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[54] **CONTROL MEANS FOR PRESSURE RELIEF IN
HYDRAULIC MACHINES**
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137/492.5
[51] Int. Cl. **B30b 15/16**
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100/52, 53, 269, 256; 72/453, 441; 137/492.5;
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ABSTRACT: A control means for relieving pressure of the working fluid in a hydraulic operated machine having a press piston mounted for reciprocal movement in a hydraulic chamber with the chamber defining a piston working chamber portion and a piston return portion with a reservoir for a working fluid. The control means comprises a decompression valve body mounted in a valve chamber with one side of the body extending on one side of the valve seat and a second part of the body extending on a second side of the valve seat. Fluid communication means connect the valve chamber with the pressure chamber portion. A means for moving the body from the seat to cause the working fluid to initiate further movement of the valve body is provided. A switch means is operatively associated with the valve body with for returning fluid from the pressure chamber portion to the reservoir on the further movement of the valve body whereby progressive pressure relieving of the working fluid in the pressure chamber portion is carried out and brutal shocks which might damage material are avoided.

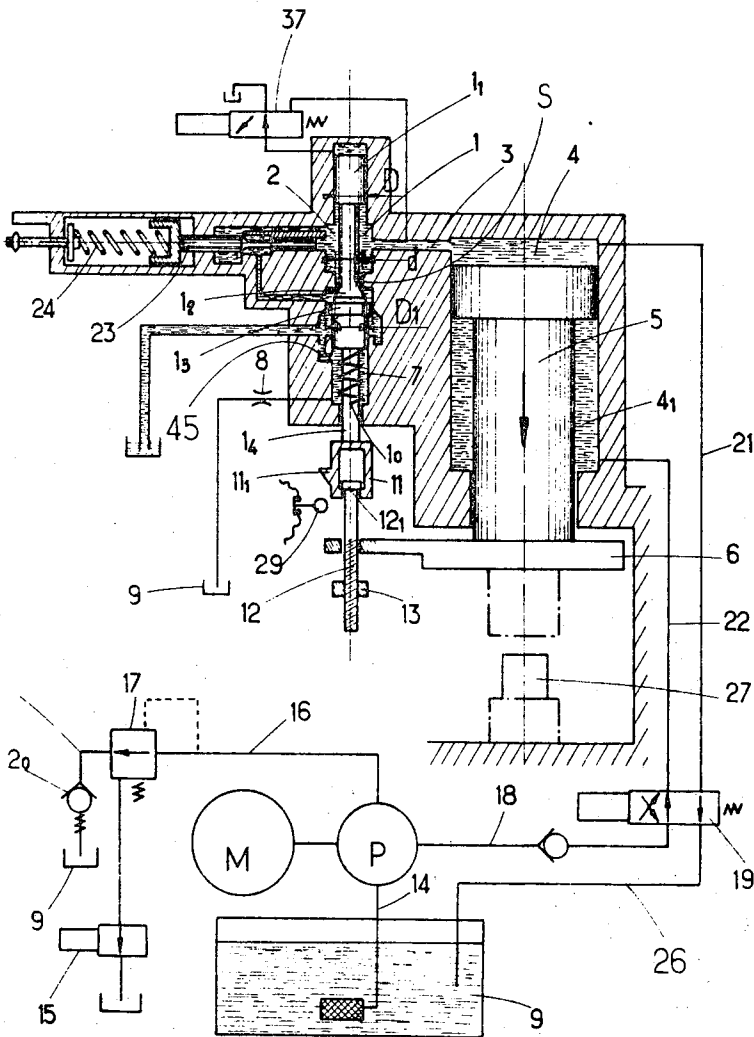
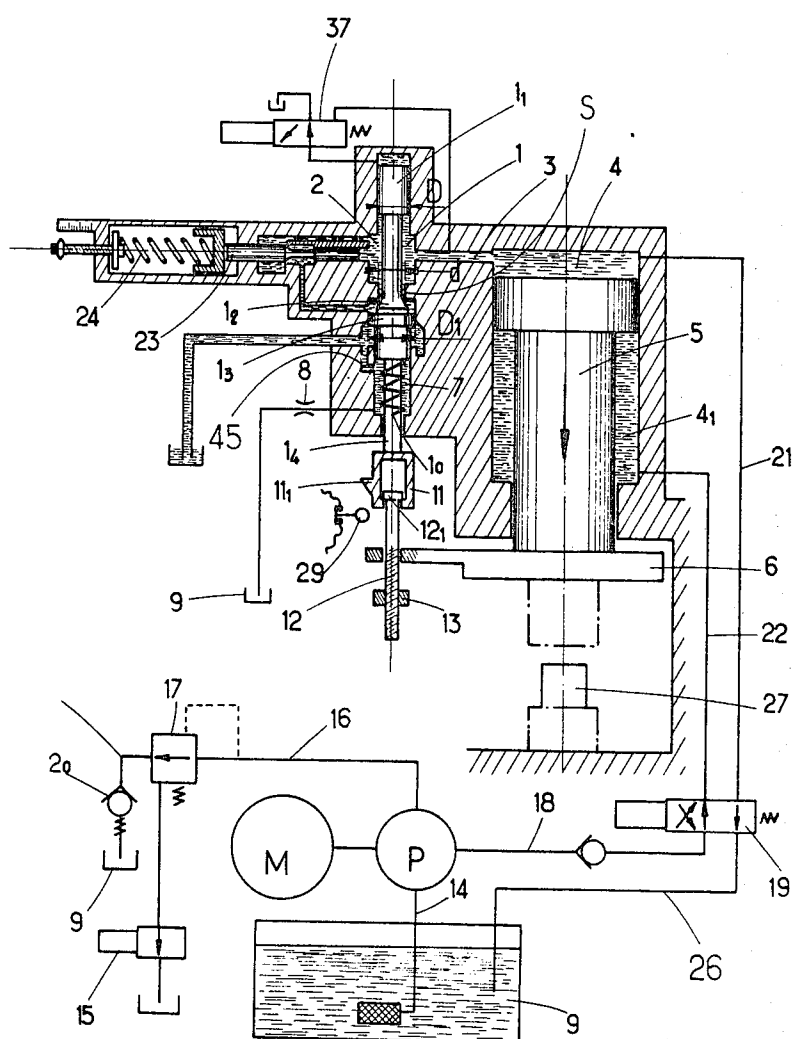


Figure 1



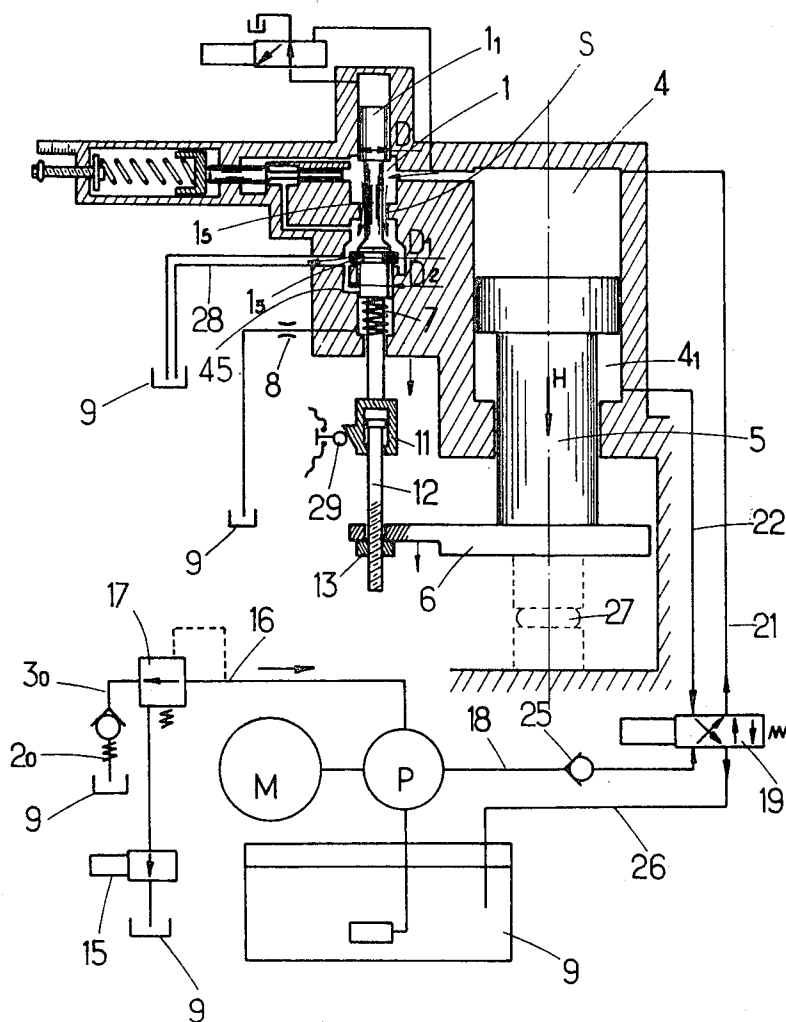
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Figure 2



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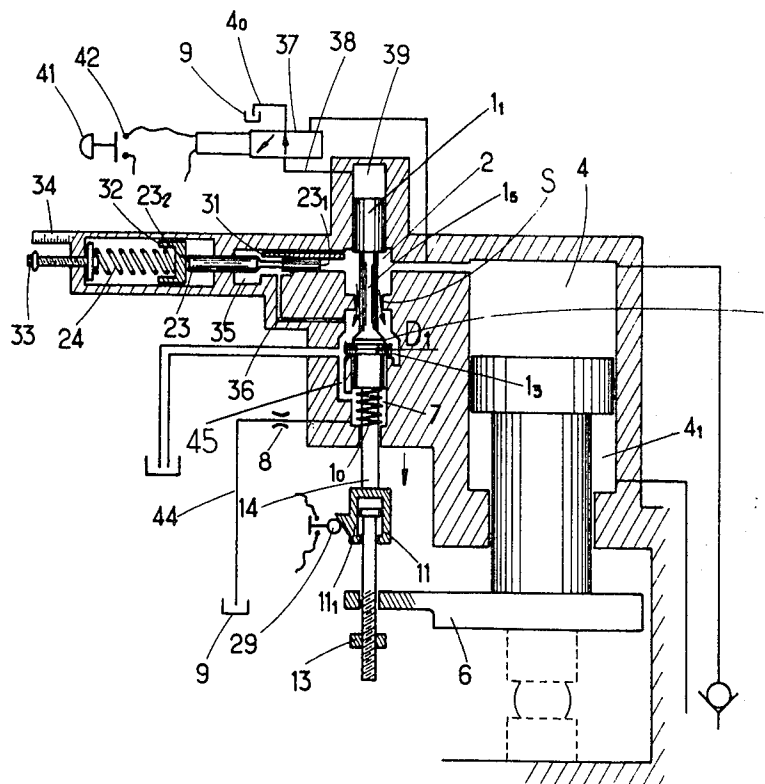


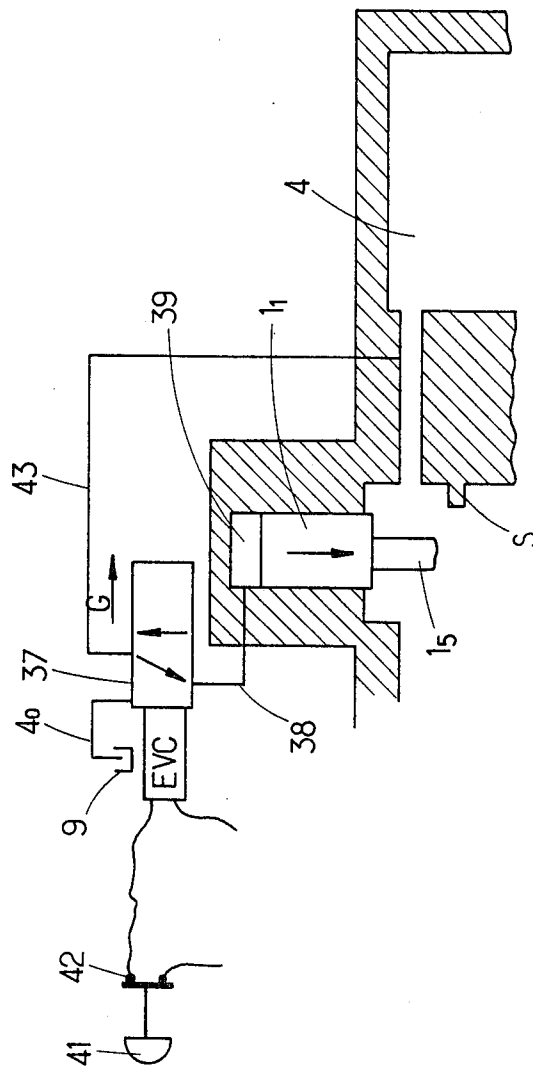
Figure 3

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CONTROL MEANS FOR PRESSURE RELIEF IN HYDRAULIC MACHINES

SUMMARY OF THE INVENTION

The invention concerns a device for the control of the decompression of the working fluid in hydraulic machines such as presses, characterised in that it comprises a decompression valve mounted on a damper, the valve being immersed in a chamber in communication with the pressure chamber of the press piston, which valve is lifted from its seat by the working piston as soon as the latter has effected its shaping operation, this liberating the compressed fluid which takes over the valve and urges it downwardly until it comes to act through the intermediary of a switch member, on a contact providing inversion of the control electrovalves, the compressed fluid then being returned to the reservoir, this permitting a progressive decompression of the working fluid and thus avoiding the brutal shocks which can have a harmful effect on the longevity of the material.

According to a feature of the invention the valve is mounted on a hydraulic damper and has on the one hand a conical portion coming into contact with its seat, and on the other hand a consequent annular shoulder, such that the compressed fluid which escapes from the pressure chamber of the press piston when the valve is lifted from its seat encounters a surface which is sufficiently large to be able to entrain the decompression valve in the downward direction so that this valve actuates through the intermediary of a cap integral therewith, a switch gear stopping the arrival of fluid under pressure in the pressure chamber of the press piston.

According to another feature of the invention, the press piston is provided with a table which is sliding with respect to a control rod upon which is mounted a nut which can be adjusted for position, the rod being provided at one of its ends with a cylindrical head which acts against the cap integral with the stem of the decompression valve, in such a way that when the press piston has descended to its lowest preset point, its table which slides with respect to the rod, comes into contact with the adjustable nut of which the position has been predetermined, which has the effect of exerting a traction force on the rod and consequently on the decompression valve which is thus lifted from its seat to be taken over by the working fluid hitherto compressed in the pressure chamber of the press piston.

The invention also concerns hydraulic machines such as presses, equipped with a control device according to one or other of the various embodiments or the like.

BRIEF DESCRIPTION OF THE DRAWINGS

A device according to the invention is illustrated by way of nonlimitative example in the attached drawings, in which:

FIG. 1 is a plan view showing the device according to the invention adapted to a hydraulic press, the installation being ready for operation, i.e. the press piston is in its raised position and the operator has not yet pressed the control button of the motor.

FIG. 2 is a plan view similar to FIG. 1 illustrating the device in the course of operation in the form of rods.

FIG. 3 is a plan view similar to FIG. 1 the hydraulic group not being shown, the device operating not by rods but by manometric action.

FIG. 4 is a detail view showing the safety device in action.

The essential aim of the invention is in some manner to provide a control device for the relief of pressure on or decompression of the fluid after the press piston has effected its pressing operation.

The invention also lies in providing a control device which permits a progressive decompression of the working fluid in order to avoid any brutal shock which can cause premature deterioration of the material.

Finally the device according to the invention also sets out to provide with precision, particularly on a hydraulic press, the control in the thickness or pressure of the parts subjected to

deformation and to permit on the other hand the precise arresting of the working operations; in other words to permit a rapid cycle while retaining a precise and regular cycle.

To carry this out, and according to the invention, the device is made according to an embodiment so as to be able to act either by a system of rods if operation is effected as a function of a determined height of the part to be shaped, or by manometric action if operation is effected starting from a given pressure.

BRIEF DESCRIPTION OF PREFERRED EMBODIMENTS

The following description will successively take up the two possibilities grouped in the same device and operating by means of one and the same decompression valve.

A. ROD SYSTEM OPERATION

According to the embodiment shown in FIG. 1, the device applied to a hydraulic press comprises a decompression valve 1 mounted vertically movable in a chamber 2 which is in communication through a conduit 3 with a pressure chamber 4 located behind the shouldered press piston 5.

This decompression valve has different diameters and particularly has a head 1₁, of which the diameter D is greater than the small diameter d located at the precise point at which the conical surface 1₂ of the valve comes into contact with its annular seat S projecting in the interior of the chamber 2.

The decompression valve comprises moreover an annular shoulder 1₃ of which the diameter determines a large surface D₁, this shoulder being a sealing sliding fit in the interior of the chamber 2.

The decompression valve is mounted on a hydraulic damper 7 so that its possible downward displacement is controlled by a restriction 8 connecting the chamber of the hydraulic damper to the reservoir 9.

A return spring 10 acting on the bottom face of the decompression chamber tends constantly to urge this valve in an upward direction.

The stem 1₄ of the decompression valve 1 is terminated at its lower part by a cap 11 showing the particular feature of having a projecting cam 11₁, the cap receiving moreover the head 12₁ of a rod 12 upon which is screwed a nut 13 of which the position is adjustable.

The press piston 5 is provided with a table 6 adapted to be displaced during the shaping operation with respect to the rod 12 so as to come into abutment against the nut 13 of which the position has been preset, as will be explained hereinafter.

The hydraulic group substantially comprises a motor M and a pump P in communication with the reservoir 9 through a conduit 14, this pump also being in communication with an electrovalve 15 through the conduit 16, passing through a safety valve 17, and finally with the pressure chamber 4 of the press piston through the conduit 18, an electrovalve 19 permitting the inversion of the fluid pressures on the two faces of the press piston 5.

In FIG. 1, the safety valve 17 is connected to the reservoir 9, i.e. the fluid from the pump may pass to this reservoir while maintaining a sufficient pressure which is a function of the pressure determined by the calibration of the check valve 20 to permit the upward return and the maintenance in the raised position, of the working piston 5, while the electrovalve 19 is in this case connected in parallel so that the fluid contained in the pressure chamber 4 can flow freely through the conduit 21 into the reservoir 9 while the fluid under slight pressure is directed toward the chamber 4₁ of the working piston through the conduits 18 and 22.

In the rod system operation, it is necessary to neutralise the manometric action by immobilising the pilot valve 23 by the action of a spring 24 having a pressure greater than that which will be attained at the culminating working point in the pressure chamber 4 of the working piston.

In this state, the press piston is therefore in the raised position; the table 6 of this piston is removed from the nut 13

which is set at a height such that it will limit the travel of the piston, this height being a function of the thickness of the part shaped, and the head 12₁ of the rod is applied against the cap 11 of the compression valve which is firmly applied against its annular seat 5 by the calibrated spring 10 and from the fact that, the section D being greater than *d*, this valve is self-closing.

OPERATION (FIG. 2)

When the operator presses the general control button, he sets in motion the motor M and causes inversion of the two electrovalves 15 and 19.

Thus the safety valve 17 is disconnected from the conduit 16. The fluid under pressure delivered by the pump P is sent into the working chamber 4 through the conduits 18 and 21 by means of the electrovalve 19 which connects these conduits, a nonreturn clack valve 25 preventing the fluid from returning toward the pump.

Moreover the pressure which hitherto prevailed in the chamber 4₁ of the press piston, decreases from the fact that the chamber is directly connected to the reservoir 9 through the conduits 22 and 26.

Thus the pressure of the fluid increases in the pressure chamber 4 and decreases inversely in the chamber 4₁. When the pressure of the working fluid has attained a sufficient value to overcome the inertia of the working piston 5, the working piston 5 is then urged downwardly in the direction indicated by the arrow H and comes into contact with the part to be shaped 27.

The travel of the working piston 5 is then interrupted at a given thickness of the part 27 by the press table 6 coming into contact with the nut 13, of which the position has been preset so that when the table 6 encounters the nut 13, the part 27 has been deformed to a precise height calculated in advance.

As soon as the pressing table 6 comes into contact with the preset nut 13, this table draws the rod 12 in a downward direction, which consequently entrains the decompression valve 1 with which it is in connection through the assembly cap 11.

This travel of the compression valve is greatly reduced by the fact that, as soon as the valve is lifted from its annular seat S, the highly compressed fluid escapes into the annular passage defined between the seat S and the valve stem 1₃, this fluid thus coming into contact with the cylindrical shoulder 1₃ of which the pressure surface D₁ is greater than that determined by the diameter D of the head 1₁ of the valve.

Thus the compressed fluid entrains in a downward direction the decompression valve which moves rapidly until it blocks the aperture 45, and then moves slowly, in view of the presence of the hydraulic damper 7 and the restriction 8.

The fluid coming into contact with the pressure surface 1₃ then escapes through the channel 28 to return to the reservoir 9.

At the same time the cap 11 comes into contact with the switch gear 29 which inverses the electrovalves 15 and 19 so as to return these electrovalves to the position which they occupy in FIG. 1.

As soon as the electrovalves 15 and 19 are inverted, the pump P is brought back into communication through the conduits 16 and 30 with the reservoir 9, although the fluid maintains a sufficient pressure to move the piston 5 upwardly, this pressure being determined by the clack valve 20.

As soon as the pressure has sufficiently decreased in the chamber 4 of the working piston, and consequently in the chamber 2 of the decompression valve, the spring 10 returns the decompression valve so as to again apply it against its annular seat S, the valve thus remaining in position whatever may be the pressure which will prevail in the chamber 2, due to the fact that the valve head 1₁ has a working surface D which is greater than the diameter *d* taken in the vicinity of the seat of this valve.

B. MANOMETRIC ACTION

When the control device according to the invention operates by manometric action, it is necessary to neutralise the control by rods. In order to provide this neutralising action, it is sufficient to move away the adjusting nut 13, so that the pressing table 6 can no longer come into contact with this nut, even when the press piston is in its lowest position.

Operation by manometric action is essentially provided by a pilot valve 23 of which the terminal face 23₁ is immersed in the chamber 2 in which is housed the decompression valve.

This pilot valve is strongly applied on to its seat 31 by the calibrated spring 24 of which one of the ends rests in a cap 32 which is applied to the rear face 23₂ of the pilot valve, the spring 24 being calibrated at a predetermined force by an adjusting nut 33 which is displaced in front of a vernier 34; this vernier 34 permits very precise calculation of the pressure which must be applied to the spring 24 so that this spring 24 applies to the pilot valve 23 a force equal to that which the working fluid will apply to the terminal face 23₁ of the pilot valve 23 when the pressure has achieved the desired value in the chamber 4 and consequently in the chamber 2.

OPERATION

At the beginning, the hydraulic installation (not shown in FIG. 3), is arranged in the same manner as that illustrated in FIG. 1, i.e. the safety valve 17 is in communication with the reservoir 9 while conserving a sufficient pressure to maintain the press piston in the raised position, this pressure being provided by the calibrated clack valve 20. On the other hand the electrovalve 19 is positioned as in FIG. 1, i.e. the conduit 18 of the pump P is not in communication with the conduit 21 leading to the pressure chamber 4.

As soon as the operator presses the control button, this button determines the inversion of the two electrovalves 15 and 19 so as to close the safety valve 17 and to bring into communication the conduit 18 with the conduit 21 so that the compressed fluid delivered by the pump P is delivered to the pressure chamber 4 so as to exert a high degree of pressure on the rear face of this piston to urge it downwardly.

When the pressure of the working fluid contained in the pressure chamber 4 has attained a value slightly greater than that exerted on the pilot surface 23 by the calibrated spring 24, the pilot valve is then lifted from its seat by the action of the fluid on its terminal surface 23₁, which causes the fluid to rush into the chamber 35 and then coming to act on the face D₁ of the annular shoulder 1₃ of the decompression valve 1, passing through the delivery tube 36.

As soon as the fluid lifts the decompression valve 1 very slightly from its seat S, the compressed fluid contained in the chamber 2 then rushes directly through the annular channel defined between the seat S and the valve stem 1₃ to come to act against the surface D₁ and thus entraining the decompression valve downwardly, the displacement of which valve is controlled by the damper 7, the return spring 10 and the restriction 8 of the conduit leading to the reservoir 9.

Here too as in the case of control by rod system, the cap 11 integral with the valve stem 1₁ comes into contact with its cam 11₁ with the switch gear 29 which again inverses the electrovalves 15 and 19.

C. SAFETY

The safety of the device, permitting the instantaneous arrest of the machine in case of difficulties or disturbances particularly due to poor presentation of the parts, is assured by an electrovalve 37, shown in FIGS. 1 to 4, this electrovalve being connected when the hydraulic press is operating normally, through a conduit 38 to the chamber 39 located behind the head 1₁ of the decompression valve 1, which conduit is itself in communication through the electrovalve 37 with the conduit 40 leading to the reservoir 9; in this state, the pressure is practically nil in the chamber 39.

In case of difficulty, it is sufficient for the operator to press the press button 41 to bring this press button into contact with the contacts 42 which actuate the electrovalve 37 in such a manner as to displace it in the direction indicated by the arrow G (FIGS. 4, 5), in order to bring the conduit 38 into communication with the conduit 43 which is itself connected to the pressure chamber 4 in which the working fluid is compressed.

As soon as this communication is established, the working fluid is immediately passed into the chamber 39 through the conduits 38 and 43, which immediately entrains the compression valve downwardly, lifting it from its seat S, whereupon the pressure fluid immediately rushes into the annular space defined between the stem 1₅ of the valve and the annular seat S to come to act on the surface 1₃ and thereby cause the entrainment of the decompression valve, the displacement of which is controlled by the hydraulic damper 7, the return spring 10 and the restriction 8 of the conduit 44 leading to the reservoir 9.

Here too as in the case of operation by rod system or in the case of manometric action, the cap 11 comes into contact with the switch gear 29 which inverses the electrovalves 15 and 19 which immediately returns the working piston to its raised position, the pressure decreasing in the chamber 4 and on the contrary increasing in the chamber 4₁.

Obviously this device can be applied to any hydraulic machine whatever, such as a hydraulic press, ram or the like, i.e. in all cases in which it is necessary progressively to decompress a fluid subjected to a high pressure, in a manner such as to prevent a too brutal decompression which entails the risk of causing deterioration of the material.

It is obvious that the invention is not limited to the embodiments hereinbefore described and illustrated, and it is possible according to choice, either to construct the device with the rod system control only, or to construct it with the manometric action control only, or again with both types of control, as illustrated in FIGS. 1 to 3.

I claim:

1. In a hydraulic operated machine having a press piston mounted for reciprocal movement in a hydraulic chamber, said hydraulic chamber defining a piston working pressure chamber portion and a piston return portion, with a reservoir for a working fluid, the improvement comprising:

a control means for relieving pressure of said working fluid in said pressure chamber portion after said piston has moved in a first direction;

said control means comprising a decompression valve body;

a valve chamber for said valve body defining a seat for said body with a first portion of said body extending on one side of said seat and a second portion of said valve body extending on a second side of said seat;

fluid communication means connecting said valve chamber with said pressure chamber portion;

second fluid communication means connecting said valve chamber with said reservoir;

means for moving said body from said seat to cause said working fluid to cause further movement of said valve body; and

switch means operatively associated with said valve body for returning fluid from said pressure chamber portion to said reservoir on said further movement of said valve body whereby progressive pressure relieving of said work-

ing fluid in said pressure chamber portion can be carried out and brutal shocks avoided.

2. The improvement of claim 1 wherein said valve body is mounted on a hydraulic damper.

3. The improvement of claim 2 wherein a return spring constantly urges said control valve body against said seat with a predetermined force.

4. The improvement of claim 2 wherein said means for moving said body from said seat is interconnected with said piston and actuated by said piston,

said second portion of said valve body carrying an annular shoulder defining a surface having a larger area than a facing surface on said first portion of said piston whereby when said valve is moved from said seat, said working fluid escapes from said pressure chamber portion and entrains said valve body to cause actuation of said switch means.

5. The improvement of claim 4 wherein said means for moving said body from said seat comprises a control rod having an adjustable stop means thereon,

said control rod being interconnected with an extension of said valve body,

a table interconnected with said piston for movement therewith,

said adjustable stop means being adjusted to engage said table upon predetermined movement of said piston to cause said valve body to be moved from said seat.

6. The improvement of claim 5 wherein said extension of said valve body is substantially coaxial therewith and carries a downwardly opening cup means within which said rod is axially slidable,

said rod and said piston being substantially parallel.

7. The improvement of claim 4 wherein said means for moving said body from said seat comprises a pilot valve actuated by manometric action, said pilot valve having a valve body in fluid contact with said valve chamber whereby pressure in said valve chamber is communicated to said pilot valve body.

8. The improvement of claim 7 wherein said pilot valve body is interconnected with a calibrated spring having a predetermined degree of compression,

adjusting screw means for compressing said calibrated spring in association with a calibrated scale to preset the fluid pressure required to move said pilot valve body,

second fluid communication means interconnecting said pilot valve and said second portion of said control valve body whereby, when said working fluid in said control valve chamber reaches a predetermined pressure, said pilot valve body is moved to connect said second fluid communication means with said control valve chamber allowing working fluid to act on said second portion of said valve body and entrain it to move said control valve body from said seat and cause further movement which actuates said switch means.

9. The improvement of claim 4 and further comprising a second control valve chamber positioned on a side of said first control valve body portion,

and electropressure valve for controlling fluid pressure in said second control valve chamber whereby action of said electropressure valve moves said control valve body from said seat whereupon said working fluid entrains said control valve body to progressively move it and thereby relieve pressure in said pressure chamber portion.