Aug. 31, 1943. W. ERNST 2,328,438

PRESS RAM

Filed May 14, 1940

FIG 1

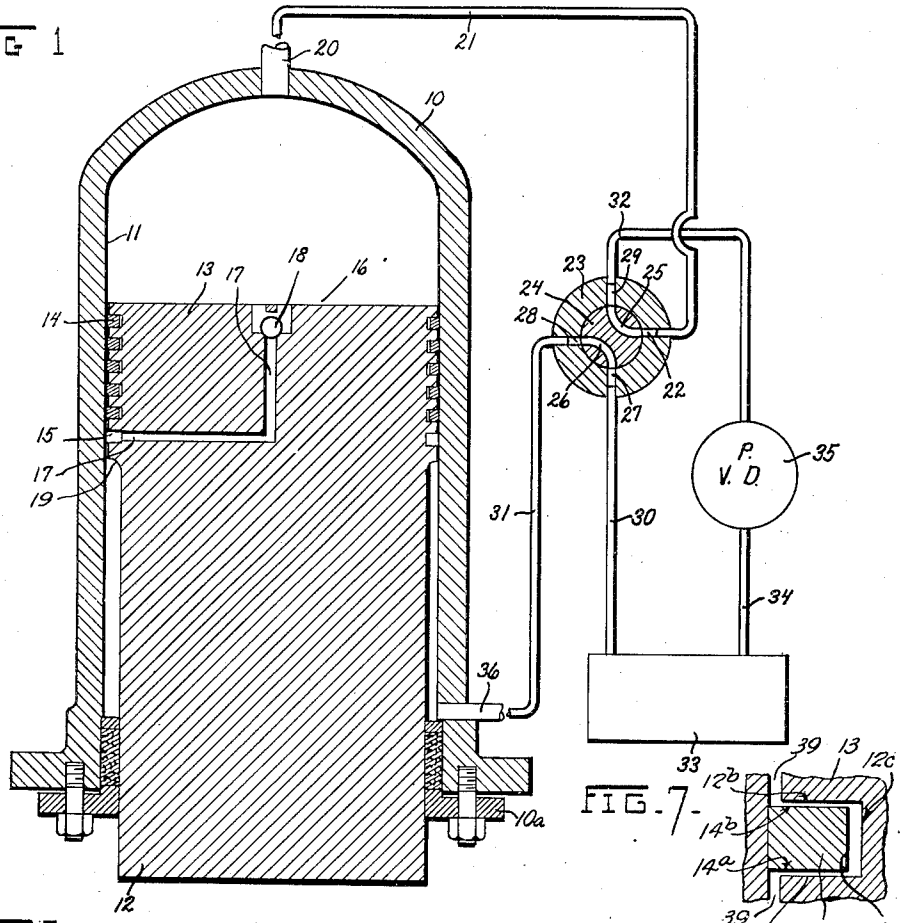


FIG 7

FIG 2

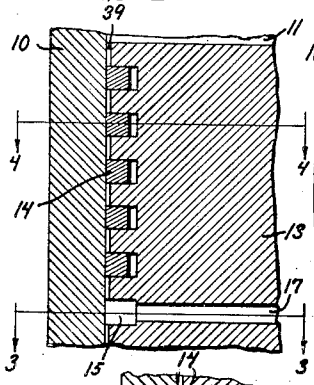


FIG 3

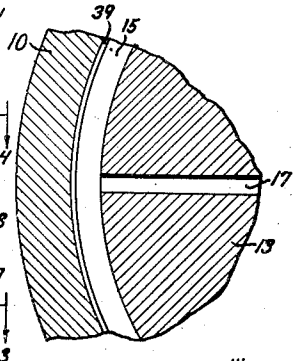


FIG 4

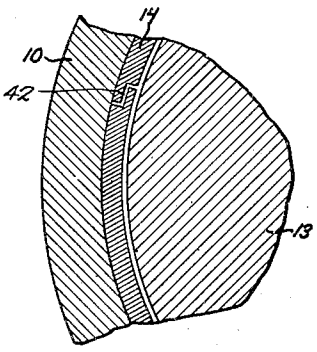


FIG 5

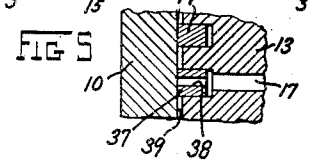
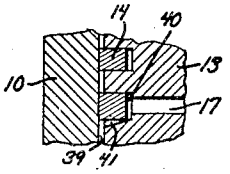


FIG 6



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PRESS RAM

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Application May 14, 1940, Serial No. 335,091

8 Claims. (Cl. 121—38)

The present invention relates to improvements in fluid operable rams, particularly in double-acting rams.

Double-acting rams of fluid operable motors, for instance, presses, are often provided with a large or main area used for accomplishing the working stroke and with a smaller annular area provided on the opposite side of the ram head for returning the ram to its retracted position.

Leakage past the ram head is usually reduced by piston rings placed in grooves in the ram head which smoothly fits in a cylinder bore of the fluid operable motor. The piston rings, having a tendency to expand, serve to further reduce the clearance between the ram head and the cylinder wall, so that no appreciable amount of oil passes by the ram head even under high pressure. The piston rings are further urged outwardly against the cylinder wall by oil under pressure getting into the grooves behind the piston rings. This increases the friction of the rings as they slide along the cylinder wall. However, while during the power stroke of the ram this frictional resistance is of no practical consequence, it is of material importance during the retraction stroke of the ram inasmuch as it reduces the speed with which the ram can be retracted.

In other words, while it is important to keep the annular retraction area as small as possible in order to secure comparatively high speed of a pump of given displacement, the retraction area must necessarily be great enough to furnish sufficient force to return the ram, including the weight of the moving parts, while overcoming the frictional resistance between the ram and the walls of the cylinder bore engaged thereby. Therefore, a reduction in the frictional resistance encountered by the ram during its retraction stroke will make possible an increase in the retraction speed of the ram.

Consequently, it is an object of this invention to provide a double-acting ram adapted to reduce the frictional resistance encountered thereby to speed up the retraction stroke of the ram.

It is a further object of this invention to provide a double-acting ram having piston rings therein and comprising a larger area for performing the working stroke and a smaller area for performing the retraction stroke, while means are provided for automatically reducing the frictional resistance of the ram during the retraction stroke.

It is another object of the invention to provide a ram of the character described in the preceding paragraph in which automatic means reduce the frictional resistance of the ram at the beginning of the retraction stroke of the ram.

It is a further object of the invention to provide a double-acting ram with piston rings therein, and two different areas on each side of the ram head, in which, during the retraction stroke of the ram, a restricted hydraulic connection is established between the said two areas to reduce the frictional resistance of the ram during its retraction stroke.

It is a still further object of the invention to provide a double-acting ram having piston rings therein, and comprising a larger area for performing the working stroke and a smaller area for performing the retraction stroke, while valve means are provided for automatically controlling conduit means adapted to establish a restricted communication between the said two areas.

These and other objects and advantages will appear more clearly from the following description in connection with the accompanying drawing, in which:

Figure 1 diagrammatically illustrates a cylinder having a double-acting ram reciprocably mounted therein in connection with a hydraulic circuit for reciprocating the ram.

Figure 2 illustrates, on a somewhat larger scale, a portion of the ram head and the adjacent cylinder wall.

Figure 3 is a section along the line 3—3 of Figure 2.

Figure 4 is a section along the line 4—4 of Figure 2.

Figures 5 and 6 are further embodiments of the invention.

Figure 7 illustrates on an enlarged scale the position of a piston ring in a groove provided in the piston.

In general, the problem underlying the present invention is solved by preventing the pressure acting on the retraction side of the ram from getting behind the piston rings during the retraction stroke, thereby reducing the friction of the piston rings with the adjacent cylinder wall.

In the drawing, 10 is a hydraulic cylinder with a cylinder bore 11, in which a ram 12 is adapted to be reciprocated. The lower end of the cylinder 10 is provided with packing material and a gland 10a, screwed to or connected in any other convenient manner to the cylinder 10 to prevent leakage between the cylinder and the ram 12. The ram 12 has an enlarged head portion 13

with piston rings 14 fitting in annular grooves 15 around the circumference of the ram head 13. According to Figure 1, another annular groove 15 is provided which contains no piston ring, but communicates with the main area or working stroke performing area 16 through a drilled passage 17. The drilled passage 17 is controlled by a check valve 18.

The ram head 13 is accurately fitted in the cylinder bore 11 and the clearance between the ram head and the cylinder bore is held within close limits so that the leakage between the retraction area 19 and the groove 15 is slight.

The upper portion of the cylinder bore 11 communicates through conduits 20 and 21 with the port 22 of a valve casing 23. Rotatably mounted in the valve casing 23 is a cock 24 having two channels 25 and 26 therein. The valve casing further comprises three ports 27, 28 and 29 respectively communicating with conduits 30, 31 and 32. The conduit 30 leads to a fluid tank 33 which communicates through a conduit 34 with the suction side of the pump 35. The pressure side of the pump 35 communicates with the conduit 32.

The conduit 31 leads to a conduit 36 which communicates with the lower part of the cylinder bore 11.

In the position of the valve cock 24 as shown in Figure 1, pressure fluid is delivered from the pump 35 into the upper portion of the cylinder bore 11, while rotation of the valve cock 24 by 90° in clockwise direction would cause the channel 26 to effect communication between the conduits 31 and 32, so that pressure fluid from the pump 35 would be delivered to the lower portion of the cylinder bore 11. In this instance, the channel 25 of the valve cock 24 would establish communication between the conduits 31 and 30.

According to the embodiment of Figure 5, all the annular grooves of the piston head 13 are occupied by piston rings. However, whereas the upper piston rings 14 are solid, at least one of the lower piston rings, that is, at least the lower piston ring 37, adjacent the retraction area 19, is provided with a plurality of transverse openings 38 communicating with the drilled passage 17 so that pressure fluid acting on the retraction area 19 and coming up in the clearance 39 between the piston head 13 and the adjacent wall of the cylinder 10, may pass into the drilled passage 17, and after having lifted the check valve 18 may escape into the upper portion of the cylinder bore 11. Also, in this instance, the pressure fluid in the clearance 39 is prevented from pushing the piston rings against the adjacent cylinder wall, whereby frictional resistance of the piston rings with the said wall would be increased.

According to the embodiment of Figure 6, only solid piston rings 14 are provided. However, at least the groove 40 pertaining to the lowermost piston ring is provided at its bottom with a plurality of spaced tapered recesses 41 affording a free passage of the pressure fluid in the clearance 39 to the drilled passage 17, so that also in this embodiment, the pressure fluid in the clearance 39 cannot press the piston rings against the adjacent wall portion of the cylinder 10.

It is, of course, understood that in case the ram comprises a plurality of piston rings 37 (Figure 5) or a plurality of grooves with tapered recesses 41 (Figure 6), the drilled passage 17 is to be provided with branch passages leading to each groove having a piston ring 37, or being provided with recesses 41 respectively.

In operation, assuming that the valve cock 24 occupies the position shown in Figure 1, fluid pressure is delivered by the pump 35 through the conduit 32, the channel 25, and the conduits 21 and 20 into the upper portion of the cylinder bore 11. This pressure fluid closes the check valve 18 and causes a downward or working stroke of the ram 12, while fluid from the lower portion of the cylinder bore 11 escapes through the conduits 36, 31, the channel 26, and the conduit 30 into the fluid tank 33. At the same time, pressure fluid acting upon the main area 16 enters the clearance 39 between the piston head 13 and the adjacent cylinder wall (see Figure 7), and passes between the top surface 14*b* of the uppermost piston ring 14 and the adjacent groove surface 12*b* into the space between the groove surface 12*c* and ring surface 14*c*. This will move the piston ring 14 downwardly with respect to the piston head 13, thereby slightly increasing the space between the faces 13*b* and 14*b*, while correspondingly decreasing the space between the bottom surface 14*a* of the piston ring 14 and the adjacent groove surface 12*a*. Furthermore, the pressure fluid between the surfaces 12*c* and 14*c* presses the piston ring 14 against the adjacent cylinder wall, thereby increasing the frictional resistance encountered by the cylinder head 13. While the oil film between the surfaces 12*a* and 14*a* may form a seal between these surfaces, oil in the space between the surfaces 12*c* and 14*c* passes through the usual clearance 42 between the ends of the uppermost piston ring 14 and through clearance 39 behind the next following piston ring and so forth, in the manner described above, thereby likewise pressing the said rings against the cylinder wall and increasing the frictional resistance encountered by the cylinder head 13. This increase in the frictional resistance is, however, of no practical importance on the working stroke of the ram.

As soon as the ram 12 has finished its working stroke and is now to be retracted, the valve cock 24 is shifted, either manually or automatically, so that the channel 26 establishes communication between the conduits 22 and 31, while communication between the conduits 30 and 21 is effected by the channel 25. Pressure fluid from the pump 35 now is conveyed through the conduits 32, 31 and 36 upon the retraction area 19, while the main area 16 communicates through the conduits 20, 21 and the channel 25, and the conduit 30 with the fluid tank 33.

While the ram 12 thus performs its retraction stroke, pressure fluid acting on the retraction area 19 and entering the clearance between the piston head 13 and the adjacent cylinder wall may, according to Figure 1, enter the groove 15. From here the fluid may pass through the drilled passage 17 and open the check valve 18. The fluid then will pass to the upper portion of the cylinder bore 11, and from here escape to the tank 33. In this way, the pressure fluid entering the clearance between the piston head 13 and the adjacent cylinder wall from the retraction area 19 can not press the piston rings against the adjacent cylinder wall in a manner similar to that described above in connection with the description of the forward stroke of ram 12, so that the frictional resistance encountered by the ram during its retraction stroke is less than the frictional resistance of the ram encountered during its working stroke, thereby enabling a speeded up retraction stroke of the ram.

A similar operation is effected with the embodi-

ments of Figures 5 and 6, in which, the pressure fluid acting upon the retraction area 19 and entering the clearance between the piston head 13 and the adjacent cylinder wall cannot press the piston rings against the adjacent wall of the cylinder 10, due to the openings 38 and 41 respectively.

It will be understood that I desire to comprehend within my invention such modifications as come within the scope of the claims.

Having thus fully described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. A fluid operable motor comprising a cylinder, a piston reciprocable in said cylinder and having a first effective area for moving said piston in one direction, and a second effective area for moving said piston in the opposite direction, means for admitting pressure fluid selectively to said first or second effective area, sealing means arranged at the periphery of said piston and engaging adjacent wall portions of said cylinder for substantially preventing hydraulic communication between said first and second areas, a passageway in said piston and directly communicating with a groove at the periphery of said piston, and means associated with said passageway and responsive to fluid pressure on said sealing means, while pressure fluid is acting on said second effective area for effecting direct fluid connection between said passageway and said first effective area.

2. A fluid operable motor comprising a cylinder, a double-acting ram reciprocable in said cylinder and having at the periphery thereof an annular groove with a piston ring therein engaging the adjacent wall of said cylinder, means for selectively admitting pressure fluid to one or the other side of said ram, conduit means in fluid communication with said groove, said conduit means being arranged to directly communicate with the one side of said ram only, while being adapted to communicate with the other side of said ram through said groove, and check valve means responsive to fluid pressure in said groove during the movement of said ram in one direction for establishing fluid connection between said conduit means and the one side of said ram.

3. A fluid operable motor comprising a cylinder, a ram reciprocable in said cylinder and having a first effective area for moving said ram in one direction and a second effective area for moving said ram in the opposite direction, at least one groove at the periphery of said ram with a piston ring therein engaging the adjacent wall of said cylinder, means for selectively admitting pressure fluid to said first effective area or said second effective area, restricted conduit means arranged in said ram and leading to the periphery of said ram intermediate said first and second effective areas, and means responsive to pressure in said conduit means, while pressure is acting on said second effective area, for effecting restricted communication between said conduit means and said first effective area.

4. A fluid operable motor comprising a cylinder, a double-acting ram reciprocable in said cylinder and having a working stroke performing area and a retraction area, piston rings mounted in said ram and engaging the adjacent surface of said cylinder, means for selectively admitting pressure fluid to one of said areas for actuating said ram, a groove at the periphery of said ram, conduit means in said ram in direct continuous fluid communication with said groove, and valve means controlling fluid connection between said conduit means and said working stroke performing area, said valve means being arranged to prevent said fluid connection in response to the supply of pressure fluid to said working stroke performing area and to establish said fluid connection in response to fluid pressure on said rings while pressure fluid is conveyed to said retraction area, thereby venting the pressure in said groove.

5. A fluid operable motor comprising a cylinder, a double-acting ram reciprocably mounted in said cylinder and having one or more peripheral grooves therein and also having a working stroke performing area and a retraction stroke performing area, one or more piston rings mounted in said groove or grooves, a bore arranged in said piston and leading into one of said grooves, means for selecitvely admitting pressure fluid to said working stroke performing area or said retraction stroke performing area for performing an advancing or a retracting stroke of said ram, and means responsive to pressure in said bore for establishing fluid connection between the latter and an exhaust, to thereby vent said groove or grooves during said retraction stroke.

6. A fluid operable motor comprising a cylinder, a double-acting ram reciprocably mounted in said cylinder and having a working stroke performing area and a retraction area, said ram being provided in its periphery with a plurality of annular grooves, piston rings mounted in said grooves for engagement with the adjacent wall of said cylinder, at least one of said piston rings having transverse openings therethrough communicating with the bottom of the groove pertaining thereto, means for selectively supplying pressure fluid to one of said areas, restricted conduit means communicating with said transverse openings, and means operable during the retraction stroke of said ram to establish restricted hydraulic communication through said restricted conduit means between the pressure stroke performing area and a groove containing a piston ring with transverse openings therethrough.

7. A fluid operable motor comprising a cylinder, a double-acting ram with a working stroke performing area and a retraction area, said ram being reciprocably mounted in said cylinder and having a plurality of peripheral grooves, at least one of said grooves having one or more tapered recesses therein extending from the bottom of the groove to the periphery of the ram, means for selectively admitting pressure fluid to one of said areas, restricted conduit means communicating with at least one tapered recess, and means operable during the retraction stroke of the ram to establish fluid communication through said restricted conduit means between the pressure stroke performing side of the ram and a piston ring groove comprising the tapered recess.

8. A fluid operable motor comprising a cylinder, a piston reciprocable in said cylinder and having a first effective area for moving said piston in a first direction and a second effective area for moving said piston in a second direction, means for admitting pressure fluid selectively to said first or second effective area, piston rings arranged at the periphery of said piston, conduit means in direct and unrestricted fluid communication with the periphery of said piston, said conduit means being only restrictively connected to said second effective area, and control means responsive to pressure in said conduit means while said piston is moving in said second direction for releasing fluid pressure from said piston rings.

WALTER ERNST.