Oct. 12, 1948. F. B. HUNTER 2,451,089

HYDRAULIC CYLINDER CONSTRUCTION

Filed Aug. 20, 1945

Fig. 1.

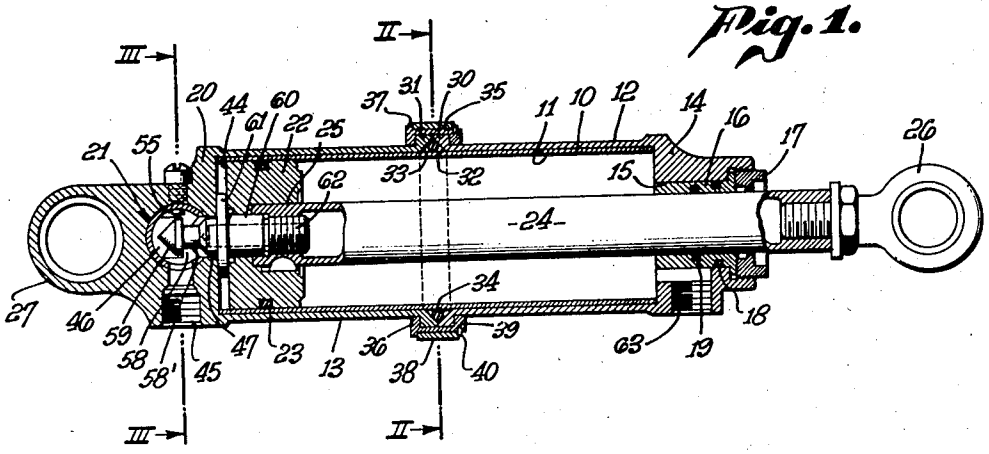


Fig. 3.

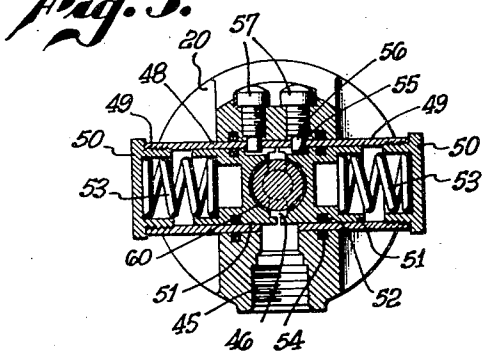


Fig. 2.

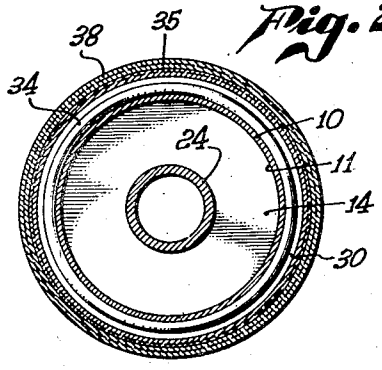
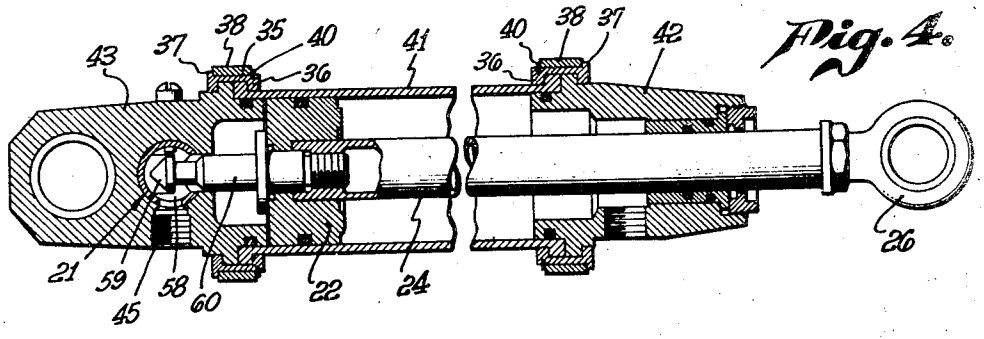


Fig. 4.



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Patented Oct. 12, 1948 2,451,089

UNITED STATES PATENT OFFICE

2,451,089

HYDRAULIC CYLINDER CONSTRUCTION

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Application August 20, 1945, Serial No. 611,623

9 Claims. (Cl. 309—2)

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My invention relates to hydraulic cylinders and the construction thereof in a manner permitting a hydraulic cylinder assembly of relatively precise design to be constructed of parts which need not be held to a close tolerance during the fabrication.

Hydraulic cylinders and rams have long been used in order to utilize the pressure exerted by hydraulic liquids for moving some mechanical device or other. If the stroke of the hydraulic cylinder need be long the simplest means of effecting the long stroke is to provide a correspondingly long hydraulic cylinder. The longer the cylinder in proportion to its diameter, the more care must be exercised in boring out the interior so that a piston sliding within the bore of the cylinder will have the necessary snug fit in order that all of the hydraulic pressure on the liquid may be utilized efficiently. Obviously, when a great deal of care is necessary in order to hold close tolerances in a long bore, the operation becomes correspondingly expensive. If the price of devices of this kind, particularly when made in large sizes, is to be held within an economical range, the cost of producing cylinders with a long bore need be held to a reasonable minimum.

It is therefore among the objects of my invention to provide a hydraulic cylinder construction which will permit the assembly of a hydraulic cylinder of precise dimensions from parts where a relatively greater latitude is permitted in holding the critical dimensions.

Another object of my invention is to construct a hydraulic cylinder of relatively long bore from a number of different parts which, when suitably assembled together and anchored in place, will provide a hydraulic cylinder having a long stroke capable of efficiently utilizing hydraulic pressures of relatively great magnitude.

Still another object of my invention is to provide a hydraulic cylinder of relatively long stroke in proportion to its diameter which is adapted to operate efficiently upon a sudden demand so that hydraulic liquid under relatively high pressure, when released by operation of a suitable trip, will be utilized at high efficiency in order to operate the cylinder throughout the full length of its stroke.

A still further object of my invention is to provide in a hydraulic cylinder construction a means for connecting parts of the device forming the cylinder walls to similar parts or to ends of the cylinder, which means is capable of dispensing with a threaded connection and provides in its stead a connection which can be quickly clamped into place with sufficient tightness to insure

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against all leaks to which the cylinder may be subjected and which can be as readily disconnected for servicing or replacement of parts of the device.

With these and other objects in view, my invention consists in the construction, arrangement and combination of the various parts of my device whereby the objects contemplated are attained, as hereinafter more fully set forth, pointed out in my claims and illustrated in the accompanying drawings, in which:

Fig. 1 is a longtiudinal sectional view of the hydraulic cylinder assembly showing the piston in initial position.

Fig. 2 is a cross section taken on the line II–II of Fig. 1 through a connection.

Fig. 3 is a section taken on the line III–III of Fig. 1 showing details of a trip operable with the device.

Fig. 4 is a longitudinal sectional view of a modified form of my device.

In machining out the bores of cylinders of any kind, the operation customarily consists of an initial rough bore followed by one or more finished bores so that the inside wall may be perfectly smooth and in a true cylindrical shape. Practical difficulties invariably arise, making it impossible to make a perfectly cylindrical shape. For various uses different tolerances may be permitted. In hydraulic cylinders wide tolerances may sometimes be permissible if the hydraulic pressure is not high. In other instances where the hydraulic pressure is relatively high or where it is undesirable to have even a slight leak past the piston within the cylinder, much closer tolerances are desirable and even necessary. To hold close tolerances when the bore is relatively long necessitates the use of expensive machinery and expensive machine setups.

It will also be appreciated that almost any machining operations are expensive as compared with casting operations. In view, however, of the relative cheapness of casting operations, where they can be utilized to good advantage, they permit a sufficient saving of machining operations so that a device utilizing some casting operations has a great advantage over a corresponding device which is made entirely by those machining operations.

In the embodiment chosen to illustrate my invention there is shown a hydraulic cylinder assembly which consists of a full length tubular liner 10, the inside wall 11 of which forms the bore of a hydraulic cylinder. The tubular liner may be of suitable commercial tubing drawn

to dimensions within permitted tolerances and cut to length as desired. Since the wall of the tubular liner may be of relatively thin gauge and incapable of providing sufficient strength to withstand hydraulic pressures customarily used, it is reinforced by the provision of a casing 12 at one end and a corresponding casing 13 at the other. The inside wall of the respective casings may be formed by either rough boring or, on occasions, may be cast, since the dimensions need not be held to a close tolerance so long as the liner is adapted to be readily inserted into the casing. The casing 12 is provided with an end 14 having an axial aperture 15 in which is positioned a packing sleeve 16 retained in place by a packing nut 17. Ring seals 18 and 19 are provided in order to make a fluid-tight fit.

The casing 13 is provided with an end portion 20 of special construction in order to accommodate a hydraulic release indicated generally by the reference character 21.

Within the liner is positioned a piston 22 which has a sliding fit within the inner wall 11 of the liner and which is provided with a ring packing 23 which has a sliding friction fit against the wall of the liner. A piston rod 24, here shown tubular in section, is anchored at one end 25 to the piston and extends outwardly past the packing gland 16 and packing nut 17 within which it has a sliding fit. At the outer end of the piston rod is provided a ring 26 or other suitable connection which may be connected to a work member of the machine or other apparatus with which the cylinder is to be used. The opposite end of the hydraulic cylinder assembly is provided with an apertured boss 27 by means of which it may be secured to some stationary portion of the machine.

The casings 12 and 13 are designed to be connected together by some means other than threading. As here shown, the casings are provided respectively with flanges 30 and 31 which are shown abutting against each other and which have their respective inner corners 32 and 33 beveled so as to provide a recess therebetween within which may be inserted a packing ring 34.

For holding the flanges in abutted relation there is provided a pair of split rings 35 having lateral flanges 36 overlying the sides of the flanges on the ends of the casings. When a ring, such as 35 is used, it is usually split along a plane passing along the axis (diametrically) so as to form two halves, thereby giving rise to a pair of semi-circular split ring portions.

On the outer surfaces of the split rings is provided a rim portion 37. For holding the split rings in position there is provided a continuous ring 38 which surrounds the split rings in assembled position and which bears at one edge against the rim 37. So that the continuous ring will remain in place, the split rings are provided with a recessed portion 39 into which may be positioned a snap ring 40.

When the split ring assembly is applied to the flanges of the casing in order to hold them together, the packing ring 34 is compressed between the inside beveled faces of the flanges and the adjacent outside wall of the liner so as to be fluid-tight and prevent any hydraulic pressure within the interior of the liner from escaping at this connection. A construction of this kind makes it unnecessary to have a snug fit between the outside wall of the liner and the interior of the casing.

A similar construction is shown in the modified form in Fig. 4 wherein the ring assembly is adapted to the connection of a hydraulic cylinder 41 to the respective end sections 42 and 43.

In order to operate the hydraulic cylinder of Fig. 1, hydraulic fluid is admitted through a port 45 at one end of the hydraulic cylinder assembly from which it passes into a chamber 46. From the chamber the fluid is adapted to flow through a passage 47 into the interior of the hydraulic cylinder where its force can be exerted upon a face 44 of the piston 22.

The piston, however, is normally locked in the initial position shown in Fig. 1 so that although pressure exerted by the hydraulic fluid may be present upon the piston, there will be no movement of the piston until the pressure exceeds a certain predetermined figure.

Within the closed end 20 is a transverse passage 48 positioned at right angles to the passage 47 which is axially disposed to the bore of the hydraulic cylinder member. The chamber 46 is formed at the intersection of transverse passage 48 and the passage 47.

Positioned within the passage 48 and extending from either end thereof is a sleeve 49, said sleeve being provided with a port in alignment with port 45 and another port in alignment with the transverse passageway 47. This sleeve is provided with a cap 50 at each end. A pair of opposing release pistons 51 is slidably positioned within the sleeve 49, these pistons being spring pressed in the direction of the central chamber by means of coiled springs 53. Suitable packing rings 52 are carried by each of the release pistons and external packing rings 54 completely seal the sleeve in position.

In order to prevent the release pistons 51 from rotating and in order to keep the ports of the sleeve 49 in alignment with the passageways 45 and 47, each of the pistons is provided with a longitudinal slot 55 adapted to slidably receive dog ends 56 of set screws 57. These dog screws also prevent the release pistons from coming into complete contact.

The end of each release piston is specially shaped in that it is provided with a semicircular flange 58 which is designed to engage within a portion of an annular recess 58' located beneath a head 59 of a pin 60. It will be noted that the pin has a flange 61 resting against the face 44 of the piston. The pin extends through the piston and into a threaded engagement 62 with the piston rod 24. The pin is thus securely anchored in place upon the piston. Ample space is provided around the outside end of the pin so that hydraulic fluid may pass freely along its sides through passage 47 and into the hydraulic cylinder wherein it presses against the face 44 of the piston. At the other end 14 of the cylinder there is provided a second port 63.

In operation, the piston, in initial position, is located at the end of the cylinder member as shown in Fig. 1 wherein the pin is locked by reason of the fact that the springs 53 press the release pistons inwardly so that the ends engage beneath the head 59 of the pin. Fluid under pressure is then admitted into the port 45 from which it is enabled to pass through the bore 47 into the cylinder where it sets up a pressure against the piston. As the pressure builds up the piston will not move but will remain fixed in position so long as the release pistons engage the pin. After fluid pressure has built up to an amount sufficient to overcome the pressure of the springs 53, the release pistons will be pushed outwardly

but of engagement with the head of the pin. When this is accomplished, the pin will be released and the piston 22 will be moved from the position shown in Fig. 1 to a position adjacent the other end of the cylinder member. Meanwhile, should there be any fluid within the cylinder on the opposite side of the piston, it may be exhausted outwardly through the port 63.

To return the piston to its initial position it is necessary only to reverse the flow of the pressure fluid so that it enters the port 63, driving the piston from the righthand end of the cylinder as viewed in Fig. 1 to the lefthand end. As the piston is pushed against the lefthand end, the head 59 of the pin penetrates into the space left remaining between opposite ends of the release pistons forcing them far enough apart so that the head of the pin may be completely inserted in order for the annular recess adjacent the head to be re-engaged by the appropriate portions of the release pistons. It will be noted from this that the cylinder may be set to operate at a high, suddenly released, instantaneous pressure, even though the piston stroke is long.

It will be noted from the description given that the cylinder (or cylinder portions) are free from threads cut thereinto. In the modification shown in Fig. 1 the end pieces are an integral part of the cylinder. In the modification shown in Fig. 4, the end pieces are simply but effectively connected to the cylinder. Here two split rings 35 are used. By eliminating threaded ends, the problems ordinarily encountered in cutting threads precisely so that an engaging cap will be in proper alignment with the axis of the cylinder are eliminated. The boring of the cylinder and the cutting off of the ends of such cylinder may be accomplished upon the same machine tool and result in end faces which are perpendicular to the axis of the cylinder. Any slight misalignment of the cylinder sections 12 and 13 is nullified by the continuous inner liner.

It will also be evident that cylinders constructed in accordance with this invention may be dismantled while one end of the cylinder is still attached to the structure which carries the cylinder. It is only necessary to remove the snap ring 40 and slip the retaining ring 38 off the split ring sections 35 in order to remove one of the cylinder portions 12 or 13.

In actual practice it has been found that the construction shown is of lighter weight than that available heretofore. It will be understood, however, that the locking mechanism, including pin 60, release pistons 51, etc., need not be employed unless the function or use to which the piston is to be put renders desirable the utilization of a locking mechanism. Although specific reference has been made to hydraulic cylinders, it will be obvious that the construction here shown may be used not only with hydraulic liquids but also with pneumatic fluids.

I claim:

1. A hydraulic cylinder assembly comprising a full length tubular liner forming a central bore of relatively precise dimension, structural casing members surrounding the liner including a cylindrical body member and end members and means for connecting a pair of adjacent members comprising opposed and abutting flanges thereon, a recessed portion between said members and the liner, a packing in the recessed portion adapted to be compressed against the exterior of the liner, a split ring assembly adapted to enclose the flanges throughout their circumferences, a continuous retaining ring surrounding the split ring assembly and an annular circumferential rim on the split ring assembly adapted to retain the continuous ring in place.

2. A hydraulic cylinder assembly comprising end members and a cylindrical member having a bore therein for reception of a slidably mounted piston in the bore having a piston rod thereon extending from one end, and means for connecting said members together comprising opposed and abutting flanges on adjacent members recessed at the inner corner forming a space therebetween, a split ring assembly adapted to enclose the flanges throughout their circumferences, a circumferential exterior rim on the ring assembly, a continuous ring retained by the rim and surrounding the split ring assembly, an annular circumferential recess in the side of the split ring assembly opposite the rim and a spring snap ring adapted to be retained in the recess for anchoring the continuous ring in place.

3. A hydraulic cylinder assembly comprising a full length tubular liner forming a central bore of relatively precise dimension, a piston slidably mounted in the bore having a piston rod thereon extending from one end, a structural casing surrounding the liner comprising elements each of less than the full length of the liner and having a closed end thereon forming one end of the cylinder assembly and means for connecting the open ends comprising opposed and abutting flanges on the structural elements, a packing between the ends of the structural casing elements and the exterior of the liner, and a retainer cooperable with the flanges for anchoring the ends of the structural casing elements in place.

4. A hydraulic cylinder assembly comprising a full length tubular liner forming a central bore of relatively precise dimension, a piston slidably mounted in the bore having a piston rod thereon extending from one end, a structural casing surrounding the liner with a clearance therebetween comprising elements each of substantially one half the length of the liner and having a closed end thereon forming one end of the cylinder assembly and means for connecting the open ends comprising opposed and abutting flanges on the structural elements, a ring packing adapted to be compressed between the ends of the structural casing elements and the exterior of the liner, a split ring assembly adapted to enclose the flanges throughout their circumferences, and means for retaining the ring assembly in place.

5. A hydraulic cylinder assembly comprising a full length tubular liner forming a central bore of relatively precise dimension, a piston slidably mounted in the bore having a piston rod thereon extending from one end, a structural casing surrounding the liner with a clearance therebetween comprising elements each of substantially one half the length of the liner and having a closed end thereon forming one end of the cylinder assembly and means for connecting the open ends comprising opposed and abutting flanges on the elements of the structural casing recessed at the inner corner forming a space therebetween, a ring packing in the space formed by the recesses adapted to be compressed against the exterior of the liner, a split ring assembly adapted to enclose the flanges throughout their circumferences, a circumferential exterior rim on the ring assembly, a continuous ring retained by the rim and surrounding the split ring assembly, an annular circumferential recess in the side of the split ring assembly opposite the rim and a spring snap ring

adapted to be retained in the recess for anchoring the continuous ring in place.

6. In a fluid pressure actuating cylinder construction: a hollow cylinder provided with a closed end and an open end, an outwardly extending flange at said open end, said flange having a face lying in a plane transverse to the cylinder axis, a closure member for the open end of the cylinder, said closure member having an outwardly extending flange adapted to abut the first-named flange, a split ring of channel section adapted to grasp the abutting flanges, a continuous retainer ring slidable upon said split ring to hold the latter in flange-grasping position, and releasable means for holding the retainer ring upon the split ring.

7. In a fluid pressure actuating cylinder construction: a pair of cylinder portions each provided with a closed end and an open end and an outwardly extending flange at said open end, whereby said cylinder portions may be placed in alignment with said flanges in contact, a split clamping ring of channel section adapted to grasp said flanges and restrain said cylinder portions from relative axial movement, a continuous unbroken retainer ring slidable upon said clamping ring in an axial direction and releasable means for holding the retainer ring upon the clamping ring.

8. In a fluid pressure actuating cylinder construction: a pair of cylinder portions each provided with a closed end and an open end and an outwardly extending flange at said open end, whereby said cylinder portions may be placed in alignment with said flanges in contact, a split clamping ring of channel section adapted to grasp said flanges and restrain said cylinder portions from relative axial movement, a continuous retainer ring slidable upon said clamping ring, releasable means for holding the retainer ring upon the clamping ring and a tubular liner within said cylinder portions and extending between the closed ends thereof.

9. In a fluid pressure actuating cylinder construction: a pair of cylinder portions each provided with a closed end and an open end and an outwardly extending flange at said open end, whereby said cylinder portions may be placed in alignment with said flanges in contact, a split clamping ring of channel section adapted to grasp said flanges and restrain said cylinder portions from relative axial movement, a continuous retainer ring slidable upon said clamping ring, releasable means for holding the retainer ring upon the clamping ring, a tubular liner within said cylinder portions and extending between the closed ends thereof and a sealing ring carried between the tubular liner and said cylinder portions in the region of said joint.

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