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HYDRAULIC ACTUATOR

Filed Oct. 12, 1959

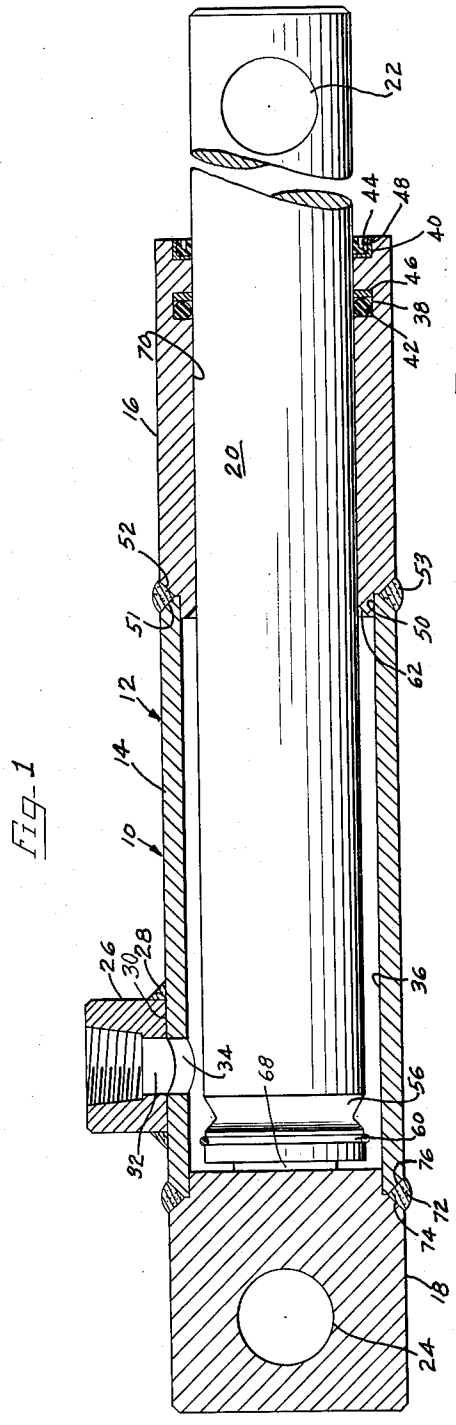


Fig. 1

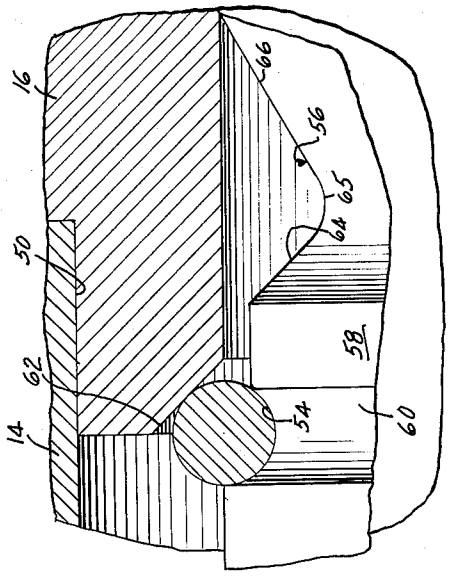


Fig. 3

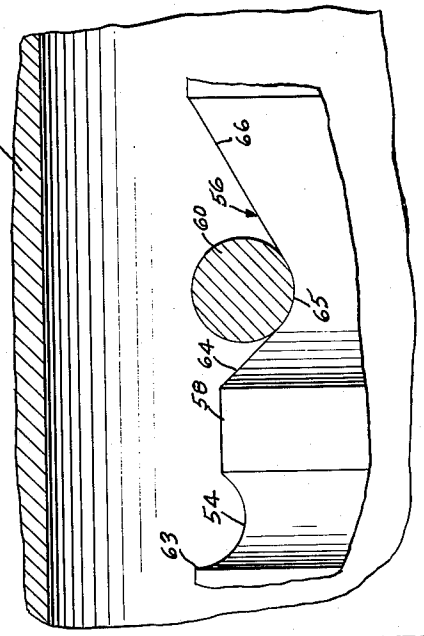


Fig. 2

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HYDRAULIC ACTUATOR

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This invention relates to a displacement type fluid pressure operated actuator, and more particularly to an actuator as described which has a removable barrel portion and is adapted to afford economic fabrication and assembly.

Heretofore, actuators of the type indicated have generally required expensive machining, such as to provide accurately threaded engagement between enlarged and reduced portions of the cylinder to permit removal of the barrel or piston rod when desired. The present invention eliminates this difficulty by providing a welded connection between these cylinder parts, while also affording easy removability of the barrel or piston rod. Previously, it had been impossible to remove the rod through the cylinder due to the presence of a snap ring at the innermost end of the rod, although I am aware that a solution has been proposed wherein a screwdriver or the like is inserted into a fluid fitting for connecting the cylinder to a source of fluid pressure to remove the snap ring from the rod through the said fitting. However, this operation is tedious and difficult, as is the task of reinserting the ring, and it also entails an undesirable partial circumferential construction of the snap ring wherein a sector of the snap ring is cut out.

The present invention provides a first circumferential recess or groove adjacent the inner end of the piston rod which receives the snap ring in a radially inward position such that the upper surface of the snap ring may be selectively disposed at least slightly below the cylindrical surface of the rod, whereby the piston rod may be taken out of the cylinder when desired. However, when it is required to utilize the snap ring as a stop element for coaction with a shoulder in the cylinder, the snap ring may be moved to a second position in a second circumferential recess or groove which is axially spaced from the first groove by a reduced inner connecting shoulder which permits easy movement of the snap ring from one position to another in response to actuation by a screwdriver or the like as received through the fluid fitting or connection for the cylinder.

Accordingly, it is an object of the present invention to provide a hydraulic actuator as described which is simple in construction and which requires very little machining of parts.

Another object of the invention is to provide a device as described wherein the several parts of the hydraulic cylinder therefor may be welded together rather than being threadedly interfitted as in previously existing structures.

Another object of the invention is to provide a device as described wherein a snap ring may be moved selectively between two respective axial positions on the rod so as to afford removal of the rod or engagement of the rod with a stop in the cylinder as desired.

Other objects and advantages of the invention will become apparent as the description proceeds in accordance with the drawings, in which:

On the drawings:

FIGURE 1 is a vertical sectional view of an actuator according to the invention;

FIGURE 2 is an enlarged fragmentary view of structure corresponding to that of FIGURE 1 showing the snap ring in position to afford removal of the rod from the cylinder; and

FIGURE 3 is a view similar to the view of FIGURE 2 and showing the snap ring in position to prevent outward movement of the rod and in engagement with the cylinder.

As shown on the drawings:

Referring now to the drawings, a hydraulic actuator 10 is shown according to the present invention which includes a hydraulic cylinder 12 having an enlarged central portion 14, a bearing portion 16 and a closed end portion 18. A piston rod or cylindrical barrel 20 is slidably received within the cylinder 12 and defines at its outermost end a transverse bore 22 coacting with a similar bore 24 in the end 18 of the cylinder so that the actuator may be engaged by suitable pivotal connecting means or the like and, for example, in a tractor operated implement or accessory. In order to introduce fluid pressure into the cylinder 12, a connector fitting 26 is welded at 28 or otherwise suitably secured to the relatively enlarged portion 14 so that the end 30 of the fitting abuts the cylinder so as to place the bore 32 of the fitting in register upon the opening 34 therein, whereby fluid may be introduced into the bore 36 of the portion 14 as hereinafter described.

The bearing portion 16 of the cylinder 12 preferably defines suitable annular recesses 38 and 40 for receiving an O-ring 42 and an annular sealing element 44 respectively, the O-ring 42 preferably having a backing washer 46 and the sealing member being positioned in a right angularly formed annular bracket 48 engaged within the recess 40 as shown.

In accordance with the invention, the relatively reduced bearing portion 16 of the cylinder 12 is provided with a reduced extension or shoulder 50 telescopically receiving thereover the outer end of the middle portion 14 of the cylinder. This outer end portion of the cylinder structure 14 may be beveled at 51 in cooperation with a beveled shoulder 52 on the portion 16 to receive an annular weld 53 as shown. Heretofore, as previously indicated, such a weld has been impracticable because it prevented removal of the piston rod 20 from the cylinder 12 except where involved procedures were employed for removing the snap ring.

Also in accordance with the invention, and to the end that removal of the piston rod 20 may be readily afforded, the piston rod 20 defines a pair of proximately axially spaced annular grooves or recesses 54 and 56 interconnected by a reduced shoulder 58 as hereinafter further described.

In order to selectively prevent movement of the piston 20 out of the cylinder 12 during regular operation of the hydraulic actuator, a snap ring 60 is provided which, as shown in FIGURES 1 and 3, extends circumferentially around the piston 20 and is releasably received in the groove 54, the groove having a depth such that the snap ring 60 when disposed therein extends upwardly therefrom by an extent sufficient to cause it to engage a beveled shoulder 62 at the inner end of the shoulder 50 of the bearing portion 16. The beveled shoulder 62 is illustrated as being formed at an angle of approximately 45° relative to the axis of the cylinder. Depending on the size of the wire used in forming the ring 60, the angle of the beveled portion 62 may be varied for example, to approximately 30° so that a good wedging action is developed without jamming.

In order to permit free removability of the piston rod 20 from the cylinder 12 when desired, the recessed groove 56 has a depth greater than that of the groove 54 and such that when the snap ring 60 is releasably received therein, as shown in FIGURE 2, the upper surface of

the snap ring is positioned substantially tangentially with the cylindrical envelope or projection of the surface of the piston rod, and thus has a maximum diameter which approximates or is slightly less than the maximum diameter of the piston rod.

In order to effect movement of the snap ring **60** from the groove **54** to the groove **56**, or vice versa, a screwdriver or the like tool (not shown) may be inserted through the connection **26** to engage the snap ring and move it over the reduced shoulder **58**. Slight relative motion between the plunger or piston and the cylinder may assist in moving the snap ring. To facilitate such movement, the shoulder **58** is, as indicated, reduced substantially below the maximum diameter of the piston rod, and preferably merges easily with the groove **54** as shown to intersect the groove well below the rear upper edge **63** thereof. Thus, the groove **54** prevents rearward movement of the snap ring upon engagement of the snap ring with the shoulder **62**, while nevertheless affording relatively easy forward movement of the ring therefrom. Further, the groove **56** has a rear surface **64** which tapers gradually downwardly to the nadir **65** of the groove, which is given a radius of curvature corresponding to that of the groove **54** and of the snap ring for snugly receiving the snap ring as shown in FIGURE 2. The opposite or forward side **66** of the groove **56** tapers gradually upwardly at an angle which is preferably less than the angle of the side **64** to prevent cutting of the sealing means **42** and **44** as the piston rod is reinserted into the cylinder.

In order that the fluid pressure introduced through the fitting connection may effectively move the rod **20** outwardly as desired, the inner end of the piston defines a relatively reduced shoulder portion **68**.

In manufacturing the hydraulic actuator of the invention, the interior surface of the bore **36** of the middle portion **14** may be relatively roughly finished, and the bearing surface **70** of the bearing portion **16** of the cylinder may be smoothly finished either initially or upon completion of the welding operation referred to hereinabove. Likewise, the piston rod **20** may be smoothly polished in a suitable manner as understood by those skilled in the art. The middle portion **14** may be welded to the end portion **18** as indicated at **72**, suitable beveled ends **74** and **76** being preferably provided for the end portion **18** and the middle portion **14**. However, the end portion **18** may also be formed integrally with the middle portion, and in fact it is within the scope of the invention to form the entire cylinder as a single unit.

Is assembling the device, it will be understood that the snap ring **60** may fit on the piston rod **20** in pre-assembly so that it may move into position in the cylinder as carried in the groove **56**, and then be moved as described to the groove **54**, thereby eliminating the complicated procedures required heretofore in assembling the snap ring on the piston rod.

There has thus been provided a simple and economical hydraulic actuator requiring very few manufacturing operations as compared with previously available devices, and which eliminates the need for close tolerances for threaded interfitting between the cylinder parts. Since the device may be assembled and disassembled with ease, and is unusually strong and rugged, it may also be used in a wide variety of applications with minimal maintenance and without the need for special skills for replacement of parts or the like.

Although I have herein set forth and described my invention with respect to certain specific principles and details thereof, it will be understood by those skilled in the art that these may be varied without departing from the spirit and scope of the invention as set forth in the hereunto appended claims.

I claim as my invention:

1. A hydraulic actuator comprising a cylinder having a coaxial bore open at one end and closed at the other end and including a relatively reduced bearing portion adjacent said open end and a relatively enlarged portion between the closed end and bearing portion thereof, said cylinder having a shoulder between said reduced bearing portion and said enlarged portion and a fluid opening extending into said enlarged portion, a piston slidably received in said cylinder in bearing relation with said reduced bearing portion, a snap ring on said piston, and means on said piston affording movement of said snap ring by a tool or the like inserted through said opening between a first position on said piston wherein said snap ring has a diameter greater than said reduced bearing portion of said bore to retain said piston in said cylinder and a second position on said piston wherein said snap ring has a diameter less than the diameter of said reduced bearing portion of said bore and said shoulder to permit removal of said piston from said cylinder.

2. A hydraulic actuator comprising a cylinder, a piston slidably received in said cylinder, a fluid opening into said cylinder, a snap ring on said piston, retaining means in said cylinder and means on said piston affording movement of said snap ring in response to actuation by a tool or the like which may be inserted through said fluid opening between a first position in which said snap ring is mounted on said piston to engage with said retaining means to retain said piston in said cylinder and a second position where said snap ring is mounted on said piston to move past said retaining means to permit removal of said piston from said cylinder.

3. A hydraulic actuator comprising a cylinder having a bore therein open at one end and closed at the other end and including a relatively reduced bearing portion adjacent said open end and a relatively enlarged portion between said closed end and said bearing portion, said cylinder having a shoulder between said reduced bearing portion and said enlarged portion and a fluid opening extending into said enlarged portion, a piston slidably received in said cylinder in bearing relation with said reduced bearing portion, a snap ring on said piston, a first annular groove and a second annular groove in said piston, said first annular groove releasably receiving said snap ring in position to engage said shoulder to prevent removal of said piston from said cylinder and said second annular groove receiving said snap ring in position to move past said shoulder to permit removal of said piston from said cylinder, said snap ring being movable between said first and second positions by a tool or the like which may be inserted through said fluid opening.

4. A hydraulic actuator comprising a cylinder, a piston slidably received in said cylinder, a fluid opening in said cylinder, a snap ring on said piston, retaining and bearing means in said cylinder and means on said piston affording movement of said snap ring in response to actuation by a tool or the like which may be inserted through said fluid opening including a first annular groove in said piston and a second annular groove in said piston, said first annular groove releasably receiving said snap ring in position to engage said retaining and bearing means selectively to prevent removal of said piston from said cylinder and said second annular groove selectively releasably receiving said snap ring in position to move past said retaining means to permit removal of said piston from said cylinder.

5. A displacement-type fluid actuator comprising a cylinder having a closed end and an open end, said open end comprising a reduced diameter elongated plunger aperture of smaller diameter than the remaining major portion of said cylinder, a plunger of substantially constant diameter projecting into said cylinder and reciprocable through said aperture, a fluid pressure port in said cyqlinder, an annular groove in said plunger inwardly of the end thereof, a snap ring of larger outside diameter than said plunger and of smaller outside diameter than the interior of said cylinder seated in said groove, whereby the snap ring limits the outward travel of the plunger with relation to the cylinder, and an annular recess in the peripheral

surface of said plunger axially adjacent said groove and being of sufficient depth to seat said snap ring with the outside diameter thereof radially inwardly of the plunger peripheral surface when it is desired to remove said plunger from said cylinder, said snap ring being movable between said groove and said recess upon engagement with a tool inserted through said fluid pressure port.

6. A hydraulic actuator comprising a cylinder having a bore therein open at one end and closed at the other end and including a relatively reduced bearing portion adjacent said open end and a relatively enlarged portion between said closed end and said bearing portion, said cylinder having a shoulder between said reduced bearing portion and said enlarged portion and a fluid opening extending into the enlarged portion of said bore, a piston slidably received in said cylinder in bearing relation with said reduced bearing portion, a snap ring on said piston, a first annular groove and a second annular groove in said piston, said first annular groove releasably receiving said snap ring in a first position to engage said shoulder to prevent removal of said piston from said cylinder, said second annular groove receiving said snap ring in a second position to move past said shoulder to permit removal of said piston from said cylinder with said snap ring retained in said second annular groove, and a shoulder between said first and second grooves having a diameter less than the diameter of said piston, said snap ring being movable between said first and second positions by a tool or the like which may be inserted through said fluid opening.

7. A hydraulic actuator comprising a cylinder having a coaxial bore open at one end and closed at the other end and including a relatively reduced bearing portion adjacent said open end and a relatively enlarged portion between said closed end and said bearing portion, said cylinder having a shoulder between said reduced bearing portion and said enlarged portion and a fluid opening extending into said enlarged portion, a piston slidably received in said cylinder in bearing relation with said reduced bearing portion, a snap ring on said piston, a first annular groove in said piston and a second annular groove in said piston, said first annular groove releasably receiving said snap ring in position to engage said shoulder to prevent removal of said piston from said cylinder and said second annular groove receiving said snap ring in position to move past said shoulder to permit removal of said piston from said cylinder, and a shoulder between said first and second grooves having a diameter less than the diameter of said piston, said second groove having a gradually sloping side approaching said reduced shoulder to afford easy movement of said snap ring between said positions by a tool or the like which may be inserted through said fluid opening.

8. A displacement-type fluid actuator as defined in claim 5, sealing means in said elongated plunger aperture to engage the peripheral surface of said plunger, and said recess having a side sloping gradually toward the open end of said cylinder to prevent damage to said sealing means when said plunger is withdrawn through said aperture.

9. A hydraulic actuator comprising a cylinder having a bore therein open at one end closed at the other end and including a relatively reduced bearing portion adjacent said open end and a relatively enlarged portion adjacent said open end and a relatively enlarged portion between the closed end and bearing portion thereof, said cylinder having a shoulder between said reduced bearing portion and said enlarged portion of said bore, a piston slidably received in said cylinder in bearing relation with said reduced bearing portion, a snap ring on said piston, a first annular groove and a second annular groove in said piston, said first annular groove releasably receiving said snap ring in position to engage said shoulder to prevent removal of said piston from said cylinder, said second annular groove receiving said snap ring in position to move past said shoulder to permit removal of said piston from said cylinder, and a shoulder between said first and second grooves having a diameter less than the diameter of said piston, said snap ring being movable between said positions by a tool or the like which may be inserted through said fluid opening, said reduced shoulder intersecting said first groove at a level such as to afford easy movement of said snap ring from said first groove to said second groove and said second groove having a first side gradually sloping toward said reduced shoulder to afford easy movement of said snap ring from said second groove to said first groove and a second side sloping gradually toward the open end of said piston, said reduced bearing portion of said cylinder having sealing means therein and said second side of said second groove sloping more gradually than the first side of said second groove to prevent damage to said sealing means.

10. A hydraulic actuator comprising a cylinder having a bore therein open at one end and closed at the other end and including a relatively reduced bearing portion adjacent said open end and a relatively enlarged portion between the closed end and bearing portion thereof, said cylinder having a shoulder between said reduced bearing portion and said enlarged portion and a fluid opening extending into the enlarged portion of said bore, a piston slidably received in said cylinder in bearing relation with said reduced bearing portion, a snap ring on said piston, and means on said piston affording axial and radial movement of said snap ring by a tool or the like inserted through said opening between a first position of said piston wherein the snap ring has a diameter greater than said reduced bearing portion of said bore to coact with said shoulder to retain said piston in said cylinder and a second position on said piston wherein said snap ring has a diameter less than the diameter of said reduced bearing portion of said bore to permit removal of said piston from said cylinder, said shoulder forming an angle of between 30° and 45° with the axis of said cylinder to prevent jamming of said snap ring therein.

11. A hydraulic actuator comprising a cylinder having a coaxial bore, a piston rod slidably received in said bore, a fluid pressure opening in said cylinder adjacent a closed end thereof, and a snap ring on said piston rod, said cylinder having a reduced portion defining a stop shoulder and said piston rod having a first groove of relatively small depth receiving said snap ring to prevent movement of the piston rod past said shoulder and a second groove proximately and axially spaced from the first groove and having a greater depth than the first groove such as to place said snap ring below the outer surfaces of said piston rod to permit easy movement of the rod from the cylinder or into the cylinder as desired, said snap ring riding beneath said shoulder during movement of the rod from or into the cylinder.

12. A hydraulic actuator comprising a cylinder having a coaxial bore, a piston rod slidably received in said bore, a fluid pressure opening in said cylinder adjacent a closed end thereof, and a snap ring on said piston rod, said cylinder having a reduced portion defining a stop shoulder and said piston rod having a first groove of relatively small depth receiving said snap ring to prevent movement of the piston rod past said shoulder, a second groove proximately and axially spaced relative to the first groove having a greater depth than the first groove such as to place said snap ring below the outer surfaces of said piston rod to permit easy movement of the rod from the cylinder or into the cylinder as desired and an interconnecting shoulder between said grooves having a diameter less than the maximum diameter of said rod to permit easy movement of the snap ring between said grooves in response to actuation by a tool which may be inserted through said hole into engagement with said snap ring.

13. A hydraulic actuator comprising a cylinder having a coaxial bore, a piston rod slidably received in said bore, a fluid pressure opening in said cylinder adjacent a closed end thereof, and a snap ring on said piston rod,

said cylinder having a reduced portion defining a stop shoulder and said piston rod having a first groove of relatively small depth receiving said snap ring to prevent movement of the piston rod past said shoulder, a second groove proximately and axially spaced relative to the first groove and having a greater depth than said first groove such as to place said snap ring below the outer surfaces of said piston rod to permit easy movement of the rod from the cylinder or into the cylinder as desired, said second groove having a gradually tapering surface extending toward the outer end of said rod and said cylinder

having sealing means at the outer end thereof, said gradually tapering surface affording movement of said piston rod into and out of position in said cylinder without interference by said sealing means or damage to the same.

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