June 20, 1961 J. L. MODRICH 2,989,299

HYDRAULIC CYLINDER AND CHECK VALVE THEREFOR

Filed May 5, 1958

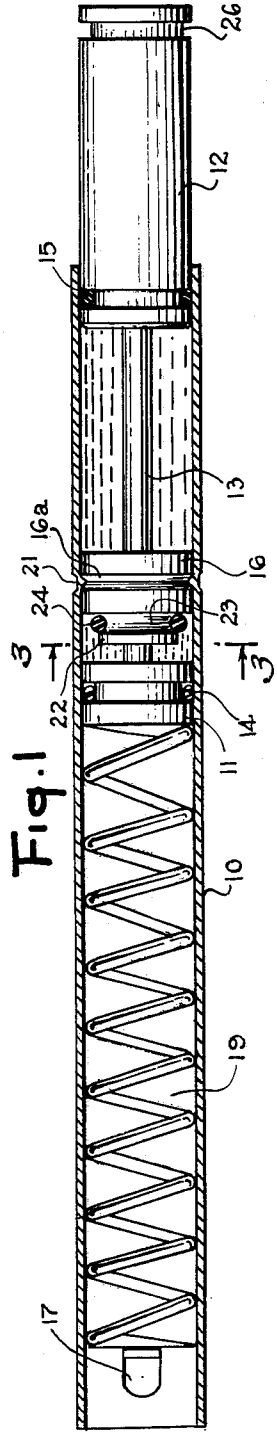

Fig. 1

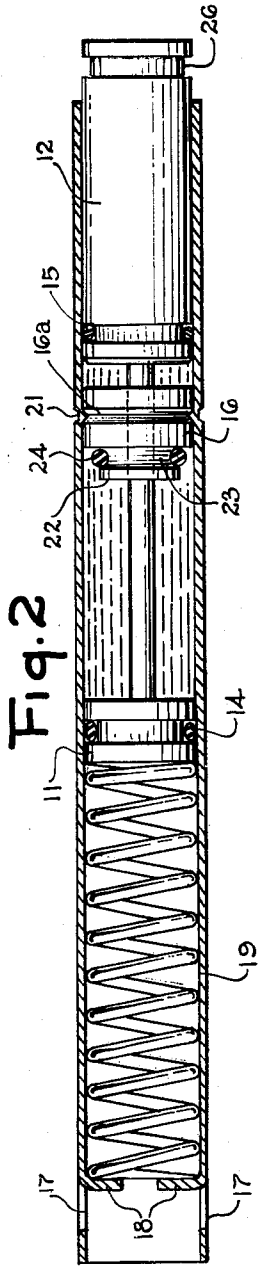

Fig. 2

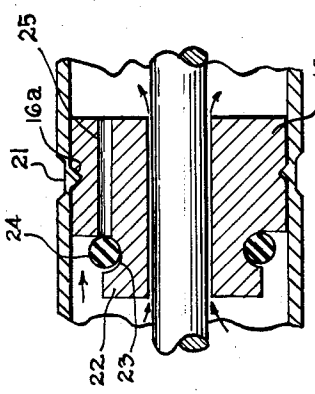

Fig. 5

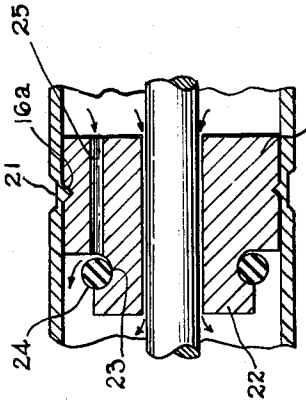

Fig. 4

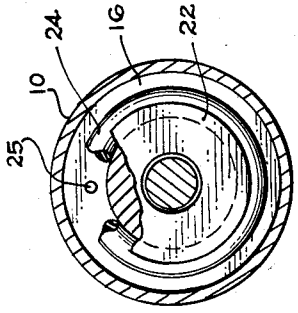

Fig. 3

INVENTOR.
Jack L. Modrich

BY
Ooms, McDougall, Williams & Hersh
Attorneys

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HYDRAULIC CYLINDER AND CHECK VALVE THEREFOR

Jack L. Modrich, 311 Sunset Drive, Lakewood, Crystal Lake, Ill.

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This invention relates to the field of hydraulic cylinders, and particularly to cylinders characterized by efficient operation and low-cost construction.

My hydraulic cylinder is so designed that all its parts can be inexpensively machined on a lathe, and a particular feature of the invention is a novel and inexpensive check valve. Indeed, one of the major objects of the invention is to provide, in a low-cost hydraulic cylinder, an effective and particularly simple check valve requiring no expensive machining.

A further object of the invention is to provide, in a hydraulic cylinder, an arrangement permitting the entire group of moving parts to be prepared as a subassembly, slid into a thin-walled metal cylinder, and then locked in position by a single swaging operation.

Other objects and advantages of the invention will appear from the following detailed description of a typical embodiment.

The embodiment which I have illustrated in the drawing and shall describe in some detail is a single-ended, spring-loaded hydraulic cylinder of the type having widespread application in the toy industry, for use in operating toy dump trucks and the like. It will of course be understood that this embodiment is merely illustrative, and the principles of my invention can be employed in any type of power cylinder or fluid motor wherein simple low-cost construction is desired.

In the appended drawing, FIGURE 1 is a sectional view of a typical hydraulic cylinder according to the present invention, showing the parts in the position occupied when the power spring is at minimum compression. FIG. 2 is a sectional view generally similar to FIG. 1, except that the cylinder is shown rotated 90 degrees from the FIG. 1 position, and the moving parts are shown in the position of maximum spring compression. FIG. 3 is a transverse sectional view, partially cut away, along the line 3—3 of FIG. 1, showing the structural details of the check valve which forms an important part of my invention. FIG. 4 is an enlarged sectional fragmentary view of the bulkhead containing my novel check valve, bringing out other structural details of the valve and particularly showing its operation during the part of the hydraulic cycle in which the valve is open. FIG. 5 is a fragmentary sectional view similar to FIG. 4 but showing the parts of the check valve in the position they occupy during the portion of the hydraulic cycle in which the check valve is closed.

The type of power cylinder illustrated in the drawing, as heretofore mentioned, may be used in such applications as toy dump trucks, in which the piston is "cocked" manually to store energy in a spring, is latched until cylinder operation is desired, and is then manually released, whereupon the energy in the spring moves the ram or piston and actuates the tiltable dump-truck body or other part to be moved. A cylinder of this type should be so arranged that it can be cocked rapidly, but the power stroke preferably should occur at a slower rate. The desirability of this type of operation in a toy dump truck is obvious, and it is usually also desirable in other applications. As will be presently explained, the illustrated embodiment of my invention is so designed as to accomplish that objective.

Referring now to FIG. 1, I show therein a hydraulic power device mounted within a cylinder **10**, which can

be a simple extruded metal tube of aluminum or other metal. The piston assembly comprises an inner piston or plunger **11** and an outer piston or hydraulic ram **12**, joined together by means of a piston rod **13**. The plunger **11** and ram **12** may be made from aluminum or the like; the rod **13** is preferably made of steel. The plunger **11** and the ram **12** are both cylindrical in shape and dimensioned so as to fit slidably within the cylinder **10**. Both the plunger and the ram are machined so as to define an annular recess on their respective outer surfaces, in which an O-ring sealing member is carried, the sealing member on the plunger being marked **14** and the sealing ring on the ram being marked **15**. The O-rings **14** and **15**, as well as the O-ring **24** to be described later, may be made of rubber or other suitable plastic material.

In the illustrated embodiment, the ram **12** is shown as having considerable length, such that a portion of its length protrudes beyond the end of the cylinder **10** when the ram **12** is fully retracted. This type of construction is appropriate in applications where the ram bears directly against some object to be moved, making an external piston rod unnecessary. It will of course be understood that in applications requiring an external piston rod, such a rod may be mounted, either rigidly or pivotally, as the case may be, on the outer end of the ram **12**.

Interposed between the plunger **11** and the ram **12** is a central bulkhead **16**, which may also be made of cylindrical aluminum stock. The bulkhead **16** is centrally apertured, as shown clearly in FIGS. 3–5, and the piston rod **13** passes through such central aperture. The diameter of the central aperture in bulkhead **16** is slightly larger than the diameter of the rod **13**, permitting the rod to slide readily within the aperture and allowing also a slight amount of clearance permitting liquid leakage through the aperture around the rod **13**. The amount of this clearance is intentionally exaggerated in FIGS. 3–5. In practice, it will be only sufficient to allow slow leakage. This liquid leakage, as will be presently explained, not only controls the speed with which the power stroke takes place but also provides lubrication for the rod **13**, preventing its binding or sticking in the bulkhead element **16**.

The bulkhead element **16** is likewise dimensioned to slide within the cylinder **10** and is machined on its outer surface to define an annular V-shaped groove **16**.

Near the end of cylinder **10** opposite the ram **12**, the cylinder is punched, as indicated at **17**, to provide a pair of inwardly extending ears **18**, which form a seat for a compression spring **19**. The other end of spring **19** seats against the plunger **11**, as shown in FIGS. 1 and 2.

The apertures **17** provide convenient mounting holes for supporting the cylinder **10** on the apparatus with which it is to be used; normally the cylinder **10** will be mounted so as to have freedom to rock through a limited arc.

The entire free space within cylinder **10** between the plunger **11** and the ram **12** is filled with a suitable hydraulic fluid, normally a light oil such as propylene glycol, which is non-toxic and stain-proof.

When the parts of the motor have been assembled within the cylinder **10** in the manner shown in FIG. 1, an annular swaging operation may then be performed on the outer surface of the cylinder **10**, as indicated at **21**, with the result that the wall material of cylinder **10** is forced into the annular groove **16***a* of the bulkhead element **16**. This permanently locks together the various parts of the power cylinder, anchors the bulkhead element **16** in the proper position, and affords an effective liquid seal preventing leakage of liquid around the outer surface of the bulkhead **16**.

The portion of bulkhead element **16** adjacent plunger **11** is provided with a reduced-diameter extension **22**, in which a round-bottomed annular groove **23** is machined. This groove **23** carries within it an O-ring **24** so dimensioned as to fit snugly within the groove but slightly smaller in cross-sectional area, so that the O-ring **24** has a very slight freedom to roll forward and backward within the groove **23**, as is clearly brought out in FIGS. 4 and 5.

Drilled through the bulkhead member **16** in a direction parallel to the axis of the cylinder **10** is a small passage **25**, which passes entirely through the bulkhead element, communicating at one end with the liquid-filled space behind the ram **12** and communicating at its other end with the inner wall of the annular groove **23**. The position of passage **25** is clearly brought out in FIGS. 3–5.

In operation, the groove **23**, O-ring **24**, and passage **25** cooperate to form an extraordinarily simple yet effective check valve. When the power cylinder is to be cocked, manual force is applied between the ram **12** and the cylinder **10**. This usually, in a practical application, will be achieved by application of manual pressure to the dump body or other part which is to be operated by the hydraulic motor. On application of such manual pressure, the ram **12** and the plunger **11** move into the cylinder **10**, ultimately reaching the position shown in FIG. 2. While this is taking place, the liquid in the space between bulkhead **16** and ram **12** is forced through the bulkhead into the enlarging space between the bulkhead **16**, and the plunger **11**. Some small part of this liquid passes through the limited clearance between the rod **13** and the central aperture of bulkhead **16**, but for the most part the liquid passes through the passageway **25** drilled in the bulkhead **16**. As hydraulic pressure develops in passage **25**, the O-ring **24** is pushed away from the opening of passage **25** as shown in FIG. 4, thus providing clearance for the hydraulic liquid to move readily and rapidly from one side of the bulkhead **16** to the other. In the course of this operation, the spring **19** is compressed between the plunger **11** and the spring seat **18**, and the energy thus stored in the spring remains available to drive the rod **13** and the ram **12** outwardly whenever they are unlatched. (Any suitable latching means may be provided to hold the ram **12** in its retracted position. One type of such latch may consist of a dog or pawl (not shown) so positioned as to enter the recess **26** on ram **12** and thus hold it until the pawl is manually released. Since the latching means does not form any part of the present invention, no further illustration or description of it is believed necessary.)

Whenever the mechanism is unlatched, permitting the stored energy in spring **19** to force the piston assembly outward, the hydraulic pressure in the chamber between plunger **11** and bulkhead **16** forces the O-ring **24** tightly against the passage **25** and cuts it off, preventing flow of liquid therethrough. As a result, the only opening through which the hydraulic fluid can pass from one side of bulkhead **16** to the other is via the narrow clearance between the central aperture of bulkhead **16** and the piston rod **13**. The liquid is able to flow through this passage only at a slow rate, with the result that the piston assembly and the ram **12** return to their advanced position, as shown in FIG. 1, at a slow, gradual rate.

From the foregoing description, it will be realized by persons skilled in the art that I have provided an extraordinarily simple, inexpensive mechanism, useful in many important applications and capable of being manufactured very inexpensively. Notwithstanding the absence of expensive machining in its construction, my invention works very efficiently, has long life, and is characterized by remarkably trouble-free operation.

As heretofore mentioned, the embodiment of my invention herein illustrated and described is merely exemplary, and the scope of my invention is accordingly to be determined primarily with reference to the appended claim.

I claim:

In a hydraulic power device, the combination comprising a cylinder of soft metal such as aluminum, said cylinder carrying near one end a spring seat, a coil spring within the cylinder and bearing against said seat, said spring being dimensioned to slide readily within said cylinder, an assembly comprising a pair of cylindrical pistons, a piston rod, and a generally cylindrical bulkhead element, said pistons being rigidly joined by said piston rod, said bulkhead element being centrally apertured sufficiently to receive said rod and to allow limited liquid leakage room therearound, said piston rod passing through said aperture intermediate said pistons, said pistons and said bulkhead being received within said cylinder with one of said pistons bearing against said spring, said bulkhead having check-valve means therein affording passage for liquid therethrough in one direction and having also on its outer surface an annular groove, said cylinder being annularly swaged at the position overlying said groove, whereby a portion of the wall of said cylinder is compressed into said groove, anchoring said bulkhead in position, and hydraulic liquid filling the open space in said cylinder between said pistons, said bulkhead having a reduced-diameter portion at one end carrying an annular seat for an O-ring, said bulkhead being bored to define a passage therethrough communicating at one end with said seat, said check-valve means comprising a plastic O-ring mounted on said seat, hydraulic pressure on one side of said bulkhead being operative to press said O-ring against said passage and close it off, such pressure on the other side of said bulkhead being operative to transmit hydraulic force through said passage and to move said O-ring away from said passage, permitting flow of liquid therethrough.

References Cited in the file of this patent

UNITED STATES PATENTS

1,273,059	Hild	July 16, 1918
1,366,151	Astrom	Jan. 18, 1921
2,527,980	Bachman	Oct. 31, 1950
2,587,121	Deardorff et al.	Feb. 26, 1952
2,608,403	Luther	Aug. 26, 1952
2,624,566	Caramelli	Jan. 6, 1953

FOREIGN PATENTS

442,827	Italy	Dec. 2, 1948
182,625	Austria	July 25, 1955