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3 Sheets-Sheet 2

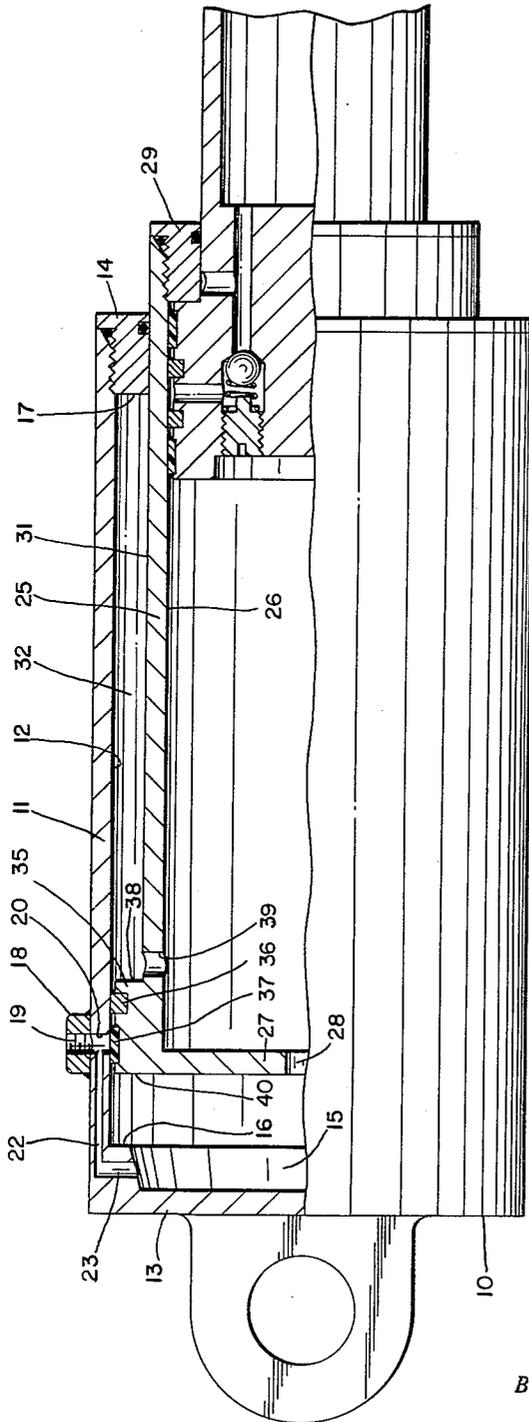


Fig. 2

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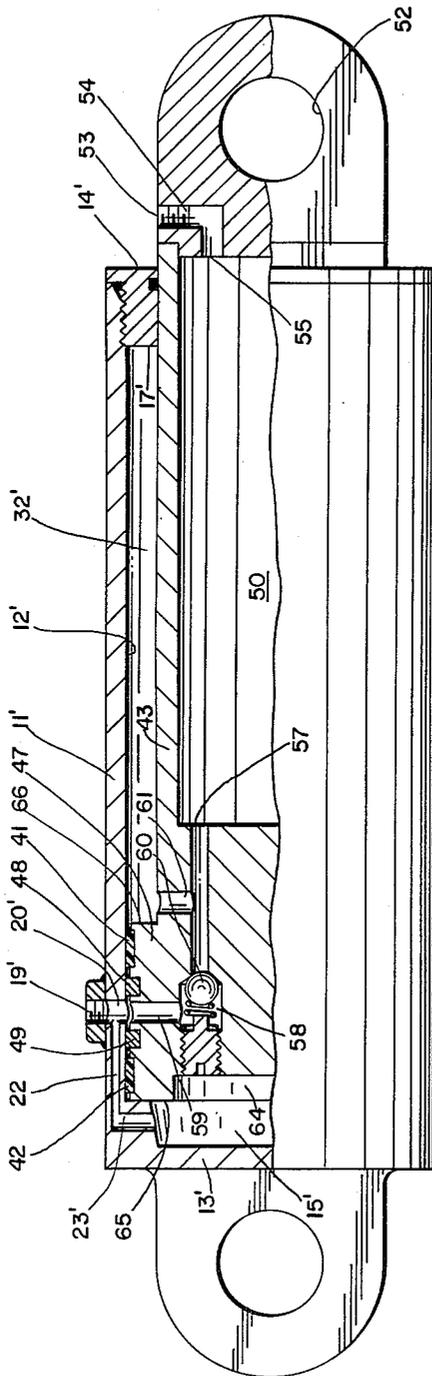


Fig. 3

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DOUBLE ACTING HYDRAULIC CYLINDER WITH PRESSURE FLUID BYPASS

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This invention relates to hydraulic cylinders and more particularly to cylinders of the double acting type wherein fluid pressure is used for both extending and retracting the piston. It is also adaptable to either single or multiple stage type cylinders in which the piston rod is either a single element or in which it may be composed of several sections which telescope one within the other.

An object of the invention is to provide a cylinder of the double acting type in which there is a means for relieving the fluid pressure at the end of the retraction stroke of the piston by bypassing fluid from the pressure side of the piston to the exhaust side so that the pump which is supplying the fluid under pressure need not maintain the pressure unnecessarily.

It is another object of the invention to provide a double acting cylinder of the type described in which the fluid pressure for retracting the piston is introduced to the cylinder through a port in the projecting portion of the rod, such port being connected to the interior of the cylinder by means of passages within the piston rod. This arrangement permits the supply conduit for the retracting stroke to be mounted on the member to which the piston rod is attached and to have but a short conduit connection between such member and the piston rod in contrast to the longer conduit connection that would have to be made on such member to the cylinder if fluid for effecting retraction is introduced through the cylinder rather than through the piston rod.

It is another object to provide a means for unloading pump pressure at the end of the retraction stroke which is adaptable to either single or multiple stage cylinders.

It is another object to provide an unloading means of the type described which is simple to manufacture and which is fool proof in operation.

Other objects of the invention will be apparent from the following description and from the drawings in which:

FIG. 1 is a cross section view of a multiple stage cylinder shown in fully retracted position;

FIG. 2 is a partial cross section, partially fragmentary, view of a multiple stage cylinder in partially extended position; and

FIG. 3 is a partial section view of a single stage cylinder embodying the invention.

In the form of the invention shown in FIGURES 1 and 2, the multiple stage cylinder is generally indicated by the numeral 10. It includes a first stage cylinder 11 having a bore 12 closed at one end by a wall 13 and having a nut 14 threaded into its other end. A recess 15 and an abutment shoulder 16 is provided at one end of the cylinder 11. The nut 14 provides an abutment shoulder 17 at the other end of the cylinder.

The cylinder 11 has a boss 18 welded thereto which provides a port opening 19 in registry with a passage 20 through the wall of the cylinder 11 and in communication with bore 12. Other passages 22, 23 connect port opening 19 with recess 15.

Mounted within first stage cylinder 11 is a second stage cylinder 25 having a bore 26 which is closed at one end by a wall 27 having an opening 28 therethrough. Threadedly attached to the other end of cylinder 25 is a nut 29 having an abutment face 30.

The outer cylindrical surface 31 of cylinder 25 is spaced from bore 12 so as to provide an annular space 32 there-

between and it has a slide fit within nut 14 and is sealed thereagainst by means of packing 33.

The inner end of cylinder 25 has an enlarged diameter portion 35 which serves as a piston head in a manner to be described. Piston head 35 carries a packing 36 which is in sealed engagement with bore 12 and a suitable bearing 37 which is also in engagement with bore 12. The front face 38 of the piston head 35 is adapted to engage the face 17 of nut 14 to limit outward movement of second stage cylinder 25 within first stage cylinder 11. A duct 39 connects annular space 32 with the bore 26 of cylinder 25 and end face 40 of end wall 27 is engageable with shoulder 16 to limit inward, or retracting movement, of cylinder 25 within cylinder 11.

Mounted within cylinder 25 is a piston rod 43 which has an outer cylindrical surface 44 spaced from second stage cylinder bore 26 so as to provide an annular space 45 therebetween. The outer cylindrical wall 44 is a slide fit within nut 29 and is sealed with respect thereto by packing 46.

The inner end of piston rod 43 has an enlarged portion 47 which serves as a piston and which has annular packing rings 48, 49, and annular bearings 41, 42 in engagement with bore 26.

Piston rod 43 has a hollow portion 50 for reducing the weight thereof and for forming a fluid passage through the piston rod. The hollow portion 50 is closed at its outer end by a member 51 welded thereto and which has an opening 52 therethrough for connection to a member to be moved by the cylinder. The member 51 has a fluid port 53 therein and passages 54, 55 for connecting port 53 to the hollow portion 50.

The piston head 47 extends across the inner end of the piston rod 43. A passage 57 connects the hollow portion 50 with a valve chamber 58 and the latter is connected by means of a passage 59 to the exterior of piston head 47 at a location between the annular packings 48, 49. Passage 57 is normally closed at its inner end by a spring seated check valve 60 and is in open communication with annular chamber 45 by means of a passage 61.

The inner end of the piston head 47 has an annular recess 64 and an end face 65 which is adapted to contact end wall 27 of cylinder 25 to limit inward movement of piston rod 43 within cylinder 25. Piston head 47 also has an abutment face 66 which is adapted to contact face 30 of nut 29 to limit outward movement of piston rod 43 with respect to cylinder 25.

From the foregoing description it is apparent that second stage cylinder 25 has a dual function in that it serves as a cylinder for containing piston 47 and rod 43 and also serves as a piston and piston rod with respect to cylinder 11 and has extended and retracted positions with respect thereto.

To extend rod 43 and second stage cylinder 25 from the retracted position shown in FIG. 1, fluid under pressure is admitted to port 19. A portion of such fluid passes through passage 20 and enters annular space 32, duct 39, passage 59, and valve chamber 58. It is prevented from gaining access to annular space 45 by packing 48 and to passage 57 by check valve 60.

At the same time, fluid being admitted through port 19 passes through passages 22 and 23 to recess 15 and opening 28 to recess 64. The fluid acts upon the inner end of piston head 47 across its entire diameter to move piston rod 43 to an extended position with respect to cylinder 25 until abutment face 66 contacts face 30 to limit further relative movement between piston rod 43 and cylinder 25.

At the same time, fluid acts against piston 35 of cylinder 25 on a differential area determined by packings 33 and 49 to start outward movement of cylinder 25 with respect to cylinder 11. As soon as piston face 66

contacts face 30 the outwardly acting pressure of fluid upon piston 47 is transmitted by such contact to cylinder 25 to assist in continued outward movement of cylinder 25 with respect to cylinder 11. Such outward movement is stopped when piston face 38 contacts face 17 of nut 14.

During such outward or extending movement of piston rod 43, fluid from annular chamber 45 exhausts through passages 61, 57, 50, 55, 54, and port 53 to the system reservoir. At the same time, trapping of fluid within annular space 32, which would interfere with outward movement of cylinder 25, is prevented by the fact that annular space 32 is in communication with port 19 by means of passage 20 until packing 36 crosses passage 20 to cut it off from space 32, and is also in communication with chamber 64 after packing 49 crosses passage 39.

To retract piston rod 43 and second stage cylinder 25, fluid under pressure is admitted to port 53 and port 19 is permitted to exhaust. Such fluid passes through a passage means comprising port 53 and passages 54, 55, 50, rightward portion of 57, and 61 and enters annular space 45 to act upon piston face 66 to cause retraction of piston rod 43 within second stage cylinder 25. During this retraction movement, pressure fluid in passage 57 opens check valve 60 to pressurize chamber 58 and passage 59 but is dead ended by packings 48 and 49 until piston rod 43 has been retracted in second stage cylinder 25 to the point where packing 49 crosses port 39. At this time fluid under pressure from passage 59 passes through duct 39 into annular space 32 and acts upon piston face 38 for retracting second stage cylinder 25 with respect to first stage cylinder 11.

When packing 36 again crosses duct 20, annular space 32 will be connected with duct 20 and port 19. Since the latter is now serving as an exhaust port and pressure fluid entering through port 53 now has a free path to such exhaust port, the fluid will lose substantially all its pressure and thus unload the pump so that the latter will not be required to do work after retraction has been completed.

This same method of unloading the system pump at the completion of the retraction stroke can be applied to a triple stage cylinder by, in effect, inserting another cylinder corresponding to cylinder 25 between cylinder 25 and cylinder 11, extending piston head 35 to both sides of duct 39, and adding another packing corresponding to packing 36 to the other side of duct 39 so that piston head 35 will resemble piston 47 with respect to such packings. Similarly, still further additional stages can be added as desired.

The pump unloading feature may be applied to a single stage cylinder by omitting the second stage cylinder 25 of FIG. 1 and reportioning cylinder 11 of FIG. 1 so that it has an inside diameter corresponding to the outside diameter of piston head 66. This arrangement is illustrated in FIG. 3 wherein piston rod 43 is identical to piston rod 43 of FIG. 1 and has its portions thereof identified by like reference numerals. In this case, cylinder 11' corresponds with cylinder 11, except for diametral dimensions, and reference numerals also correspond except that they have prime designations.

In the single stage form of FIG. 3, extension of piston rod 43 is effected by admitting pressure fluid to port 19', such pressure fluid making its way through passages 22' and 23' to the inner end of piston 47 to force the latter in an outward or rod extending direction.

Retraction of piston rod 43 is effected by admitting pressure fluid to port 53 while connecting port 19' to exhaust. In such case, pressure fluid entering through port 53 passes through passages 54, 55, 50, 57, and 61 to annular space 32' to act upon piston face 66 for moving piston 47 in a retracting or inward direction. During such retracting movement, pressure fluid gains access to chamber 58 and passage 59 but is trapped therein by packings 48 and 49 until packing 49 moves across duct

20'. At such time, passage 59 is connected to exhaust port 19' by means of duct 20' to drop the pressure and thus unload the pump.

From the above, it is apparent that a simple and effective method for unloading the pump at the end of the retraction stroke of double acting cylinders, of either single or multiple stage types, has been provided. It is obvious that various modifications of the detail construction illustrated and described can be made by those skilled in the art without departing from the invention as covered by the claims.

I claim:

1. A fluid pressure operated device comprising a cylinder, a piston having a rod connected thereto mounted in said cylinder and reciprocable between extended and retracted positions, said piston having opposed areas, first passage means in one end of said cylinder through which fluid under pressure may be admitted from an external source and directed against one of said areas for moving the piston to said extended position, second passage means leading from an external portion of said rod to the other of said areas and through which fluid under pressure may be admitted from an external source and directed against said other of said areas for moving the piston to rod retracted position, third passage means leading from said second passage means, a fourth passage means leading from said first passage means and communicating with said third passage means when said piston is in retracted position whereby fluid from said second passage means may pass through said third and fourth passage means to said first passage means, and means for blocking said communication between said fourth and third passages when said piston is in said extended position and fluid pressure in said second passage is greater than in said first passage.

2. A device in accordance with claim 1 in which there is a means located within the piston for preventing flow of fluid from said third passage means to said second passage means but permitting flow from the second passage means to the third passage means.

3. A device in accordance with claim 1 in which there is a spring seated normally closed check valve in said third passage means which permits flow of fluid from the second passage means to the third passage means but not from the third passage means to the second passage means.

4. A fluid pressure operated device comprising a cylinder having a bore, a piston having a rod connected thereto mounted in said bore and reciprocable between extended and retracted positions, said piston having opposed areas, first passage means in one end of said cylinder through which fluid under pressure may be admitted from an external source and directed against one of said areas for moving the piston to said extended position, second passage means leading from an external portion of said rod to the other of said areas and through which fluid under pressure may be admitted from an external source and directed against said other of said areas for moving the piston to retracted position, a pair of spaced packings on the piston in sealing contact with said bore, third passage means in said piston and connecting said second passage means with the exterior of the piston between said packings, a fourth passage means connecting said first passage means to the exterior of the piston between said packings when said piston is in retracted position whereby fluid from said second passage means may pass through said third and fourth passages via said piston exterior between said packings to said first passage means, one of said packings blocking communication between said fourth and third passages when said piston is in extended position.

5. A device in accordance with claim 4 in which said fourth passage means intersects said bore and one of said packings passes over said intersection for blocking com-

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munication between said fourth and third passage means when said piston moves toward extended position.

6. A fluid pressure operated device comprising a cylinder having a bore, a piston having a rod extending from one side thereof mounted in said bore and reciprocable between extended and retracted positions, said rod being of smaller diameter than said bore so as to form an annular chamber therebetween, said piston having a first area exposed to said chamber and having a second area opposed to said first area, first passage means in one end of said cylinder through which fluid under pressure may be alternatively admitted and directed against said second area for moving the piston to said extended position or exhausted to permit retraction of said piston, second passage means leading from an external portion of said rod to said annular chamber through which fluid under pressure may be alternatively introduced to said annular chamber to act on said first area for retracting said piston or exhausted from said chamber to permit extension of said piston, third passage means in said piston and connecting said second passage means with the exterior of the piston, a fourth passage means connecting said first and third passage means when said piston is in retracted position whereby fluid from said second passage means may pass through said third and fourth passage means to said first passage means, means for blocking communication between said fourth and third passages when said piston is in extended position and fluid pressure in said second passage is greater than in said first passage, and means for preventing fluid from said first and fourth passage means for entering said chamber and said second passage means in all positions of said piston.

7. A multiple stage fluid pressure operated device comprising a first stage cylinder, a second stage cylinder having an enlarged end portion which serves as a piston head, said second stage cylinder being mounted within said first stage cylinder for reciprocation between extended and retracted positions, a piston having a rod connected thereto mounted within said second stage cylinder for reciprocation between extended and retracted positions, said piston head and said piston each having opposed areas, first passage means in one end of said first stage cylinder through which fluid under pressure may be admitted for moving said second stage cylinder to extended position, a first duct in said piston head connecting said first passage means with one of said areas of said piston whereby said piston may be moved to its extended position by fluid from said first passage, second passage means

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leading from an external portion of said rod to said other of said areas and through which fluid under pressure may be introduced and directed against said other of said areas on said piston for moving the piston to retracted position, a third passage in said piston connecting said second passage to the exterior of the piston, a second duct in said second stage cylinder for directing fluid from said third passage means when said piston is retracted to the other of said piston head areas for retracting said second stage cylinder, a fourth passage means connecting said second duct with said first passage means when said second stage cylinder is retracted whereby fluid from said second passage means may pass through said third passage means, second duct, and fourth passage means to said first passage means when both the second stage cylinder and said piston are in retracted position, and means to prevent fluid from said second passage means from passing through said third passage means and second duct to said first passage means when either said piston or said second stage cylinder is in extended position and fluid pressure in said second passage is greater than in said first passage.

8. A device in accordance with claim 7 in which means is provided for cutting off communication between said third passage means and said second duct when said piston is extended.

9. A device in accordance with claim 7 in which means is provided for cutting off communication between said second duct and said fourth passage means when said second stage cylinder is extended.

10. A device in accordance with claim 7 in which said third passage means contains a check valve which prevents fluid flow from said third passage means toward said first passage means but permits fluid flow in the opposite direction.

11. A device in accordance with claim 7 in which said preventing means comprises a first packing on said piston which seals against said second stage cylinder between said third passage means and said second duct when said piston is extended and also comprises a second packing on said piston head which seals against said first stage cylinder between said fourth passage means and said second duct when said second stage cylinder is extended.

References Cited in the file of this patent

UNITED STATES PATENTS

2,364,741	Merchant	Dec. 12, 1944
2,517,153	Wood	Aug. 1, 1950
2,595,307	Selberg	May 6, 1952