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SAFETY ELECTRIC CONTROL FOR FLUID-OPERATED MACHINES

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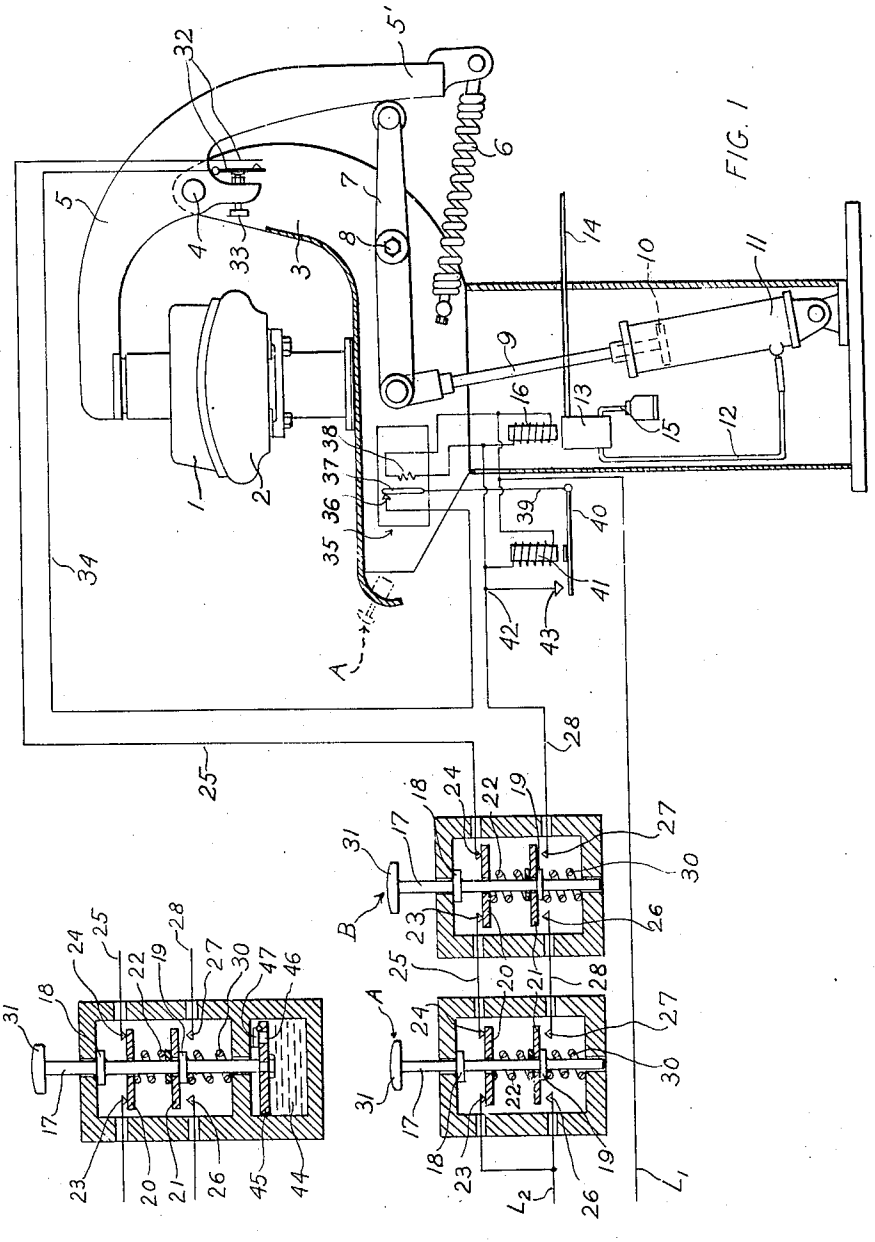


FIG. 1

FIG. 2

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SAFETY ELECTRIC CONTROL FOR FLUID-OPERATED MACHINES

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12 Claims. (Cl. 192—131)

This invention relates to fluid-operated machines and has particular reference to electric control means for such machines.

More specifically, the invention relates to fluid-operated machines, such as garment presses, moulding presses, forming presses, or similar machines having a two-hand safety control. Such two-hand safety controls are being used to avoid danger to the operator during the period the press is closing. The two-hand control requires that the operator, to close the press, actuates two widely separated switches and holds them until the jaws of the press have reached a safe position, that is, a position of the jaws so close together that the operator can no longer insert his hand. If the operator releases one or both switches prematurely, the press opens up and can be closed again only by actuating both switches and holding them both long enough to allow the press to reach its safe position in which a holding circuit is established.

It is an object of this invention to provide a two-hand control for fluid-operated presses requiring the operator to actuate as usual two switches to initiate the closing of the press, but then also to release both switches to close the holding circuit after the press has reached its safe position. To tie down one of the switches would result in making impossible the completion of the holding circuit.

It is a further object of this invention to provide a two-hand control for fluid-operated presses which, besides compelling the operator to actuate, hold and release the switches in the prescribed order so that he cannot become caught between the jaws of the closing press as a result of his carelessness, will avoid bringing into play the holding circuit should the press close by accident, as by reason of a failure of parts normally holding the press in the open position.

Another object of the invention is to provide a two-hand safety control for fluid-operated machines requiring for the establishment of the holding circuit first the depression and afterwards the release of both manually operable switches, each of these switches controlling two circuits in such a manner that opening of the circuits will take place with a short time delay.

It is a further object of the invention to provide a two hand control for fluid-operated presses in which the two manually operable switches are equipped each with two switching members which are displaceable relatively to each other.

It is a still further object of the invention to provide a two-hand control for fluid-operated presses in which one of the two switching members of each of the two manually operable switches can open only after the other switching member of the same switch has reached its closing position.

Another object of the invention resides in the provision of two circuits controlling the fluid supply to the press, one of said circuits being closable by the actuation of the two manually operable switches and the other circuit being closable by the release of both switches after this latter circuit has been preconditioned as a consequence of the closing of the first named circuit.

Still another object of the invention is to provide a relay for preconditioning the holding circuit, such relay comprising a coil arranged in parallel to both circuits which control the fluid supply to the press, whereas the armature of the relay forms a switch in the holding circuit.

Further objects of the invention will appear as the description proceeds, reference being had to the accompanying drawing in which:

Fig. 1 shows by way of example an elevation, partly in section, of a fluid-operated garment press embodying my invention; and

Fig. 2 is a sectional view of a modified form of one of the manually operable switches.

For the sake of clearness I have shown in Fig. 1 the two manually operable switches at a larger scale than the other parts of the machine and at a place removed from the machine whereas in practice they are arranged at the front of the machine as indicated in dash and dot lines in the drawing.

The garment press shown comprises a movable pressing head 1 and a stationary pressing buck 2, the latter being supported by a frame 3. Pivotally mounted at 4 on the frame 3 is a yoke 5 which carries at its forward end the movable pressing head 1 while a rear extension 5' of the yoke 5 is acted upon by a spring 6 and also by an oscillating lever 7. The spring 6 tends to lift the pressing head 1 and thereby to open the press, whereas the lever 7 is adapted to bring the head 1 into engagement with the buck 2. The lever 7 is fulcrumed at 8 and is actuatable by a piston rod 9 attached to a piston 10 in a cylinder 11 so as to move the head 1 towards the closed position when pressure fluid, e. g., compressed air, is admitted to the cylinder 11 through a conduit 12. The supply of pressure fluid to the cylinder 11 is controlled by a valve 13 which may be of the well known three-way type having a normally closed inlet conduit 14 and a normally open exhaust conduit 15. The valve 13 can be actuated

by a solenoid 16 which, when energized, moves the valve 13 into its actuated position in which it admits pressure fluid from the conduit 14 through the conduit 12 to the cylinder 11. The solenoid 16 can be supplied with current from a current source L_1, L_2 over one of two circuits which are controlled by two double-throw switches, generally indicated as A and B. The switches A and B are spaced apart wide enough to force the operator to use both hands to operate them. Each switch comprises a knob 31 on a stem 17. Fixedly mounted on said stem 17 are two collars 18 and 19, slideably mounted on the stem are two switching members 20 and 21. A spring 22 situated between the switching members 20 and 21 tends to separate these members. Another spring 30 is arranged below the lower collar 19, tending to move this collar and the stem 17 upwardly. The switching member 20 of each switch A, B is adapted to establish connection between contact points 23, 24 of a line 25, whereas the switching member 21 is adapted to connect contact points 26, 27 situated in a line 28. The contact points 23, 24, 26, and 27 may be constructed in any suitable manner, such as in the form of contact springs. The distance between the two collars 18, 19 is appreciably larger than the distance from the contact points 23, 24 to the contact points 26, 27.

When the switches A and B are in the released position shown in the drawing, the switching member 20 of each switch is held against the contact points 23, 24 by means of the spring 22, so that the line 25 is closed. The switching member 21, although being urged downwardly by the spring 22, cannot make contact with the contact points 26, 27 because it is held by the collar 19 which is balanced by the spring 30.

Upon pushing down the knob 31 of either switch, the stem 17 is moved downwardly carrying with it the collars 18, 19. As the distance between these two collars 18, 19 is larger than the distance from the contact points 23, 24 in line 25 to the contact points 26, 27 in line 28, the spring 22 may expand, forcing the switching member 21 to follow the advancing lower collar 19, while still holding the other switching member 20 pressed against the contact points 23, 24. The spring 22 will expand until the member 21 is stopped by the contact points 26, 27. The distance between the collars 18, 19 is so chosen that the collar 18 will meet the switching element 20 and force it out of contact with the contact points 23, 24 in line 25 only after the collar 19 has descended far enough to allow the switching member 21 to reach the contact points 26, 27 and thereby to close the line 28. There will be, therefore, a short period during the actuation of the switch when both switching members 20 and 21 are keeping connected their respective contact points. After this period the collar 18 reaches the switching member 20 and forces it down against the action of the spring 22 which is bearing against the now blocked member 21. The connection between the contact points 23, 24 is thus broken and kept broken until the knob 31 is released by the operator.

When the knob 31 is released the stem 17, urged by the spring 30, moves upwardly. On account of the spacing of the two collars 18, 19 described above, the lower collar 19 does not meet the lower switching member 21 until the stem 17 has moved already an appreciable distance, the collar 18 freeing thereby the switching member 20 to connect the contact points 23, 24 in line 25. The contact points 26, 27 in line 28 remain connected by the switching member 21 until the ascending collar 19 reaches this member and lifts it out of contact with the contact points 26, 27 into the position shown in the drawing, which is the position in which the effects of the two springs 22 and 30 are in balance.

The line 25 leads from the supply terminal L_2 to a limiting switch 32 which can be closed by an adjustable screw member 33 carried by the yoke 5. The member 33 closes the switch 32 when the yoke 5 has brought the movable head 1 of the press into a position in or close to engagement with the buck 2. The switch 32 is connected by a lead 34 to a contact 36 of a timing device 35. This timing device may comprise in a manner well known a bimetal strip 37 which, when cold or below a certain temperature, keeps the contact 36 closed, but breaks this contact 36 when warmed up above that temperature. A heater coil 38 arranged in parallel to the solenoid 16 provides that heating of the strip 37 starts when the press head 1 starts to close, and is maintained as long as the solenoid 16 is active. If desired the heater coil 38 can be arranged in parallel with the contacts 36 and 37, instead of with solenoid 16, so that when current is flowing through lines 34 and 39 it will also be flowing through the heater coil 38. A connection 39 leads from the bimetal strip 37 of the timer 35 to an armature 40 which is operable by a relay coil 41. The coil 41 is arranged in parallel to the solenoid 16 and one end of the coil is connected to a point 42 of the line 28 and further to a normally open contact 43 to be closed by the armature 40 when the coil 41 is energized.

To close the press, the operator depresses the button 31 of both switches A and B establishing thereby a circuit from L_1 over the solenoid 16, point 42 and the line 28, which is closed by the depressed switching members 21, to L_2. The solenoid 16 being thus energized actuates the fluid valve 13 so as to supply pressure fluid, e. g. compressed air, to the cylinder 11 and thereby to cause closing of the press. Simultaneously with the solenoid 16 the relay coil 41 is energized attracting its armature 40 and closing thereby the contact 43. The heater coil 38 of the timer 35, being also in parallel connection to the solenoid 16, is energized too and starts heating the bimetal 37 which at this time is cold and keep the contact 36 closed.

While the pressing head 1 is moving towards the safe (closed) position, the screw member 33 carried by the yoke 5 is moving towards the contact 32 and upon the head 1 reaching the safe position the member 33 reaches and closes the contact 32. Thereby a holding circuit is prepared extending from L_1 over the relay coil 41, point 42, contact 43, relay armature 40, timer contacts 37, 36 line 34, and contact 32 to line 25. To complete this holding circuit, line 25 has to be connected to the supply lead L_2, which requires that the operator releases both switches A and B so that the switching members 20 of these switches may connect their respective contact points 23, 24. It will be seen that the relay coil 41 is arranged in parallel to both the circuits provided for energizing the solenoid 16 which have just been described, and that these two energizing circuits are interdependent not only in that the holding circuit over line 25 which contains the timer contacts 36, 37 cannot be established without having been preconditioned at 43 by a previous operation of the circuit over line 28, but

also in the respect that to establish the holding circuit over line 25 the operator must release approximately simultaneously both switches A and B after the switch 32 has been closed. If the operator releases one of both switches A, B before the switch 32 has been closed, the solenoid 16 will become deenergized and the press will open under the pulling action of the spring 6. If after closure of the switch 32 the operator releases one switch only, for example the switch A, both energizing circuits for the solenoid 16 will be interrupted, since the switch A will interrupt line 26 and the switch B will keep interrupted line 25. The operator must, therefore, depress both switches to initiate the closing of the press and must release both switches to establish the timer circuit which keeps the press locked. As has been described, each switch A, B act in such a manner that one switching member closes its circuit before the other switching member breaks its circuit. This assures also the correct operation of the safety device in case the operator does not release both switches at exactly the same moment. The time difference between the closing of the line 25 and the breaking of the line 28 by the switch released first will allow the operator to follow up with the second switch in time to have both switching members 20 in the closing position before the switching member 21 of the switch released first has moved away from its contact points 26, 27. This time delay is, however, too short to allow the operator to reach between the closing parts 1, 2 of the press if he should attempt to do so at a time when the head 1 is about to close.

As a measure to prevent a too snappy action of the spring 30 and to allow for any lack of synchronism in the release of the two switches A, B by the operator, some suitable buffer or damping device may be used in connection with the switches A, B. As an example of such a damping device I have shown in Fig. 2 a switch equipped with a dash-pot. The stem 17 of the switch which is otherwise the same as the switches shown in Fig. 1 carries at its lower end a plunger 45 which is movable in an oil-filled chamber 44. An oil passage 46 in the plunger 45 is closable by a flap 47 or the like arranged at the upper side of the plunger 45. When the plunger 45 is moved downwardly by the stem 17 the passage 46 remains open so that the switch can be depressed easily, whereas on release of the switch the flap 47 closes the passage 46 as soon as the stem 17 starts its upward movement, providing thereby a delay in the action of the spring 30. It will be understood that the delaying action of such a dash-pot or other damping device must be kept within narrow limits. If too long a delay would be introduced by the damping device the safety feature aimed at by the present invention would be defeated for if the operator intentionally released both hands the press would be slow in responding and, therefore, might coast on a short distance. Accordingly the delay secured by the dash-pot must be held to a very small part of the time which it normally takes to get the machine to the point where the operator's attention is no longer needed. Thus, if the closing time of the garment press which is used as an illustration is one second, the lag of the switch created by the dash-pot should not be over $1/25$ second.

The holding circuit over line 25 being established in the manner described, the press will remain closed under pressure until the timer 35 breaks automatically this holding circuit after a preset period of time. The holding circuit can also be interrupted at will by pressing down one or the other switch A, B. In both cases the solenoid 16 and the relay coil 41 becomes deenergized, so that the supply of pressure fluid to the cylinder 11 is cut off and the contact 43 is broken. The contact at 43 cannot be reestablished by means other than the actuation of both switches A and B. The safety of the operator requires at the time of closing that her hands be occupied even if thereby the operator is prevented from using either hand to get ready for the next operation. No such requirement exists in opening the press and as one operator often attends to more than one press there is a distinct advantage in the operator being able to open the press by using but one hand and that the operator can use either hand to do that, leaving either the right or the left hand available for some other task.

Accidents with fluid-operated presses have been experienced as a consequence of a failure in the fluid supply with the current supply intact. Whereas such an interruption of the fluid supply is not dangerous as long as the interruption takes place before the holding circuit is completed, an additional element of danger is introduced if the failure in the fluid supply occurs at a time when the press has closed already and is held locked by the holding circuit which at the same time keeps the fluid valve open. If the holding circuit were allowed to stay closed in spite of such a failure in the fluid supply, the press would close automatically as soon as fluid were supplied again and the operator might be caught unawares. This danger can be avoided by providing means which open the holding circuit if the air supply fails. In the device shown in Fig. 1 this purpose is achieved by a suitable arrangement of those elements only which are instrumental in controlling the holding circuit under normal fluid supply conditions. In the event of an interruption of the fluid supply while the current supply is intact, the fluid valve 13 will remain open but no fluid will pass through it to the cylinder 11. Therefore, the spring 6 will be free to open the press, which in turn opens the limiting switch 32. As the relay coil 41 lies in series with the limiting switch 32, the opening of this limiting switch will cause deenergization of the relay coil 41 and thereby the opening of the conditioning contact 43. With the contact 43 open, however, no accidental closing of the press is possible when the fluid supply starts working again because, as has been explained before, the contact 43 when once broken can be reestablished only by pressing down both switches A and B. It will be obvious that the same arrangement will also prevent accidental closing of the press should the same have been locked by the holding circuit and then have become opened on account of a failure in the current supply. In this case too, the opening of the limiting switch 32 will bring with it the opening of the contact 43 so that when current becomes available again there will be no circuit ready for actuating the solenoid 16 until the operator depresses again the two switches A and B.

While I have shown and described a certain embodiment of the invention, it is to be understood that this embodiment has been given by way of example only and that various changes, rearrangements and modifications may be made without departing from the spirit of the invention or from the scope of the appended claims. For example, while the invention has here been shown as applied to a garment press, this in-

vention is equally applicable to other fluid-operated machines in which there is greater danger to the operator during the initial stages of the operation of the machine than during the later part of the operation, and while a press has been shown in which the fluid is air it will be understood that the fluid might be steam or a liquid under pressure. With steam or a liquid used as the pressure fluid it would naturally be necessary to provide a pipe to conduct the exhaust at 15 away from the machine.

What I claim is:

1. In combination, fluid-operated means, electric means for controlling the supply of fluid to said fluid-operated means, two electric circuits each containing said electric means for controlling the fluid supply, two manually operable switches each having a pair of switching elements, each element of each pair being adapted to open or close one of said two circuits, and means holding one of said elements of each pair, against assuming its opening position until the closing position of the other element of the same pair has been reached.

2. In combination, fluid operated means, electric means for controlling the supply of fluid to said fluid-operated means, two electric circuits each containing said electric means for controlling the fluid supply, two manually operable switches each having a pair of switching elements, each element of each pair being adapted to open or close one of said two circuits, and means allowing opening of either of said elements only after the closing position of the respective other element of the same pair has been reached.

3. In combination, fluid-operated means, electric means for controlling the supply of fluid to said fluid-operated means, two electric circuits each containing said electric means for controlling the fluid supply, two manually operable switches, said switches comprising each a stem, two collars fixed on said stem, two switching elements each adapted to connect or disconnect one of said two circuits and slideably disposed on said stem between said two collars, and resilient means for urging apart said switching elements.

4. In combination, fluid-operated means, electric means for controlling the supply of fluid to said fluid-operated means, two electric circuits each containing said electric means for controlling the fluid supply, two manually operable switches, said switches comprising each a stem, two collars fixed on said stem, two switching elements each adapted to connect or disconnect one of said two circuits and slideably disposed on said stem between said two collars, and resilient means for urging apart said switching elements, the distance between said two collars being larger than the distance between the closing positions of the two switching elements of each pair.

5. In a garment press, fluid-operated means adapted to close the press and hold it closed under pressure, a solenoid for controlling the supply of fluid to said fluid-operated means, two electric circuits for alternately supplying said solenoid with current, a relay having a coil and a armature, said relay coil being arranged in parallel to said solenoid as well as being a part of each of said circuits, and said relay armature forming a switch in one of said circuits so as to precondition said circuit while the other circuit is active.

6. In a garment press, fluid-operated means adapted to close the press and hold it closed under pressure, a solenoid for controlling the supply of fluid to said fluid-operated means, two electric circuits for alternatively supplying said solenoid with current, a relay having a coil and an armature, said relay coil being arranged in parallel to said solenoid and said relay armature forming a switch in one of said circuits so as to precondition said circuit while the other circuit is active, two manually operable switches, said switches comprising each a pair of switching elements, each element of each pair being adapted to open or close one of said two circuits, and means allowing opening of either of said elements only when the closing position of the respective other element of the same pair has already been reached.

7. In a safety control for fluid-operated garment presses of the kind in which, to close the press, the operator must actuate two switches and hold them until the press has reached a safe position, the combination of electric means for controlling the fluid supply to the press with two circuits, the one closable by the actuation of said two switches and the other closable only after having been preconditioned on account of the first named circuit being closed and upon release of both said switches, said electric means being arranged in parallel to means adapted to actuate a contact in the second named circuit so that said contact is kept closed as long as said fluid supply is operated, each of said switches having a pair of switching elements, each element of each pair being adapted to open or close one of said circuits, the two elements of each pair being movable relative to each other, and means allowing the element belonging to the first-named circuit to occupy its opening position only after the closing position of the other element of the same pair has already been reached.

8. In a garment press, fluid-operated means adapted to close the press and hold it closed under pressure, a solenoid for controlling the supply of fluid to said fluid-operated means, two electric circuits for alternatively supplying said solenoid with current, a relay having a coil and an armature, said relay coil being arranged in parallel to said solenoid and said relay armature forming a switch in one of said circuits so as to precondition said circuit while the other circuit is active, two manually operable switches, said switches comprising each a stem, two collars fixed on said stem, two switching elements each adapted to connect or disconnect one of said two circuits and slideably disposed on said stem between said two collars, and resilient means for urging apart said switching elements, the distance between said two collars being larger than the distance between the closing positions of the two switching elements of each pair.

9. In a safety control for electrically controlling a machine, means for compelling a full actuation of the control by both hands of the operator, comprising, in combination, a starting circuit, a holding circuit, a relay in said starting circuit for conditioning said holding circuit, two switching elements in said starting circuit, two switching elements in said holding circuit adapted to maintain the operation of the machine after that holding circuit has been preconditioned by the starting circuit, two manually operable devices, each adapted to close one of the switching elements of the starting circuit and to break one of the switching elements in the holding circuit, spring

means for restoring the devices to their initial position upon release by the operator, means for correcting slight lack of synchronism in the release of said two devices by the hands of the operator comprising means actuated by the spring means of each device to first close the holding circuit and after a delay to break the starting circuit during which delay the device released slightly later may close the holding circuit before loss of preconditioning by the opening of the starting circuit.

10. In a garment press, fluid-operated means adapted to close the press and hold it closed under pressure, spring operated means for opening the press and keep it open, electric means for controlling the supply of fluid to said fluid-operated press-closing means, two electric circuits for alternatively supplying said electric means with current, two manually operable switches each comprising a pair of switching members, each member of each pair being adapted to open or close one of said circuits, one of said circuits being closable by the actuation of both said switches and the other circuit being closable only after having been preconditioned on account of the first named circuit having been closed and upon releasing both said switches, so that actuation or release of only one of said switches will allow said spring actuated means to open the press.

11. In an electric safety control for fluid-operated presses of the kind in which, to close the press, the operator must actuate two switches and hold them until the movable press head has reached a safe position, in combination, fluid-operated means adapted to close the press and hold it closed under pressure, spring operated means for opening the press and keeping it open, electric means for controlling the fluid supply to the press, a starting circuit closable by the actuation of said two switches, a holding circuit closable only after having been preconditioned on account of said starting circuit being closed and upon release of both said switches, and means for eliminating the preconditioning of said holding circuit upon a failure in the fluid supply occurring at a time after said holding circuit has been completed by the release of said two switches.

12. In an electric safety control for fluid-operated presses of the kind in which, to close the press, the operator must actuate two switches and hold them until the movable press head has reached a safe position, in combination, fluid-operated means adapted to close the press and hold it closed under pressure, spring operated means for opening the press and keeping it open, electric means for controlling the fluid supply to the press, a starting circuit closable by the actuation of said two switches, a holding circuit closable only after having been preconditioned on account of said starting circuit being closed and upon release of both said switches, said electric means being arranged in parallel to conditioning means adapted to actuate a contact in the holding circuit, and means for eliminating the preconditioning of said holding circuit upon a failure in the fluid supply at a time after said holding circuit has been completed by the release of said two switches, said last named means comprising a limiting switch operable by the movable press head and adapted to open when said movable press head is in any position other than the safe position, said limiting switch being arranged in series to said conditioning means.

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