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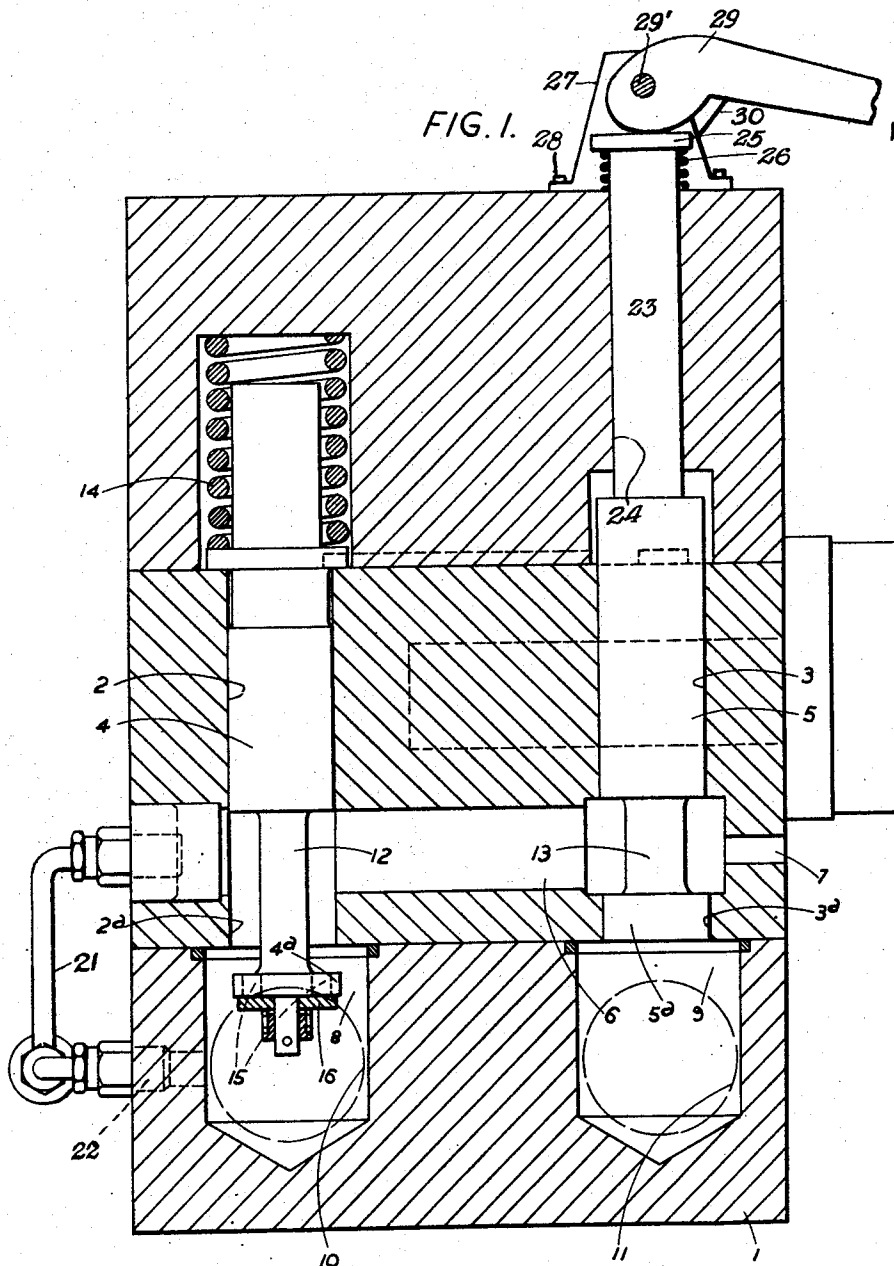
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CONTROL VALVE FOR HYDRAULIC PRESSES

Filed March 30, 1942

2 Sheets-Sheet 1



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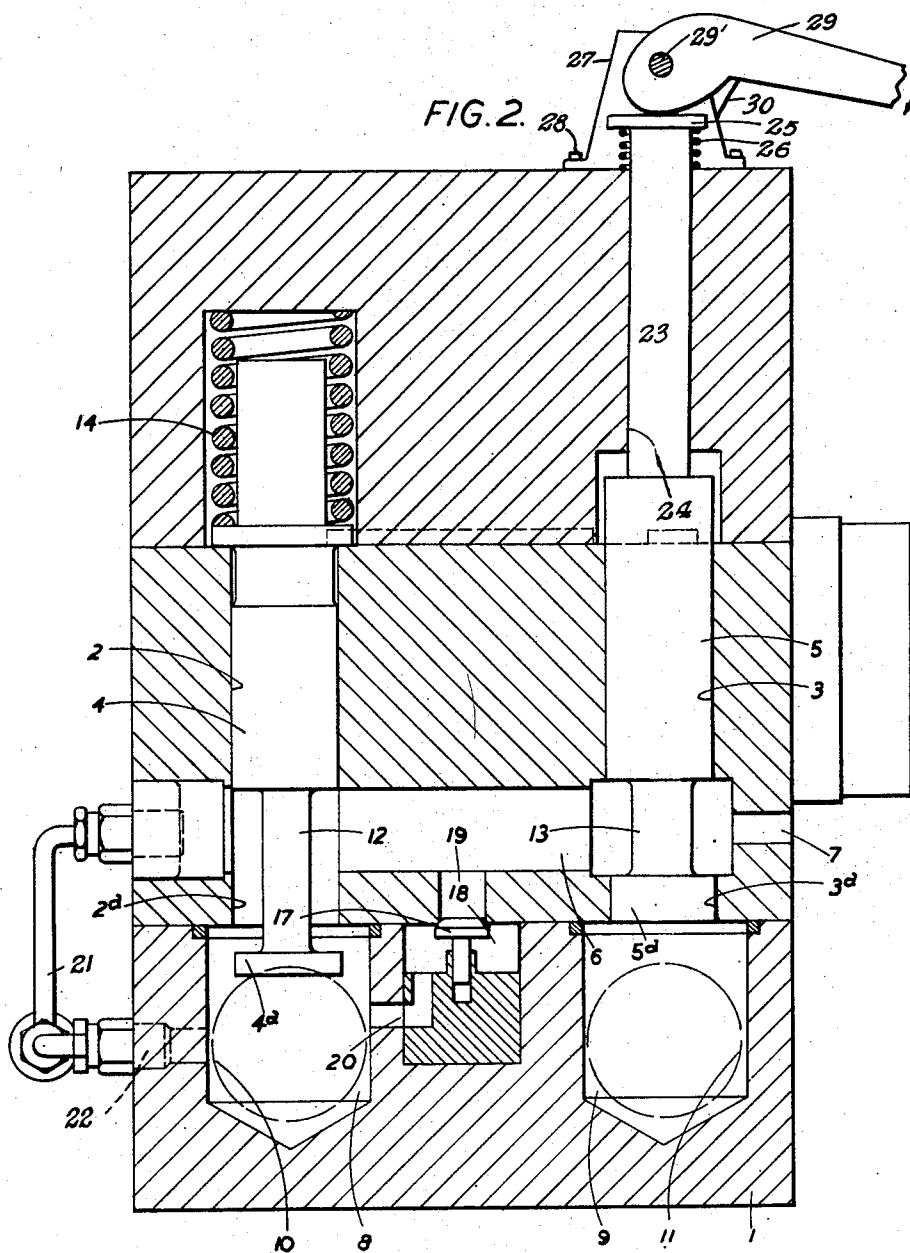
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CONTROL VALVE FOR HYDRAULIC PRESSES

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CONTROL VALVE FOR HYDRAULIC PRESSES

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7 Claims. (CL 121-46.5)

This invention relates to control valves for hydraulic presses.

If the control valve connected to a comparatively large hydraulic press is suddenly opened to exhaust, it will cause a sudden surge of pressure in the exhaust main due to the sudden release of the hydraulic energy stored in the press. The object of this invention is to provide an auxiliary valve having means which automatically control the release of pressure from the press cylinder so as to prevent any sudden surge of pressure in the exhaust main, no matter how the control valve is operated.

The present invention consists broadly of a valve for controlling the release of pressure liquid from a hydraulic press to exhaust, said valve comprising a main outlet which permits of a sudden release of pressure liquid from the press and a subsidiary outlet of restricted area which permits of a gradual release of pressure liquid from the press and valve means controlling the escape of liquid through said main outlet said valve means operating automatically to close the main outlet when a predetermined pressure of the liquid in the press is reached whereby the initial release of pressure liquid from the press occurs gradually through the restricted subsidiary outlet, and to open the main outlet to permit of a sudden release of the pressure from the press when the pressure of said liquid falls to a predetermined safe level.

A control valve according to a preferred embodiment of the invention comprises a transfer passage, an inlet for the delivery to said transfer passage of pressure liquid from a pump or accumulator, communications connecting said transfer passage on the one hand with the hydraulic press and on the other hand with exhaust, an automatically operating valve for opening and closing the communication between the hydraulic press and the transfer passage, a further valve for closing and opening the communication between the transfer passage and exhaust and a subsidiary or branch passage of restricted area for by-passing the automatically operating valve which opens and closes the communication between the transfer passage and the hydraulic press the arrangement being such that during the delivery of pressure liquid from the pump or accumulator to the press the connection between the transfer passage and exhaust is closed by its valve whilst the other connection between the transfer passage and the press is open until a predetermined pressure of liquid in the press is attained when the valve controlling said com-

munication is automatically closed and on operation of the valve to open the connection between the transfer passage and exhaust pressure liquid passes from the hydraulic press to the transfer passage for escape to exhaust through the subsidiary or branch passage to ensure that the initial release of pressure liquid from the press to exhaust occurs gradually until such time as the pressure of said liquid falls to a safe level when the automatically operating valve opens to permit of full and sudden release of said pressure liquid from the press to exhaust.

A control valve according to the above preferred embodiment also includes an automatically operating non-return valve for permitting delivery of liquid from the pump or accumulator to the press when the automatically operating valve associated with the communication between the press and the transfer passage is closed. Such non-return valve is preferably a separate valve but it may also be constituted by the lower end of the first mentioned automatically operating valve by making the lower part of said latter valve separate from the upper portion thereof so that when the upper part is moved by the pressure liquid away from the lower portion, said lower portion is free to open to pass pressure liquid to the press.

In order that the invention may be clearly understood and carried into effect a control valve according to two embodiments of the invention will now be described as examples by aid of the accompanying drawings in which:

Fig. 1 is a cross section through a valve according to the invention showing the use of a non-return valve of the disc type.

Fig. 2 is a similar view of the valve but showing the use of a non-return valve of the mitre type.

In the valve illustrated in the drawings the valve body 1 is machined to provide two parallel bores 2 and 3 in each of which slides a closely fitting valve plunger 4 and 5 respectively, of the packingless piston type. These two bores are intersected near their lower ends by a transverse transfer passage 6 which has an inlet 7 at one end for the admission of pressure liquid from an hydraulic pump or accumulator.

The lower ends of the bores 2 and 3 open into chambers 8 and 9 respectively and these in turn communicate, in the case of chamber 8, with the press cylinder through an opening 10 and in the case of chamber 9, the exhaust main, through an opening 11. The communicating openings between the transfer passage 6 and the chambers 8 and 9 are therefore constituted by

the lower portions of the bores 2 and 3 and for the sake of clarity these are indicated on the drawings by the references 2a and 3a respectively. Such openings are closable by the lower ends 4a and 5a of the valve plungers 4 and 5 when said plungers are in their raised positions, said lower ends being separated from the upper and main part of the plungers by reduced portions 12 and 13.

As shown in the drawings the plunger 4 is in its lowest position and the plunger 5 in its raised position. The transfer passage 6 is therefore closed to exhaust by reason of the portion 5a of the plunger 5 residing within the lower bore 3a and open to the press by reason of the portion 4a of the plunger 4 being below and clear of the bore 2a. Pressure liquid entering through inlet 7 is therefore permitted to pass directly to the press cylinder for operating the press.

Pressing against the upper end of the plunger 4 is a spring 14 which is loaded so as to hold the plunger in the open and lowered position shown against all pressures in the press cylinder below a predetermined maximum. When this maximum pressure is reached the valve plunger is forced upwards to compress the spring and close the lower bore 2a.

So that the pump or accumulator shall continue to deliver pressure liquid to the press cylinder after the valve plunger 4 has lifted to the closed position, an alternative passage for the liquid between the transfer passage 6 and the chamber 8 is provided, which passage is closable against the reverse flow of pressure liquid by a non-return valve.

In the example illustrated in Fig. 1 this alternative passage is constituted by holes 15 in the lower portion 4a of the plunger 4 whilst the non-return valve is of the disc type and consists of a flexible washer 16, seating against the lower face of the portion 4a so as to close the holes 15.

In the modification illustrated in Fig. 2 a mitre type non-return valve 17 is used. This valve is located in a recess or chamber 18 and serves to close the inner end of a passage 19 connecting the chamber 18 with the transfer passage 6. The connection between the chamber 18 and the passage 6 is constituted by the right angled port or passage 20.

The valve plunger 5, which constitutes the main control valve, includes a stem 23 slidable within the reduced bore 24, the upper end of the stem being headed or flanged, as at 25; an expansion spring 26 is interposed between the head 25 and the top of the valve mechanism housing, the head being threaded upon the end of the stem 23, to permit of the location of the spring in surrounding engagement with the stem. A bifurcated bracket 27, bolted to the housing as at 28, serves as a mounting for the cam lever 29, as at 29'. As the cam lever is actuated toward the housing, the valve is urged to seated position (as shown) in opposition to the spring 26, the movement of the cam lever in the reverse direction permitting the valve to move under the influence of said spring to open the passage 3a between the delivery passage 6 and the chamber 9. A stop 30 is provided to limit the movement of the lever toward the housing to insure accuracy in the seating of the valve. With the main control plunger in the raised position shown the delivery from the pump or accumulator passes directly to the press cylinder to force the press ram against the work. As compression of the work proceeds the resistance to the move-

ment of the ram will increase and in consequence the pressure of the liquid in the press cylinder will rise. When this pressure reaches a predetermined figure, herein referred to as the pressure at which the liquid may with safety be permitted rapidly to exhaust, it overcomes the resistance of the spring 14 and forces the plunger 4 upwards to close the passage 2a. Pressure liquid is still permitted to pass to the press cylinder but it is now constrained to flow through the alternative passage and past the non-return valve.

When the pressure stroke of the press ram is completed the control valve plunger 5 is moved downwards to open the passage 3a and so place the interior of the transfer passage 6 in communication with exhaust. The delivery from the pump or accumulator now passes directly to exhaust through the open passage 3a. The sudden escape of liquid from the press cylinder to exhaust is however prevented by the previous closure of the passage 2a by the raised plunger portion 4a. A gradual escape is however provided for by the provision of a choked or restricted by-pass passage, comprising a branch pipe 21 having in its length a choke, generally indicated at 22. This pipe connects the chamber 8 with the transfer passage 6 and permits the liquid from the press cylinder to escape gradually at a regulated rate until the pressure in the press cylinder and the chamber 8 falls to a level at which it may with safety be suddenly released into the exhaust main. At this lower pressure the spring is permitted to return the plunger to its lowered position, thus opening the non-restricted passage 2a and permitting the liquid to pass rapidly to exhaust.

In practice it is preferred to use as valve members plungers of the packingless piston type but the invention is not to be limited by this stated preference as any suitable valve means may be used which are capable satisfactorily of controlling the escape of liquid from a press so that a gradual initial release takes place when the pressure in the press exceeds a predetermined maximum as hereinafter defined in the claims.

It is also to be understood that the main valve in the form of a single acting plunger 5 is not an essential part of the invention as in this form it is unsuitable for use where the pressure liquid is supplied from an accumulator as it does not provide for a cutting off of the supply from the accumulator. Even where the pressure liquid is supplied by a pump, this main control valve would very often be of the double-acting type.

What I claim is:

1. A control valve for hydraulic presses comprising a housing having a transfer passage, an inlet for the delivery to said transfer passage of pressure liquid from a source of supply, a bore connecting with said transfer passage and connectable to the hydraulic press, a second bore parallel to the first bore, communicating with the transfer passage and connectable to the exhaust, an automatically operating valve in said first bore for closing and opening the communication between the transfer passage and the hydraulic press, a valve in the second bore for closing and opening the communication between the transfer passage and the exhaust, a branch passage of restricted area for by-passing the automatically operating valve when operative to close the communication between the transfer passage and the hydraulic press, and an auto-

atically operating non-return valve carried by said first mentioned valve to permit delivery of liquid to the press through said first mentioned valve when such valve is closed, whereby during the delivery of pressure liquid to the press the communication between the transfer passage and the exhaust is closed by the valve in said second bore while the communication between the transfer passage and the press is maintained until a predetermined pressure of liquid in the press is attained, when said first-mentioned valve controlling such communication is automatically seated, the liquid continuing to flow to the press past said non-return valve until full pressure is applied to the press and the communication between the transfer passage and the exhaust is opened by the actuation of the valve in said second bore to permit the liquid to pass from the hydraulic press to the transfer passage for escape to exhaust through said branch passage, to ensure that the initial release of pressure liquid from the press to exhaust occurs gradually until such time as the pressure of said liquid falls to a safe level, when the automatically operating valve in the first bore opens to permit of full and sudden release of said pressure liquid from the press to the exhaust.

2. A valve mechanism for controlling the release of pressure liquid from a hydraulic press to an exhaust, including a housing having a bore, a chamber communicating with the lower end of said bore, said chamber having an outlet connectable to the exhaust, a second bore parallel to the first bore, a chamber communicating with the lower end of said second bore provided with an outlet connectable to the press cylinder, a passage connecting said bores above the respective chambers, said passage being connectable to a source of pressure liquid supply, a manually actuatable valve adjustable within said first bore to close communication between said bore and the exhaust through the chamber associated with said first bore, a valve in said second bore, means cooperating there with to render such valve normally responsive to the pressure fluid, when communication between said passage and the exhaust is closed, to maintain communication between said passage and the outlet to the press cylinder, said latter valve being operable in response to an increase in the pressure of the liquid at a predetermined stage of operation of the press, to interrupt communication between said passage and the chamber associated with said second bore, and a by-pass between said passage and the chamber connected to said bore to retard the movement of the pressure liquid from the latter chamber to the exhaust, when said first valve is actuated to open communication between said passage and the exhaust and communication between said passage and the chamber connectable to the press cylinder is closed by said second valve.

3. A valve mechanism for controlling the release of pressure liquid from a hydraulic press to an exhaust, including a housing having a bore, a chamber communicating with the lower end of said bore, said chamber having an outlet connectable to the exhaust, a second bore parallel to the first bore, a chamber communicating with the lower end of said second bore provided with an outlet connectable to the press cylinder, a passage connecting said bores above the respective chambers, said passage being connectable to a source of pressure liquid supply, a manu-

ally actuatable valve adjustable within said first bore to close communication between said bore and the exhaust through the chamber associated with said first bore, a valve in said second bore, to close the area of communication between said passage and the chamber associated with the second bore, liquid flow-controlling means incorporated in said second valve adapted to yield to the pressure exerted by the liquid flowing to the press in the functioning of said latter valve to close communication between said passage and the chamber having an outlet to the press cylinder, to permit of the transfer of the liquid from said passage to the latter chamber through said second valve in a reduced amount, said liquid flow-controlling means becoming inoperative when said second valve assumes its normal position for maintaining communication between said passage and the chamber outlet to the press cylinder, and means for permitting the pressure liquid to by-pass said second valve to escape gradually to the exhaust when said second valve is closed and the first-mentioned valve is actuated to open communication between said passage and the exhaust.

4. A valve mechanism for controlling the release of pressure liquid from a hydraulic press to an exhaust, including a housing having a bore, a chamber communicating with the lower end of said bore and provided with an outlet connectable to the exhaust, a second bore parallel to the first bore, a chamber communicating with the lower end of said second bore and provided with an outlet connectable to the press cylinder, a passage connecting said bores above the respective chambers, said passage being connectable to a source of pressure liquid supply, a manually actuatable valve in said first bore for closing communication between said passage and the outlet to the exhaust, a valve in said second bore, means for normally maintaining said valve open when communication between said passage and the outlet to the exhaust is closed, to maintain communication between said passage and the outlet to the press cylinder to insure flow of the pressure liquid to the press, said valve being movable, in response to a predetermined increase in the pressure of the liquid, to a closed position to interrupt such communication, a subsidiary connection between said passage and said outlet to the press cylinder, a check-valve in said subsidiary connection for permitting transfer of the liquid to the press in a reduced amount when the valve in said second bore is moved to its closed position, and a by-pass between the outlet to the press cylinder and said passage for the gradual release of the pressure liquid from the press cylinder when the valve in the first bore opens to exhaust, until the pressure of the fluid is reduced sufficiently to permit the valve in the second bore to return to its open position.

5. A valve mechanism for controlling the flow of pressure liquid to and from a hydraulic cylinder, comprising a housing having a bore, an inlet and an outlet respectively connected to a source of pressure liquid supply and to the hydraulic cylinder, passages connecting said inlet and said outlet to said bore to provide a communication between said inlet and said outlet for the flow of the pressure liquid to the cylinder, a plunger slidable in said bore and movable to a position for closing said communication, through the bore, in response to a predetermined increase in the pressure of the liquid, a non-re-

turn valve carried by said plunger for permitting continued flow of the pressure liquid to the cylinder when the plunger moves to its closed position; said non-return valve automatically moving to a closed position to interrupt the supply of pressure liquid to the cylinder when the desired maximum pressure is attained therein, and a passage of restricted area to permit the pressure liquid to escape slowly from the hydraulic cylinder past the plunger and the non-return valve to exhaust while said plunger and said non-return valve are in their closed position.

6. A valve mechanism for controlling the flow of pressure liquid to and from a hydraulic cylinder comprising a housing having a bore, an inlet and an outlet respectively connected to a source of pressure liquid supply and to the hydraulic cylinder, passages connecting said inlet and said outlet to said bore, a plunger slidable in the bore, spring means for normally maintaining said plunger in an open position, a portion of reduced diameter in said plunger to provide an annular space within the bore permitting free flow of the pressure liquid to the cylinder through the bore when the plunger is in its open position, said plunger being movable to a closed position in response to a predetermined increase in the pressure of the liquid, a non-return valve carried by said plunger to permit continued flow of the pressure liquid to the cylinder when the plunger moves to its closed position, said non-return valve cooperating with the plunger to automatically close the communication between the inlet and the outlet through the bore when the pressure of the liquid

in the cylinder reaches the desired maximum, and a passage of restricted area to permit pressure liquid to escape slowly from the hydraulic cylinder past the plunger and the non-return valve to exhaust when said communication through the bore is closed.

7. A valve mechanism for controlling the flow of pressure liquid to and from a hydraulic cylinder, comprising a housing having a bore, an inlet and an outlet respectively connected to a source of pressure liquid supply and to the hydraulic cylinder, passages connecting said inlet and said outlet to said bore, to provide a communication between said inlet and said outlet for the flow of the pressure liquid to the cylinder, a plunger slidable in said bore and embodying a valve portion, said plunger being movable to a position wherein said valve portion closes said communication through the bore in response to a predetermined increase in the pressure of the liquid, a passage by-passing said valve portion and communicating with said inlet and said outlet, a non-return valve in said passage opening to permit continued flow of the pressure liquid to the cylinder when the plunger moves to its closing position, said non-return valve automatically moving to a closed position when the pressure of the liquid in the cylinder reaches a predetermined amount, and a further passage of restricted area to permit pressure liquid from the hydraulic cylinder to escape slowly to exhaust while said plunger and said non-return valve are in their closed position.

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