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MULTIPLE OVERLOAD PRESS PROTECTION DEVICE AND ADJUSTABLE PRESS TONNAGE DEVICE

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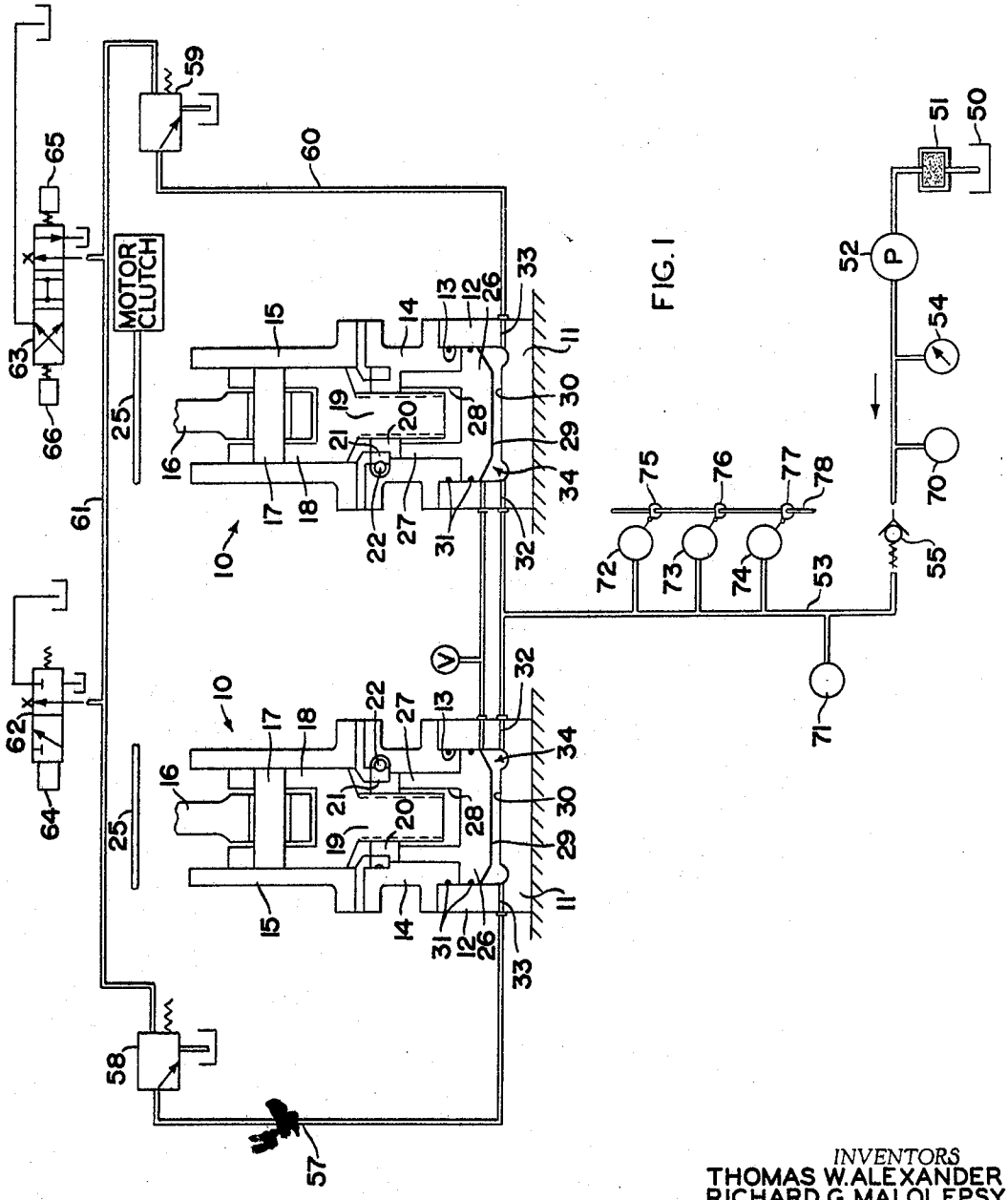
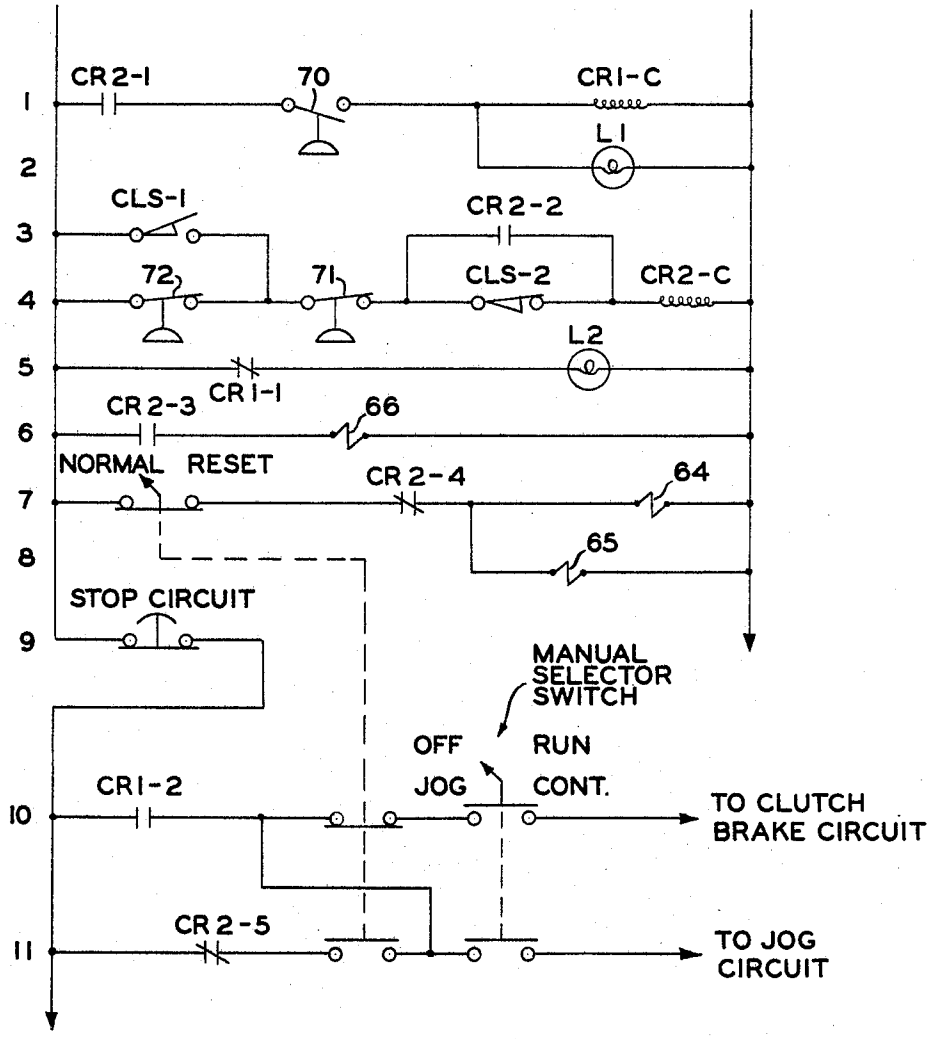


FIG. 1

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FIG. 2



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MULTIPLE OVERLOAD PRESS PROTECTION DEVICE AND ADJUSTABLE PRESS TONNAGE DEVICE

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U.S. Cl. 72—20 9 Claims

ABSTRACT OF THE DISCLOSURE

A plurality of hydraulic pressure switches are sequentially actuated by cams with each switch being set for the press tonnage developed at a particular part of the press stroke and operable only during that part of the stroke. In the event an overload condition is present at any point in the press stroke, the appropriate switch senses such overload, relieves the hydraulic system and discontinues operation of the press. By adjusting the pressure at which the switches are actuated, the maximum tonnage generated by the press may also be adjusted.

This invention relates to power presses and more particularly to an overload protection device for such presses.

It is not an unusual occurrence that a press is subjected to an overloaded condition. This condition may occur where a press is employed in attempting to form metal blanks of a thickness in excess of the rated capacity of the press or it may result where more than one blank of metal is inserted in the press simultaneously. An overload condition may also occur where the necessary adjustments in the press have not been made to accommodate the particular type of metal on which the press is operating or for any of a number of other reasons such as the presence of tools inadvertently left in the press. Inevitably such overloading causes damage to the press resulting in delays which are costly both from the standpoint of time lost in the operation of the press as well as the expense necessary to repair the damaged parts of the press.

In view of the serious consequences of overloading a press, the prior art has provided various types of overload devices which are designed to discontinue operation of the press when an overload condition occurs. Typically, these prior art devices have been incorporated either in the slide assembly of the press, the press tie rods or in the bed of the press. These overload systems are usually of a hydraulic nature with the compression of hydraulic fluid above a certain predetermined level signalling the presence of an overload condition and a relief valve is then actuated to vent the hydraulic fluid while, simultaneously, the drive system of the press is deactivated.

Although the prior art overload relief systems have been satisfactory to sense and prevent an overload condition, these systems have been operative only when the full rated tonnage of the press is exceeded. The maximum rated tonnage of a press is normally developed at or near the bottom of the press stroke. It will be appreciated that the press may be overloaded by the development of rated tonnage at some point in the stroke other than near the bottom which may be the cause of damage to the press. However, since the overload system is set for operation only when the maximum rated tonnage is exceeded, the overloaded condition will not be sensed. As a result, there has been no overload protection for the press at any point in the press stroke other than near the bottom. Some of the prior art systems can be adjusted to be actuated at levels other than when the full tonnage of the press is exceeded. However by so doing, this limits the press in that the full tonnage of the press cannot be utilized. Moreover, even by so adjusting the prior art systems, there is no protection available for the press at any point during the press stroke other than as it exceeds the maximum tonnage for which the overload system is set.

I is an object of this invention to provide an improved press protection system.

More particularly, the primary object of this invention is to provide a multiple overload press protection device.

It is a further object of this invention to provide a press protection system having greater flexibility than was heretofore obtainable.

It is another object of this invention to provide a press protection system which may be used to sense the presence of an overloaded condition at any point in the press stroke.

A further object of this invention is the provision of an overload sensing system which may be employed to sense the presence of an overload at any point in the press stroke without limiting the utilization of the full rated tonnage of the press.

Another object of the invention is to provide an overload sensing system which is effective to sense the pressure of an overloaded condition at a plurality of points in the press stroke.

It is a still further object of this invention to provide a press protection system which may be used to adjust the maximum tonnage generated by the press.

A further object of the invention is to provide a system which may be used to adjust the maximum tonnage developed by the press and may also be used to provide an overload protection for the press during various stages of the press stroke.

These objects, as well as other objects and advantages which will be apparent to those having ordinary skill in the art, are achieved through the use of an overload protection system which is centered around the slide mechanism of the press. Thus, prior art slides have employed a fluid chamber in the slide mechanism with the hydraulic fluid in the chamber being used in the overload sensing system. This same hydraulic fluid chamber is used in the present invention. However, a plurality of pressure sensing switches are included in the system together with relief valves and single or multiple solenoid operated dump valves. One of the hydraulic pressure switches is normally set to be actuated when the full tonnage contemplated for the press is exceeded. When actuated, this switch operates the solenoid dump valves which in turn vent the fluid in the system. The other hydraulic pressure sensitive switches are set at various pressure levels which correspond to the particular press tonnage desirably developed at various stages of the press stroke. These latter switches are actuated by cams in the press cam limit switch with each pressure switch being controlled by a separate cam so that each switch is operative only during a predetermined portion of the press cycle. When a particular switch is operable, and if an overload condition is present, the switch actuates the solenoid valves to vent the system and discontinue operation of the press. Any number of pressure switches may be employed thereby providing accurate control over the stresses imposed on the press throughout its operating cycle.

A more complete understanding of the invention will be had from reading the following description in connection with the drawings wherein like reference numerals indicate like parts in the various views.

FIGURE 1, is a diagrammatic view of the various components of the hydraulic system comprising the present invention.

FIGURE 2, is a schematic diagram of a representative

electrical circuit useable with the hydraulic system of the instant invention.

Referring now to FIGURE 1, there are illustrated a pair of substantially conventional slide mechanisms for a power press, indicated generally by the reference numeral **10**. These slide mechanisms are adapted to be employed in a press of a conventional construction as will be understood by those having ordinary skill in this art. Each slide **10** includes a lower portion **11** adapted to support a die member and a slide adjustment assembly which includes cylinder member **12**. The cylinder includes a central opening **13** with a cylindrical intermediate member **14** connected, as by bolts, to the cylinder **12**. A sleeve **15** is secured by bolts to the member **14**. A pitman or connecting rod **16** is secured by a wrist pin **17** to a connection wrist **18**. The connection wrist has a sliding fit with the sleeve **15** and includes a threaded extension **19** which is threaded in engagement with a nut **20**. The nut **20** is driven by a worm gear **21** which in turn is rotated by a screw **22** carried in the cylindrical member **14**. It will be appreciated that as the screw **22** is rotated, the nut **20** is also rotated causing the connection wrist **18** to be displaced along the length of the sleeve **15**. This mechanism, which is essentially conventional in construction, normally comprises the slide and slide adjustment mechanism found in many presses. Also, as is conventional with presses of this type, the connecting rod **16** is adapted to be actuated by a crank shaft **25** (the interconnection not being shown) in a manner well known in the art. The crank shaft **25** is driven by an appropriate source of power which is connected through a clutch arrangement to the crank shaft.

The precise details of the slide and the slide adjustment mechanism form no part of this invention and it will be appreciated that many other constructions of slides and slide adjustment mechanisms may be employed without departing from the principles of the invention.

Incorporated in the cylindrical recess **13** in the slide adjustment assembly is a piston **26**. The piston is reduced in diameter at its upper portion **27** to fit within the cylindrical member **14**. A central recess **28** in the piston accommodates the extension **19** of the connection wrist **18**. The piston is so dimensioned that when the upper portion **27** of the piston is in engagement with the nut **20**, the lower surface **29** of the piston is spaced from the bottom wall **30** of the recess **13**, thereby defining a fluid chamber **34** between the piston **26** and the member **12**. Appropriate seals **31** may be carried by the piston **26** as well as the cylindrical member **14**. The member **12** further includes entrance and exit ports **32, 33** are in communication with the fluid chamber **34** with the ports being adapted to be connected to fluid lines as will be more fully hereinafter described.

The above described mechanism thus defines a fluid chamber in which hydraulic fluid may be subjected to pressure as the press is operated. It will be appreciated that the pressure created on the hydraulic fluid may be used as a means for sensing an overload condition. Although the fluid chamber **34** in which the fluid is placed has been described in connection with a slide mechanism, it is to be understood that the present invention is not restricted to a slide mechanism and may be incorporated in any portion of the press that is subjected to loading throughout the cycle of operation of the press.

By injecting fluid into the fluid chamber **34** under a predetermined pressure, the piston **26** is held in the position illustrated in FIGURE 1 and the entire slide mechanism is, due to the essential incompressibility of the fluid, an unitary rigid connection. However, the pressure on the fluid in the fluid chamber will vary as the slide goes through the various phases of its stroke and as different types of work are performed. The varying pressure applied to the fluid thus provides a potential method of sensing the presence of an overload condition at any particular point in the press cycle and it is a system for sensing this condition that will now be described.

A source of hydraulic fluid, indicated at **50**, is available for the system. This fluid is passed through a filter **51** and supplied under pressure to the system by a pump **52**. The pump may be either air or electric operated. The fluid is supplied through a line **53** with a gauge **54** indicating the pressure level. The fluid passes through a check valve **55** and into the fluid chamber **34**. As illustrated, two cylinders are supplied with fluid by the same system but it will be appreciated that either more or less than that number of cylinders may be employed.

A fluid line **57** is connected to the outlet port **33** and this line is connected to a relief valve **58**. A similar relief valve **59** is connected to a fluid line **60** which is in fluid communication with the fluid chamber in the other of the slide mechanisms. Both relief valves **58** and **59** are preset to vent fluid in lines **57** and **60** only above a predetermined level of pressure. This pressure ordinarily is somewhere near the maximum tonnage for which the press is rated plus a certain percent of overload.

A vent line **61** is common to both valves **58, 59** with a solenoid valve **62** and a further solenoid valve **63** in fluid communication with the line **61**. The solenoid valve **62** is normally closed and is opened only when the solenoid **64** is energized. The valve **63** is normally closed when the solenoid **66** is energized and opened when solenoid **65** is energized. However, it is to be understood that the valves **62** and **63** may operate in the reverse manner and be normally open with energization of the solenoids holding the valves closed. The arrangement here illustrated is only by way of example and the relationship between the normally open or normally closed position and energization of the solenoids may be varied depending on the electrical circuit used as well as other factors.

The relief valves **58, 59** are of a conventional balanced piston construction such as a Vickers valve and it is believed that a detailed description of their working mechanism is unnecessary. Although, two such relief valves have been illustrated, it is to be understood that a different number of relief valves may be employed and the number which may be used with any particular system is not limited.

Included in the system are a plurality of hydraulic pressure switches. One such pressure switch **70** is used as a preload pressure switch with another pressure switch **71** serving as a full overload tonnage pressure switch. In addition, there are illustrated in FIGURE 1 pressure switches **72, 73, 74** all of which are in fluid communication with line **53**. The pressure switches **72, 73, 74** are set for various pressures which correspond to the maximum press tonnage suitable for a particular portion of the press stroke. Each of the pressure switches is controlled by a separate cam **75, 76, 77** which are a part of the press cam limit switch mechanism. The relationship of the cams to the switches is only schematically illustrated in FIGURE 1 and it will be understood that the cams, in practice, may control the switches in various ways, such as shown in FIGURE 2. These cams rotate on a one-to-one ratio with the press crank shaft **25** so that the cams are precisely timed to the operation of the press. The cams are such that they may be adjusted on the cam shaft **78** in the event that the timing is to be adjusted. The cams control the operation of the pressure switches **72, 73, 74,** so that each switch is operative only during a predetermined portion of the press cycle.

The pressure switches **71, 72, 73, 74** are electrically connected to the solenoid valves **62** and **63** and control the operation of these valves. FIGURE 2 is a schematic diagram of an electrical circuit which may be used with a system such as that hereinabove described. Only one pressure switch **72** is shown in this circuit in addition to the full overload pressure switch **71** but it will be appreciated that a similar circuit arrangement would be employed for the pressure switches **73, 74**. The circuit shown in

FIGURE 2 illustrates the condition of the components when the press is stopped and the slide is at the top of its stroke.

Referring more specifically to the circuit shown in FIGURE 2, a pair of relays are illustrated with the first relay having a coil CR1–C in line 1, normally closed contacts CR1–1 in line 5 and normally open contacts CR1–2 in line 10. The other relay has a coil CR2–C in line 4 with normally open contacts CR2–1 in line 1, CR2–2 in line 3 and CR2–3 in line 6. The second relay further includes normally closed contacts CR2–4 in line 7 and CR2–5 in line 11. A preload light L1 is in line 2 and an overload light L2 is in line 5. A cam limit switch CLS–1 is in line 3 and a second cam limit switch CLS–2 is in line 4. The circuit further includes a manual selector switch and a manual stop button as is conventional.

When the circuit is in the condition illustrated in FIGURE 2, the coils CR1–C and CR2–C are de-energized and the lights L1 and L2 are off. When the press is running, the preload switch 70 is closed, the coils CR1–C and CR2–C are energized, closing contacts CR2–3 and opening contacts CR2–4 and CR2–5. Thus, solenoid 66 is energized and solenoids 64 and 65 are de-energized.

The cam limit switch CLS–1 is controlled by a cam on the cam shaft which may be adjusted to operate to close the switch when the slide is a predetermined distance up from the bottom of the stroke through 270°. With the switch CLS–1 closed, the pressure switch 72 is rendered ineffective and the presence of an overload in the system is sensed only by the pressure switch 71.

In the event, the pressure switch 71 is actuated, the light L2 signals the presence of the overload, the relay coils CR1–C and CR2–C are de-energized and the various relay contacts are returned to their original position stopping the press. A similar condition exists when the pressure switch 72 is actuated with the limit switch CLS–1 open.

The press with the overload system hereinabove described operates in the following manner. To actuate the press, the pump 52 is operated and fluid is drawn from the tank 50 and introduced through line 53 to the fluid chambers 34 in the slide mechanisms 10. The preload switch 70 is set to be actuated after a predetermined fluid pressure build up has occurred. When this pressure level has been achieved the switch 70 is closed energizing coil CR1–C and closing contact CR1–2 thereby actuating the clutch and brake circuit. Also coil CR2–C is energized which results in the energization of solenoid 66 and the de-energization of solenoids 64 and 65 so that the valves 62 and 63 are closed. Operation of the press may then commence. As the press is operated, the cams controlling the pressure switches 72, 73, 74 are operative to actuate each of the cams sequentially at the appropriate predetermined portion of the stroke. In the event that an overload condition exists at the portion of the stroke when any particular pressure switch is activated, the pressure switch will sense the overload condition and the switch will be opened. The opening of the switch will de-energize coil CR2–C causing contact CR2–4 to be closed and the solenoids 64, 65 to be energized. The energization of the solenoids 64, 65 opens valves 62, 63 and thence line 61 to reduce the hydraulic pressure in the line to close to zero. When the fluid pressure in line 61 is reduced, an unbalanced condition exists between line 61 and lines 57 and 60 causing the relief valves 58, 59 to become unbalanced. In this condition, the relief valves open to relieve the pressure in the overloaded cylinders. As the pressure is reduced, the pressure switch 70 opens, de-energizing coil CR1–C which opens contact CR1–2 and the press is stopped.

In the event that the overload condition exists when the full tonnage of the press is being generated, the hydraulic pressure switch 71 will be opened and the hydraulic and electric circuits will be operated in the above described manner to vent the hydraulic fluid from the overloaded cylinders and the press will be stopped. Unlike switches 72, 73, 74, the full tonnage pressure switch 71 is not controlled by any cam since its function is to operate solely at a predetermined point in the stroke, that is, at or near the bottom.

It will be appreciated that many variations in the above described system may be made. For example, instead of employing two solenoid valves, it might, in some circumstances, be satisfactory to use but a single solenoid dump valve. Moreover, the actuation of the solenoid valves may be selective depending on the particular pressure switch actuated. Thus, the full tonnage pressure switch 71 may be employed only to actuate the dump valve 62 with the dump valve 63 being actuated by the pressure switches 72, 73, 74. However, by using two dump valves and having both valves actuated by any of the pressure switches 71, 72, 73, 74, a certain safety factor is available since the failure of one valve will not render the overload system inoperative. Moreover, the use of two dump valves decreases the time required to vent the line 61 and thereby decreases the time lag between the sensing of an overload condition and the stopping of the press.

Modifications such as these, as well as others which will be apparent to those having ordinary skill in the art, are intended to be included in the scope of this invention. The invention is not limited to any particular type of valve or any particular number of valves in the hydraulic system. In its broadest aspect, the invention requires merely a hydraulic system in which means are available to vent the system when an overload condition at any predetermined point in the cycle is signaled and the particular method of achieving the venting of the system may vary widely. What is important in achieving the objects set forth hereinabove is the provision of pressure sensing switches, in addition to the full tonnage overload pressure switch, which are controlled to be operative over a predetermined portion of the press cycle, thereby to sense the presence of an overload condition at less than full tonnage and, through appropriate means, signal the presence of the overload to cause the hydraulic system to be vented. The number of pressure switches employed will, of course, vary depending upon the particular application, as will the portion of the press cycle over which the pressure switches are operative. It is apparent, however, that through utilization of this invention, the entire stroke of the press may be monitored for an overload condition thereby precluding damage to the press.

Moreover, by adjusting the pressure level at which the pressure switches are activated and the cams that actuate the switches, the press tonnage can be adjusted up to the maximum rated tonnage of the press.

Having thus described our invention, we claim:

1. A press protection system for sensing the presence of an overload condition in a press, said press including force applying means, first and second members defining a fluid chamber therebetween and means subjecting said first and second members to loading over a predetermined cycle by said force applying means, the system comprising:

a fluid system for supplying fluid to said fluid chamber;

hydraulic pressure sensing means in the fluid system;

venting means in the fluid system operative to vent the system when actuated;

means operatively connecting said pressure sensing means with said venting means for actuating said venting means; and

control means operatively connected to said sensing means to render said sensing means operative only during a predetermined portion of the cycle of said force applying means.

2. The system of claim 1, wherein said pressure sensing means comprises a pressure actuated switch;

said venting means including solenoid actuated valve means; and

means electrically connecting said switch with said

solenoid valve means whereby the actuation of said solenoid valve is controlled by said switch.

3. The system of claim 2 and further including relief valve means in said fluid system;

said relief valve means being interposed in the system between said fluid chamber and said solenoid valve means; and

means hydraulically connecting said relief valve means with said solenoid valve means.

4. The system of claim 1 and including additional pressure sensing means in the fluid system operatively connected to said venting means;

said additional sensing means being independent of said control means and operative to actuate said venting means whenever the pressure in the system exceeds a predetermined level.

5. The system of claim 4, wherein said pressure sensing means comprise pressure actuated switches;

said venting means including solenoid actuated valve means; and

means electrically connecting said switches with said solenoid valve means whereby the actuation of said solenoid valve means is controlled by said switches.

6. The system of claim 5, wherein said venting means further includes relief valve means in the fluid system hydraulically isolating said solenoid valve means from said fluid chamber.

7. The system of claim 4, wherein said venting means includes a plurality of valves;

said additional sensing means being operative to actuate at least one of said valves when the pressure in said system reaches a predetermined level.

8. The system of claim 1, wherein said pressure sensing means comprises a plurality of pressure actuated switches;

each of said switches being operable at a different level of pressure and only during a predetermined portion of the cycle of said force applying means.

9. The system of claim 1, wherein said control means is connected to said force applying means.

References Cited

UNITED STATES PATENTS

2,358,269	9/1944	Wemhoner	72—20
2,382,041	8/1945	Ernst	72—20
2,382,046	8/1945	Flowers	72—20
2,569,034	9/1951	Auer	72—20

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