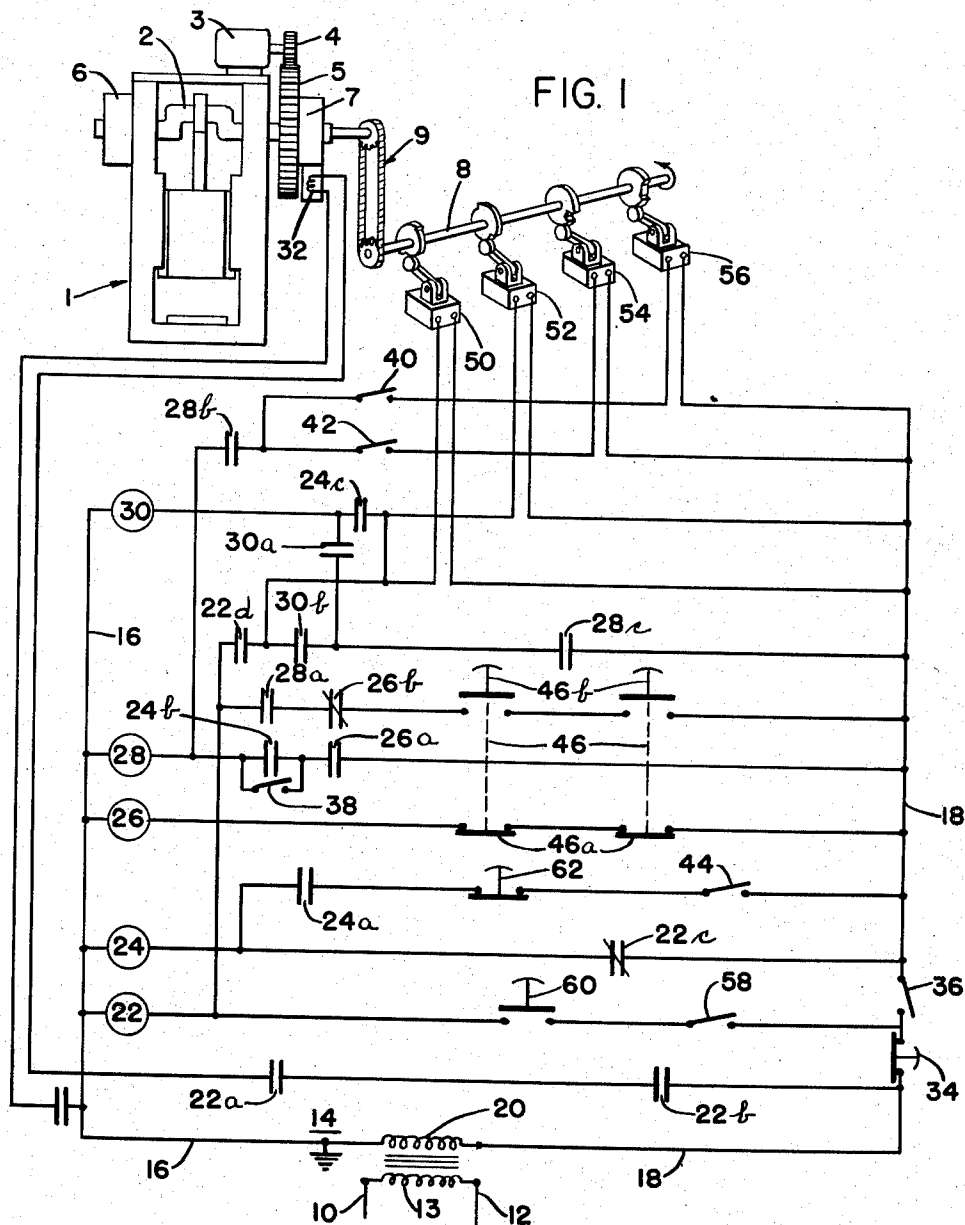
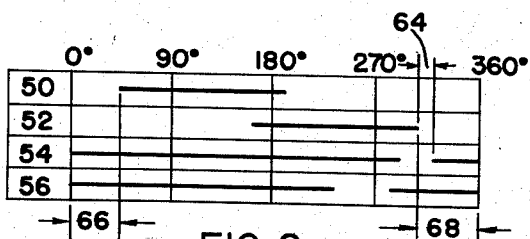


May 12, 1959

R. W. HADLEY
PRESS CONTROL CIRCUIT

2,886,155

Filed Nov. 5, 1956



INVENTOR.
ROBERT W. HADLEY
BY
William E. Tilley
ATTORNEYS

1

2

2,886,155

PRESS CONTROL CIRCUIT

Robert W. Hadley, Toledo, Ohio, assignor to E. W. Bliss Company, Canton, Ohio, a corporation of Delaware

Application November 5, 1956, Serial No. 620,349

3 Claims. (Cl. 192—142)

This invention relates to controls for use with power presses and more particularly to press control circuits incorporating safety features to protect press operators.

The operation of industrial presses frequently presents dangerous conditions wherein workmen may be severely injured. Many serious injuries result when an operator places a hand or arm in the die space of the press after the slide has started on its downstroke. In order to prevent injury it has been the practice to provide a plurality of run or starting switches, the exact number depending upon the number of press operators, so connected that all of them must be closed before the press is started. These run switches are so placed that the operators must use both hands to actuate them, thereby insuring that the operator does not have a hand free to place inside the die space when the slide is moving downward.

Inasmuch as a certain period of time is required for the press slide to reach the bottom of its stroke, the run switches must be held closed for a portion of this period. If any of the switches are prematurely released at a time when the operator can still reach inside the die space as the slide is moving downward, the press slide will stop instantly. Such a hold down feature is standard equipment for single stroke operation of presses, that is, the operation wherein the press is brought to a complete stop at top dead center after having completed one full cycle. However, when a press is set up for continuous operation, that is, the operation wherein the press continues to cycle without stopping until stopped by the press operator, the initial stroke presents the same dangers as on single stroke operation, but heretofore no such hold down protection has been available.

After continuous operation, prior art top stop control means enables a press to finish its last cycle of operation and thereafter disengages the driving mechanism so that the slide will normally coast to a halt at top dead center. However, if the top stop button is pressed shortly before the slide reaches top center, or at top center, an immediate disengagement of the driving mechanism results and the inertia of the various moving parts may carry the slide to a stop past top dead center. While pneumatic counterbalances may retain the slide in such a position, if the air supply should fail or be improperly adjusted, the slide might drop, thereby creating a hazardous condition for workmen near and around the press.

It is, therefore, an object of this invention to provide a novel press control circuit which provides a hold down period on both single stroke and continuous operation. It is also an object of this invention to provide a novel press control circuit having a top stop control which will positively stop the press slide at top dead center regardless of the point in the press cycle at which such control is actuated. It is a further object of the invention to provide a press control circuit which provides the above and other objects together with standard press operations with improved performance and simplicity.

Still further objects and advantages will become ap-

parent to those skilled in the art upon reading the following detailed description in conjunction with the accompanying drawings in which the present invention is disclosed by way of illustration only, and such advantages may be resorted to without departing from the scope of the invention which is intended to be limited only by the appended claims.

In the drawings:

Figure 1 is a schematic wiring diagram of a press control circuit incorporating the present invention; and

Figure 2 is a timing diagram showing preferred settings of the press rotary limit switches shown in Figure 1.

Referring now to Figure 1 in greater detail, a press 1 is shown having a crankshaft 2 driven by motor 3 through drive pinion 4 and flywheel bull gear 5. A brake 6 is mounted on one end of crankshaft 2, and a solenoid operated clutch 7 is mounted on the opposite end of crankshaft 2 to disengage flywheel bull gear 5 from the crankshaft, all of which is standard practice. A cam shaft 8 is driven by chain and spocket means 9 from crankshaft 2, the purpose of which will be developed as the description of the invention progresses.

In the control circuit shown in Figure 1, in association with the press 1, power is supplied to this circuit from power lines 10 and 12 through the primary 13 of a transformer 14. Supply lines 16 and 18 are connected to the secondary 20 of transformer 14, which furnishes power to the rest of the circuit. A group of relays 22, 24, 26, 28, and 30 each has one side connected to supply line 16 which is grounded and has its other side connected through appropriate control switches, relay contacts, and limit switches to the other supply line 18, as explained more fully hereinafter.

Also connected between line 16 and 18 in the clutch operating valve solenoid 32 which actuates a press clutch, such as a standard air operated clutch and brake unit in common usage on presses. Clutch operating solenoid 32 is isolated from lines 16 and 18 by normally open contacts 22a and 22b of relay 22. Although one contact is sufficient to operate solenoid 32, as a safety measure two contacts are used, one to each line, for positive de-energization of solenoid 32 if either contact should fail to open. A normally closed emergency stop switch 34 and a selector switch 36 are placed in line 18.

For the intended purpose of explaining the remaining portion of the circuit in the clearest and most straight-forward manner, the following discussion is directed toward a detailed description of its structure taken in conjunction with its function and operation. In accord with the usual terminology, the reference to relay contacts as being either normally closed or normally open refers to the position of the contacts when the relay operating them is deenergized, and they are so shown in Figure 1. Switches 36, 38, 40, 42, 44, and 58 have been termed selector switches because it is through their operation that the circuit is connected for either single stroke, continuous, or jog operation. While no mechanical interconnection between these switches has been shown, it is to be understood that such switches in common practice are ganged to gether so that a single control can select the desired method of press operation. It is of course possible, as shown in Figure 1, to separately select and operate each switch manually. For single stroke operation only selector switches 36, 38 and 40 are closed, while for continuous operation switches 36, 42 and 44 are closed, and for jog operation only switch 58 is closed. Switches 50, 52, 54 and 56 are timing switches such as rotary limit switches and are opened and closed in response to the position of the press crank shaft. These rotary limit

3

switches serve to synchronize the operation of the press circuit with the cyclic operation of the press.

When the press is to be set for single stroke operation, as aforesaid, selector switches 36, 38, and 40 are closed. Selector switch 36 maintains continuity in line 18, selector switch 38 shunts out normally open contact 24b of relay 24, and selector switch 40 connects rotary limit switch 56 to relay 28 through normally open contact 28b. From Figure 2 it will be seen that at the beginning of a cycle, with the press at top dead center, limit switches 50 and 52 are open while limit switches 54 and 56 are closed. Since selector switch 42 is open on single stroke operation, however, limit switch 54 does not affect this mode of operation.

At the start of a cycle of operation, some of the relays are energized and some are de-energized, therefore it is perhaps best to start with the circuit in a condition where all the relays are deenergized. It will be seen that if selector switch 36 were to be opened, relays 24, 26, 28 and 30 could not be energized, and since selector switch 58 is open relay 22 is also deenergized. If selector switch 36 were then closed, as would be the case if the method of operation selector were turned from an off position wherein all of the selector switches are open to the single stroke position where switches 36, 38 and 40 are closed, all of the relays could be energized depending upon the positions of the relay contacts and the limit switches. Relay 24 will then be energized through the normally closed contact 22c of deenergized relay 22. Since selector switch 44 always remains open on single stroke operation, relay 24 can be energized only through contact 22c and therefore relay 24 will be energized whenever relay 22 is deenergized and vice versa. Contacts 46a of run switches 46 are normally closed and therefore relay 26 will be energized. Since normally opened contact 26a will then be closed and selector switch 38 is closed, relay 28 will also be energized. After relay 28 has been energized through contact 26a, its own relay contact 28b is closed and relay 28 remains energized through closed selector switch 40 and closed limit switch 56. Furthermore, since limit switches 50 and 52 are both open at this point, relay 30 is also deenergized. Thus before the start of a cycle of operation relays 22 and 30 are deenergized while relays 24, 26 and 28 are energized.

To start the press cycle of operation, the operator presses the run switches 46. While only two run switches are shown in Figure 1, as required for one man operation, it is understood that any other number of run switches, depending upon the number of press operators, could be used without affecting the operation of the circuit, such additional switches being similar to and connected in series with the two switches shown. When the run switches 46 are depressed, the normally closed contacts 46a are opened, thereby deenergizing relay 26. Even though this opens contacts 26a, relay 28 remains energized through its normally opened contact 28b, closed selector switch 40, and the closed rotary limit switch 56. The depressing of run switches 46 also closes its normally opened contacts 46b and energizes relay 22 through normally closed contacts 26b and normally opened contacts 28a of energized relay 28. When relay 22 is energized, it closes contacts 22a and 22b to energize the clutch operating solenoid 32 and start the press in motion. At the same time normally closed contact 22c opens to deenergize relay 24.

At this point, just after the press crankshaft has started to move the press slide on its downstroke, although contacts 22a and 22b are closed, since neither of the rotary limit switches 50 or 52 is closed, the run switches 46 must be held in closed or depressed position to maintain relay 22 energized through contacts 46b. If the press operator were to release any or all of the run switches, relay 22 would drop out thereby deenergizing the clutch operating solenoid 32 and consequently stopping the press.

4

Therefore the press operator must keep the run switches depressed until limit switch 50 closes as shown in Fig. 2. This provides the necessary hold down protection on single stroke operation.

Limit switches 50 and 52 overlap in the closed position to maintain relay 22 energized. As the press slide returns to the top of its stroke, limit switch 52 opens and thereby deenergizes relay 22. When relay 22 drops out, the clutch operating solenoid 32 is deenergized to disengage the press clutch and set the press brake in the usual manner. The opening point of limit switch 52, of course, is set at a predetermined position so that the press will stop at top dead center. Since relay 22 will be energized during the time that either of the rotary limit switches 50 or 52 is closed, relay 24 will then remain deenergized during this period of time. Thus, contacts 24c are never closed while either of the limit switches 50 or 52 are closed and consequently relay 30 is never energized during single stroke operation.

If the press operator desires to operate the press "on the hop" that is, set the press control to initiate the next cycle before the clutch is disengaged to give, in effect, a continuous operation, he must depress the run switches 46 before limit switch 52 opens so that relay 22 and clutch operating solenoid 32 will remain energized. However, if the run switches are depressed before limit switch 56 closes, relay 26 will be deenergized, thereby opening contact 26a, and relay 28 will drop out. When relay 28 is deenergized, its contacts 28a will then be opened and contacts 46b of the run switches 46 are unable to maintain relay 22 energized. Because contact 28b will then also be open, relay 28 can be reenergized only by releasing the run switches 46 to reclose contacts 46a, energize relay 26 and hence close contacts 26a and picking up relay 28, which then holds through contact 28b and switch 56. Therefore, for "on the hop" operation, the run switches 46 can not be depressed until after limit switch 56 has reclosed on the upstroke.

When it is desired to operate the press on continuous cycling, selector switches 36, 42 and 44 are closed while selector switches 38 and 40 remain open. In such case, at the start of the press cycle, relays 22 and 30 will be deenergized, while relays 24, 26 and 28 will be energized, as was the case for single stroke operation. The setting of the rotary limit switches 50, 52, 54 and 56 will be as shown in Figure 2, again remaining the same as for single stroke operation. It will be noted that now limit switch 54 instead of limit switch 56 is connected through contact 28b to relay 28. Since selector switch 44 is now closed, as long as top stop switch 62 remains undepressed, relay 24 will remain energized regardless of the operation of relay 22. Consequently contact 24c of relay 24 will remain closed, thereby allowing relay 30 to be energized through rotary limit switches 50 and 52 after the press cycle has started.

When the operator depresses the run switches 46, the press starts in much the same manner as for single stroke operation. As contacts 46a open, relay 26 drops out. Although contacts 26a are opened, relay 28 again remains energized, this time through contacts 28b, selector switch 42 and limit switch 54. Hence relay 22 will be energized through contacts 28a, 26b and contacts 46b of the run switches 46. As soon as the press cycle has progressed to the point where limit switch 50 closes, relay 30 will be energized and relay 22 can then remain energized through contacts 22d, 30b and 28c. However, if the press operator were to release the run switches before limit switch 50 closed, that is, before relay 30 is energized, contact 30b would remain open and relay 22 would drop out. Thus on continuous operation, the same hold down protection is present on the first or initial cycle as is present on single stroke operation.

Once relay 22 is energized and the operator has released run switches 46 to re-energize relay 26, relay 28 will remain energized through contacts 24b and 26a.

5

Relay 30 will remain energized through contacts 30a and 28c regardless of the operation of the rotary limit switches 50 and 52. Thus the positions of rotary limit switches 50, 52, 54, and 56 no longer influence the operation of any of the relays, and relay 22 will remain continuously energized through contacts 22d, 30b and 28c. It must be noted that the operator must release the run switches 46 to reclose contacts 46a and reenergize relay 26 so that relay 28 can remain energized through contacts 26a, when limit switch 54 opens near the end of the first cycle. If the operator were to keep the run switches 46 depressed thereby leaving relay 26 deenergized and contacts 26a opened, relay 28 would drop out when limit switch 54 opens. This would open relay contacts 28a and 28c so that relay 22 would be deenergized when rotary limit switch 52 opens shortly thereafter.

When a press is on continuous operation, it may be stopped by two methods. One of these is by depressing the emergency stop switch 34 which disconnects the rest of the control circuit including all of the relays. Since relay 22 is immediately deenergized regardless of the point in the cycle of operation at which the emergency stop switch 34 is depressed, contacts 22a and 22b immediately open to deenergize the clutch operating solenoid 32, thereby disengaging the press clutch and setting the press brake. When the press is stopped in this manner, it stops at whatever position the crankshaft and slide were in when the emergency stop button was depressed. Such a stop is necessary for safety considerations, but only by chance can the press be so stopped at top dead center, which, as aforesaid, is necessary if work is to be done on the press or if it is to be left unattended. It is therefore necessary after stopping a press with the emergency stop to jog the press slide to top center position, and this is at best a delicate and time consuming operation.

For the above mentioned reasons, a top stop control is often provided to be used in stopping the press on continuous operations. While the press is cycling, relay 22 remains continuously energized so that normally closed contacts 22c are open. When top stop switch 62 is depressed, relay 24 then immediately drops out. This opens contacts 24c and disconnects relay 30 from the limit switches 50 and 52, although relay 30 remains energized through contacts 30a and 28c. When the crankshaft has rotated to the angular position where limit switch 54 opens, since contacts 24b are now opened, this deenergizes relay 28. In turn, contacts 28c are opened to deenergize relay 30 which has remained energized through contacts 30a and 28c. Contact 30b is now opened, so relay 22 is held in only through limit switches 50 and 52. When limit switch 52 opens, relay 22 is deenergized and the press stops in the same manner as at the end of a single stroke cycle of operation.

The above discussion assumes that the top stop switch 62 is depressed at some point in the cycle before limit switch 52 is opened. If the top stop switch 62 is depressed in the portion 64 (see Figure 2) of the press cycle, the press will stop at once at top dead center. Since limit switches 50 and 52 are both open, relay 22 is held in through contact 28c, and since relay 28 is held in only through contact 24b, limit switch 54 being opened, depressing top stop switch 62 energizes relay 24 to open contacts 24b and deenergize relay 28, which then opens the contacts 28c to deenergize relay 22 and stop the press, causing the press slide to coast slightly beyond top center, which is not objectionable.

If the top stop switch 62 were depressed after limit switch 54 has reclosed, even though this is done before the crankshaft and press slide reach top dead center, the press will not stop until the end of the next cycle. Although, when top stop switch 62 is opened, relay 24 drops out, relay 28 will continue to hold in through limit switch 54 which has reclosed. Thus relay 22 can not become deenergized until near the end of the subsequent cycle

6

when both limit switches 52 and 54 are opened, and when relay 30 is dropped as before described.

When the circuit is set up for jogging the press, selector switches 36, 38, 40, 42 and 44 are left open while selector switch 58 is closed. This breaks line 18 so that none of the relays 24, 26, 28 and 30 or any of the limit switches 50, 52, 54 and 56 are operative. This leaves the jog switch 60 free to energize relay 22 directly from line 18 without interference with the rest of the circuit.

It will be seen, therefore, that what has been described is a complete press control circuit adapted to provide all of the functions of a standard press control circuit, with the addition of a novel hold down period at the beginning of continuous operation and a novel top stop which is positive acting regardless of the point in the press cycle at which it is activated. The hold down period as shown by portion 66 of the press cycle (see Figure 2) may be varied as desired for different presses and press operations by changing the timing of limit switch 50, the same hold down period applying to both single stroke and continuous operation. Likewise, the instantaneous stop portion 64 and the braking portion 68 of the press cycle may be varied depending upon the time necessary to stop the press at top center. Moreover, the instantaneous top stop portion 64 need not be present at all, because relay 24 remains deenergized after the top stop switch 62 is released. Hence, it is the sequential opening first of limit switch 54 and then of limit switch 52 which deenergizes relay 22, and limit switch 54 may even reclose before limit switch 52 opens without altering the functioning of the circuit, since relay 28 is not thereby reenergized.

While only one embodiment of the invention has been herein described, it has been disclosed for purposes of illustration only. Other embodiments and arrangements, including different numbers of relays, contacts, and switches may occur to those skilled in the art upon reading this disclosure and may be resorted to without departing from the scope and spirit of the invention which is intended to be limited only by the appended claims.

I claim:

1. In a power-operated press having a crankshaft and a clutch adapted to engage said crankshaft, the improvement in clutch control circuits adapted to selectively provide single or continuous stroke operation comprising; selector switch means adapted to selectively connect said press for single stroke or continuous stroke operation; manually operated run switch means; timing switch means operable responsive to the angular position of said crankshaft; a clutch actuating solenoid; first relay means adapted to actuate said solenoid; said selector switch means when set for single stroke operation, said timing switch means, and said manually operated run switch means coacting to activate said first relay means when said manually operated run switch means is closed, and to deactivate said first relay means when said manually operated run switch means is opened during a predetermined portion of each stroke, thereby to provide a single stroke hold down period; second relay means adapted to coact with said selector switch means when set for continuous stroke operation, said manually operated run switch means, and said timing switch means to activate said first relay means; third relay means adapted to coact with said timing switch means, said manually operated run switch means, and said second relay means to deactivate said first relay means upon release of said manually operated run switch means during a predetermined portion of the first stroke of the press, said first portion being predetermined by the setting of said timing switch means, thereby to provide a hold down period during the first stroke of continuous stroke operation; and fourth relay means adapted to coact with said timing means, and said manually operated run switch means to continuously maintain the activation of said first relay means after said predetermined first portion of the first

7

stroke and independent thereafter of said timing switch means.

2. The apparatus set forth in claim 1, including fifth relay means adapted to coact with said manually operated run switch means, said timing switch means, and said selector switch means to deactivate said first relay means when said manually operated run switch means is not released after a second predetermined portion of a stroke of the press; top stop switch means; and top stop relay means adapted to coact with said timing means to deactivate said first relay means after said second predetermined portion of a stroke of the press, whereby to eliminate interference between said manually operated run switch means and said top stop switch means.

3. The apparatus set forth in claim 1, including top stop switch means, top stop relay means adapted to coact with said timing means to selectively deactivate said first relay means before and after a predetermined

8

portion of the end of a press stroke cycle whereby upon deactivation of said first relay means before said predetermined portion the press will come to stop at top dead center of the stroke during which the top stop switch is actuated, and whereby upon deactivation of said first relay after said predetermined portion the press will pass through an additional stroke cycle and thereafter come to rest at top dead center.

References Cited in the file of this patent

UNITED STATES PATENTS

2,471,505	Winther	May 31, 1949
2,636,138	Few et al.	Apr. 21, 1953
2,639,796	Dean	May 26, 1953
2,675,507	Geiger	Apr. 13, 1954
2,818,150	Eck et al.	Dec. 31, 1957

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 2,886,155

May 12, 1959

Robert W. Hadley

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 2, line 34, for "in the" read -- is the --; column 5, line 63, for "energizes" read -- deenergizes --.

Signed and sealed this 22nd day of September 1959.

(SEAL)

Attest:

KARL H. AXLINE

Attesting Officer

ROBERT C. WATSON
Commissioner of Patents