

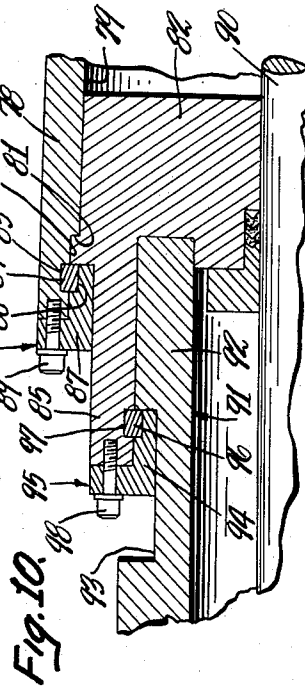
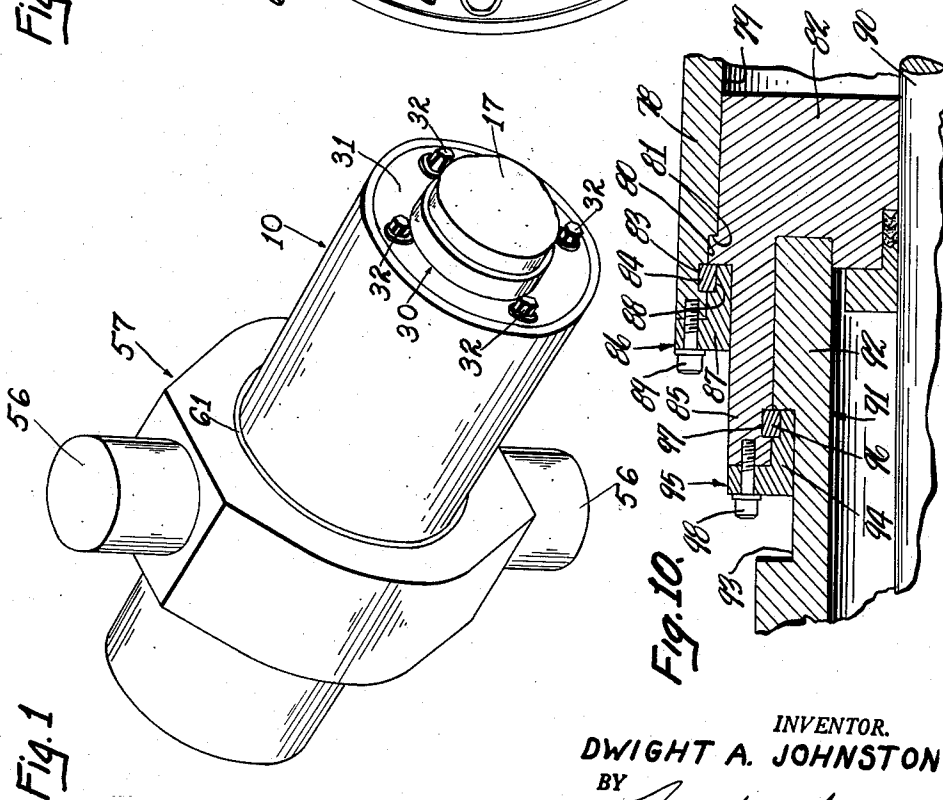
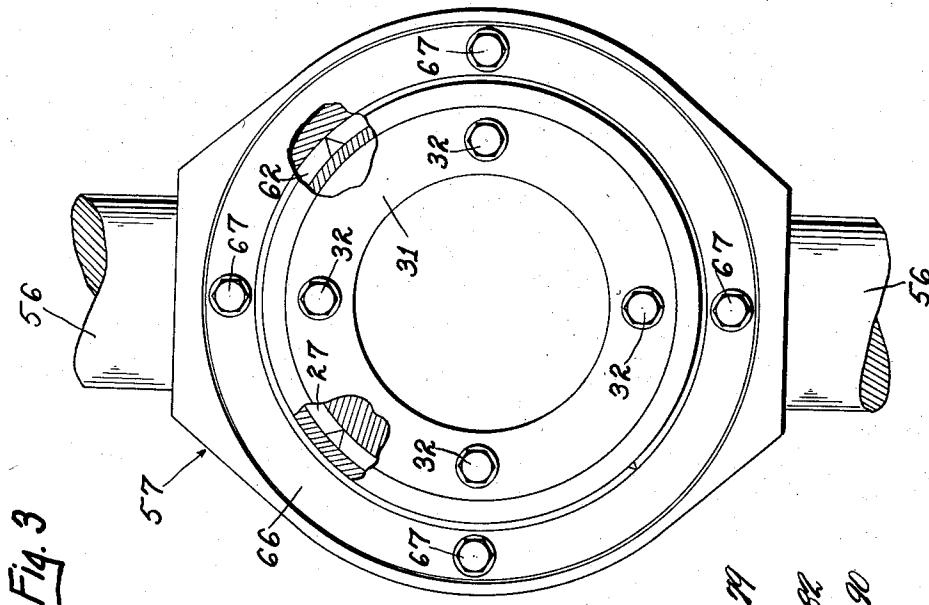
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D. A. JOHNSTON
FLUID CYLINDER STRUCTURE

2,849,263

Filed May 9, 1955

3 Sheets-Sheet 1



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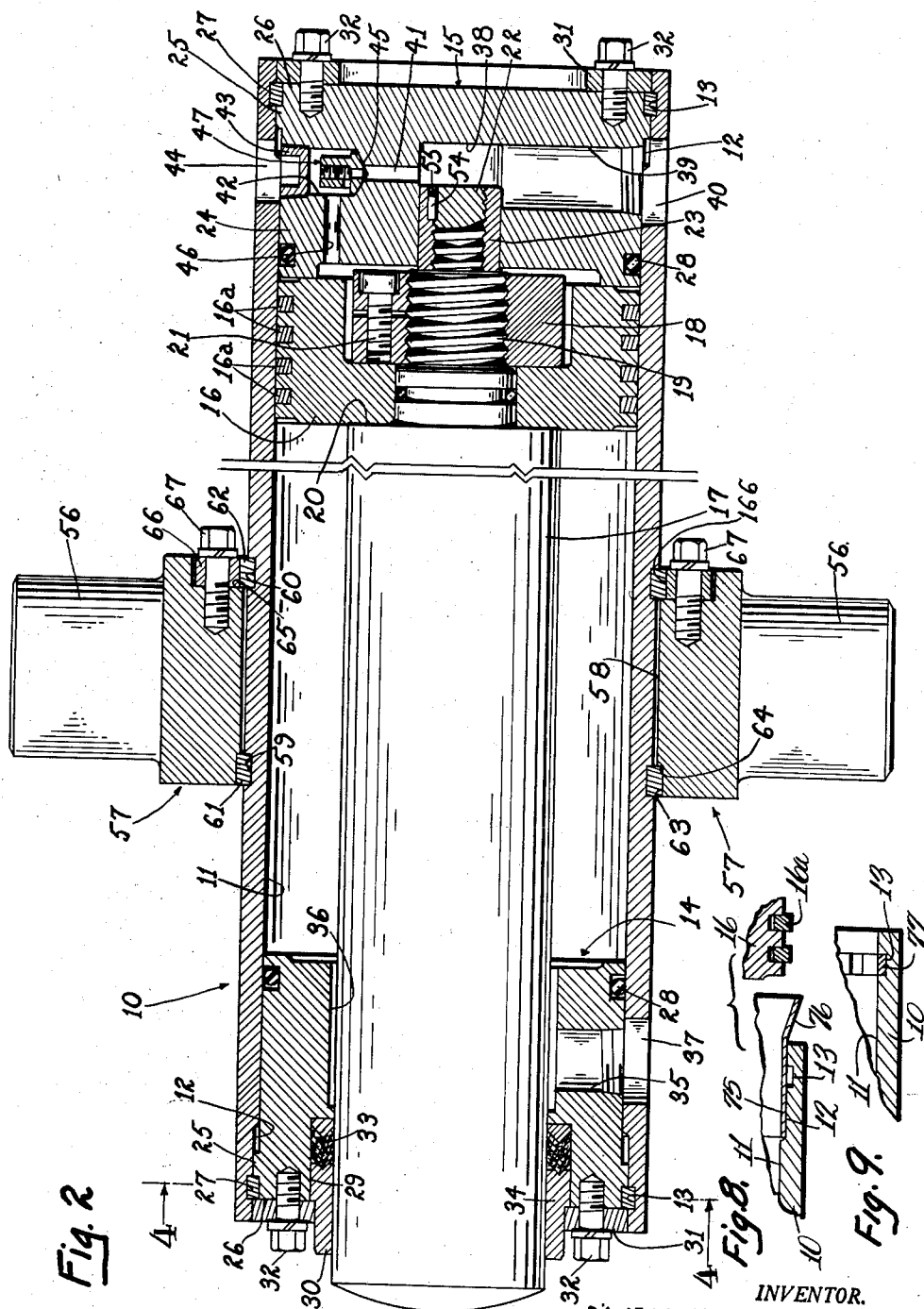
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FLUID CYLINDER STRUCTURE

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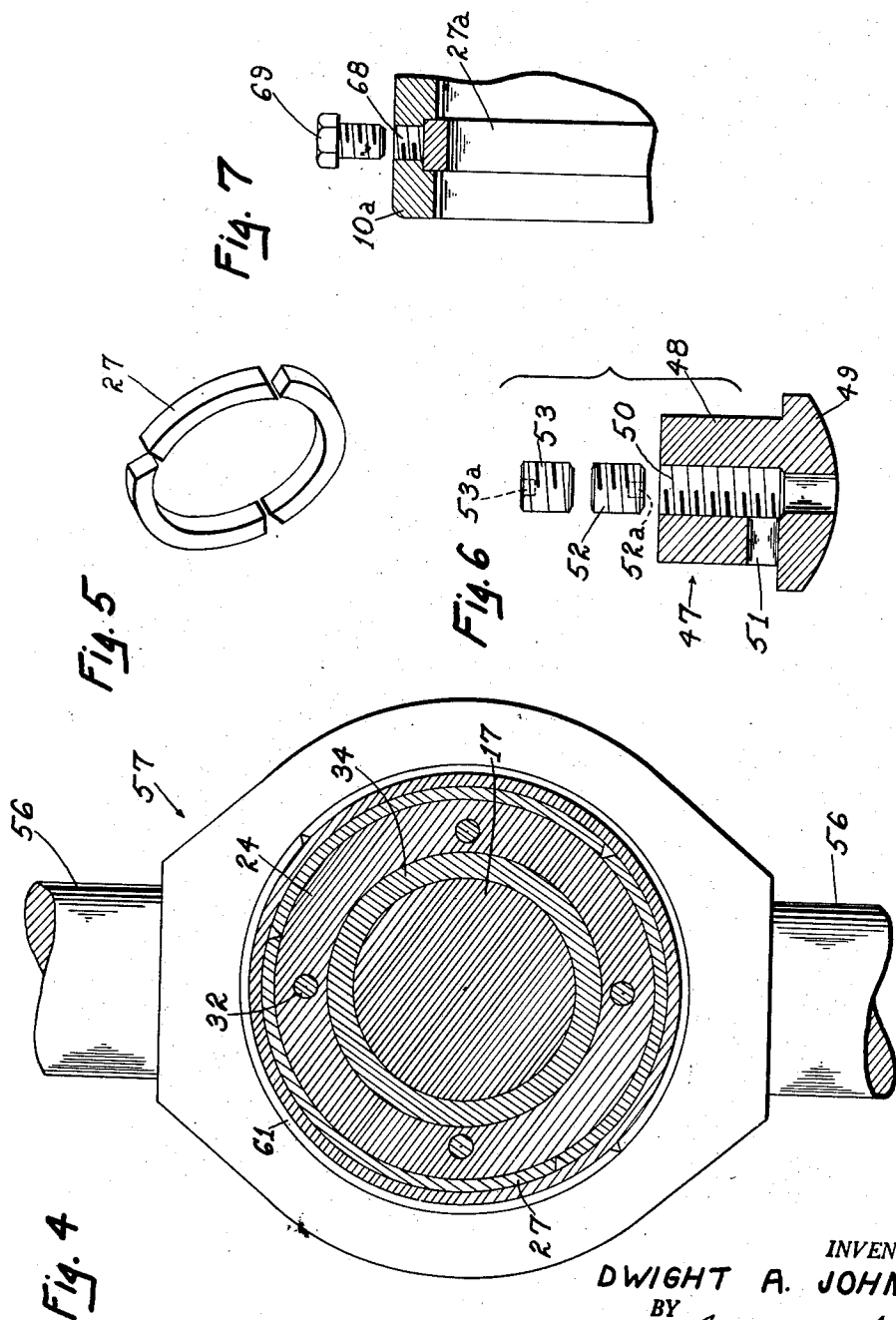
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FLUID CYLINDER STRUCTURE

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FLUID CYLINDER STRUCTURE

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8 Claims. (Cl. 309—2)

The present invention relates to fluid operated apparatus, more particularly to fluid cylinder structure, and the principal object of the invention is to provide new and improved apparatus of such character.

Despite intensive development of the fluid cylinder art, there has long existed a need for high quality fluid cylinders which can be manufactured and sold at low cost and which can be quickly and easily serviced in the field by ordinary workmen without the use of special tools.

The present invention provides a fluid cylinder which can be produced at a considerably lower cost than prior art cylinders of comparable quality. Moreover, a fluid cylinder made in accordance with the present invention may be easily disassembled by ordinary mechanics for inspection or replacement of the normal wearing parts without the use of special tools. These and other advantages of the invention will readily become apparent from a study of the following description and from the drawings appended hereto.

In the drawings accompanying this specification and forming a part of this application, there are shown, for purpose of illustration, embodiments which the invention may assume, and in these drawings:

Figure 1 is a perspective view of a fluid cylinder embodying the present invention,

Figure 2 is an enlarged longitudinal sectional view of the embodiment shown in Figure 1,

Figure 3 is an end elevational view of the blank end of the cylinder, certain parts being broken away to illustrate interior construction,

Figure 4 is a transverse sectional view generally corresponding to the line 4—4 of Figure 2,

Figure 5 is a reduced size, perspective view of a detail,

Figure 6 is an enlarged, exploded sectional view of certain details,

Figure 7 is an enlarged fragmentary view of a fluid cylinder illustrating a modified construction,

Figures 8 and 9 are fragmentary sectional views illustrating several methods of assembling the piston into the cylinder barrel, and

Figure 10 is a fragmentary sectional view illustrating a further modified construction.

Referring particularly to Figure 2, the present fluid cylinder comprises a barrel 10 which is preferably formed of seamless tubing of the requisite size. The bore 11 of the barrel 10 is enlarged at each end of the barrel as indicated at 12 and an annular groove 13 is formed in each bore enlargement 12 for a purpose to be shown. It will be understood that the bore enlargements 12 may be omitted so that the bore is of the same diameter the entire length of the barrel.

Opposite ends of the barrel 10 are adapted to be closed by respective end caps, or heads, 14, 15 and a piston 16 having piston rings 16a is reciprocable between the heads and within the bore 11. A piston rod 17 is secured to piston 16 and one end of the piston rod extends outwardly of the cylinder barrel through head 14. In the presently disclosed embodiment, piston 16 is secured to piston rod

17 by means of a nut 18 which is threaded on a reduced diameter portion 19 of the piston rod and tightly clamps the piston against a shoulder 20 formed on the rod. Nut 18 is partially split as shown and a bolt 21 draws the separated portions of the nut together to lock the latter in position. For a purpose later to be disclosed, piston rod 17 is further reduced in size at 22 and is externally threaded to receive a sleeve 23 which may be formed of any suitable bearing metal.

Each cylinder head 14, 15 comprises an inner portion 24 of a diameter to closely fit with bore 11, an intermediate portion which provides a radially extending shoulder 25 of a diameter to closely fit with the adjoining bore enlargement 12, and an outer portion 26 of a diameter to closely fit within respective locking rings 27 which are adapted to be seated in respective adjoining annular grooves 13 to provide inwardly directed shoulders which abut shoulders 25 of the respective heads. The inner portion of each head carries a sealing member such as an O ring 28 and a recess 29 extends inwardly of the outer end of head 14 and receives a sealing device 30 which prevents leakage of fluid around the piston rod.

Means are provided for maintaining the heads in position at respective ends of the cylinder barrel, such means comprising respective retaining rings 31 which seat against the outer ends of respective heads and engage respective locking rings 27. Any suitable means, such as bolts 32, may be employed to hold the retainer rings 31 in position.

In order to provide for easy assembly and disassembly of locking rings 27, each locking ring is formed in three segments (see Figure 5), the adjoining ends of the segments being formed to provide an angle which converges toward the center of the ring to provide an opening in which a suitable tool may be inserted to pry the segments from their grooves.

Each head is assembled with the cylinder barrel in a similar manner; consequently, only the assembly of head 15 with the barrel will be described in detail. In assembling head 15 with the barrel, the head will be inserted in the barrel as far as possible, or until shoulder 25 reaches the inner end of bore enlargement 12. The three segments of locking ring 27 will then be seated in the adjoining annular groove 13 and the head then shifted outwardly to cause outer portion 26 of the head to enter the inside of the locking ring. Although not shown, portion 26 of the head may be rounded, or beveled, to facilitate its entry into the locking ring. Retaining ring 31 will next be positioned in the end of the cylinder barrel and against the locking ring and bolts 32 tightened to draw the head and the retaining ring together to tightly clamp the locking ring therebetween. It will be noted that the bolts 32 are positioned closely adjacent to the segmental key or locking ring 27 to exert the maximum amount of pressure in this area for clamping purposes.

Head 14 will be secured in position in a manner similar to head 15; however, since the piston rod extends through this head, the sealing device 30 must be installed prior to the time the retaining ring 31 is assembled. The packing device presently comprises a plurality of substantially V cross-sectioned rings 33, formed of leather or the like and sold under the trade-mark "Chevron," which are adapted to be positioned in recess 29 and about the piston rod. A compression sleeve 34, having an internal diameter to slideably fit with the piston rod and an external diameter to slideably fit in recess 29, maintains the necessary amount of axial compression on the chevron rings. Note that sleeve 34 has a shoulder which engages behind the retaining ring 31 so that the latter holds the sealing device in place in addition to holding the head and the cylinder barrel in assembled relation.

Head 14 is provided with a transverse passage 35 which

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is threaded to receive the conduit (not shown) which carries fluid to and from this end of the cylinder, and an annular recess 36 is formed in the inner end of the head and intersects passage 35 to provide a path for fluid flow about the piston rod and between the passage 35 and the interior of the cylinder barrel. An aperture 37 is formed in the cylinder barrel in register with passage 35 to provide clearance for the conduit which threads into this passage.

The fluid cylinder herein disclosed is of the fluid cushioned type; that is, flow of displaced fluid ahead of the piston is sharply reduced as the piston approaches the end of its stroke to reduce the velocity of the piston and prevent its slamming against the cylinder head. In the use for which the present cylinder was designed, only the blank end of the cylinder is so cushioned; however, it will readily be apparent that both ends of the cylinder could be cushioned if desired.

Referring to head 15 at the blank end of the cylinder, it will be noted that a recess 38 extends from the inner end of the head and closely receives sleeve 23 carried by the piston rod. Recess 38 is intersected by a transverse port 39 which is threaded to receive the conduit (not shown) which conducts fluid to and from this end of the cylinder. Cylinder barrel 10 is apertured at 40 in register with port 39 to provide clearance for the conduit which threads into this passage.

Also extending transversely of head 15 and intersecting recess 38 is a passage 41 which terminates in a valve chamber 42. Valve chamber 42 is closed by a threaded plug 43 and the cylinder barrel is apertured at 44 in register with the plug to permit the latter to be removed and replaced in the head. Chamber 42 is provided with a valve seat 45 adjacent passage 41 and a passage 46 connects a portion of chamber 42 spaced from the valve seat with the interior of the cylinder barrel.

Positioned within chamber 42 is a valve member 47 which, in the present embodiment and as best shown in Figure 6, has a shank portion 48 and a radially enlarged head portion 49. Head portion 49 is formed for sealing engagement with valve seat 45 and valve member 47 is provided with a longitudinally extending passage 50 and a transversely extending, intersecting passage 51. Passage 50 is internally threaded as shown, the threads extending from that end of the valve member opposite head portion 49 to a point adjacent passage 51. A conventional set screw 52 is adapted to be threaded into passage 50 to throttle fluid flow between passages 50, 51 and a second set screw 53 abuts screw 52 to lock the latter in place. Set screws 52, 53 may be formed with sockets 52a, 53a, as shown in dotted lines in Figure 6, for the reception of an Allen wrench for easy adjustment of the set screws from opposite ends of the passage 50.

With the parts in the position shown in Figure 2, operation of the cylinder is as follows: When fluid is admitted to port 39, it will force the piston 16 to the left by exerting pressure against the portion of the piston rod within recess 38. Fluid will also be admitted behind the piston since fluid will push valve member 47 off its seat and allow a relatively unobstructed flow of fluid from recess 38 through passage 41, valve chamber 42 and passage 46. As the piston moves to the left in Figure 2, fluid in advance of the piston will be exhausted through port 35.

Assuming that the piston is at the left end of the cylinder, the former will be returned to the position shown in Figure 2 by admitting fluid under pressure to port 35 and by allowing fluid to escape from port 39. Until the piston approaches the end of its stroke, fluid to the right of the piston will be displaced by passing freely into recess 38 and thence to port 39. However, once the sleeve 23 carried by piston rod portion 22 enters recess 38, it blocks flow of the displaced fluid. At this time, the only path open to the displaced fluid

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is through passage 46, chamber 42, passage 41 and thence to recess 38 and port 39. Flow of fluid in this direction will force valve member 47 against its seat thus blocking flow of fluid around the valve member and forcing the fluid to flow through the passages 51, 50 in the valve member. Since flow of fluid through the valve member is throttled by set screw 52, the velocity of the piston will be sharply reduced as it approaches the end of its stroke to prevent it from slamming against the head. In the event it is desired to adjust the cushioning action herein provided, it is merely necessary to unscrew plug 43, remove valve member 47 from chamber 42, make the necessary adjustments to screws 52 and 53, and thereafter replace valve member 47 and plug 43. It will be appreciated that the sleeve 23 may be cylindrical, as shown, or tapered from a smaller diameter at its end to a larger diameter adjacent to the portion 19 of the piston rod, or it may be tapered in part and cylindrical in part, depending upon the requirements for which the cylinder is designed.

It is an important feature of the present invention that the sleeve 23 is permanently locked to the piston rod. In the past, most attempts to secure a sleeve (formed of suitable bearing metal to reduce the possibility of its seizure with the head) to the rod have either resulted in expensive constructions or in constructions which were not completely reliable. It will readily be apparent that considerable damage to the cylinder results if the sleeve should loosen. In the present construction and as previously pointed out, the sleeve is threaded upon portion 22 of the rod and an axially extending key 54, engageable with both the sleeve and the piston rod, prevents loosening of the sleeve. As an added precaution, the key may be welded to the rod as indicated at 55 to insure that the key will not loosen under vibration.

The cylinder herein disclosed is of the trunnion mounted type and, accordingly, is provided with aligned, transversely extending stub shafts 56, 56 formed integrally with or suitably secured to body means which comprises a ring-like flange member 57 adapted to be removably secured to the exterior of the cylinder barrel and a retaining ring 66 carried by the flange member. Flange member 57 has an aperture 58 of a size to freely pass the cylinder barrel and, since the aperture is preferably somewhat larger than the barrel, neither the aperture 58 nor the exterior of the barrel need be machined to close tolerances.

Referring now to the cylinder barrel, it will be noted that a pair of spaced-apart annular grooves 59, 60 are formed in the exterior thereof. Groove 59 is adapted to receive a ring member 61 while groove 60 is adapted to receive a ring member 62. As best shown in Figure 3, each ring member 61, 62 is formed of two segments, the adjoining ends of the segments being formed to provide an angle which converges away from the center of the ring to provide an opening in which a suitable tool may be inserted to pry the ring segments from their grooves. Since the axis of the trunnion must be accurately located relative to the bore of the cylinder barrel and since the bore may not be perfectly concentric with the exterior of the barrel, grooves 59, 60 are machined in the cylinder barrel concentric with the latter's bore and not with its exterior. Moreover, as will be understood, the outer periphery of each ring member 61, 62 is formed concentric with its inner periphery to insure concentricity of the ring members with the bore of the cylinder barrel.

Returning to flange 57, a recessed annular surface 63 terminating in an internal shoulder surface 64 is formed at one end of the flange as shown. Surface 63 closely fits with the periphery of ring member 61 while shoulder surface 64 abuts the ring member. In the present construction, the other end of the flange is also recessed to provide a shoulder surface 65 which abuts ring member 62 and against which the aforementioned retaining ring

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66 is adapted to be secured by means of bolts 67. Note that the interior of retaining ring 66 provides an annular surface 166 which closely fits with the periphery of ring member 62. It will be understood that surfaces 63, 64, 65 and 166 will be formed using the axis of the stub shafts 56, 56 as a reference point to insure that such axis will be accurately located with respect to the bore of the cylinder barrel when the body means is assembled with the latter. In Figure 2, the space between the exterior diameter of the ring 66 and the interior adjacent surface of the recess in flange 57 is exaggerated. In actual practice, it is preferable to have this space on the order of five or ten thousandths of an inch in order to assist in the centering and supporting of the flange 57.

In assembling flange 57 with the cylinder barrel, the segments of ring member 61 will first be positioned in groove 59 and the flange moved to the left until shoulder surface 64 abuts ring member 61. The segments of ring member 62 will then be assembled in groove 60 and retaining ring 66 slid over this ring member and against shoulder surface 65 of the flange. The installation of bolts 67 will complete the assembly and firmly lock the flange 57 to the cylinder barrel.

In the event rather large diameter cylinders are made in accordance with the present invention and since locking rings 27 necessarily fit rather tightly in their grooves, it is contemplated that some difficulty may arise in removing the locking ring segments from such grooves. As shown in Figure 7, and where applicable, tapped holes 68 will be provided in the cylinder barrel 10a at the base of the annular grooves in which are seated locking rings 27a. Each hole 68 is adapted to receive a suitable bolt 69 which may be threaded into the holes to force the ring segments from their grooves. Following disassembly of the ring segments from the cylinder barrel, bolt 69 will, of course, be removed so that it will not interfere with subsequent assembly operations. While only one hole 68 has been shown, it will readily be apparent that as many as necessary may be provided to facilitate removing each ring segment from its groove.

Figures 8 and 9 show constructions for inserting the piston 16 into the bore 11 of the barrel 10 and for preventing the piston rings 16a from expanding and locking into the annular groove 13. In the event the bore 11 is formed with enlargements 12, a sheet metal cylindrical member 75 is slid into the enlargement to span the opening formed by the annular groove 13. The member 75 may be formed with an enlarged mouth 76 whereby the piston rings 16a are automatically compressed as the piston 16 is moved to position within the bore 11.

In the event the bore 11 is formed without the enlargements 12, as shown in Figure 9, a snap ring 77 may be disposed within the groove 13. The snap ring need not possess great mechanical strength since its only function is to fill the groove 13 and generally form an uninterrupted continuation of the bore 11. Accordingly, the snap ring may be formed of any suitable material which will permit its easy assembly to and disassembly from position in the groove 13.

Referring to the construction shown in Figure 10, the embodiment therein disclosed comprises a barrel 78 having a bore 79 formed with an enlargement 80 at its end. The enlargement forms a shoulder 81 with the bore 79. A head 82 is disposed within the bore end, the head having a portion fitting the bore and a portion fitting the enlargement, the shoulder formed between the two portions abutting the shoulder 81 and restraining movement of the head 82 in a direction inwardly of the barrel. An annular groove 83 is formed in the enlargement 80 and receives a ring-like key 84 which is formed in sections similar to the key 27 hereinbefore described.

The head 82 has a tubular portion 85 of an external diameter less than the internal diameter of enlargement 80 to form a space therebetween and a ring-like retainer member 86 has a portion 87 fitting within such space.

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The tubular portion 85 forms a shoulder which abuts the inwardly directed side surface of the shoulder formed by the key 84 to restrain movement of the head 82 outwardly of the barrel.

The portion 87 of the retainer member 86 has an undercut 88 which provides a face directed against the inwardly extending surface of the key 84 to hold the latter within the annular groove 83, and the undercut 88 forms a shoulder which abuts the outwardly directed side surface of the shoulder formed by the key 84. A series of bolts 89 pass through apertures in the retainer member 86 and are threaded into apertures in the end of the barrel to fix the assembly in place.

The tubular portion 85 need not be of the length shown in Figure 10 if the head 82 is used merely as an end closure for the cylinder barrel. However, in some cases, it is desirable to mount the cylinder from its end and, in such cases, the tubular portion may be well suited for mounting purposes.

As seen in Figure 10, the head 82 is apertured to pass the rod 90 of the piston (not shown). A tubular member 91 is formed with a cylindrical portion 92 having an outside diameter to fit the inside diameter of the tubular member 85. The member 91 is undercut at 93 to provide space for the reception of a portion 94 of a ring-like retainer member 95. The undercut 93 forms a shoulder which abuts against the inwardly directed side surface of a segmental ring-like key 96 which is similar to the key 83 and is seated in an annular groove 97 formed in the tubular member 85.

The end of the portion 94 of the retainer member 95 is undercut to provide an annular face directed against the inwardly extending surface of the key 96 to hold the latter in its groove 97. The undercut provides a shoulder which abuts against the outwardly directed side surface of the shoulder formed by the key 96 and bolts 98 hold the retainer member 95 to the member 85.

The tubular member 92 may extend away from the fluid cylinder any desirable amount and may be formed with a flange (not shown) or any suitable mounting member for securement to a support, also not shown.

In view of the foregoing it will be apparent to those skilled in the art that I have accomplished at least the principal object of my invention and it will also be apparent to those skilled in the art that the embodiments herein described may be variously changed and modified, without departing from the spirit of the invention, and that the invention is capable of uses and has advantages not herein specifically described, hence it will be appreciated that the herein disclosed embodiments are illustrative only, and that my invention is not limited thereto.

I claim:

1. A fluid cylinder construction, comprising a cylinder barrel having a pair of spaced annular grooves in its outer periphery, a ring member seated in each of said grooves and providing spaced, outwardly extending shoulders, the outer peripheral surface of each of said ring members being concentric with the bore of said cylinder barrel when said ring members are seated in their respective grooves, and body means apertured to fit about said cylinder barrel and extending longitudinally between said ring members, said body means having spaced surfaces engageable with the latter and certain of said surfaces being engageable with respective shoulders provided by said ring members to restrain said body against movement axially of said cylinder barrel and certain other of said surfaces being closely engageable with the respective outer peripheries of said ring members to insure accurate radial location of said body means relative to the bore of said cylinder barrel.

2. A fluid cylinder construction, comprising a cylinder barrel having a pair of spaced annular grooves in its outer periphery, a ring member seated in each of said grooves and providing spaced, outwardly extending shoulders, the outer peripheral surface of each of said ring members

being concentric with the bore of said cylinder barrel when said ring members are seated in their respective grooves, a body apertured to slide axially over said cylinder barrel and extending longitudinally between said ring members, said body having spaced-apart abutment surfaces engageable with the shoulders provided by said ring members to restrain said body against movement axially of said cylinder barrel and said body having an annular surface closely engageable with the outer periphery of one of said ring members to insure accurate radial location of the adjoining portion of said body relative to the bore of said cylinder barrel, and a retaining ring carried by said body and having an annular surface closely engageable with the outer periphery of the other of said ring members to insure accurate radial location of said retaining ring relative to the bore of said cylinder barrel and consequent accurate radial location of the adjoining portion of said body, said retaining ring normally preventing unintentional displacement of the adjoining ring member from its groove but being removable from said body to permit removal of said adjoining ring member to permit separation of said body from said cylinder barrel.

3. A fluid cylinder construction, comprising a cylinder barrel having a pair of spaced annular grooves in its outer periphery and each groove having a bottom surface concentric with the bore of the cylinder barrel, a ring member seated in each of said grooves and providing spaced, outwardly extending shoulders, the outer peripheral surfaces of said ring members being concentric with their inner peripheral surfaces so that said outer surfaces will be concentric with the bore of said cylinder barrel when said ring members are seated in their respective grooves, a body apertured to freely slide axially over said cylinder barrel and extending longitudinally between said ring members, said body providing a trunnion and having spaced-apart abutment surfaces engageable with the shoulders provided by said ring members to restrain said body against movement axially of said cylinder barrel and said body having an annular surface located with reference to the axis of said trunnion and closely engageable with the outer periphery of one of said ring members to insure accurate radial location of the adjoining portion of said body relative to the bore of said cylinder barrel, and a retaining ring carried by said body and having an annular surface located with reference to the axis of said trunnion and closely engageable with the outer periphery of the other of said ring members to insure accurate radial location of said retaining ring relative to the bore of said cylinder barrel and consequent accurate radial location of the adjoining portion of said body, said retaining ring normally preventing unintentional displacement of the adjoining ring member from its groove but being removable from said body to permit such removal of said adjoining ring member to permit separation of said body from said cylinder barrel.

4. In combination, a cylindrical member having an annular groove in its inner wall at a point spaced inwardly of an open end, a ring-like key closely seated in said annular groove and extending inwardly beyond said inner wall to provide a shoulder, said key being formed of sections to provide for assembly into said groove, a body positioned within said cylindrical member and having a wall engageable with the inner face of said shoulder to hold said key sections in said groove and having a portion abutting the inwardly directed side surface of the shoulder formed by said key, a retainer member having a face abutting the outwardly directed side surface of the shoulder formed by said key, and means drawing said body and said retainer member toward each other to rigidly clamp them against respective inwardly and outwardly directed side surfaces of said key shoulder.

5. A fluid cylinder construction, comprising a cylinder barrel housing a reciprocable piston, said barrel having an annular groove in its inner wall adjacent an end there-

of, a ring-like key closely seated in said annular groove and extending inwardly beyond said inner wall to provide a shoulder, said key being formed in sections to provide for assembly into said groove, cap means fitting within and generally closing said barrel end, having a wall engageable with the inner face of said key shoulder to hold said key sections in said groove and having a portion abutting the inwardly directed side surface of the shoulder formed by said key, a retainer member having a face abutting the outwardly directed side surface of the shoulder formed by said key, and means drawing said body and said retainer toward each other to rigidly clamp them against respective inwardly and outwardly directed side surfaces of said key shoulder.

6. A fluid cylinder construction, comprising a cylinder barrel housing a reciprocable piston, said barrel having an annular groove in its inner wall adjacent an end thereof, a ring-like key closely seated in said annular groove and extending inwardly beyond said inner wall to provide a shoulder, said key being formed in sections to provide for assembly into said groove, cap means fitting within and generally closing said barrel end, said cap means having an annular groove providing a face directed against the inner face of said key shoulder to hold said key sections in said groove and also providing a shoulder portion abutting the inwardly directed side surface of the shoulder formed by said key, a ring-like retainer member fitting within said barrel end and having a face abutting the outwardly directed side surface of the shoulder formed by said key, and a plurality of bolts passing through apertures in said retainer member and threaded into said cap means for drawing said cap means and said retainer member toward each other and rigidly clamping them against respective inwardly and outwardly directed side surfaces of said key shoulder.

7. A fluid cylinder construction comprising body means providing a bore extending inwardly from a margin thereof and the defining wall of said bore adjacent its mouth providing an annular groove, a locking ring seated in said groove and providing an annular shoulder projecting radially inwardly of said bore, cap means for closing the mouth of said bore and having a first portion proportioned to closely fit within said bore and extending beyond said ring inwardly of said bore mouth, a second portion proportioned to closely fit within said ring to maintain the latter within its groove, and an annular shoulder between said first and second cap means portions abutting that side of said ring spaced from said bore mouth, means for maintaining said cap means in position with its shoulder abutting said ring, and sealing means carried by said first cap means portion in sealing engagement with both the latter and said bore.

8. A fluid cylinder construction comprising body means providing a stepped diameter bore extending inwardly from a margin thereof, the enlarged diameter portion of said bore being adjacent its mouth and the defining wall of said bore portion providing an annular groove, a locking ring seated in said groove and providing an annular shoulder projecting radially inwardly of said enlarged bore portion, cap means for closing the mouth of said bore and having one portion of a diameter to closely fit within said ring to maintain the latter within its groove and another portion of a diameter to closely fit within said enlarged bore portion and providing axially spaced, oppositely facing annular shoulders one of which is engageable with that side of said ring spaced from said bore mouth to limit outward disposition of said cap means and the other of which is engageable with a shoulder formed between the stepped diameters of said bore to limit inward disposition of said cap means, the axial spacing between said cap means shoulders being less than the spacing between the side aforesaid of said locking ring and said shoulder formed between the stepped diameters of said bore to provide for limited axial movement of said cap means therebetween to provide for assembly

and disassembly of said ring, and means for maintaining said cap means in position with its shoulder abutting said ring.

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