

March 4, 1952

S. M. WEISBERG

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PROTECTION OF HYDRAULIC POWER PRESSES

Filed May 6, 1946

5 Sheets-Sheet 1

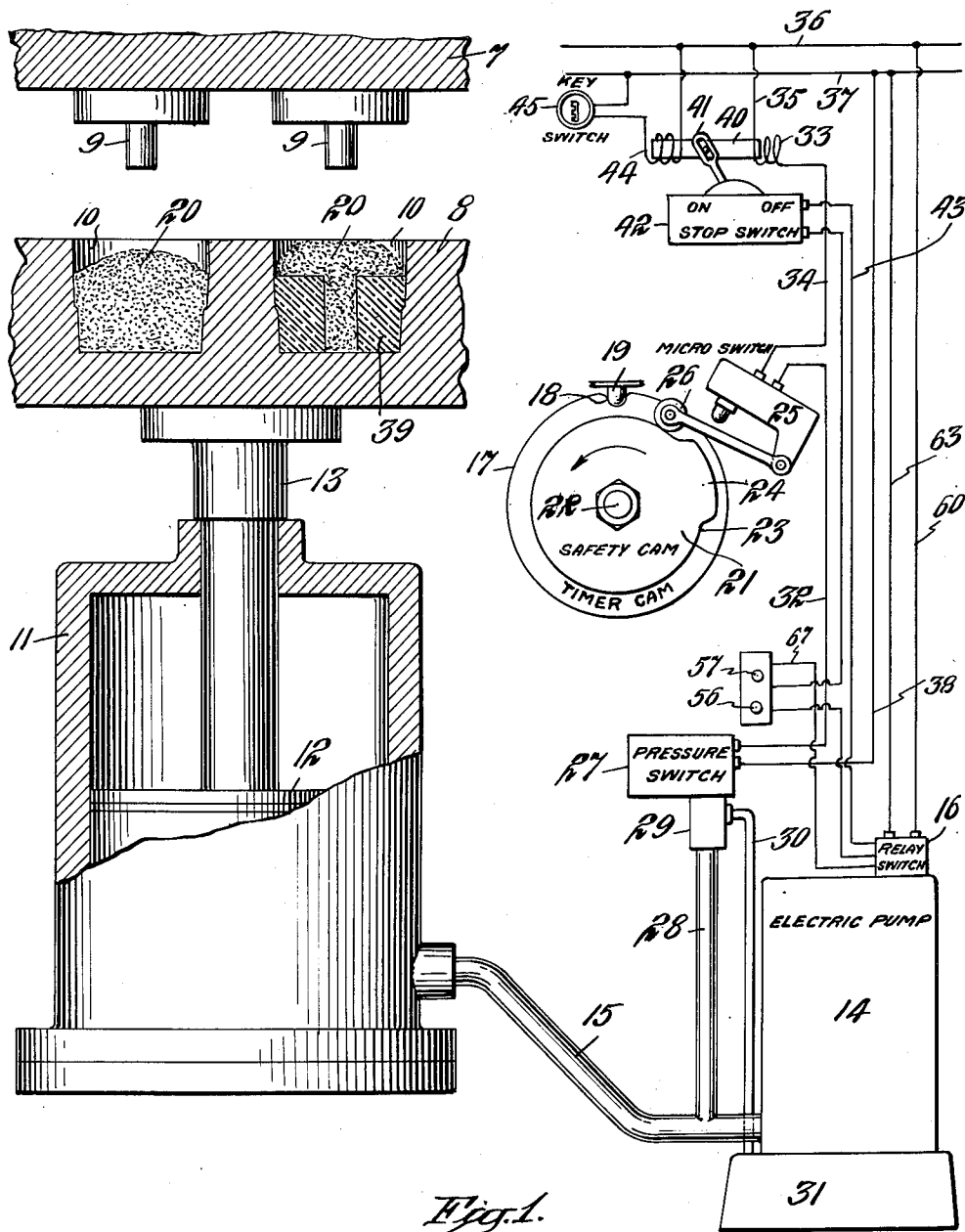


Fig. 1.

SIDNEY M. WEISBERG
INVENTOR

BY *Philip S. Mean*
ATTORNEY

March 4, 1952

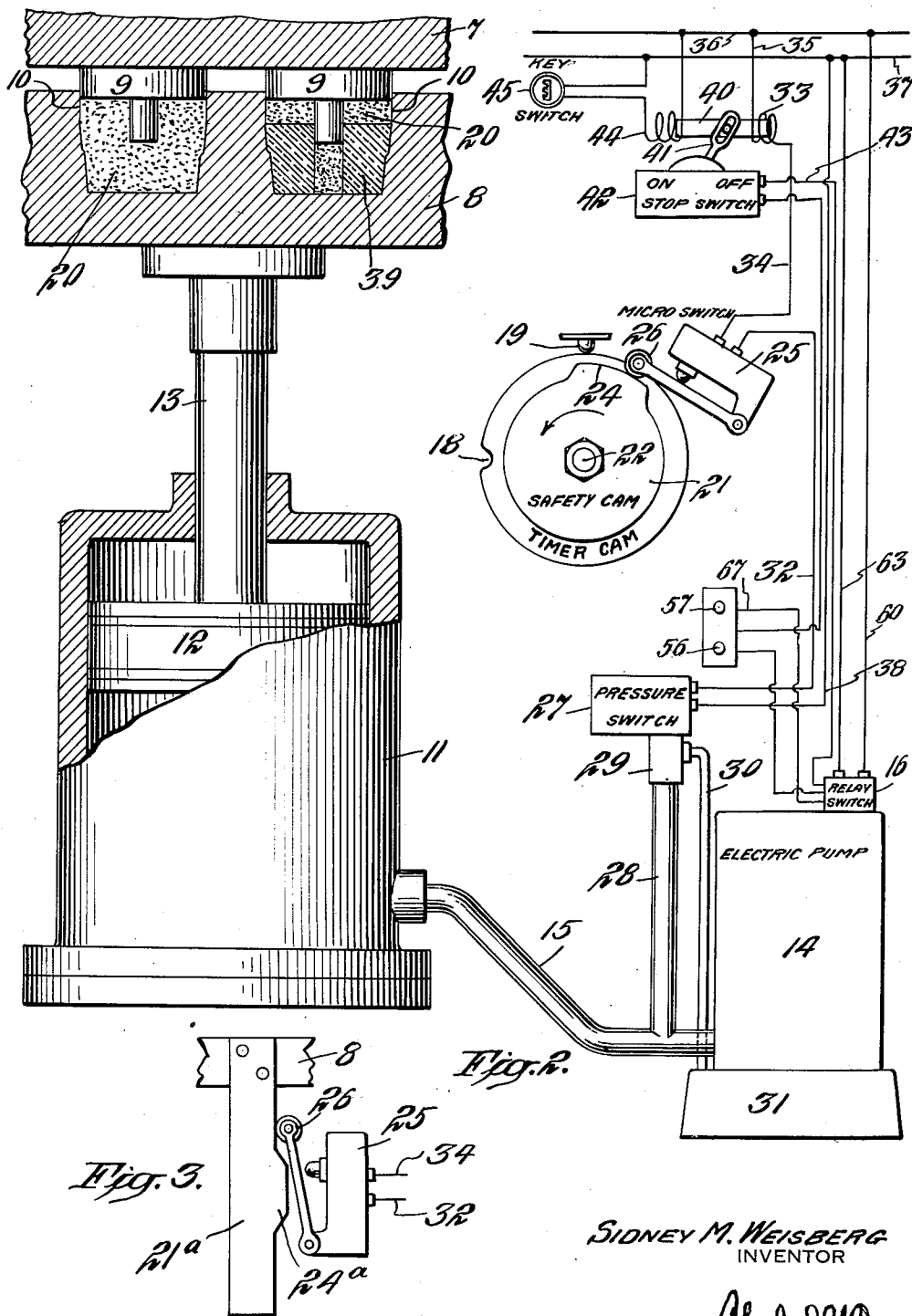
S. M. WEISBERG

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SIDNEY M. WEISBERG
INVENTOR

BY *Philip S. Weisberg*
ATTORNEY

March 4, 1952

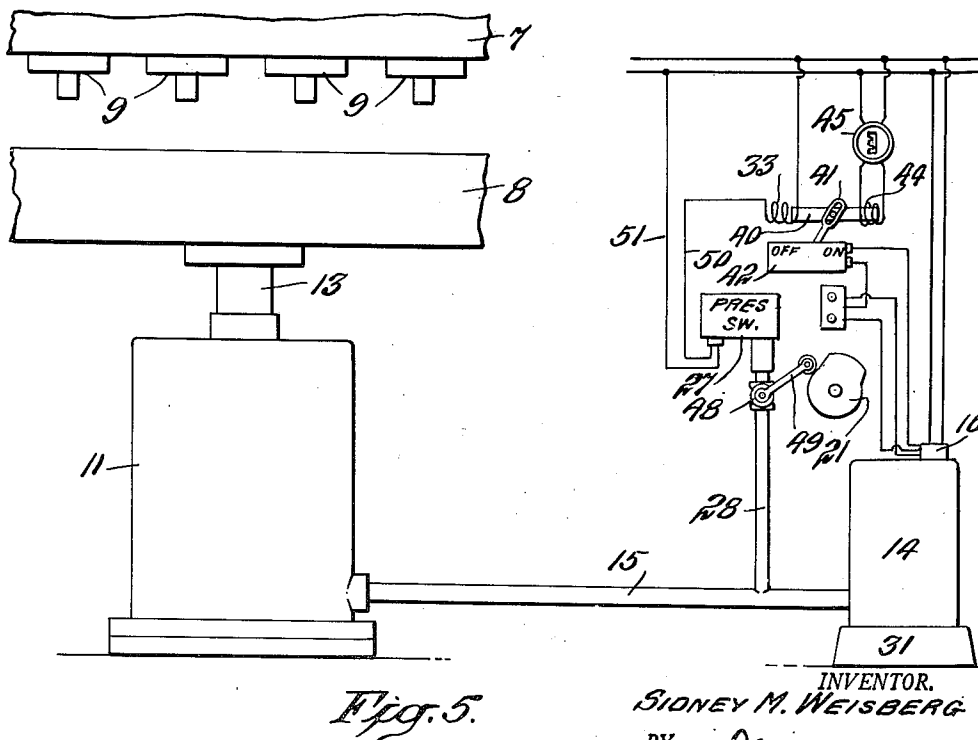
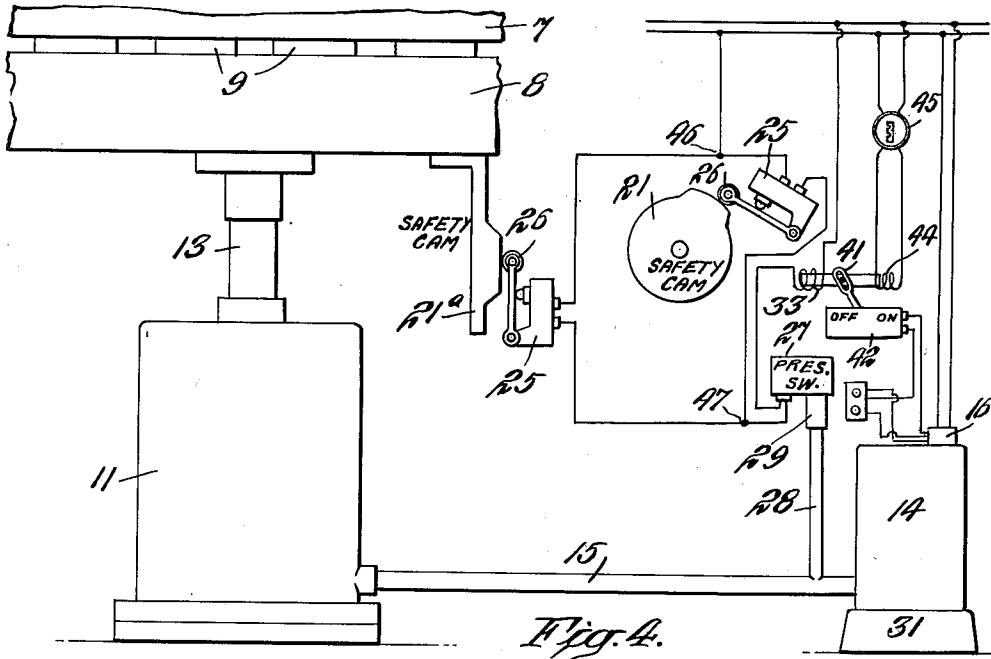
S. M. WEISBERG

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PROTECTION OF HYDRAULIC POWER PRESSES

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5 Sheets-Sheet 3



INVENTOR.
SIDNEY M. WEISBERG

BY

Philip S. Mearns
ATTORNEY

March 4, 1952

S. M. WEISBERG

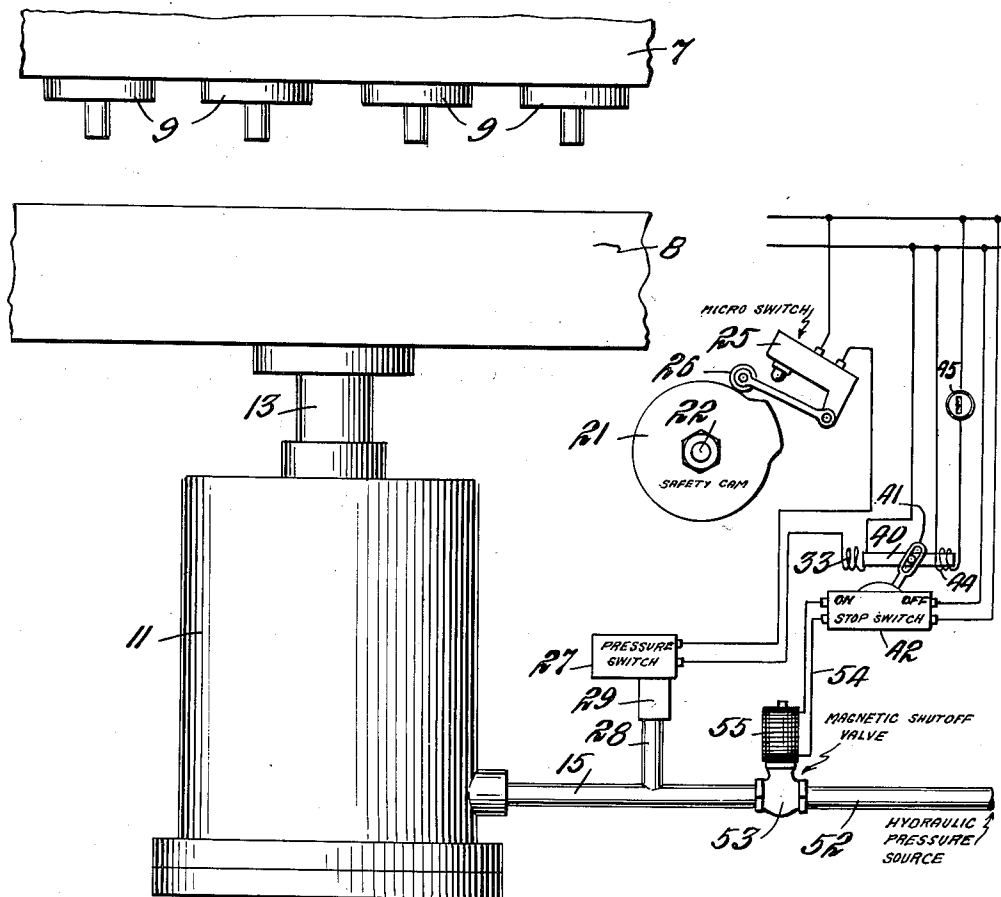
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PROTECTION OF HYDRAULIC POWER PRESSES

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Fig. 6.



SIDNEY M. WEISBERG
INVENTOR.

BY

Philip S. Weisberg

ATTORNEY

March 4, 1952

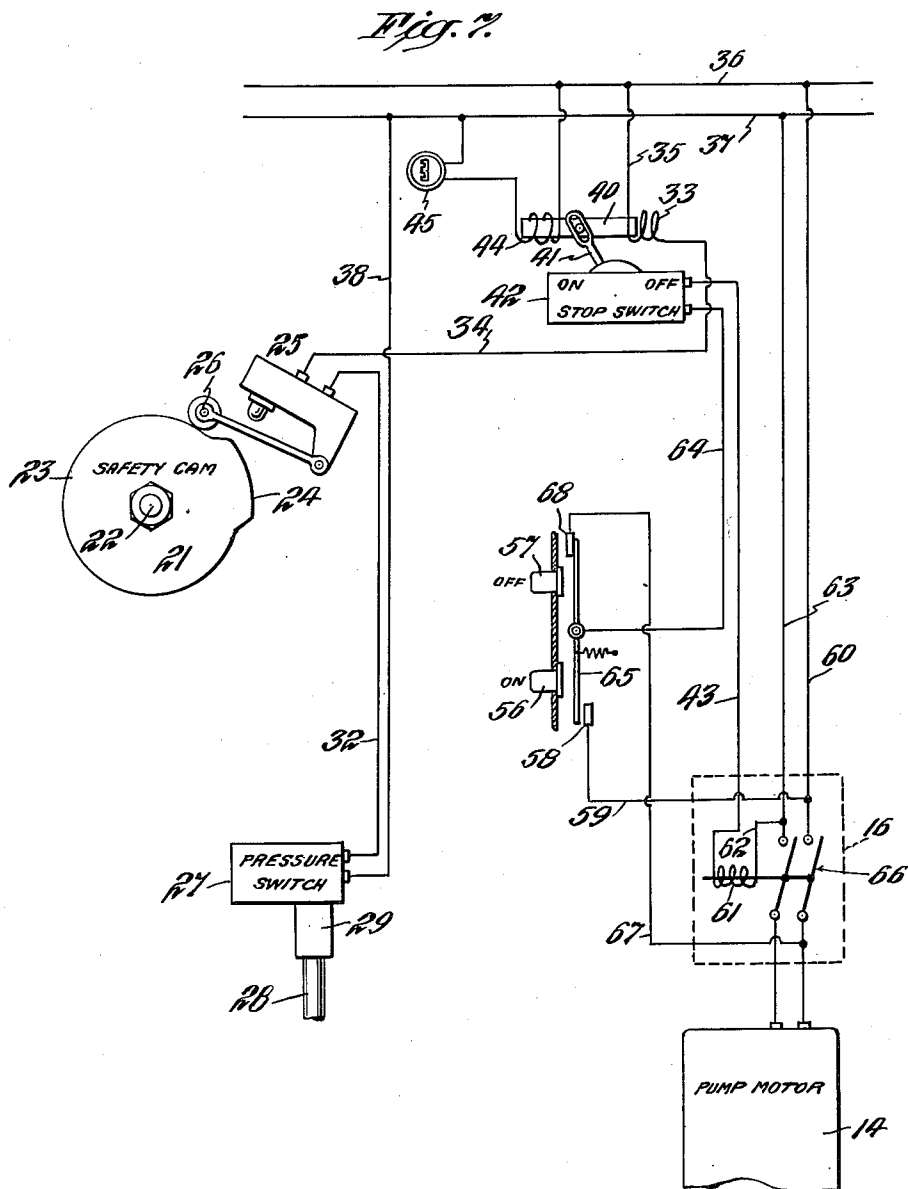
S. M. WEISBERG

2,588,066

PROTECTION OF HYDRAULIC POWER PRESSES

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SIDNEY M. WEISBERG
INVENTOR.

BY *Philip J. McLean*
ATTORNEY

UNITED STATES PATENT OFFICE

2,588,066

PROTECTION OF HYDRAULIC POWER
PRESSES

Sidney M. Weisberg, Newark, N. J., assignor to
Allied Electric Products, Inc., Irvington, N. J.,
a corporation of New Jersey

Application May 6, 1946, Serial No. 667,699

3 Claims. (Cl. 192—125)

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The invention herein disclosed relates to the protection of hydraulic power presses and the main purpose of the invention is to prevent the overloading of such presses.

In the operation of power presses, particularly molding presses of the multiple cavity type, it more or less frequently happens that a molded piece will remain caught in a die cavity and if this remains unobserved, the build-up of pressure occasioned by the loading on top of this piece may break or otherwise injure the dies or other parts on the next press closing operation.

Special objects of the invention are to provide means which will sense the dangerous condition and stop the mold closing movement in time to avoid injury to the dies or other portions of the press.

Special objects also are to provide means of the type indicated which will be readily applicable at reasonable cost to existing machines and which will then at all times exercise protective control over the operation of such machines.

Further special objects are to utilize operating characteristics present in such machines to effect the desired automatic control. In the case of hydraulic presses, for example, to utilize pressure developed in the hydraulic system at a time when no such pressure should be present, as a means to effect necessary safety control operations.

Other objects are to enable application of the safety control outlined to power presses and power press systems of the different types now in more or less common usage.

Further objects are to provide a safety control system for power presses which will not add materially or objectionably to the bulk of the press or interfere in any way with the usual press operations.

Other desirable objects and the novel features by which the purposes of the invention are attained are set forth or will appear in the course of the following specification.

The drawings accompanying and forming part of the specification illustrate various practical embodiments of the invention. Actually, however, the structure and mode of application and operation may be further modified and changed in various ways, all within the true intent and broad scope of the invention as hereinafter defined and claimed.

Figure 1 in the drawings is a broken part sectional and partly diagrammatic view illustrating an application of the invention to a multiple cavity hydraulic molding press, showing the press

at the start of a molding operation with one mold cavity properly charged and a second mold cavity overcharged by reason of a molded piece having been retained in the mold.

Figure 2 is a similar view showing the mold at the closing stage and the overloading of the one mold cavity detected to effect the stopping of the press.

Figure 3 is a fragmentary and somewhat diagrammatic view illustrating a modification of the safety cam for timing the excess pressure sensing action.

Figure 4 is a generally diagrammatic view illustrating the use of double cams, one on the timer and one on the press platen for doubly checking the possible presence of dangerous pressure conditions.

Figure 5 is a similar view of another modification showing the safety cam employed to admit pressure to the pressure sensing switch at that time when presence of excessive pressure would indicate existence of a dangerous condition.

Figure 6 is a generally diagrammatic view illustrating another modification involving use of a valve to shut off the press from a common pressure source upon detection of the existence of dangerous pressure conditions.

Figure 7 is a wiring diagram.

In the several views the bed and platen of an ordinary hydraulic press are conventionally indicated at 7 and 8 carrying the cooperating elements 9 and 10 of a plurality of article forming molds.

The press cylinder is represented at 11, having a piston 12 directly or indirectly coupled at 13 with the movable platen 8.

An electric pump is indicated at 14 for supplying the operating pressure through a hydraulic line 15. This pump is started and stopped or otherwise suitably controlled to effect the press closing and opening operations through a suitable relay switch conventionally represented at 16.

Presses of the type illustrated are often equipped or connected with a so-called "timer" for controlling the press closing, "curing" and press opening operations, such timer having a rotary cam or dial 17 with a notch 18 receiving the point of a controller 19 in the normal, stop position of the press.

Details of the timer are not shown, it being sufficient for present purposes to understand that when the press is started, after the die cavities have been properly loaded with the plastic or other material 20 to be molded, the controller

element 19, lifted out of the notch 18, will ride the rim of the cam and at the end of the press cycle, drop back in the notch 18 to stop the press in the open position, with the molded pieces discharged or ready to be discharged from the dies. The complete cycle as determined by this cam may include the time for closing the molds, time for curing the material in the molds while the press remains closed and then the time for opening and leaving the molds in open condition.

The timer operating in accurately timed relation with the press provides convenient and reliable means for effecting the sensing of dangerous pressure conditions.

This is accomplished in the embodiment illustrated in Figures 1 and 2 by mounting a special safety cam 21 on the timer shaft 22 in front of the regular timer cam 17.

This special safety cam is shown as having a major generally concentric portion 23 and a raised portion 24 of lesser circumferential extent and disposed to effect operation of a switch or other control mechanism during that period in which the press is approaching and attaining the mold closed position—in effect, that time at which the existence of a double load in a mold cavity would be manifested by sudden rise of pressure in the hydraulic system.

In the illustration the control device is shown as a micro switch 25 having a switch closing lever 26 riding the rim of the safety cam, with the parts arranged as shown in Figures 1 and 2 so that this switch will remain open while the switch lever is in engagement with the concentric portion 23 of the cam and will be closed when the switch lever is engaged by the high portion 24 of the cam. This closure is effected as shown in Figure 2 at or approximately the time the mold starts to close and therefore will develop higher than normal operating pressure in the hydraulic system if a mold cavity has been double loaded.

Means for sensing the pressure are provided in the illustration in the form of a pressure switch 27 connected at 28 with the pressure supply line 15.

This pressure switch may be of any suitable commercial type, the one conventionally indicated having a piston operating in the chamber 29 connected with the hydraulic pressure line 28 and serving when pressure is attained for which the mechanism is set, to close a switch in the upper body portion of the device, designated 27. The piping shown at 30 extending from the upper portion of the piston chamber 29 is a return connection commonly used with such switches for relieving any leakage of pressure fluid back into the sump base 31 of the pump.

The time or press-phase sensing switch 25 and pressure switch 27 are shown connected in series with each other by wiring 32 and in series with a solenoid winding 33 by wiring 34, said coil being connected at the other side by wiring 35 with one side 36 of a power circuit. The other side 37 of the power source is shown connected by wiring 38 with the other side of the pressure switch.

It follows from this that when micro switch 25 is open as in Figure 1, the pressure switch 27 will be unable to exercise any control over the solenoid winding 33, but that if switch 25 is closed as in Figure 2, the circuit through solenoid winding 33 will be closed if the pressure in the hydraulic system has attained that value for which the pressure switch has been set.

Assuming that the pressure switch has been

set for 100 lbs. per square inch, a pressure ordinarily sufficient for raising the ram to the mold closing position, it will be seen that if this pressure is not exceeded, as when there is no obstruction or overloading of any mold cavity, the closing of the phase switch 25 at that time will have no effect as to closing the circuit described, said circuit remaining open at the pressure switch 27.

With a condition as represented in Figure 2, however, that is, with a previously molded piece 39 remaining in one of the mold cavities, with a charge of the molding material on top of it, pressure above the normal press closing pressure will immediately start to build up, causing pressure switch 27 to close and this at the time when the safety cam is holding the phase or time sensing switch 25 closed.

Consequently, under these conditions solenoid 33 will be energized and will, as shown in Figure 2, shift solenoid core 40 to the right, rocking the lever 41 to throw the stop switch 42 to the off position. This switch is shown as connected by wiring 43 to control the relay switch 16 of the electric pump.

Thus rise of pressure in the hydraulic system to a value greater than it should be, at a time when the press is closing, is recognized at once and utilized as a means for halting or stopping the operation of the press, before any breakage, strain or injury can be caused to the dies or other portions of the press.

When the press has been thus stopped, the ram may be lowered and the die cavities cleared, ready for a regular molding operation.

To make sure that the press will not again be started until everything has been cleared, a special starting solenoid is shown provided at 44 under control of a key switch 45 and which can thus be energized to shift the solenoid core 40 and turn the stop switch back into "On" position only by one in authority having the key for operating switch 45.

While a rotary form of safety cam is desirable as being readily mounted on the shaft of the timer, it is contemplated that other forms of safety cams may be employed, such as the straight form of cam shown at 21a, Figure 3, attached to the ram of the press and arranged to operate the time sensing switch 25 in the straight up and down operation of the ram.

In this form of the invention the high part 24a of the cam is positioned to effect the closing of switch 25 at or about the time the press reaches the closed condition, after the manner of the rotary cam, the operation and coaction of the parts being otherwise as above described.

This straight form of safety cam may be preferred with presses having manually operated lever controls.

The rotary cam, Figure 2, carried by the timer, makes one full revolution for each complete cycle of the press, including the press closing, curing and press opening phases. The straight cam, Figure 3, attached to the ram, travels in one direction on the closing movement, rests during curing and then returns in the opposite direction in the press opening movement. In the latter movement it will again close the switch 25 but will then have no effect because pressure on the ram has been released or reduced to open the press. The pressure switch 27 therefore will be open at this time so even though cam 21a closes switch 25, in the reverse press opening movement, this will have no effect unless something has happened

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to keep the pressure above what it should be at that time and in which event the cam will act in a safety capacity to effect stopping of the press.

Both forms of safety cams, rotary and reciprocating, operate to the same effect, to close the circuit for the pressure sensing switch at the time when the mold is just closing; in other words, at that critical time when there should be no abnormal pressure, but when such pressure will be created if there is an obstruction in one or more of the mold cavities.

The high part of the cam is therefore so placed as to come into action at the time of mold closing and the extent of this active portion is limited to hold the switch 25 closed only during that time while the mold is closing and before that time in normal operations when pressure will build up for applying the full molding pressure. In other words, the testing for dangerous pressure should be initiated as soon as the existence of such a condition might occur and it should be completed before the buildup of pressure necessary to complete the molding operation. This pressure buildup may quickly rise from the normal low of 100 lbs. in the example supposed to 1000 lbs. or more.

The safety cam is therefore designed as indicated to quickly accomplish the pressure sensing action and then if no dangerous condition exists, leave the press free to go through with its normal cycle.

Figure 4 shows how the two forms of cams can be combined, each operating a timing switch 25 and these being connected in parallel with each other at 46, 47, with each in series with the pressure switch 27 and the off solenoid coil 33 so that each will be fully capable of effecting the stopping of the press if a dangerous pressure condition exists.

In the construction last described the rotary cam on the timer is a check on the straight cam on the ram and vice versa so that if anything should happen to one cam unit, the other will still be effective to stop the press under dangerous loading conditions.

Figure 5 shows how the testing for dangerous or excessive pressure conditions can be effected by employing the safety cam, in the instance illustrated, the cam 21 on the timer, to open a valve 48 in the pressure connection 28 to the pressure switch 27 during the critical closing phase of press operation.

In this case the valve 48 for admitting pressure to the pressure sensing switch is equipped with a suitable stem or handle 49 engaged by the safety cam and operated by the high part of the cam to admit pressure to this switch during that time that the press is closing and to leave the pressure switch disconnected from the pressure line while the press is completing its cycle.

Thus in Figure 5 if a mold cavity is overloaded, the excessive pressure developed at the time of mold closure will be detected by pressure switch 27, due to opening of the pressure admitting valve 48 at that time and this switch, connected in this case by wiring 50, 51 directly with the "Off" solenoid coil 33, will then effect throwing of the switch 42 to "Off" position to arrest the closing movement of the ram.

The invention is applicable to many different kinds of presses and to single or multiple press installations.

In the case of a battery of presses all operating from a hydraulic pressure source, the automatic control may take the form shown in Figure 6,

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illustrating one of a number of press units each connected with a hydraulic power source through piping 52 having a magnetic shut-off valve 53 interposed in it, controlled by timed pressure sensing means as heretofore described.

This installation, Figure 6, is substantially the same as that shown in Figures 1 and 2, except for the fact that the stop switch 42 instead of controlling a pump stopping and starting relay 16, is connected by wiring 54 with the magnet 55 of the shut-off valve 53 in the hydraulic power supply line 52.

With magnetic shut-off valves provided as indicated in Figure 6, one for each press supplied from a common pressure source and controlled as described, each press will be independent of the others and any one press will be automatically cut off from the pressure source, if double loading occurs at that press, without disturbing or affecting operation of the other presses.

Fig. 7 is a wiring diagram showing how this new protective control may be combined with the usual push-button control for a power press by simply connecting it in between the push-buttons and the magnet coil of the relay switch.

In the illustration the push-button switch is shown as having "On" and "Off" buttons 56, 57. The latter is operative to close a switch at 58 connected by wiring 59, 60, with one side 36 of the supply line. The magnet coil 61 of the relay 16 is shown connected by wiring 62, 63, with the other side of the power line, and by wiring 43 with the stop switch 42. The latter has a return connection 64 to the rocking switch element 65 of the push-button switch. Consequently, when the "On" button 56 is pressed the magnet coil 61, through the connections last mentioned, will be energized to close a switch 66 for the pump motor 14. When this power switch is closed current can pass by way of a back connection 67 from the lower side of the switch to a contact 68, so that when pressure on the "On" button is removed a holding circuit will be provided through the magnet by way of connection 67, contact 68, switch element 65 and wiring 64, 43, to and from the stop switch to one end of the magnet coil 61. The opposite end of this coil being connected at 62, 63, with the power switch, this magnet will remain energized so long as the push-button switch remains in the position indicated and so long as the stop switch 42 remains on. At any time the "Off" button 57 may be pressed to open the circuit at 68, 65, to de-energize the switch closing coil 61. If excessive pressure occurs during the press closing stage, the automatic system will come into control to throw the stop switch to the "Off" position. Consequently both control systems, that is, the ordinary push-button control and the automatic safety control are both operative without in any way one interfering with the other.

The pressure switch 27 may be adjustable to that pressure which may be considered abnormal or excessive for the press closing stage. The safety cam may be designed and set to close and open the testing circuit at the proper times and for the proper length of time. Instead of a single testing period there may be two or more such periods in each complete cycle or a number of cycles.

This new protective system may be used with the conventional combined high and low pressure pump systems now in use on hydraulic presses, being timed to come into sensory operation at the end of the low pressure pump stage

when the press platen is reaching the mold closing position, just before the higher, pressure applying stage is reached.

Any foreign obstructions such as loading platforms, metal pieces or the like left in the press, pins out of line or molds that have shifted out of place, will accomplish the stopping of the press.

The invention makes each press to which it is applied self-protective, the elements or units of the control system are relatively few, of simple construction and readily applied without modifying or changing the structure of the press. The safety control is certain and reliable in action and can be readily applied to presses in use or to new equipment at relatively low cost.

While of particular value with presses for molding plastic articles, it will be realized that the invention is important as providing protection for power presses of any sort, such as various forms of punch presses where a blank sticking in the dies would, with the subsequent charging or feeding of the material to be pressed, create a pressure abnormal in the sense of being ahead of the time at which such a pressure should be present. By testing for the presence of this abnormally timed pressure, the invention acts in a precautionary way, trying out the conditions existing at the moment of closing the dies and stopping further action then if the abnormal pressure is present, but permitting the press to continue and finish its cycle, building up to any pressure that may be necessary, if conditions at the time of test are normal.

While designed particularly to prevent breaking of dies when parts remain caught in the same, the invention will operate to prevent injury in the event of trays or loading devices, or any other obstructions remaining between the dies when the press closes, and the invention and claims are to be so construed.

What is claimed is:

1. A safety control for preventing injury to dies or other parts of power presses in the event of previously formed blanks remaining in the dies when fresh material is fed to the dies of such a press and comprising in combination with a hydraulic pressure system variable in pressure in accordance with the load on the dies, press stopping means, pressure sensitive means connected to control said press stopping means and set to operate at a pressure above the normal pressure in the hydraulic system at the time of die closing action, a cam operating in relation to the closing of said dies, a switch having an arm in engagement with said cam, said switch being electrically connected with said pressure sensitive means, said switch arm adapted to be closed by said cam as said dies are closing and in the event of abnormal pressure in the hydraulic system at the time of die closing action will render said pressure sensitive means operative to effect actuation of said press stopping means.

2. A protective control system for a power press comprising in combination with a hydraulic pressure system variable in pressure in accordance with the pressure load on the press, a safety cam

operating in timed relation with the press, press stopping means, a pressure switch for controlling said stopping means and operable by a predetermined abnormal pressure in the hydraulic pressure system and means operable by said safety cam for rendering said pressure switch operative to control said stopping means only at the time of the press closing movement, said last-mentioned means including a timing switch electrically connected to said pressure switch and operable by said cam during press closing movement, and said safety cam having a form to actuate said timing switch in the controlling direction at the beginning of the press closing movement and of an extent to release said timing switch before the end of the press closing movement, whereby said safety cam will be of no effect during normal press operations and will become effective to accomplish stopping of the press only in the event of abnormal pressure developed during the press closing stage of an operating cycle.

3. A safety control system for hydraulic molding presses of the multiple cavity type, for immediately stopping the press in the event a previously molded piece remains in any of the mold cavities when the mold is again loaded, comprising a switch connected to stop the press, pressure sensing means connected with the hydraulic system of the press and adapted to detect abnormally high pressure at the instant of mold closing due to overloading of a mold cavity, control connections from said pressure sensing means to effect operation of said press stopping switch, a timer synchronised with the press, a cam carried by said timer and operating in relation to the closing of said press, a switch having an arm in engagement with said cam and adapted to be closed thereby as said molds are closing, said switch being electrically connected with said pressure sensing means whereby in the event of abnormal pressure in the hydraulic system at the time of mold closing action said pressure sensitive means will be rendered operative to effect actuation of said press stopping means.

SIDNEY M. WEISBERG.

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