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POWER CONTROL SYSTEM FOR HYDRAULIC PRESSES

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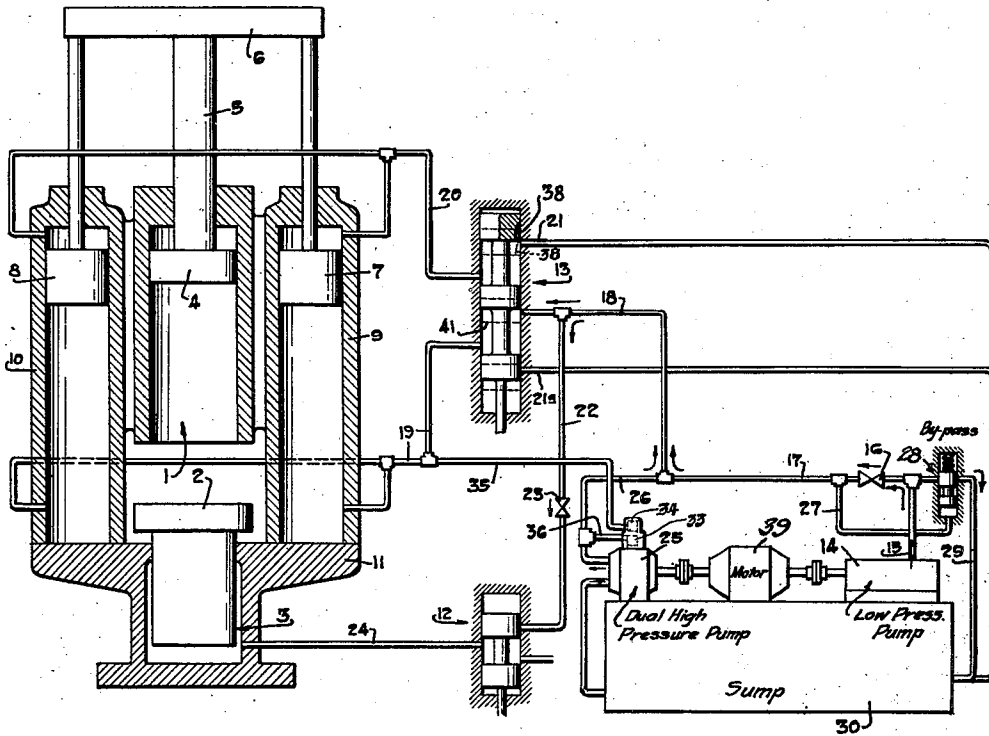


Fig. 1

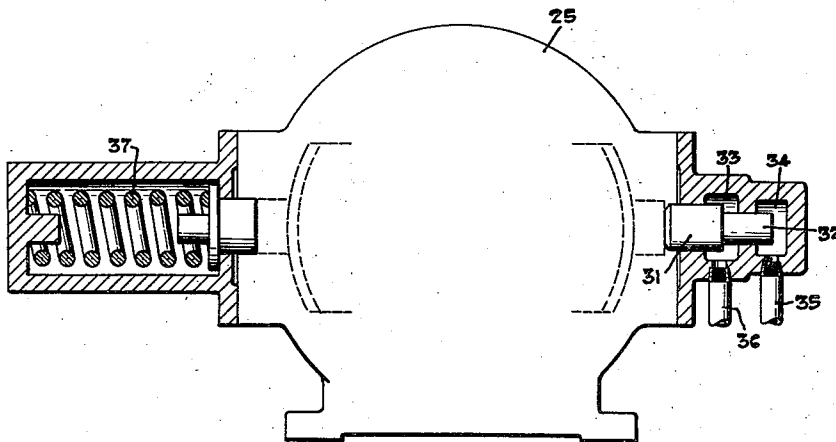


Fig. 2

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POWER CONTROL SYSTEM FOR HYDRAULIC PRESSES

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This invention relates generally to an improved hydraulic power control system for and method of operation of hydraulic presses, particularly presses for compressing carbon dioxide snow into cake form.

Various arrangements for controlling and applying power to hydraulically operated snow presses have been heretofore proposed and used, but such prior arrangements have been deficient in applying the proper degree of pressure to the snow cake or in operating the press economically and efficiently or in effectively ejecting a compressed cake without breaking or splitting the same.

It is an object of my invention to provide an improved and simplified system for applying pressure to the operating cylinders in a predetermined sequence with minimum power and manipulation of controls. A further object is to provide an improved control system and method of operation of the hydraulic power whereby a cake may be ejected intact from the press chamber. Another object is to provide a control system that is economical and simple in construction, maintenance and operation.

Other objects and advantages will be more apparent to those skilled in the art from the following description of the drawing in which:

Fig. 1 is a diagrammatic view of a press embodying my improved control system;

Fig. 2 is an enlarged diagrammatic view of a conventional dual pressure control for a pump used in my system.

In the particular embodiment of the invention which is disclosed herein merely for the purpose of illustrating one specific form among possible others that the invention might take in practice, I have shown a press having a compression or material chamber 1, the material such as carbon dioxide snow being formed or disposed therein in any well-known manner preparatory to compressing the same into cake form. The lower open end of this chamber is adapted to be closed by a platen 2 moved upwardly by a ram and cylinder generally indicated at 3 and lowered by gravity upon discharge of fluid from cylinder 3. Disposed within chamber 1 is a plunger 4 whose rod 5 is connected by a crosshead 6 to double acting pistons 7 and 8 operating within side cylinders 9 and 10 respectively. The lower ends of these side cylinders are closed by and supported on base 11.

The control system will be more readily understood by describing its mode of operation. With the press in the open position as shown in

Fig. 1, a control valve 12 is in its lower position and a control valve 13 is in its upper position. For purposes of illustration, the valves 12 and 13 are considered to be manually operated. Valve 13 thereby permits a low pressure pump 14 to supply fluid through a pipe 15, check valve 16 and pipes 17, 18 and 19 to the lower ends of side cylinders 9 and 10, thus maintaining rams 7 and 8 and plunger 4 in their upper position. Fluid from the upper end of side cylinders 9 and 10 is discharged through pipe 20 and an exhaust pipe 21 which leads to a sump 30. To initiate press operation, valve 12 is raised to supply fluid from low pressure pump 14 through pipes 18 and 22, a check valve 23 and pipe 24 to ram-cylinder 15, thereby to raise platen 2 against the lower end of snow chamber 1. Simultaneously with the discharge of low pressure fluid from pump 14, a variable displacement dual pressure pump 25 discharges through a pipe 26 into pipe 18. For purposes of illustration, the two pressure ranges of pump 25 are set at 650 pounds and 2500 pounds per square inch, the control mechanism therefor being described later. While the spring of a bypass valve 28 for pump 14 is set for a pump pressure of say 450 pounds, yet the two pumps will feed into the common line 18 at or below the lowest pressure of 450 pounds due to the fact that upward movement of platen 2 is without any substantial resistance and therefore the actual pressure from either of the pumps during this period of operation will only be sufficient to move the platen. Upon closure of the snow chamber by platen 2, sufficient resistance is then offered to the pump fluid with the result that pumps 25 and 14 will build up to a low pressure of 450 pounds. This pressure will be transmitted through a control pipe 27, thereby moving spring loaded bypass valve 28 to its open position to bypass fluid from pump 14 through pipes 15 and 29 to a sump 30. Upon initial opening of bypass valve 28, check valve 16 closes to prevent reverse flow through pipe 17 and to allow pump 25 to build up higher pressures for subsequent operations. The pump 25 will then build up to a pressure of 650 pounds to firmly close the snow chamber by platen 2.

With the lower end of snow chamber 1 closed in the manner above described, it will now be assumed that the same is filled with loose snow ready to be compressed. Chamber 1 is filled with snow in a usual manner well known in the art as disclosed in Nowak Patent 2,085,686 and my Patent 2,085,695. Valve 13 is then moved downwardly to connect supply pipe 18 with pipe 20

whereby pressure fluid from both pumps is transmitted through pipes 18 and 20 to the top of cylinders 9 and 10 while fluid in the lower ends thereof is exhausted through pipes 19 and 21g to any suitable sump such as 30. The pressure required to initiate movement of plunger 4 is less than the minimum pressure of either pump. While such minimum pressure thus exists in pipe 18, nevertheless the full 650 pounds pressure is maintained in cylinder 3 due to check valve 23 preventing reverse flow from cylinder 3. As compression of the snow takes place, the required pressure continuously increases until maximum pump pressure is necessary. This increase in pressure is accomplished automatically by adjusting pump 25 through a differential pressure responsive plunger having large and small piston areas 31 and 32 operating respectively in chambers 33 and 34. Low pressure chamber 34 is connected by a pipe 35 to pipes 19, while high pressure chamber 33 is connected by a pipe 36 to pipe 26. The pump and differential plunger control per se does not constitute a part of my invention other than its inclusion as an element of my combination. Hence the details of construction of the pump need not be described as it is the well-known variable displacement radial type, such as shown in Hele-Shaw et al. Patent 1,250,170. It will of course be understood that in such a pump a spring 37 yieldingly resists the action of the differential plungers 31 and 32. Hence during compression of the snow cake, pressure from pump 25 will continue to build up in the fluid connection to the upper end of cylinders 9 and 10 with the result that such pressure will be transmitted from pipe 26 through pipe 36 to valve chamber 33, thus moving the pump nearer to its neutral position to provide the greater pressure. The pump is so adjusted that this pressure may increase to say 2500 pounds per square inch, thus substantially compressing the snow cake to its final desired dimensions. Increase of pressure in pipe 18 above 650 pounds will cause check valve 23 to open and thus maintain a corresponding increase of pressure in cylinder 3. When the proper degree of compression has been obtained, then valve 13 is moved to a position indicated by dotted lines 41.

To release the cake, it has heretofore been the practice to first lower platen 2 and permit pressure in the upper ends of cylinders 9 and 10, or their equivalent, to eject the cake from the snow chamber on to the lowered platen 2. This mode of operation often results in the cake being broken. To overcome such breaking, it has been heretofore proposed to maintain the snow chamber closed by platen 2 and then raise plunger 4 but it has been found that this method often pulls or splits the snow cake apart. I propose herein a new method of operation of the press for ejecting a cake without damage thereto and to provide an improved structure that will expedite carrying out of this method.

In my improved method of ejecting the cake, I propose, after compression of the cake, to maintain platen 2 in its raised position and to maintain plunger 4 in contact with the cake by controlling the operating pressure in the ends of side cylinders 9 and 10 in such a manner as to avoid any movement of plunger 4, i. e. the plunger remains inert. Thereafter valve 12 is temporarily adjusted so that platen 2 is moved to a partially lowered position whereby the cake along the surfaces of the snow cylinder and plunger 4 will sufficiently evaporate to permit the cake to

slide downwardly by gravity on to the platen 2. The platen 2 is preferably initially lowered only a couple of inches so as to prevent excessive impact when the cake drops on to the platen. Thereafter the platen 2 may be completely lowered to permit the cake to be laterally removed therefrom.

To accomplish the foregoing method of operation, it is possible that valve 13 may by a succession of small and rapid port cracking operations discharge fluid from the upper ends of cylinders 9 and 10 without admitting to the lower ends thereof sufficient pressure fluid to move plungers 7 and 8 upwardly. Plunger 4 is thereby maintained in contact with the snow. However, to expedite this method of operation, I preferably provide a port 38 whereby after full compression of the cake and after valve 13 has been returned to its position 41, pipe 20 is connected to exhaust pipe 21 while at the same time communication of pipe 19 with either pipes 21 or 18 is closed thereby preventing discharge from or supply of fluid to the lower ends of cylinders 9 and 10. Hence the operating pressure in the upper ends of cylinders 9 and 10 is released without any possibility of hydraulic operating pressure causing upward movement of plunger 4. Bleeding port 38 is inoperative when valve 13 is in its lowermost position wherein pipes 18 and 20 are connected together.

When valve 13 is in its position 41 as just described, pump 25 will then operate against a closed circuit at low pressure due to control pipe 35 being connected to pipe 19. This pipe is under practically no pressure due to the lower ends of the side cylinders being open to exhaust just prior to return of the valve 13 to its neutral position. The pump 25 can, for an appreciable period of time, operate under low pressure and no discharge without damage thereto or excessive power consumption by a driving motor such as 39 which preferably commonly operates both pumps.

The sequence of operations briefly reviewed is as follows: (1) pumps 14 and 25 simultaneously supply fluid to cylinder 3 to close the open end of materials chamber 1 by platen 2; (2) when platen 2 closes said end, pump 25 builds up pressure to its minimum value of 650 pounds whereupon check valve 16 closes and pilot valve 28 opens to bypass low pressure pump 14; (3) valve 13 is then moved to its lower position to connect pipes 18 and 20 together and connect pipe 19 to exhaust 21g, and due to the absence of pressure in pipe 18 at this moment check valve 23 closes to maintain pressure in cylinder 3, check valve 16 opens and bypass 28 closes, whereupon fluid is supplied simultaneously from both pumps to the upper end of cylinders 9 and 10 thereby to initiate compressing movement of plunger 4; (4) as the pressure required for the compressing operation builds up to the minimum pressure of say 650 pounds for pump 25, then check valve 16 is again closed and bypass valve 28 is again opened to bypass the low pressure pump 14; (5) as the pressure required for the ultimate compressing operation continues to increase then this increasing pressure is transmitted through pipe 36 to chamber 33 so as to adjust pump 25 and cause it to discharge fluid under maximum pressure of 2500 pounds; (6) after the compressing operation is completed, valve 13 is moved to its position 41 whereupon the pressure in the upper ends of cylinders 9 and 10 is reduced to atmospheric pressure through bleed port 38; (7) valve 12 is then operated to discharge fluid from chamber 3 to allow lower platen

2 to move downwardly whereupon the snow cake is discharged; (8) thereafter valve 13 is moved to its uppermost position to admit pump fluid from pipe 18 through pipe 19 to the lower end of cylinders 9 and 10 thereby raising plunger 4. The various pressures mentioned herein are of course only illustrative.

From the foregoing disclosure it is seen that I have provided an improved system for controlling the supply of high and low pressure operating fluid to a hydraulic press, particularly a carbon dioxide snow press and have so arranged the component elements of my improved system that a predetermined sequence of operations may be effected with minimum effort or attention on the part of the operator. My improved control system is also highly adapted to carrying out my improved method of ejecting a cake with minimum possibility of damage thereto while in general it is seen that my improved system is comparatively simple and economical in manufacture, maintenance and operation consistent with obtaining the many desirable results.

It will of course be understood that various changes in details of construction and arrangement of parts may be made by those skilled in the art without departing from the spirit of the invention as set forth in the appended claims.

I claim:

1. In combination, a hydraulic press having a cylinder and a double acting ram therein, means forming a material chamber having a lower open end and a material compressing plunger operated by said double acting ram, movable means for closing said open end, a hydraulic pump, means for alternatively connecting said pump with the opposite ends of said cylinder including valve mechanism adapted in one position to prevent said pump from communicating with either end of said cylinder, means for bleeding hydraulic pressure fluid from one end of said cylinder while said valve mechanism is substantially in its last-mentioned position whereby said compressing plunger remains inert by not being subjected either to a pressing force or to a pullback force although held against gravity movement by fluid pressure in the pullback cylinder, and means for controlling the movable means for said lower end whereby the lower end may be open during said inert period of the compressing plunger thereby allowing material in said material chamber to be discharged therefrom substantially under the action of gravity.

2. In combination, a hydraulic press having cylinder and ram elements movable in one direction to effect a pressing stroke and in the opposite direction for a pullback stroke, means forming a material chamber having a lower open end and a material compressing plunger operated by said cylinder and ram elements, means movable axially relative to said material chamber for closing said open end thereof, a hydraulic pump, means for alternatively connecting said pump with the

pressing and pullback ends of said ram and cylinder elements including valve mechanism adapted to prevent supply of actuating fluid from said pump to either end of said cylinder and ram elements, and means adapted, after completion of a pressing operation, to bleed hydraulic pressure fluid from the pressing end of said ram and cylinder elements while said valve mechanism prevents supply of actuating fluid from the pump to either end of said ram and cylinder elements, whereby said compressing plunger is operative to remain in contact with the material in said chamber upon completion of the compressing stroke but without having either a pressing force applied to the material or a pullback force applied to the material compressing plunger thereby allowing material in said material chamber to be discharged therefrom substantially only under the action of gravity.

3. In combination, a hydraulic press having cylinder and ram elements movable in one direction to effect a pressing operation and in the opposite direction to effect a pullback operation, means forming a material chamber having a lower open end and a material compressing plunger operated by said ram and cylinder elements, movable means for closing said open end and adapted to be moved a spaced distance therefrom to support compressed material discharged from said chamber through said open end, a hydraulic pump, means for alternatively connecting said pump with the opposite ends of said rams and cylinders to effect said pressing and pullback operations including valve mechanism adapted to prevent supply of actuating fluid to either end of said ram and cylinder elements, and means adapted after completion of a pressing operation to bleed hydraulic pressure fluid from the pressing end of said cylinder and ram elements while said valve mechanism prevents supply of actuating fluid from the pump to said pullback end whereby said compressing plunger remains in contact with the compressed material but without having a pressing force applied thereto thereby allowing the compressed material to be discharged by gravity through said open end and on to the closing means therefor when the closing means is in its spaced relation to said open end.

4. In combination, a hydraulic press having a cylinder and a double acting ram therein, means forming a material chamber having a lower open end and a material compressing plunger operated by said double acting ram, movable means for closing said open end, a hydraulic pump, means for alternatively connecting said pump with the opposite ends of said cylinder including a unitary valve mechanism adapted in one position to prevent said pump from communicating with either end of said cylinder, and means for bleeding hydraulic pressure fluid from one end of said cylinder while said valve mechanism is substantially in its last mentioned position.

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