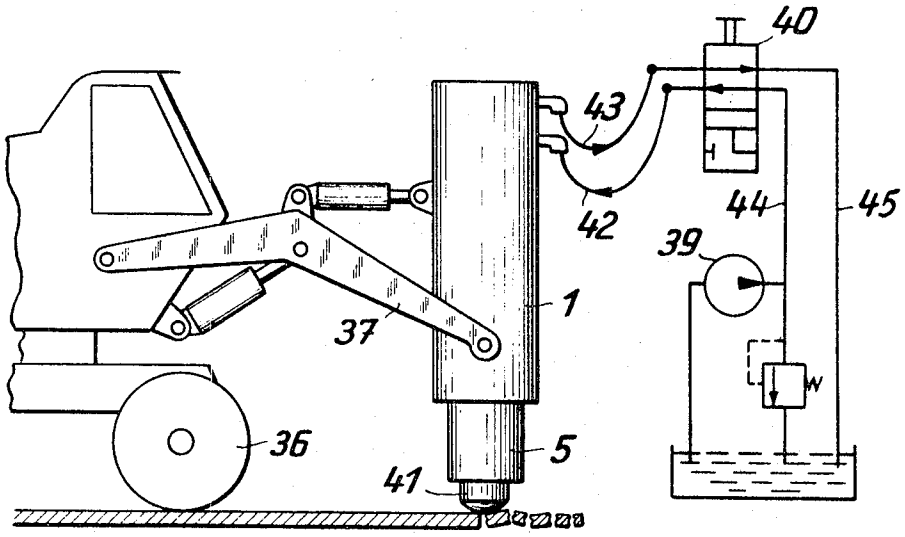
Sept. 23, 1969 H. H. CORDES ET AL 3,468,222

CONTROL FOR A RAMMING HAMMER WITH HYDRAULIC DRIVE

Filed June 30, 1967 3 Sheets-Sheet 1

Fig. 1



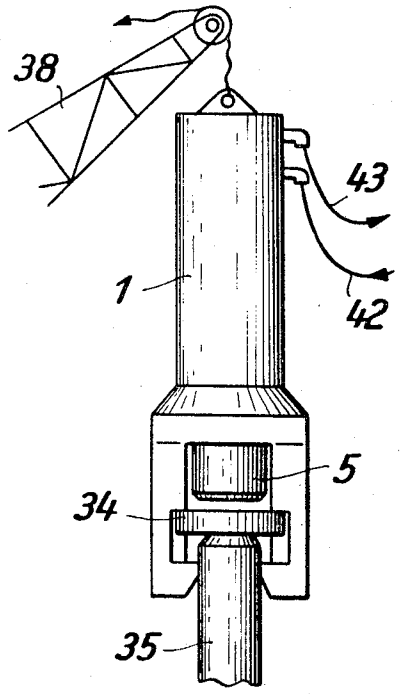


Fig. 2

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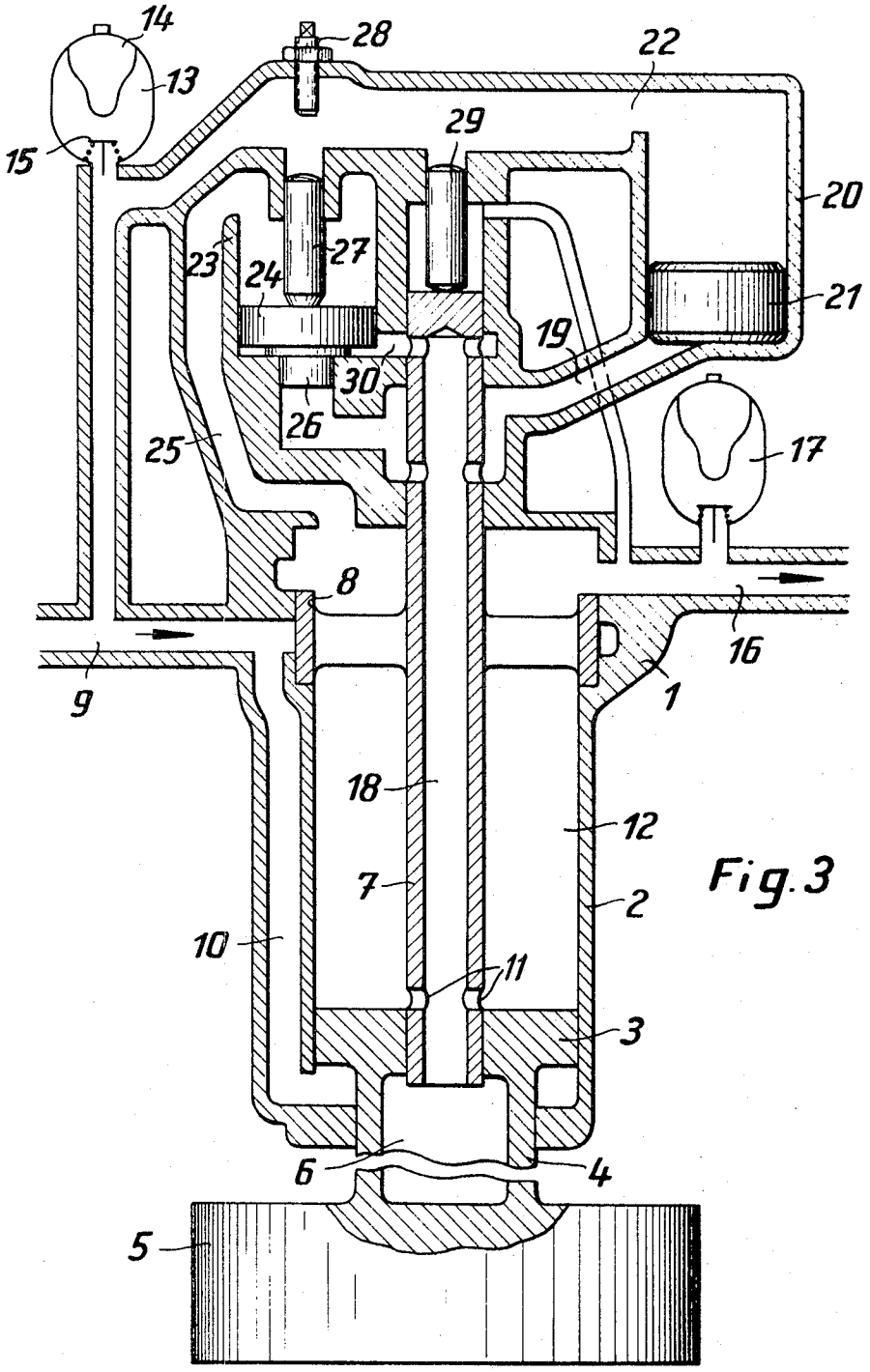

Fig. 3

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CONTROL FOR A RAMMING HAMMER WITH HYDRAULIC DRIVE

Filed June 30, 1967 3 Sheets-Sheet 3

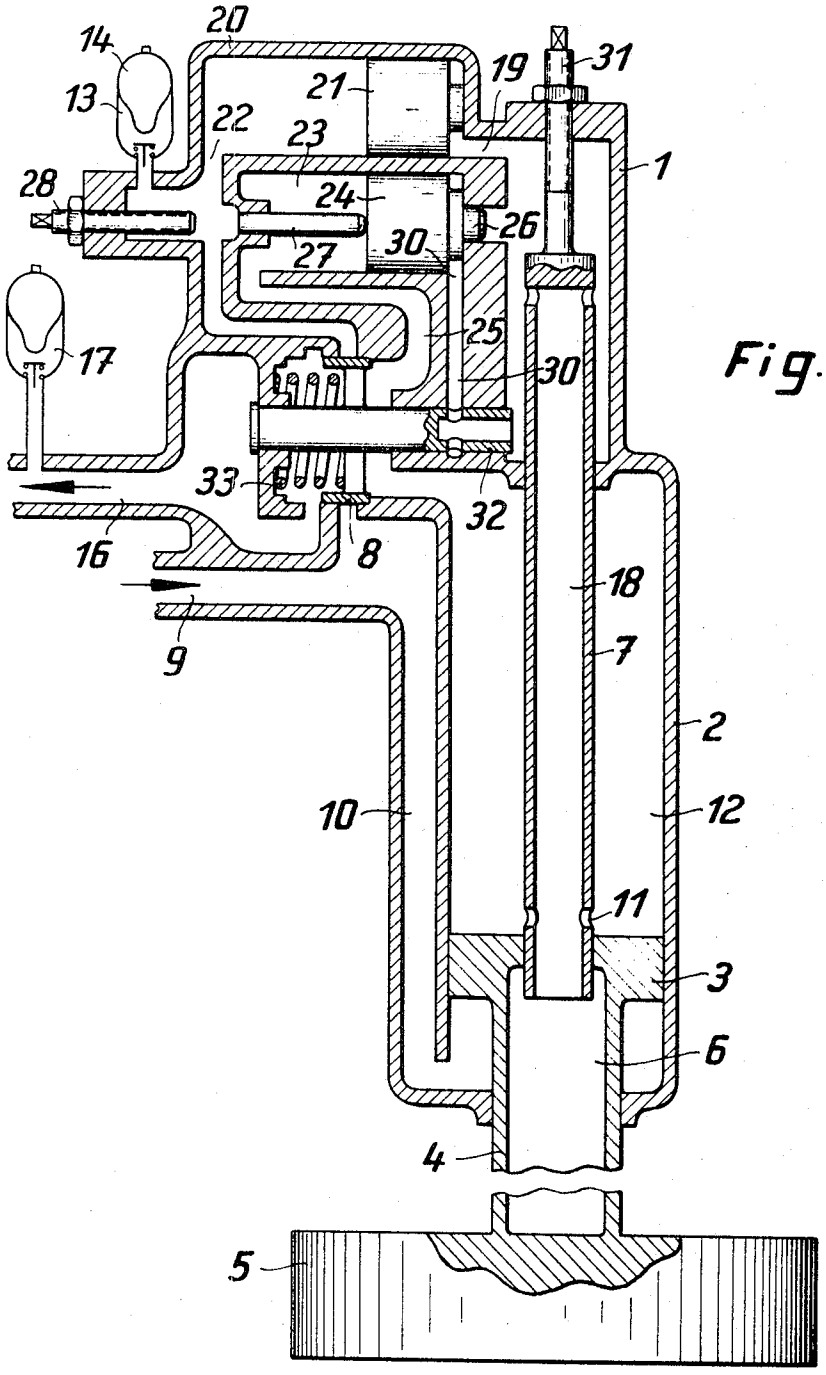

Fig. 4

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United States Patent Office 3,468,222
Patented Sept. 23, 1969

3,468,222

CONTROL FOR A RAMMING HAMMER WITH HYDRAULIC DRIVE

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Filed June 30, 1967, Ser. No. 650,411
Claims priority, application Germany, July 6, 1966, C 39,536
Int. Cl. F01l 21/04
U.S. Cl. 91—222 8 Claims

ABSTRACT OF THE DISCLOSURE

The ram consists of a ram block rigidly connected with a working piston displaceable in a hydraulic cylinder. The displacement of piston and block results from supply of pressure fluid into the cylinder at the one or the other side of the working piston. A valve spool automatically controls and reverses the fluid flow so that both sides of the working piston are alternately biased. The automatic reversal makes possible a great frequence of strokes.

Background of the invention

The invention relates to a ram with hydraulic drive. Such rams are used on mobile carrier equipment for smashing or compacting purposes. They are also employed to drive in sheet piles, piles or the like while suspended from a rope or guided by a ram guide.

The object of the invention is to provide a ram of high efficiency with handy dimensions which is mobile and may be employed in any position i.e. not only with the working member moving in the vertical direction.

Another object is to provide a ram with a simple and reliable automatic hydraulic control which allows for a wide variety of sequence of strokes.

The ram comprises a ram block which is movable with respect to the ram housing and which is connected with the piston of a hydraulic cylinder to which pressure fluid is supplied at a substantially constant rate from a pressure fluid pump situated outside the ram.

Summary of the invention

According to the invention the pressure fluid flow is controlled by an automatically operable control device disposed in the ram housing with a compressed air hydraulic accumulator arranged at the supply end as well as at the discharge end thereof.

The accumulators enable the ram block to continue its movement after reversal in that they accumulate the amount of pressure liquid coming from the working cylinder as well as from the pump and the control device. The accumulators also impart to the downwardly moving ram block a greater impact velocity than would correspond to the quantity of liquid delivered by the pump. The accumulators arranged near to the control device reduce the pressure fluctuations in the supply and discharge lines and make available a sufficient quantity of pressure fluid for the control. Thereby, a safe and quick control is made possible. There is also a practically steady supply and drain flow taking place through the hoses, thus sparing them.

In an especially preferred embodiment of the invention the piston which is displaceably guided in a working cylinder is connected with the ram block by means of a hollow piston rod. The volume portion of the working cylinder through which the piston rod passes, may be steadily connected to the delivery side of the pump. A hollow control rod adapted to be pushed into the hollow piston rod passes through the upper volume portion of the working cylinder. The control rod connects at times the hollow space of the piston rod with the upper portion of the working cylinder by means of openings. Moreover, the hollow control rod connects permanently the hollow space of the piston rod with a control chamber. This control chamber is open to at least one accumulator cylinder.

The control supported in the ram housing for longitudinal movement therein. Moreover, the control rod is connected to a valve spool controlling the liquid flow in the ram. The control rod may also be stationarily supported in the ram housing. Then, the valve spool will be arranged separately and moved by a piston projecting into the control space. The pressure fluid displaced from the cavity of the piston rod during the upward movement of the ram block at first pushes back a storage piston arranged in a first storage cylinder, to a stop and then displaces the valve spool against the action of a small piston pressurized by the supply pressure, and/or against a spring.

It may be recommendable to provide the control space with a second storage cylinder in which a storage piston designed as a separating piston is arranged, the side of which faces away from the control space which is subjected to the supply pressure.

In this manner, at first, a very exact and reliable reversal is effected by means of the valve spool and thereafter the working piston is still capable of moving a further small distance in the same direction while displacing one storage piston.

The ram designed in accordance with the invention may be employed with any angle with respect to the vertical line.

Further improvements and suitable features of the invention are explained by way of the drawing which shows some embodiments in a diagrammatic view.

Brief description of the drawing

FIG. 1 shows a ram for smashing or compacting operations, which is pivotally connected to the cantilever of a dredge or other building machinery vehicle, the pressure fluid feed with constant flow of delivery being shown diagrammatically.

FIG. 2 shows the same ram however with a ram plate having the ram block beating thereon, for driving in posts and sheet piles.

FIG. 3 shows a longitudinal sectional view of one embodiment of the control device for automatically controlling the liquid flow within the ram housing, the accumulators being shown diagrammatically on a reduced scale.

FIG. 4 shows a longitudinal sectional view taken on another embodiment of the control device.

Description of the preferred embodiments

The two control devices according to the invention shown in the FIGS. 3 and 4 essentially differ from each other in that the embodiment of FIG. 3 makes use of an axially displaceable control rod and the embodiment of FIG. 4 uses a stationary one. Like reference numerals are used in the figures for corresponding parts.

In accordance with FIGS. 1 and 2 pressure fluid is supplied to the housing **1** of the ram from a pump **39** after the master valve **40** has been opened. Said pressure fluid moves the ram block **5** supported in the ram housing **1** up and down. In this operation, the ram housing (FIG. 1) mounted at a cantilever **37** of a mobile building machine may be guided over the ground in such a manner that the ram block **5** strikes the ground by its tool **41**. The ram housing **1** may also be suspended freely (FIG. 2) or with guidance in a ram guide and put onto a post

35 with an intermediate ram plate 34, the ram block 5 beating onto the post 35 via the ram plate 34 and driving the same into the ground.

The pump 39 with the main valve 40 and accessory is arranged on the carrier stand, i.e. the mobile building machine 36. The pressure line 44 of the pump 39 is connected with the supply line 9 of an automatic hydraulic control device by means of a hose 42, said control device being arranged in the ram housing 1. In a corresponding manner, a hose 43 is used to connect return line 45 to the control device return line 16. The ram housing 1 contains a working cylinder 2 with working piston 3, piston rod 4 and a ram plate 5 fastened thereat. The piston rod 4 is provided with a cavity 6 with a hollow plunger rod 7 adapted to be plunged thereinto. The inflowing pressure fluid in the supply line 9 is controlled by a valve spool 8, the pressure fluid being capable, for example, of permanently biasing the underside of the working piston 3 via the line 10. The plunger 7 is provided with bores 11 communicating the cavity 6 of the piston rod 4 with the upper volume portion 12 of the working cylinder 2 with the ram block 5 being near its lowest position.

A compressed-air hydraulic accumulator 13 is inserted in the supply line 9 which may be designed as a bubble accumulator with a gas bubble 14 and a bottom valve 15 or also as a piston accumulator.

A compressed-air hydraulic accumulator 17 for low pressure is fitted in the return line 16. The bore 18 of the plunger rod 7 is permanently in communication with the control chamber 19 and a storage cylinder 20, the piston 21 of which is subjected to supply pressure on its other side via the line 22. A differential piston 24 is fitted in another storage cylinder 23 the large piston surface of which is in communication with the upper volume portion 12 of the working cylinder 2 via the line 25. The small surface 26 of piston 24 is permanently in communication with the cavity 6 via the hollow plunger rod 7. This differential piston 24 is additionally permanently biased by a psring or by a piston 27 subjected to supply pressure. Its stroke is limited by the adjustable abutment member 28. The small piston surface and its annular surface may be interchanged. Instead of the emerging action of the small piston as shown in the drawing, it is also possible to overrun slots.

FIG. 3 shows the plunger rod 7 rigidly connected with the valve spool 8 while movably supported in the ram housing 1. The plunger rod 7 is pressed into a position in which the valve spool 8 fixed thereto causes a lifting movement of the ram block 5, by a spring or a small piston 29 subjected to supply pressure. In this operation, the annular area of the differential piston 24 is in communication with the cavity 6 of the piston rod 4 via the passage 30 and the bore 18.

In the embodiment shown in FIG. 4, the plunger rod 7 which may be axially adjusted by means of an adjusting screw 31, is rigidly connected with the ram housing 1. The liquid displaced from the cavity 6 acts on the piston 32 connected with the valve spool 8 and, with high pressure, causes the reversal against a permanently effective return force for example by the spring 33. This spring may also be replaced by a small piston 29 subjected to supply pressure as shown in FIG. 3.

The mode of operation is as follows:

The valve spool 8 is initially in a position effective to cause the lifting movement of the ram block 5 (FIG. 3). Before lifting, the bores 11 are open so that a balance may take place between the volumes 12 and 6. During the lifting movement, these bores 11 become blocked by the piston 3. The liquid displaced from the volume 6 flows now through the upper bores of the plunger rod 7 and first displaces the differential piston 24 against the force of the small piston 27 to the abutment member 28. Upon further increase of the pressure within volume 6, until the upward force acting on plunger 7 exceeds the

downward force on piston 29, the plunger 7 will be moved upwardly shifting valve 8 to its upper position. This occurs because the small piston 29 has a smaller diameter than the plunger rod 7.

In accordance with FIG. 4, the reversal is effected in that a liquid pressure smaller than the supply pressure and acting on the piston 32, suffices to revert the valve spool 8 against the force of the spring 33. Instead of the spring 33, a small piston subjected to the supply pressure and having a diameter smaller than that of the piston 32 may effect the return movement.

After reversal of valve 8, the ram block 5 will continue its upward movement due to inertia. Thereby, pressure liquid is pressed into the accumulator 13, and liquid is displaced from the cavity 6 into the storage cylinder 20. This liquid moves the piston 21 against the supply pressure and the displaced liquid is pressed into the accumulator 13.

The ram 3 will stop its upward movement upon forcing fluid into accumulator 13, and as the supply fluid communicates with chamber 12 and exhaust passage 16 is blocked the ram 3 is forced downward. During the lowering movement, the piston 21 returns into its starting position. The differential piston 24 returns only until the small piston surface 26 enters into its cylinder bore because the liquid trapped in the annular space cannot escape through the channel 30. Now, the reversal into the position causing the lifting movement is effected, namely by the small piston 29 in accordance with FIG. 3 and by the spring 33 in accordance with FIG. 4, because the liquid pressure in the cavity 6 drops. The shifting of the plunger 7 under the influence of the small piston 29, and the shifting of the piston 32 under the influence of the spring 33 in the embodiment of FIG. 4, results from the differential pressure acting upon these small pistons due to the pressure drop occurring in cavity 6. This pressure drop in cavity 6 results from the fact that less fluid flows into cavity 6 from the chamber between pistons 24 and 26 than was previously accepted from cavity 6, due to the stopping of the piston 24 at the location determined by the entering of the piston 26 into its cylindrical bore. Thus, the introduction of a lesser amount of fluid into cavity 6 results in a lowering of its pressure permitting the shifting of the plunger 7, or the piston 32, before the initial position of the ram block 3 is reached. After reversal has been effected, the annular space of the differential piston 24 is drained via the now open line 30 into the cavity 6 and the bores 11 are opened.

The upper point of reversal may be varied by adjusting the abutment member 28.

In accordance with FIG. 4 the plunger rod 7 can be axially displaced by means of the adjusting screws 31 whereby the lower point of reversal is adjusted.

What we claim is:

1. A double action ram adapted to be supplied at a substantially constant rate of delivery of pressurized medium comprising, in combination, a ram housing having a cylinder defined therein, a piston movably mounted in said cylinder and including first and second oppositely related faces, said first face having a smaller area than said second face, a ram block mounted on said piston, an axially extending chamber defined in said piston, a tubular plunger mounted on said housing located within said chamber and slidably sealed with respect thereto and having an inlet communicating with said chamber and an outlet, a pressurized fluid supply conduit communicating with said first piston face, a passage defined in said housing between said piston second face and said supply conduit, a valve within said passage controlling fluid flow therethrough, piston reversing control means communicating with said plunger sensing the pressure within said piston chamber as said piston is axially translated relative to said plunger selectively positioning said valve, and an exhaust conduit selectively communicating with said piston second face.

2. In a double-acting ram as in claim 1 wherein said piston reversing control means includes a differential pressure piston mounted in said housing in communication with said plunger outlet.

3. In a double-acting ram as in claim 2, biasing means biasing said differential pressure piston.

4. In a double-acting ram as in claim 1 wherein said valve is mounted on said plunger.

5. In a double-acting ram as in claim 4, means mounting said plunger on said housing for limited axial movement relative thereto.

6. In a double-acting ram as in claim 1, a control piston slidably mounted in said housing communicating with said plunger, said valve being mounted on said control piston.

7. In a double-acting ram as in claim 6, means adjustably fixing said plunger to said housing.

8. In a double-acting ram as in claim 1, a first compressed gas accumulator communicating with said supply conduit and a second compressed gas accumulator communicating with said exhaust conduit.

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U.S. Cl. X.R.

91—280, 317, 321; 92—114; 173—134