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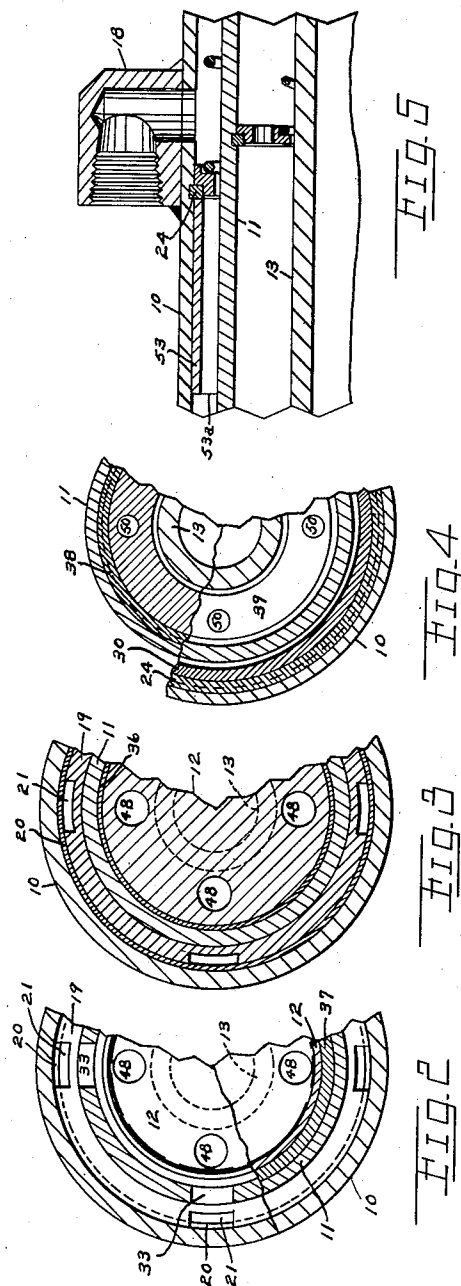
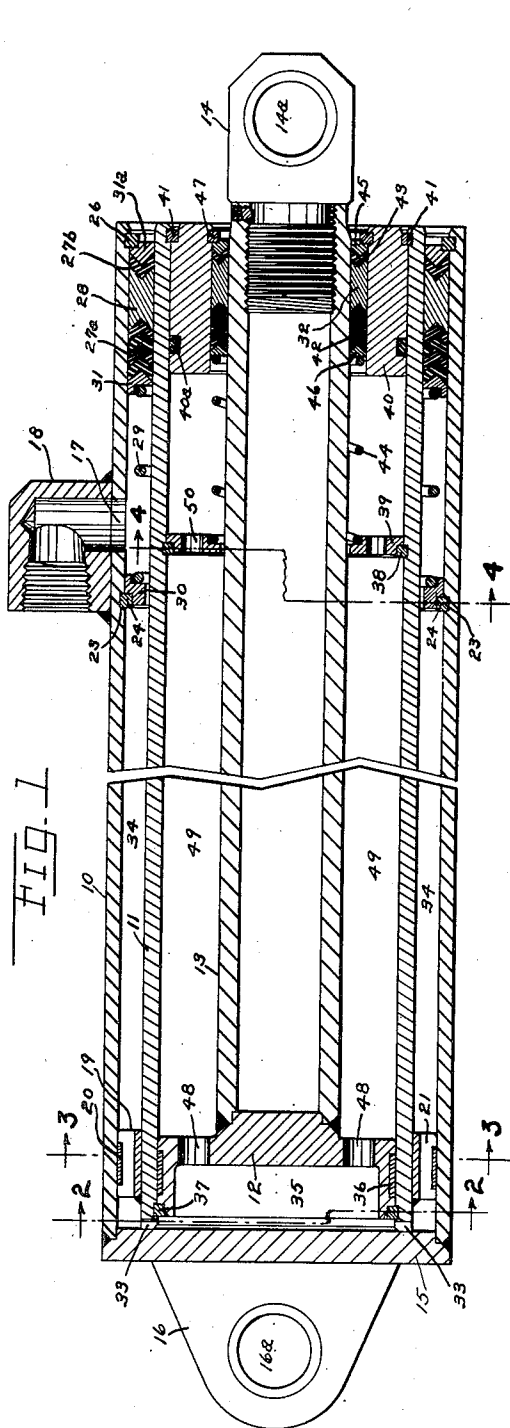
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EXPANSIBLE CHAMBER TYPE HYDRAULIC HOIST CONSTRUCTION

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EXPANSIBLE CHAMBER TYPE HYDRAULIC
HOIST CONSTRUCTION

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This invention relates to novel and improved hydraulic power applying devices comprising an expansible chamber motor having two or more telescoping elements. One familiar embodiment of such device is a hydraulic hoist of the single or multiple extension type wherein a piston actuates a ram to perform the necessary work.

This invention is a continuation-in-part of our copending application for "Hydraulic Hoist Construction," Serial No. 71,056, filed January 15, 1949, now abandoned.

An object of the invention is to provide a hydraulic power device of the piston and cylinder type wherein the cylinder or cylinders are of true cylindrical internal bore whereby to permit the use of internal honed finish throughout.

Another object of the invention is to provide a device as defined in the last preceding paragraph wherein the cylinder or cylinders can be formed directly from lengths of commercially available standard metal tubing with only simple finishing and assembling operations being required.

Another object of the invention is to provide a hydraulic power device wherein the cylinder or cylinders are of substantial diameter, but wherein the end sealing operation does not require threaded closures or other relatively expensive expedients on the cylinder ends.

A further object of the invention is to provide novel and improved packing arrangement for sealing the various meeting surfaces of relatively movable parts so as to simplify the assembly and to maintain even tension on the packing.

Other objects and advantages will be apparent from a study of the following specification in conjunction with the accompanying drawings, in which:

Fig. 1 is a longitudinal sectional view taken on the axis of a hydraulic hoist cylinder unit embodying our invention;

Figs. 2, 3 and 4 are sectional views taken respectively on the lines 2-2, 3-3, and 4-4 of Fig. 1;

Fig. 5 is a fragmentary sectional view similar to a corresponding portion of Fig. 1, but showing a modified form of our invention;

Fig. 6 is a side elevational view shown partly in section along the longitudinal axis of a modified form of hydraulic hoist cylinder construction;

Fig. 7 is a fragmentary sectional view enlarged of the packing in the upper right hand portion of Fig. 6;

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Fig. 8 is a transverse sectional view taken along line 8-8 of Fig. 6; while

Fig. 9 is a transverse sectional view taken along line 9-9 of Fig. 6.

Referring now to Figs. 1 to 4, we show an expansible chamber motor comprising an outer cylinder 10, an intermediate cylinder 11 telescopically movable out of the cylinder 10, within limits, and an inner work-performing member including a piston 12, a rod or arm 13 fixed to the piston at its inner end, and at its outer end attached to a block 14. The outer cylinder has a rear end closure or cylinder head 15 provided with a lug 16. The lug 16 and the block 14 are bored at 16a and 14a respectively, one of said bores receiving a supporting pin (not shown) which serves as a fixed abutment and the other bore receiving a pin (not shown) which is moved to perform the work desired. In the present description, for convenience, and because the hoist is usually so used, we will describe the lug 16 as operating on a fixed pivot pin, and the rod eye 14a as being the movable member responsible to telescoping movement of the rod 13 or cylinder 11, or both in unison, as will appear.

The end closure 15 is a disc provided with a peripheral rabbeted groove affording a seat for the rear end of the cylinder tube, thus avoiding the use of a threaded connection which is an expensive operation with large size tubing. The actual attachment in the present instance is by welding.

The cylinders 10 and 11, and the rod 13 may be formed from suitable lengths of standard seamless tubing of such wall thickness and composition as to meet the physical and mechanical requirements of the pressure and load. Use of such tubing avoids preliminary rough machining operations such as would be necessary with cast cylinders, and permits final finishing throughout by interior honing since the cylinders do not vary in diameter from end to end.

The outer cylinder 10 has an inlet port 17 provided with a suitable fitting 18 through which oil or other fluid means of applying pressure can be admitted. This port 17 and fitting 18 may be located in any portion of the cylinder, either in the cylinder wall or in the cylinder head 15.

The intermediate cylinder 11 is a simple length of tubing having near its rear end a stop shoulder 19 carrying a guide ring or bearing ring 20. The shoulder here is shown as of annular character, welded to cylinder 11. The shoulder is provided with circumferentially spaced slots 21 to permit passage of the hydraulic fluid and with

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a peripheral groove which serves as a seat for bearing ring 20.

The inner wall surface of cylinder 10 is provided with an inner circumferential ring groove 23 which serves as a seat for an inner stop ring 24. It will be apparent that outward movement of the intermediate cylinder 11 may proceed until the leading face of shoulder 19 comes into contact with ring 24. This stop ring may be placed at any desired location along the bore of the outer cylinder, and it is immediately obvious that it determines the length of travel of the intermediate cylinder 11.

A second or outer stop ring 26 is placed in an outer groove adjacent the open end of cylinder 10. The annular space between rings 24 and 26 is occupied by resilient means comprising a helical compression spring 29 surrounding and concentric with said cylinder 11 and rod 13 to maintain longitudinal pressure on the packing, a spring aligning or seating ring 30 which is peripherally rabbeted to seat against ring 24 to retain or to lock ring 24 in groove 23, and a pair of packing retainer rings 31 and 31a on opposite ends of the packing. In the embodiment shown the bushing 28 is grooved to a V contour to receive chevron type packing and the seal or packing retainer rings 31 and 31a are contoured to be complementary to the packing. The inner packing 27a serves as a hydraulic fluid seal, and the outer packing or wiper member 27b serves as a dirt seal or wiper member. The outer packing retainer ring has a reduced diameter fitting into the bore in stop ring 26 to serve as a stop ring retainer to lock ring 26 in its associated groove.

The inner end of cylinder 11 is notched at spaced points 33 to permit passage of hydraulic fluid from the space 34 between cylinders 10 and 11 to space 35 behind piston 12. Obviously, piston 12 is moved by the unbalanced pressure opposite the rod 13.

Piston 12 and rod 13 are telescopically movable within cylinder 11 as hereinabove mentioned. The piston may be a simple disc, or it may be cup shaped as shown in Fig. 1. The guide and bearing ring 36 serves the same purpose as ring 20 previously described. Snap ring 37, seated in a groove on the inner surface of cylinder 11, provides a back stop for piston 12. A forward stop ring 38 and a spring seat ring 39 function as did similar elements 24 and 30 already described. The outer end of cylinder 11 is provided with a bearing sleeve or annular cylinder head 40 retained by a stop ring 41, and the bearing sleeve 40 carries therewithin a bushing 32, packing elements 42 and 43, and a tension maintaining spring 44, with suitable front and rear retaining rings 45 and 46 at the exposed packing faces. The outer cylindrical periphery of bearing sleeve 40 is sealed by a conventional O-ring packing 40a.

Stop rings 24, 26, 38, 41 and 47 may take the form of either split snap rings or rings each formed from a plurality of ring segments, for example, four segments.

The resilient means, such as springs 29 and 44 in Fig. 1, not only compresses packings 27a and 42 but also resiliently urges the inner edge of the resilient wiping material rings 27b and 43 into engagement with the reciprocating cylinders 11 and 13 respectively. The springs also resiliently secure the chevron shaped rings in the assembly. These rings 27b and 43 serve as efficient dirt seal or wiper members in this hydraulic hoist construction.

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Assembly of the whole unit is accomplished as follows. Assuming that all identified parts have been completely disassembled, cylinder 11 with stop ring 19 welded thereon and carrying back stop ring 37 therein is inserted into cylinder 10. Stop ring 24 is then inserted and seated in its groove, after which spring seating ring 30, spring 29, packing or seal retainer ring 31, packing 27a, bushing 28, packing 27b, packing or seal retainer ring 31a, and stop ring 26 are pushed into working position in the order given. The piston and rod assembly is then dropped into cylinder 11, after which the operator inserts stop ring 38, spring seat ring 39, spring 44, bearing sleeve 40, packing seat ring 46, packing 42, bushing 32, packing 43, packing seat ring 45, and stop ring 47. Minor variations to this procedure are quite feasible. Disassembly of the elements is easily effected by performing the operations just described in the reverse order.

When hydraulic fluid is admitted through fitting 18 and port 17, it flows through the annular space occupied by spring 29, the bore of ring 30 spaced from cylinder 11, space 34, slots 21 and notches 33 into the cupped space 35 in the piston. The piston has one or more holes 48 therethrough, and the fluid proceeds through holes 48 into space 49 and thence through holes 50 in spring seat ring 39. The passageways mentioned above enable the hydraulic fluid under pressure to move cylinder 11 and piston 12 outwardly and to exert a longitudinal compressive force against the packings 27a, 27b, 42 and 43, in addition to the compressive force of springs 29 and 44, to make the packings self-sealing at a high fluid pressure. However, when the pressure is very low and the cylinders and the piston are just beginning their relative movement, the springs 29 and 44 will provide an initial pressure on the packings to keep the hydraulic fluid from seeping out. Hence, the friction exerted by the packing varies with the hydraulic pressure. Low friction exists at low pressure when the parts are just beginning their relative movement. If the springs had to be strong enough to exert by themselves sufficient pressure at all times to prevent leaks at high hydraulic pressure, the starting load friction would be exceedingly high. The present construction cures this last difficulty.

When the pressure builds up to a point where it overcomes the resistance of the load on block 14, the intermediate cylinder 11, piston 12 and rod 13 begin to move outwardly simultaneously until ring 19 contacts stop ring 24. This stops the intermediate cylinder but the piston and rod continue outwardly until the leading edge of the piston contacts stop ring 38. Stop rings 24 and 38 are prevented from coming out of their respective grooves by the rabbeted overlap of spring seat rings 30 and 39.

While we have shown and described a double extension unit, it is obvious that the advantages of our invention may be embodied in a unit having only a single extension wherein cylinder 11 acts as a piston rod, or a triple extension, etc.

Fig. 5 shows means for modifying the hydraulic unit hereinabove described so that by the use of the same basic parts, with a minor addition, the maximum unit extension can be varied. In Fig. 5 we show a sleeve 53 inserted in the outer cylinder and within the space normally traversed by ring 19. As a result, ring 19 can advance only to contact with the end 53a of sleeve 53, after which the inner cylinder 13 constituting the piston rod proceeds independently as before. A

number of sleeves of varying length can be kept in stock, and a single hydraulic unit can be modified in accordance with varying requirements, or successive units may be turned out with varying strokes, by insertion of the proper sleeves.

Figs. 6 to 9 inclusive disclose a modified form of hydraulic hoist construction. Much of this modified form of construction is very similar to Fig. 1 when cylinder 11 acts as a piston rod and the Fig. 1 construction has only a single extension. The expansible chamber motor comprises a cylinder 110 having a telescopically slidable inner work-performing member including a piston 112 and a rod or ram 113 fixed to the piston at its inner end and attached to a block 114 at its outer end. The cylinder 110 has a rear end closure or cylinder head 115 provided with a lug 116. The lug 116 and the block 114 are bored at 116a and 114a respectively, one of said bores receiving a supporting pin (not shown) which serves as a fixed abutment and the other bore receiving a pin (not shown) which is moved to perform the work desired. In the present description, for convenience, and because the hoist is usually so used, we will describe the lug 116 as operating on a fixed pivot pin, and the rod eye 114a as being the movable member responsive to telescopic movement of the rod 113 or cylinder 111, or both in unison, as will appear.

The end closure structure is similar to that shown in Fig. 1. The end closure 115 is a disc provided with a peripheral rabbeted groove affording a seat for the rear end of the cylinder tube, thus avoiding the use of a threaded connection which is an expensive operation with large size tubing. The actual attachment in the present instance is by welding.

The cylinder 110 and the cylindrical rod 113 may be formed from suitable lengths of standard seamless tubing of such wall thickness and composition as to meet the physical and mechanical requirements of pressure and load. Use of such tubing avoids preliminary rough machining operations such as would be necessary with cast cylinders and permits final finishing throughout by interior honing since the cylinders do not vary in diameter from end to end.

The cylinder 110 has an inlet port 117 provided with a suitable fitting 118 through which oil or other fluid means of applying pressure can be admitted. This port 117 and fitting 118 may be located in any portion of the cylinder, either in the cylinder wall or in the cylinder head 115.

The piston 112 has a stop shoulder 119 and carries a guide ring or bearing ring 120 telescopically and slidably mounted in the bore of cylinder 110. The stop shoulder 119 is provided with circumferentially spaced slots 121 to permit passage of the hydraulic fluid to the left side of piston 112 in Fig. 6. A peripheral groove on the piston 112 serves as a seat for the bearing ring 120.

The inner wall surface of cylinder 110 is provided with an inner circumferential ring groove 123 which serves as a seat for an inner stop ring 124. It will be apparent that outward movement of the piston rod 113 may proceed until the leading face of the shoulder 119 comes into contact with the ring 124. This stop ring may be placed at any desired location along the bore of the cylinder 110, and it is immediately obvious that it determines the length of travel of the piston rod 113.

The second or outer stop ring 126 is placed in

an outer groove adjacent the outer end of cylinder 110. The annular space between rings 124 and 126 houses a plurality of elements. A resilient packing member 127a, annular in form, serves as a hydraulic fluid seal. In the embodiment shown, packing member 127a is of the chevron type. A bushing or guide 128a is provided with an annular groove, V-shaped in cross section, to receive the chevron type packing and to serve as a seal or packing retainer ring. A seal or packing retainer ring 131 is located at the left side of the packing in Fig. 6 and is grooved to a contour complementary to the chevron type packing. To the right and within stop ring 124 is provided a spring aligning or seating ring 130 which is peripherally rabbeted to seat against ring 124 to serve as a stop ring retaining means for locking the ring 124 in the groove 123. Seating ring 130 has a plurality of equally spaced, blind holes 130a extending in from its right face in Figs. 6 and 7. The holes are equally circumferentially spaced in the annular passageway between the piston rod 113 and the cylinder 110, as seen in Fig. 9. Resilient means is provided to maintain longitudinal pressure on the packing. In Figs. 6 to 9, this means takes the form of a plurality of helical compression springs 129, one spring mounted in each of the circumferentially spaced blind holes in seating ring 130. These springs exert a pressure longitudinally toward the right on the seal or packing retainer ring 131 for maintaining a longitudinal pressure on the packing. A stop ring retainer ring 132 is telescopically and slidably mounted in the bore of cylinder 110 for locking the stop ring 126 in its associated groove. It should be noted in Fig. 6 that threaded, longitudinally extending holes are provided in the stop ring retainer ring 132 and in the seal or packing retainers 128 and 131. A threaded puller shaft may be inserted in each of these holes to facilitate the assembly and disassembly of the telescopically connected parts.

Stop rings 124 and 126 may take the form of either split snap rings or rings each formed from plurality of ring segments, for example, four segments.

A dirt seal or wiper member 133 is provided to the right of or outside of the stop ring retainer ring 132 in Figs. 6 and 7. Member 133 is assembled in the cylinder as a unit even though it includes several component parts. This member corresponds to the dirt seal packing member 27b in Fig. 1 which serves as a wiper member. The dirt seal in Figs. 6 and 7 has a seal or wiper retainer ring 134 telescoped into a counterbore in cylinder 110 and firmly held in position by a press fit between the parts. This retainer ring 134 comprises a retaining sleeve or ring portion 134a, tubular in form, telescopically mounted in the cylinder 110 in concentric relationship with the inner cylindrical wall. An inwardly directed retaining flange 134b is integrally formed at one end thereof. Resilient wiping or dirt seal rings 135, 135 are provided within the retainer ring 134 between spaced, inwardly projecting members—retaining flange 134b, annular spacer 138, and annular closure 136—to prevent shifting in the orientation of rings 135, 135. Each ring 135 is substantially L-shaped in cross section in Fig. 7 with the approximately horizontal bar of the L forming a bore resiliently engaging and concentric with piston rod 113 to serve as a wiper and dirt seal. Resilient means—comprising coil springs 137 and 137, each formed as an endless ring—surround the horizontal bars of L's to urge

them into engagement with said piston rod 113. Each approximately vertical bar of the L is securely held in the wiper member 133 by being wedged by a ring 139 against one of the inwardly projecting members 134b or 138. Each of the component parts can be inserted into the ring 134 and then the right end of the sleeve portion 134a in Fig. 7 can be peened over to lock them together into a unit for easy assembly onto the piston rod 113 and within the cylinder 110.

Assembly of the whole unit is accomplished as follows. Referring to Fig. 6 and assuming that all identified parts have been completely disassembled, piston rod 113 with piston 112 thereon is inserted into the cylinder 110. Stop ring 124 is then inserted and seated in its groove after which spring seating ring 130 with springs 129 assembled therewith, packing or seal retainer ring 131, packing 127a, bushing 128, stop ring 126, stop ring retainer ring 132, and the dirt seal member 133 are pushed into working position in the order given. Disassembly of the elements is easily effected by performing the operations just described in the reverse order. For convenience in disassembly, it should be noted that since port 117 is partially over groove 123, a tool can be easily inserted through the port to dislodge ring 124 from the groove. Otherwise, it may be difficult to reach in from the right side of the cylinder in Fig. 6 to dislodge ring 124 with piston rod 113 still in the cylinder. Also, the dirt seal or wiper member 133 extends slightly beyond the right end of the cylinder 110 in Figs. 6 and 7 so that a special cylindrical clamp can be fastened to the member to remove it. When the clamp is not available, a hammer and chisel may be used.

In disassembly, the hydraulic hoist in Fig. 6 has an advantage over the hoist in Fig. 1. In Fig. 1, bushing 28 and ring 31a must be pushed to the left against the compression of spring 29 in order to remove stop ring 26. Since the working space is somewhat small, this operation may be difficult. In Fig. 6, no pushing is required since stop ring 126 is held in its groove by retainer ring 132. The locking effect is from the outer side of the stop ring in Fig. 6 rather than from the inner side, as in Fig. 1.

When hydraulic fluid is admitted through fittings 118 and port 117, it flows through the annular space between piston rod 113 and the bore of cylinder 110 as well as the annular space occupied by springs 129 and the bore of ring 130 spaced from the piston rod 113. The hydraulic fluid also flows through the longitudinally extending slots 121 into the space between piston 112 and cylinder head 115. The passageways mentioned above enable the hydraulic fluid under pressure to move the piston 112 outwardly and to exert a longitudinal compressive force against the packing 127a in addition to the compressive force of springs 129 to make the packing self-sealing at a high fluid pressure. However, when the pressure is very low and the piston is just beginning to move with respect to the cylinder, the springs 129 will provide an initial pressure on the packing to keep the hydraulic fluid from seeping out. The multiple springs 129 apply an even pressure around the entire circumference of the packing. Hence, the friction exerted by the packing varies with the hydraulic pressure. Low friction exists at low pressure when the parts are just beginning their relative movement. If the springs 129 had to be strong enough to exert by themselves sufficient pressure at all times to prevent leaks at high hydraulic pressure, the starting

load friction would be exceedingly high. The present construction cures this last difficulty.

When the pressure builds up to a point where it overcomes the resistance of the load on block 114, the piston rod 113 and piston 112 begin to move outwardly until the stop shoulder 119 contacts the stop ring 124. Then, the piston 112 has reached the full limit of its stroke.

While we have shown and described a single acting cylinder arrangement as an exemplification of the invention in one actual embodiment, it is obvious that the principles of our invention can also be applied in a double acting piston construction.

This invention also contemplates that one or more of the various retainer rings, mentioned herein, may be either solid rings or split rings, whichever is desired.

Various changes in details and arrangement of parts can be made by one skilled in the art without departing from the spirit of this invention or the scope of the appended claims.

What we claim is:

1. An expansible chamber motor having a cylinder and having a piston and piston rod reciprocable longitudinally therein, there being an annular space between said cylinder and said piston rod, the inner cylinder wall being provided with an annular groove, a stop ring seated in said groove, said stop ring having a bore spaced from but surrounding said piston rod, resilient packing means inserted longitudinally outside of and spaced longitudinally from said stop ring and sealing said annular space around said rod, resilient means adjacent said cylinder wall and resiliently exerting longitudinal pressure between said stop ring and said packing, means carried by one end of said resilient means abutting against said stop ring and engaging the bore of said stop ring for locking it in said groove, and means on said cylinder for retaining said packing under the compressive effect of said resilient means.

2. An expansible chamber motor having a cylinder and having a piston and piston rod reciprocable longitudinally therein, there being an annular space between said cylinder and said piston rod, the inner cylinder wall being provided with an annular groove, a stop ring seated in said groove, said stop ring having a bore spaced from but surrounding said piston rod, resilient packing means inserted longitudinally outside of and spaced longitudinally from said stop ring and sealing said annular space around said rod, a helical compression spring adjacent said cylinder wall and resiliently exerting longitudinal pressure between said stop ring and said packing, means on said cylinder for retaining said packing under the compressive effect of said spring, and a spring aligning ring between one end of said spring and said stop ring and having a cylindrical projection engaging said stop ring bore, whereby said stop ring is locked in said groove by the pressure of said spring.

3. An expansible chamber motor having a cylinder and having a piston and piston rod reciprocable longitudinally therein, there being an annular space between said cylinder and said piston rod, the inner cylinder wall being provided with a pair of longitudinally spaced annular grooves, an inner stop ring seated in the inner one of said grooves, resilient packing means inserted longitudinally outside of and spaced longitudinally from said inner stop ring and sealing said annular space around said rod, resilient means adjacent said cylinder wall and resiliently

exerting longitudinal pressure between said inner stop ring and said packing, and an outer stop ring seated in the outer one of said grooves whereby to retain said packing under the compressive effect of said resilient means, and whereby said packing and said resilient means may be readily inserted or removed while said outer stop ring is removed from said outer groove.

4. An expansible chamber motor having a cylinder and having a piston and piston rod mounted for reciprocable longitudinal movement therein, said cylinder having a cylindrical inner wall from end to end for mounting said piston and having a closed head at one end, said cylinder being open at the piston rod end thereof, there being an annular space between said cylinder and said piston rod, the inner cylinder wall being provided with a pair of longitudinally spaced annular grooves at said piston rod end, an inner stop ring seated in the inner one of said grooves, resilient packing means inserted longitudinally outside of and spaced longitudinally from said inner stop ring and sealing said annular space around said rod, resilient means adjacent said cylinder wall and resiliently exerting longitudinal pressure between said inner stop ring and said packing, an outer stop ring seated in the outer one of said grooves whereby to retain said packing under the compressive effect of said resilient means, said resilient means and inner stop ring being spaced from said piston rod to form a passageway through said annular space to said packing, a passageway in said piston connecting in fluid communication said annular space on one side of said piston with said closed end, and passageway means in said cylinder for the admission of pressure fluid into said annular space and through said passageways for moving said piston and piston rod and for exerting longitudinal pressure against said packing in addition to said resilient means.

5. An expansible chamber motor having a cylinder and having a piston and piston rod reciprocable longitudinally therein, there being an annular space between said cylinder and said piston rod, the inner cylinder wall being provided with a pair of longitudinally spaced annular grooves, an inner stop ring seated in the inner one of said grooves, resilient packing means inserted longitudinally outside of and spaced longitudinally from said inner stop ring and sealing said annular space around said rod, resilient means adjacent said cylinder wall and resiliently exerting longitudinal pressure between said inner stop ring and said packing, an outer stop ring seated in the outer one of said grooves and having a bore spaced from said piston rod whereby to retain said packing under the compressive effect of said resilient means, and a retainer ring having a periphery telescopically engaging said inner cylinder wall and having a projection telescopically engaging said outer stop ring bore for preventing disengagement of said outer stop ring from its associated groove whereby said packing and said resilient means may be readily inserted or removed while said outer stop ring and retainer ring are removed.

6. An expansible chamber motor having a cylinder and having a piston and piston rod reciprocable longitudinally therein, there being an annular space between said cylinder and said piston rod, the inner cylinder wall being provided with a pair of longitudinally spaced annular grooves, an inner stop ring seated in the inner one of said grooves, resilient packing means in-

serted longitudinally outside of and spaced longitudinally from said inner stop ring and sealing said annular space around said rod, resilient means adjacent said cylinder wall and resiliently exerting longitudinal pressure between said inner stop ring and said packing, an outer stop ring seated in the outer one of said grooves whereby to retain said packing under the compressive effect of said resilient means, and a wiper member mounted in said cylinder in concentric relationship with said inner cylinder wall and piston rod.

7. An expansible chamber motor comprising a cylinder, a piston reciprocably movable in said cylinder, means for admitting pressure fluid power to said cylinder rearwardly of said piston, a rod attached to said piston and extending out of said cylinder forwardly of said piston, a pair of spaced ring grooves extending transversely around the inner surface of said cylinder forwardly of said piston, a stop ring seated in each said groove and having a portion thereof extending inwardly into said cylinder around but out of contact with said rod, annular packing means between said cylinder and said rod and having one end thereof abutting one said stop ring, and helical spring means compressibly disposed between said packing and the stop ring nearest said piston whereby to maintain constant compression on said packing, the stop ring nearest said piston serving as a forward stop to limit forward movement of said piston.

8. An expansible chamber motor adapted for operation by hydraulic power and provided with a plurality of telescoping cylinders comprising an outer cylinder formed from seamless metal tubing and having a true cylindrical inner wall surface and an inner cylinder having a true cylindrical outer wall surface and being advanceable and retractable within said outer cylinder, a discoidal cylinder head abutting the end of and secured to said outer cylinder, said head having a rabbeted groove around its periphery providing a true cylindrical annular shoulder fitting said true cylindrical wall surface of said outer cylinder, said outer cylinder being open at its end remote from said cylinder head, said outer cylinder being provided near its open end with a pair of longitudinally spaced annular grooves, a stop ring seated in each groove and having a portion thereof projecting into the cylinder, compressible packing material between said pair of stop rings of said outer cylinder, helical compression spring means between said pair of stop rings and effective upon said packing whereby to maintain constant compressive force thereon, said inner cylinder being provided with an outwardly extending annular flange adapted to abut the inner surface of the inner stop ring in the outer cylinder to limit outward movement of said inner cylinder, said outer cylinder being provided with passage means for the admission of pressure fluid between said outer and inner cylinders, and a spring seat ring abutting said inner stop ring, said annular flange having an opening therethrough to admit pressure fluid between said flange or inner cylinder and said cylinder head.

9. An expansible chamber motor having a cylinder and having a piston and piston rod reciprocable longitudinally therein, there being an annular space between said cylinder and said piston rod, the inner cylinder wall being provided with a pair of longitudinally spaced annular grooves, an inner stop ring seated in the inner one of said grooves, resilient packing means in-

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served longitudinally outside of and spaced longitudinally from said inner stop ring and sealing said annular space around said rod, a helical compression spring surrounding and concentric with said piston rod and resiliently exerting longitudinal pressure between said inner stop ring and said packing, and an outer stop ring seated in the outer one of said grooves whereby to retain said packing under the compressive effect of said spring, and whereby said packing and said spring may be readily inserted or removed while said outer stop ring is removed from said outer groove.

10. An expansible chamber motor having a cylinder and having a piston and piston rod reciprocable longitudinally therein, there being an annular space between said cylinder and said piston rod, the inner cylinder wall being provided with a pair of longitudinally spaced annular grooves, an inner stop ring seated in the inner one of said grooves, resilient packing means inserted longitudinally outside of and spaced longitudinally from said inner stop ring and sealing said annular space around said rod, a spring seating ring surrounding said piston rod between said inner stop ring and said packing and bearing against said inner stop ring, said seating ring having a plurality of spaced longitudinally extending apertures on one face thereof facing said packing, a plurality of helical compression springs, one spring in each aperture resiliently exerting longitudinal pressure between said inner stop ring and said packing, and an outer stop ring seated in the outer one of said grooves whereby to retain said packing under the compressive effect of said springs, and whereby said packing and said springs may be readily inserted or removed while said outer stop ring is removed from said outer groove.

11. An expansible chamber motor having a cylinder and having a piston and piston rod reciprocable longitudinally therein, there being an annular space between said cylinder and said piston rod, the inner cylinder wall being provided with a pair of longitudinally spaced annular grooves, an inner stop ring seated in the inner one of said grooves, resilient packing means removably inserted longitudinally outside of and spaced longitudinally from said inner stop ring and sealing said annular space around said rod, removable resilient means adjacent said cylinder wall and resiliently exerting longitudinal pressure between said inner stop ring and said packing, an outer stop ring removably seated in the outer one of said grooves and having a bore spaced from said piston rod whereby to retain said packing under the compressive effect of said resilient means, a removable retainer ring having a periphery telescopically engaging removably said inner cylinder wall and having a projection telescopically engaging said outer stop ring bore for preventing disengagement of said outer stop ring from its associated groove, a wiper member removably mounted in said cylinder including a resilient wiping material ring having a portion secured in the wiper member and having another portion engaging said piston rod to serve as a wiper, and resilient means urging said last-mentioned portion into engagement with said piston rod, whereby said packing and said resilient means may be readily inserted or removed while said outer stop ring and wiper member and retainer ring are removed.

12. An expansible chamber motor having a cylinder and having a piston and piston rod re-

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ciprocable longitudinally therein, there being an annular space between said cylinder and said piston rod, the inner cylinder wall being provided with a pair of longitudinally spaced annular grooves, an inner stop ring seated in the inner one of said grooves, resilient packing means removably inserted longitudinally outside of and spaced longitudinally from said inner stop ring and sealing said annular space around said rod, removable resilient means adjacent said cylinder wall and resiliently exerting longitudinal pressure between said inner stop ring and said packing, an outer stop ring removably seated in the outer one of said grooves whereby to retain said packing under the compressive effect of said resilient means, and a removable wiper member mounted in said cylinder in concentric relationship with said inner cylinder wall and piston rod, said wiper member including a retaining sleeve having a peripheral portion telescopically mounted in said cylinder in concentric relationship with said inner cylinder wall and including a ring of resilient wiping material within said peripheral portion and including spaced supporting members projecting inwardly from said sleeve and located on each side of said resilient wiping ring, said resilient wiping material ring having a bore resiliently engaging and concentric with said piston rod, whereby said packing and said resilient means may be readily inserted or removed while said outer stop ring and wiper member are removed from said cylinder.

13. A double extension expansible chamber motor adapted for operation by hydraulic power, and provided with an outer cylinder formed from seamless metal tubing and having a true cylindrical inner wall surface, an intermediate cylinder telescopically advanceable and retractable within said outer cylinder, said intermediate cylinder likewise being formed from seamless metal tubing and having true cylindrical outer and inner wall surfaces, a piston and rod assembly telescopically advanceable and retractable within said intermediate cylinder, a discoidal cylinder head abutting the end of and secured to said outer cylinder, said head having a rabbeted groove around its periphery providing a true cylindrical annular shoulder fitting said true cylindrical wall surface of said outer cylinder, said piston rod being formed from seamless metal tubing and having an end portion extending outwardly from said intermediate cylinder at the end remote from the cylinder head, said outer cylinder and said intermediate cylinder being open at their ends remote from said cylinder head, each said cylinder being provided near its open end with a pair of longitudinally spaced annular grooves, a stop ring seated in each groove and having a portion thereof projecting into the cylinder, compressible packing material between said pair of stop rings of said outer cylinder, compressible packing material and an annular cylinder head between said stop rings of said intermediate cylinder, and resilient means likewise between each pair of stop rings and effective upon said packing whereby to maintain constant compressive force thereon.

14. An expansible chamber motor structure as defined in claim 13 wherein said intermediate cylinder is provided with an outwardly extending annular flange adapted to abut the inner surface of the inner stop ring in the outer cylinder to limit outward movement of said intermediate cylinder, and wherein said piston is adapted to abut the inner surface of the inner stop ring in

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the intermediate cylinder to limit outward movement of said piston.

15. An expansible chamber motor structure as defined in claim 14 wherein passage means is provided in said outer cylinder for the admission of pressure fluid between said outer and intermediate cylinders and inside said intermediate cylinder between said cylinder head and piston, there being a resilient means seating ring abutting said inner stop ring of said intermediate cylinder, and there being an opening provided through said piston between said rod and said intermediate cylinder and another opening through said resilient means seating ring to limit pressure fluid against said annular cylinder head.

16. An expansible chamber motor having a cylinder and having a piston and piston rod reciprocable longitudinally therein, there being an annular space between said cylinder and said piston rod, the inner cylinder wall being provided with an annular groove, a stop ring seated in said groove, said stop ring having a bore spaced from but surrounding said piston rod, resilient packing means inserted longitudinally outside of and spaced longitudinally from said stop ring and sealing said annular space around said rod, resilient means adjacent said cylinder wall and resiliently exerting longitudinal pressure between said stop ring and said packing, means carried by one end of said spring abutting against said stop ring for locking it in said groove, and means on said cylinder for retaining said packing under the compressive effect of said resilient means.

17. A cylinder for an expansible chamber motor having a piston and piston rod reciprocable longitudinally therein, there being an annular space between said cylinder and said piston rod, the inner cylinder wall being provided with a pair of longitudinally spaced annular grooves, an inner

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snap ring seated in the inner one of said grooves, resilient packing means removably inserted longitudinally outside of and spaced longitudinally from said inner snap ring and sealing said annular space around said rod, removable resilient means adjacent said cylinder wall and resiliently exerting longitudinal pressure between said inner snap ring and said packing, an outer snap ring removably seated in the outer one of said grooves and having a bore spaced from said piston rod whereby to retain said packing under the compressive effect of said resilient means, a removable retainer ring having a periphery telescopically engaging said inner cylinder wall and having a projection telescopically engaging said outer snap ring bore for preventing disengagement of said outer snap ring from its associated groove, and a wiper member engageable with said retainer ring and telescopically engaging removably said inner cylinder wall, whereby said packing and said resilient means may be readily inserted or removed while said outer snap ring, wiper ring, and retainer ring are removed.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
1,690,037	Pedersen	Oct. 30, 1928
2,145,384	Allin	Jan. 31, 1939
2,204,365	Klemm	June 11, 1940
2,231,242	Barrett	Feb. 11, 1941
2,334,396	Dorward	Nov. 16, 1943
2,471,989	Weaver	May 31, 1949

FOREIGN PATENTS

Number	Country	Date
122,141	Switzerland	Sept. 1, 1927