comprising a master circuit to continue the press cycle of operation independently of said first named circuit during the extreme approach and retrograde motions only of said press.

4. In combination, a machine including elements for operation on an object, means controlling operation thereof, a fluid source, a fluid responsive motor connected to the control means and having large and small pressure faces operating the control means and, respectively, actuating and stopping the machine, a fluid responsive valve, the small pressure face being constantly connected to the fluid source and the large face being connected to the source through said valve, a conduit including an electro-responsive valve connecting the fluid source to means controlling the first valve, a source of electromotive force, a plurality of pairs of switches in series circuit relation between the electro-responsive valve and the electromotive source, each pair being inaccessible to an operator of another and the switches of each pair requiring operation by the separate hands of its operator, a circuit including a switch shunting the pairs, and means controlled by the machine for closing the shunt switch to operate the machine during a final portion of the approach, and during all of the separating, movement of the machine elements.

5. In combination, a machine including elements for operation on an object, means controlling operation thereof, energy source means, a motor connected to the control means and including high and low energy receiving portions operating the control means and, respectively, actuating and stopping the machine, a valve or the like, the low energy portion being constantly connected to the energy source means and the high energy portion being connected to the source through said valve, means including a valve or the like connecting the energy source means to means controlling the first valve, a plurality of pairs of switches or the like in series relation between said second valve and the energy source means, each pair being inaccessible to an operator of another and the switches of each pair requiring operation by the separate hands of its operator, means including a switch or the like shunting the pairs, and means controlled by the machine for closing the shunt switch to operate the machine during a final portion of the approach, and during all of the separating, movement of the machine elements.

6. In combination, in a machine including members relatively reciprocable by a substantial distance for working on objects requiring placement, and removal from, between the members by a plurality of operators stationed at different positions, actuating means for the elements, control means for the actuating means biased toward inoperative position, and governing means for the biasing means including a plurality of pairs of interdependent handles corresponding to the number of operators and each spaced from the machine beyond the reach of an operator stationed to handle the object, each pair of handles being disposed at a position normally inaccessible to an operator at another and the handles of each pair being normally spaced to require manipulation by the respective hands of its operator, and means controlled by the machine for rendering the handles ineffective and controlling the actuating means to operate the machine independently of the handles during a final portion of the approach, and during a portion of the separating movement of the said machine members relative to the object.

7. A safety system for presses comprising a power cut on and cut off device of the press, and parallel control devices for said power cut on and cut off device, one manual and the other automatic, the latter being under control of the press in its upward stroke substantially at the extreme upper end of said stroke only, and on the downward stroke of the press being under control thereof during substantially the entire downward stroke, said manual means requiring a plurality of pairs of hands for operation.

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