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HYDRAULICALLY ACTUATED STOP FOR A HYDRAULIC RAM UNIT

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FIG. 1

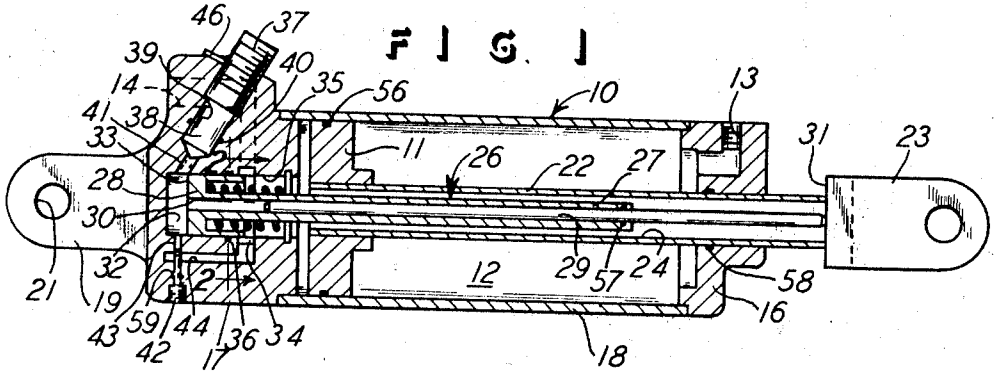


FIG. 3

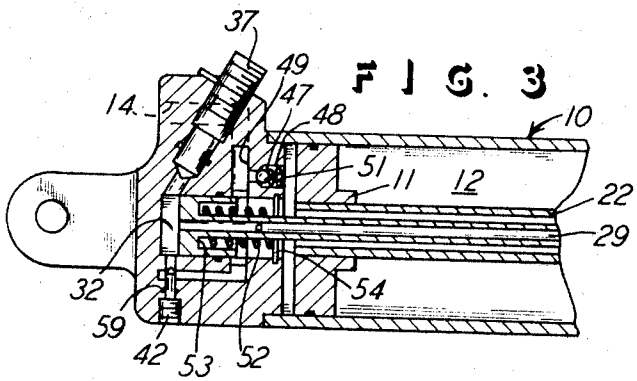
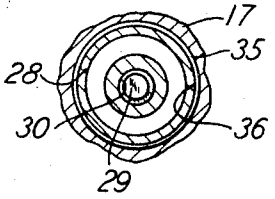


FIG. 2



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HYDRAULICALLY ACTUATED STOP FOR A HYDRAULIC RAM UNIT

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5 Claims

ABSTRACT OF THE DISCLOSURE

A hydraulically actuated stop for a hydraulic ram unit including a cylinder with a piston movable in a chamber defined by the cylinder. Fluid passageways exist in opposite ends of the cylinder, and a valve is operative intermediate one of the passageways and the cylinder chamber for closing off the passageway and thereby creating an increase in fluid pressure on one side of a piston slidable in the chamber. The increased fluid pressure limits the stroke of the piston, as desired. The valve is located in a bore which provides flow communication between the one passageway and the cylinder chamber, and the valve responds to pressure in a compartment on one side of the valve, and this fluid pressure causes the valve to close the one passageway, as desired.

This invention relates to a hydraulically actuated stop for a hydraulic ram unit. More particularly, it relates to a hydraulic ram unit which has means associated therewith for effecting the stop of the piston in the unit.

Different constructions for providing a hydraulically responsive stop for a ram unit are already known. The prior art includes constructions which are in the nature of valves which are responsive to the movement and position of the piston to create hydraulic pressure on the valve and thereby effect the stop. However, these prior constructions are complex in both their arrangements and operations, and they commonly have special parts and constructions extending exteriorly of the cylinder which forms a part of the ram unit. Also, it is common to have these prior constructions arranged with the stop or limit valve disposed in a manner such that both sides of the valve are in the fluid-flow passageway of the cylinder so that the stop itself is governed by the fluid pressure on opposite sides of the valve as determined by the pressure applied to the cylinder rather than by the control of the valve independent of a passage of fluid through the cylinder. In part, this means that the prior constructions cannot be selectively set to regulate the stopping of the piston at any desired posiion, and it also means that the piston cannot over-run a selected stop position.

Accordingly, it is a general object of this invention to improve upon the aforementioned prior construction. This object is accomplished by the provision of a ram unit with a hydraulically actuated stop which is completely contained within the cylinder of the unit, does not require any external parts, is not responsive to or dependent upon fluid flow on both sides of a control valve utilized in the stop means, and is relatively simple in its manufacture and function so that it is feasible to provide it and is reliable in its operation.

Another object of this invention is to provide a hydraulically actuated stop for a ram unit, wherein the stop provides a greater range over which it can be set as compared to the range of the constructions heretofore known. This object of course includes the arrangement wherein the stop can be readily and easily selectively set for stopping the piston in a selected position. Also included in this object is the fact that the selected set position can be maintained over repeated strokes of the piston so that the piston will come to the same position in successive strokes.

Still another object of this invention is to provide a hydraulically actuated stop for a ram unit and wherein the selectively set stop in the unit can be selectively overrun to permit the piston to go beyond the set stop position, but, nevertheless, the construction is also so arranged that on subsequent strokes of the piston, the selected stop position can be achieved, if desired, without requiring any adjustment of the unit.

Other objects and advantages will become apparent upon reading the following description in light of the accompanying drawings, wherein:

FIG. 1 is a longitudinal sectional view through a hydraulic ram unit incorporating this invention.

FIG. 2 is an enlarged sectional view taken on the line 2—2 of FIG. 1.

FIG. 3 is a longitudinal sectional view similar to FIG. 1 but showing only a fragment of the unit and showing a modification thereof.

The hydraulic ram unit of this invention can of course be used in power-lift hydraulic cylinders, and it is commonly used with a control valve which is connected to the unit by means of fluid tubes or pipes and which is constructed to control the flow of fluid to the unit in accordance with actual pressures within the cylinder of the unit. This is a type of valve commonly known in the art to be a spring-centered spool valve which has a plurality of fluid ports and wherein the spool is movable to selectively open and close the ports through manual or automatic, that is fluid pressure responsive, control means. This commonly known spool type valve is also of the pressure-operated detent release type. Further, it is conventionally arranged such that when the pressure of the fluid increases in the valve, then the spool automatically sets itself to lock the valve in that position. This is of course what will therefore lock the further flow of fluid to the ram unit and thus the piston is locked or stopped in its position. If one desires further description and disclosure of this type of combined spool valve and ram unit, and description of the valve itself, reference may be had to U.S. Patent No. 2,765,746.

The drawings show the ram unit, which includes the hydraulic cylinder **10** and the piston **11** disposed therein for the usual reciprocation in the cylinder chamber **12**. The cylinder also has the fluid ports or passageways **13** and **14** which permit the ingress and egress of hydraulic fluid with respect to the chamber **12**. It will of course also be understood that the ram unit may be of the double acting type so that either port **13** or **14** can be the inlet or outlet port. The cylinder of course also has the end caps **16** and **17** which are fluid tight with the cylindrical portion designated **18** of the cylinder **10** generally. The cap **17** shows a boss **19** having an opening **21** for mounting one end of the unit on any pin so that the end would of course be anchored as desired. Further, the piston **11** has a hollow piston rod **22** and a clevis **23** is shown attached to the end of the rod **22** which extends through the cylinder end cap **16**. The clevis **23** can of course be attached to a pin or the like so that the opposite ends of the cylinder **10** are conventionally attached for the well-known purposes.

Of course the piston rod **22** is attached to the piston **11** to reciprocate therewith, and the rod has a hollow interior **24**. A spool **26** is shown with an elongated end **27** disposed within the piston rod opening **24**. The other end of the spool **26** is designated **28** and is enlarged and serves as a valve which is more fully described and explained later. A rod **29** is disposed slidably within a hollow interior designated **30** within the spool **26**.

At this point it will therefore be observed that when for instance the piston 11 moves from right to left, the position it is now in in FIG. 1, in the cylinder chamber 12, the clevis wall 31 abuts the end of the rod 29 to slide the latter within spool 26. Thus any fluid in the spool's interior 30, and in a compartment designated 32, will have its pressure increased. It will now be understood that when the pressure on the face 33 of the spool 26, which face 33 is on the left side of the spool 26, becomes greater than the pressure on the right side or face of the spool 26, the spool will move to the right, say from the position that it is shown in in FIG. 1. This pressure differential causes the spool 26 to move over the annulus 34 formed in the end cap 17 and in fluid-flow communication with the passageway 14, as shown. The spool end 28 is of course cylindrical and is snug within the cylindrical bore 35 in the end cap 17. The spool end 28 thus acts as a valve with respect to the passageway 14 and of course stops the full flow of fluid from the chamber 12 and in front of the advancing piston 11. Thus it would of course be assumed in that description that the passageway 13 was the inlet of the fluid and the passageway 14 was the outlet so that the piston 11 moves from right to left in FIG. 1 to the position in which it is shown. Further, it is of course the blocking of the passageway 14 by the valve 28 that creates the pressure differential on the opposite faces of the spool 26, and this causes the valve 28 to retain its closed position with respect to the passageway 14.

It will then also be understood that when the pressure differential is created by the movement of the rod 29 in what is described as the compartment 32, then the pressure differential is initiated and the passageway 14 is closed off. The spool valve (not shown) then being connected to the passageways 13 and 14 senses the increase in pressure in the chamber 12 on the side of the passageway 13. This causes the spool valve to respond to this pressure increase and center itself to lock the spool in a position where no further fluid enters the chamber 12 and this of course effects the hydraulic stop of this invention.

It will of course be understood that the remote valve mentioned has a manual control, like that shown in the referenced patent, so that pressure could continue to be applied through the passageway 13 to displace the piston 11 beyond a set stop position even though the valve portion 28 of the spool 26 is over the passageway 14. This is true since the valve 28 has no fluid seal between the chamber 12 and the passageway 14 so that fluid can actually leak or be forced past the valve 28 and out the passageway 14. This therefore means that the piston 11 can go past a selected stop position by simply holding the manual control handle of the spool valve which is not shown. Further, even after this desired over-running of the stop position, the next stroke of the piston 11 could be stopped at the selected position if the control handle is not manually held as described. This is a feature of this particular construction. It will of course be noticed that the end cap 17 has a seal 36 which surrounds the spool end 28 on the left of the passageway or annulus 34 and thus fluids cannot leak out of the compartment 32.

A threaded plug-type member 37 threadedly adjustably extends into the end cap 17 and has its inner end 38 snugly received in an opening 39 in the end cap 17. A passageway 41 communicates with the opening 39 and with the compartment 32 to actually therefore be a part of the compartment 32 as well as the spool interior 30 is a part of the compartment 32 for this purpose. Thus it will then be apparent that moving the plug 37 in or out with respect to the end cap 17 will affect the pressure of the fluid in the compartment 32 and will thereby affect the action of the valve 28. In this manner, the construction is arranged to provide adjustability so that the piston 11 can be stopped at any desired point along its stroke. A fluid seal 40 prevents the fluid from leaking past the plug 37 and out of the compartment 32.

A needle valve 42 is threadedly disposed in the end cap 17 and is effective between a passageway 43, which is in part a portion of the compartment 32 and is in communication therewith and a passageway 44 which extends to the annulus 34. It will therefore be seen that the compartment 32 can be charged in the amount of fluid therein simply by opening the valve 42 and introducing fluid through the passageway 14 and into the compartment 32. The plug 37 could be retracted to a limit which may be defined by a stop 46 while the compartment 32 is being filled. Then closing the valve 42 would seal the compartment 32 again.

It will of course be understood that the passageway 14 could be used as the inlet to introduce the fluid into the chamber 12 at the face of the piston 11 and move the piston to the right from the position it is in in FIG. 1. This can even be accomplished when the valve 28 is over the passageway 14 since it will be recalled that adequate fluid pressure can be provided to have the fluid leak past the valve 28 and into the bore 35 which is open to the chamber 12. FIG. 3 shows another embodiment of the construction for the purpose of a double acting hydraulic unit. In this instance, a ball check valve 47 is disposed in a passageway 48 extending between a passageway 49 and the chamber 12. Thus pressure coming into the passageway 14 and the passageway 49 will pass the ball check 47 and move into the chamber 12. A spring 51 is shown behind the ball 47 to normally urge it in a closed or seated position in the passageway 48.

Also, a compression spring 52 is disposed between a wall 53 of the valve 28 and a snap ring 54 in the cylinder end cap 17. Thus the spring 52 normally urges the spool 26 to the left when such movement is desired. Of course the pressure differential created by fluid on opposite faces of the spool 26 overcomes the pressure of the spring 52 to move the spool 26 to the right as described.

Adequate fluid seals are provided on the construction between the moving parts described. Thus the piston seal 56 extends around the piston 11 and a seal 57 extends around the rod 29. Likewise, a seal 58 extends around the piston rod 22, and seals 59 extend around the needle valves 42. These seals are shown to be of the O-ring type which is well known.

It will therefore be understood that the valve 28 and its seal 36 are such that a minimum pressure can be retained in the compartment 32. This pressure of fluid is adequate to move the spool 26 to the right and close on the passageway 14. However, the fluid may still be forced past the valve 28 from the chamber 12 and into the passageway 14 so that the piston 11 can over-run the set stop as described. This is therefore saying that the closing ability of the valve 28 is less on the right side of the valve than it is on the left side as viewed in the drawings. However, the valve is capable of adequate closing with respect to the passageway 14 for sufficiently sealing therewith to displace the spool 26 and create the pressure in the chamber 12 and the passageway 13 for actuating the one unshown spool valve and effect the hydraulic stop desired.

With regard to the feature of leaking past the valve 28, it will of course be understood that plug 37 can be set in a desired position to effect the proper stop.

What is claimed is:

1. A hydraulically actuated stop for a hydraulic ram unit, comprising a hydraulic cylinder having a fluid passageway at each end thereof and having an intermediate chamber, a piston fluid-tightly and slidably disposed in said chamber, a piston rod attached to said piston and fluid-tightly extending through one end of said cylinder to the exterior thereof, said cylinder having a bore fluid-flow communicating one of said passageways and said chamber at the other end of said cylinder, a valve slid-

ably disposed in said bore and being operative on said one of said passageways and being fluid-flow exposed to said chamber on the side of said valve toward said one end of said cylinder, a fluid compartment in said bore fluid-flow isolated from said passageways and being fluid-tightly sealed from said chamber by said valve on the operative side of said valve opposite from said chamber for actuation of said valve in response to a minimum fluid pressure in said compartment to close said valve on said one of said passageways, said valve having a cylindrical opening defining a part of said compartment, and a plunger in said cylindrical opening and movable by abutment of one of said piston and piston rod therewith and operative on said compartment for creating said minimum fluid pressure in response to the movement of said piston.

2. The subject matter claimed in claim 1, wherein said valve is arranged with seal means to fluid-tightly seal said compartment from said chamber, said valve being sufficiently loose in said bore to be fluid-seal related to said bore to provide for fluid sealing between said chamber and said one of said passageways only at a fluid pressure lower than said minimum fluid pressure in said compartment when said valve is in a closed position on said one of said passageways.

3. The subject matter claimed in claim 1, wherein said valve and said compartment are within said cylinder and co-axial therewith for performance in direct response to axial movement of said piston rod in said cylinder.

4. The subject matter claimed in claim 1, including a valved passageway extending between said compartment and said chamber for selective introduction of fluid into said compartment and from said chamber.

5. The subject matter of claim 1, wherein said rod is axially hollow and said valve cylindrical opening is co-axial with said hollow rod, and said plunger is axially movable in said rod.

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U.S. Cl. X.R.

91—24, 405, 406; 92—85