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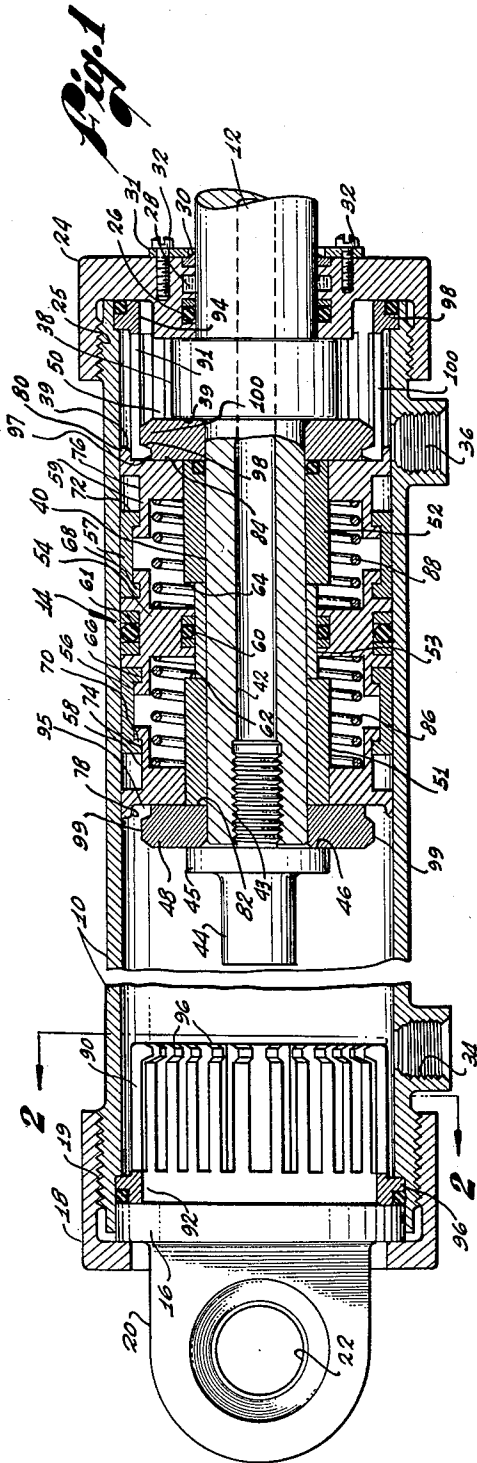
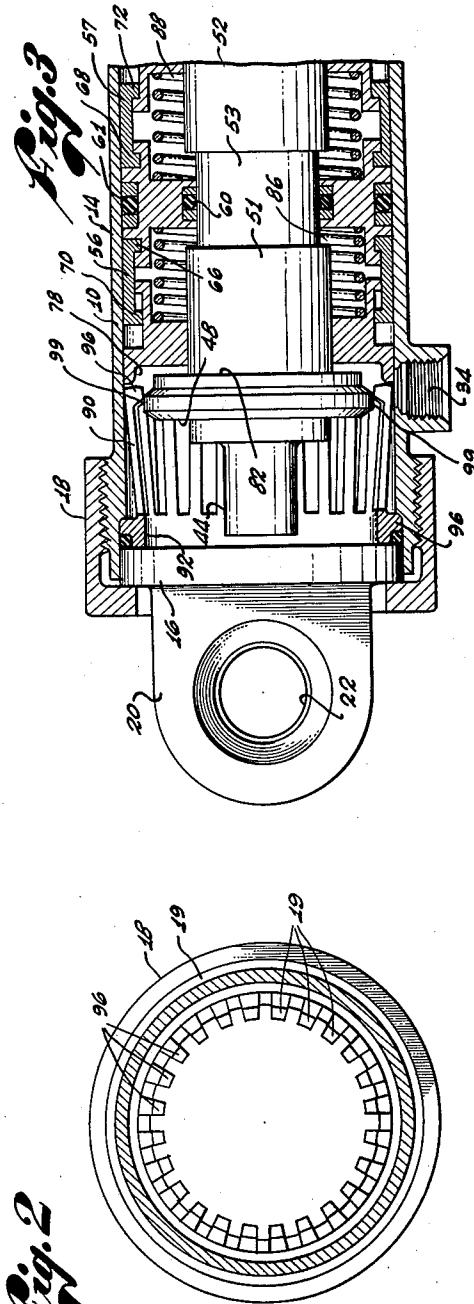
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3,072,105

LOCK FOR FLUID PRESSURE ACTUATOR

Filed July 5, 1961

2 Sheets-Sheet 1



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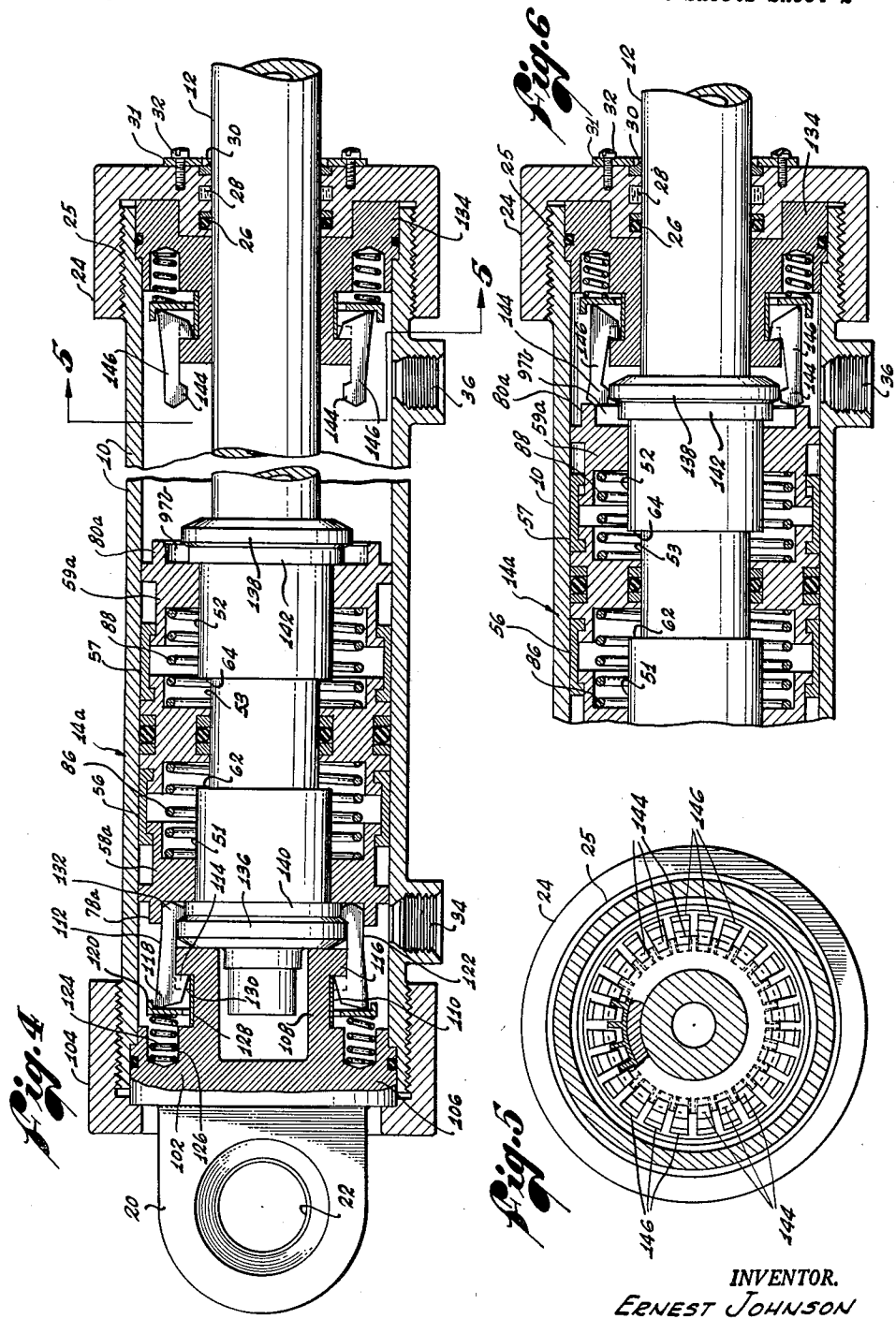
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2 Sheets-Sheet 2



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3,072,105

LOCK FOR FLUID PRESSURE ACTUATOR

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14 Claims. (Cl. 121-40)

This invention relates to extensible and retractable actuators of the hydraulic ram or jack type for applying operating force and movement to mechanisms, and more particularly, relates to improved means for automatically locking the piston or piston rods of such actuators against retrograde movement at the end of their travels in the cylinder until positively released by action of the actuating fluid pressure applied for movement in an opposite direction.

Heretofore, numerous actuator devices of the extensible and retractable ram or jack type have been known and used which, in general, combine with a cylinder and a fluid pressure actuated piston or plunger therein, some kind of lock or latch mechanism, sometimes actuated by the applied operating fluid pressure, adapted to engage the piston or piston rod at the limit of its travel in the cylinder to lock it mechanically against reverse movement until positively driven in reverse by the operating fluid.

However, in most such locking or latching devices heretofore known, when the operating fluid pressure is applied to the actuator cylinder, a substantial force is thereby immediately built up which acts against the piston or plunger in advance of its release which results momentarily in a relatively heavy loading which must be borne by the latch mechanism just prior to and during its release. This effect is undesirable because it serves no useful purpose in the operation of the actuator and imposes design conditions upon such latching mechanisms which are difficult to meet. For example, for certain applications of the actuator device, under the before-described conditions, the latching mechanism must be either impracticably large and heavy in order to have the required strength, durability, and reliability to withstand the initial loading imposed on it prior to its release, or it will be susceptible to excessive wear or even complete failure of the latching mechanism to function.

It is, therefore, an object of this invention to provide, in connection with a fluid actuated ram or jack type actuator device employing a cylinder and a fluid pressure actuated piston or piston rod therein, a locking mechanism which automatically locks the piston or piston rod positively against movement at the end of its travel, and which under the influence of operating fluid pressure applied for movement of the piston or rod in the opposite direction, automatically unlocks and releases such piston or piston rod for such movement prior to the build-up by the fluid pressure of substantial force against the piston or piston rod.

It is a further object of this invention to provide a piston or piston rod latching mechanism which, while normally keeping the piston or piston rod positively locked against movement in its cylinder, responds to the pressure of the operating fluid applied to the cylinder first to free the piston or piston rod for movement therein in response to such fluid pressure, prior to the occurrence of any movement thereof which would result in application of forces to the lock mechanism.

It is a still further object of this invention to provide a locking mechanism for the aforesaid purpose which has improved strength and operating characteristics.

The objects are attained in accordance with the broadest aspects of the present invention by an actuator em-

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ploying a cylinder and an operating piston and piston rod assembly reciprocable in such cylinder which permits limited free axial movement of such piston relative to the piston rod upon application of operating fluid pressure thereto, such limited axial movement of the piston relative to the piston rod in response to applied fluid pressure in one direction serving to actuate a locking mechanism to lock the piston rod against retrograde movement at the end of its travel, and movement of the piston relative to the piston rod in response to applied fluid pressure in an opposite direction serving to actuate the locking mechanism to unlock the piston rod for return movement in the cylinder. Thus, no preloading of the lock mechanism can occur by reason of fluid pressure applied against the piston because the piston is always free of opposition to movement and transfers no moving force to the piston rod until after the locking mechanism is released.

These and other objects, advantages and features of novelty will be evident hereinafter.

In the accompanying drawings, wherein, in connection with the following description, the best mode and preferred embodiment presently contemplated by the inventor for carrying out the invention is illustrated:

FIGURE 1 is a side view, partly in longitudinal section and partly in elevation, of a fluid pressure operated actuator device, embodying the present invention;

FIGURE 2 is a cross-sectional view taken on line 2-2 of FIGURE 1;

FIGURE 3 is a fragmentary longitudinal sectional view of a portion of the apparatus of FIGURE 1, illustrating the action of the locking mechanism as the piston approaches one end of its travel;

FIGURE 4 is a side view, partly in longitudinal section and partly in elevation, of a modified form of the fluid operated actuator device of the present invention;

FIGURE 5 is a cross-sectional view taken on line 5-5 of FIGURE 4; and

FIGURE 6 is a fragmentary longitudinal sectional view of a portion of the apparatus of FIGURE 4, illustrating the action of the locking mechanism as the piston approaches one end of its travel.

Referring first primarily to FIGURES 1, 2 and 3, wherein similar reference characters designate the same or similar parts throughout the several views, 10 is the cylinder of a fluid pressure operated actuator within which there extends an axially reciprocable piston rod 12 carrying adjacent its inner end within the cylinder 10 an axially reciprocable piston assembly indicated generally at 14. The elements of the piston assembly 14 are carried adjacent the inner end of the piston rod in such manner as to have freedom for limited axial sliding movement relative to the piston rod, as will be described hereinafter.

The head end of the cylinder 10 is closed by a cylinder head 16 which is held in sealing engagement with the end of the cylinder by an annular nut 18 threaded to the end of the cylinder at 10. The cylinder head 16 is provided with an integral end connector lug 20 containing a bearing 22, by means of which the cylinder 10 may be pivotally supported by any structure or mechanical element relative to which movement of some other mechanical element is desired. The piston rod end of the cylinder 10 is similarly closed by an annular closure member 24 threaded at 25 to the end of the cylinder 10. The bore of the closure member 24 through which the piston rod 12 slidably enters the cylinder 10 is provided with a suitable sealing gland assembly which includes an inner O ring seal 26, an intermediate felt ring 28, and an outer scraper ring 30. The scraper ring 30 is retained by an annular retainer ring 31 which is fastened to the outer end of the closure member 24 by means of

a plurality of screws 32. The piston rod 12 may be provided with the usual type of rod end connector, not shown, for connection to other mechanical element to be moved relative to the actuator cylinder 10. The cylinder 10 is provided, adjacent opposite ends thereof, with threaded ports 34 and 36 to which suitable piping connections may be made for the introduction into, or the discharge from opposite ends of the cylinder, of pressure fluid for powering the actuator.

The inner end of the piston rod 12 upon which the before-mentioned piston assembly 14 is carried is formed with a short section 38 of increased diameter, and extending inwardly thereof is an integral section 40 of reduced diameter, the juncture of such sections 38 and 40 of the piston rod forming an inwardly-facing annular shoulder 39. The piston rod 12 has a bore 42 which is provided adjacent the inner extension end thereof with internal threads 43 into which is threaded a stop nut 44 having an integral flanged portion 45 forming an outwardly-facing annular shoulder 46, positioned coaxially opposite the aforementioned inwardly-facing annular shoulder 39. Secured coaxially on the extension section 40 of the piston rod 12 between the aforesaid oppositely facing shoulders 39 and 46 is a piston supporting and retaining assembly comprising a pair of annular latch flanges 48 and 50 positioned in abutment with the annular shoulders 39 and 46 respectively, next adjacent thereto, a pair of coaxial spacer sleeves 51 and 52, and intermediate the spacer sleeves 51 and 52, an intermediate piston-supporting sleeve 53 of reduced outside diameter relative to the spacer sleeves.

The before-mentioned piston assembly 14, which is carried on the before-described piston supporting assembly, is made up of a number of coaxially arranged, axially slidable annular elements comprising a centrally located, annular, floating piston 54, a pair of intermediate channel sectioned connector rings 56 and 57, and a pair of outer, oppositely positioned end lock-ring members 58 and 59. The central, floating piston 54 is slidable axially on the sleeve 56 between end limits formed by the oppositely, inwardly-facing shoulders 62 and 64 formed at the inner ends of spacer sleeves 51 and 52, respectively, and is provided with inner and outer O ring seals 60 and 61 which make sliding, fluid sealing engagement respectively with the outer cylindrical surface of the sleeve 56 and the inner cylindrical surface of the cylinder 10. Coupled with and longitudinally slidable together with the floating piston 54 are the before-mentioned connector rings 56 and 57, and these connector rings are constructed in split or segmental form, not shown, so that they may be readily coupled at 66 and 68 with the piston 54 to be moved longitudinally therewith as a unit.

The outer, inwardly-flanged end portions 70 and 72 of the connector rings 56 and 57 make longitudinally slidable, lost motion, coupling engagement with outwardly-facing annular grooves 74 and 76 of the lock-ring members 58 and 59, respectively. Each of the annular lock-ring members 58 and 59 are provided with oppositely, axially extending annular lock rings, as shown at 78 and 80, adapted to make encircling, locking engagement with the head ends of locking fingers as hereinafter more fully described.

The two oppositely located lock-ring members 58 and 59 are urged axially outward in opposite directions toward limiting abutment with the inner-facing, annular surfaces of the latch flanges 48 and 50, respectively, and at the same time, the central, floating piston 54 is normally urged into a central location, as shown in FIGURE 1, by a pair of coil springs 86 and 88 acting oppositely under compression. Thus, in operation as hereinafter described, the floating piston 54 and lock-ring members 58 and 59 are each, within limits, independently slidable axially relative to each other and relative to the piston rod.

Retained in opposite ends of the cylinder 10 are a plurality of longitudinally directed, circumferentially spaced apart spring latching fingers 90 and 91 connected integrally at their root ends with ring members 92 and 94 respectively, which ring members are in turn retained in annular grooves 96 and 98 formed in the ends of cylinder 10, under the annular nut 18 and annular closure member 24, respectively. The outer end of each spring latch finger is provided with a radially inwardly extending, endwise chamfered head, as shown at 96 and 98, adapted to make latching engagement with the annular, chamfered grooves 95 and 97, respectively, formed between outer beads 99 and 100 on the peripheries of the latch flanges 48 and 50, and the outer axially-facing annular surfaces of the lock-ring members 58 and 59.

The operation of the apparatus of FIGURES 1, 2 and 3 is as follows:

Starting first with the piston rod 12 and piston assembly 14 in the positions shown in FIGURE 1, wherein the piston rod 12 is in the extreme right-hand end of its stroke in the cylinder 10, it will be seen that the heads 98 of the spring latch fingers 91 are positioned in engagement with the annular groove formed behind the bead 100 extending around the periphery of the latch flange 50 and the heads of these fingers are locked in such position by the superposed lock rim 80 of the lock ring member 58, the lock rim 80 thus preventing radial outward escape of the heads 98 from the groove which otherwise would occur by outward flexing of the finger 91. In this latter condition, the piston rod 12 is mechanically locked against axial movement relative to the cylinder 10, which might otherwise result from external forces applied to the piston rod.

To move the piston rod 12 from the before-described locked position, fluid pressure is introduced through port 36 to the right-hand end of the cylinder 10, and at the same time, the fluid pressure in the left-hand end of the cylinder 10 is reduced or released through port 34, resulting in a pressure differential between the fluid pressure in the right-hand and left-hand ends of the cylinder tending to force the piston assembly 14 to move to the left in the cylinder 10. However, before this differential pressure can result in any force being applied from the piston to the piston rod 12 or to any of the latching fingers 81, such differential pressure first acts on the central floating piston 54, causing it to slide to the left on sleeve 53 against the compressive force of the coil spring 86 until it is stopped by abutment with the annular shoulder 62 of the spacer sleeve 51. This axial motion of the piston 54 is transmitted through the connector ring 57 to the lock-ring member 59, resulting in withdrawal of the lock rim 80 thereof from encirclement of the tops of the heads 98 of the locking fingers 91 thereby freeing the heads 98 and the locking fingers to flex outwardly.

The fluid pressure differential then being effective on the piston 54 after moving it into abutment with the annular shoulder 62 then urges the piston rod and the piston assembly axially toward the left in the cylinder as viewed in FIGURE 1. The initial resultant left hand motion of the piston supporting assembly including the latch flange 50, by reason of the chamfer on the bead 100 of the latch flange and the corresponding chamfer on the heads 98 of the fingers 91 causes the heads to cam radially outwardly, out of the groove 97. The latch fingers 91 are thus caused automatically to release the piston and piston rod for axial movement from the initial position shown in FIGURE 1 toward the left in the cylinder whenever fluid pressure is introduced through port 36, and released through port 34.

When the piston rod 12 and piston assembly 14 is moving toward the left from the position shown in FIGURE 1 reaches the position shown in FIGURE 3, the chamfered outer end surface of the bead 99 of the lock ring flange 48 first encounters the outer ends of the head

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96 of the latching fingers 90, causing these fingers to be cammed radially outwardly, and thereby causing the outer ends of the heads 96 to move outwardly into position whereby the end edge of the locking rim 78 of the locking ring 58 is brought into endwise abutment therewith, as shown in FIGURE 3. Continued left-hand movement of the piston rod and piston assembly then results in the locking-ring member 58 and rim 78 being held stationary by the locking fingers while the latch flange 48 continues to move in a left-hand direction a distance sufficient to permit the heads 96 of the latch fingers 90 to drop into the annular groove 95 formed between the chamfered bead 99 and the adjacent annular surface of the lock-ring member 58, after which the lock-ring member 58 acting under the force of the coil spring 86 is restored to position in abutment with the annular shoulder 82 of the latch flange 48, thereby bringing the lock rim 78 into a position encircling and locking the heads 96 of the latching fingers 90 in the groove 95, thus firmly locking the piston supporting assembly and piston rod against any retrograde movement to the right in the cylinder.

When it is desired to again move the piston rod in a return direction to the right in the cylinder 10, the reverse of the before-described operation is performed.

The apparatus of the alternative construction shown in FIGURES 4, 5 and 6 is as follows:

In the construction illustrated in FIGURES 4, 5 and 6, the construction is similar to that previously described in connection with FIGURES 1, 2 and 3, except mainly that a modified form of latching fingers and mechanism for actuating them is shown which has the advantages of having somewhat stronger and more reliable locking action. In this latter construction, the head end of the cylinder 10 is closed by a cylinder head 102 which is held in fluid-tight sealing engagement with the end of the cylinder by an annular retainer nut 104, threaded to the end of the cylinder at 10. The cylinder head 102 is provided with an integral, external end connector lug 20 containing a bearing 22 by means of which the cylinder 10 may be pivotally supported by any supporting structure or mechanical element relative to which movement of some other mechanical element, by the actuator, is desired. The cylinder head 102 differs from that hereinbefore described in that it has a coaxially, inwardly-extending body portion 106 which terminates in a coaxial, cylindrical hub 108 of reduced diameter in which a radially outwardly facing annular groove 110 is formed. Retained circumferentially spaced-apart around the hub 108 are a plurality of longitudinally extending, circumferentially spaced-apart latching fingers 112. Each of the latching fingers 112 is formed, adjacent one end thereof, with a laterally extending hook-shaped projection as shown at 114, which is positioned such as to extend radially inwardly into the before-mentioned annular groove 110 and make retaining abutment with the annular shoulder 116, forming the innermost, rearwardly facing side of the annular groove 110. Each of the latching fingers 112 is also formed as a part of the before-mentioned hook-shaped projection with an end surface which slopes laterally inwardly such as to form, in effect, an endwise projection, as shown at 118, positioned to make contact with the radially extending surface of an annular retainer ring 120. The point of such contact between the projection 118 is radially off-set with respect to the area of contact between the latching finger hook 114 and the abutting annular shoulder 116 whereby axial force exerted by the retainer ring 120 against the projection 118 will set up couples tending to rotate the latching fingers 112 in the direction indicated by the arrows 122.

The retainer ring 120 is urged axially against the projection 118 of the latching fingers 112 by means of a plurality of coil springs 124 acting in compression, each of such springs being nested in longitudinal, circumfer-

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entially spaced-apart drill holes 126 in the cylindrical body portion 106 of the cylinder head 102.

Lying in the bottom of the annular groove 110 is a split ring 128 carrying integral therewith a plurality of circumferentially spaced-apart radially outwardly-extending separator elements 130, each such separator element 130 being positioned between and serving to equally circumferentially space apart the plurality of latching fingers 112.

The ends of each of the latching fingers 112 are formed, opposite the attachment ends thereof, with radially inwardly extending latching heads 132 which are similar in shape and function to the heads 96 hereinbefore described in connection with the latching fingers 90 of FIGURE 1.

The piston rod end of the cylinder 10 is provided with an end closure 24, which is similar to that described hereinbefore in connection with FIGURE 1, which is threaded at 25 to the rod end of cylinder 10. The closure member 24 is formed with a bore therein through which the piston rod 12 slidably enters the cylinder and which is provided with a sealing gland assembly including an inner O ring seal 26, an intermediate felt ring 28, and an outer scraper ring 30. The scraper ring 30, as before described, is retained by an annular retainer ring 31 which is fastened to the outer end of the closure member 24 by means of a plurality of screws 32. Retained in the piston end of the cylinder 10 by the closure 24 is a cylindrical body 134 which in all respects, internally of the cylinder, has the same shape and provisions as the hereinbefore-described body portion 106 in the head end of the cylinder, except that, for convenience of construction, it is not made an integral part of the closure 24. This body member 134 carries a latching finger supporting hub and latching finger assembly which is identical to that hereinbefore described for the body portion 106 of the head end of the cylinder.

The piston rod 12 carries, adjacent its inner end within the cylinder 10, a piston assembly indicated generally at 14a, which is identical to the piston assembly 14 heretofore described in connection with FIGURE 1, except for the specific form of the annular lock rims 78a and 80a, which serve to encircle and lock the heads 132 and 144 of the latching fingers 112 and 14b in the annular grooves 95a and 97a formed behind beads 136 and 138 of the annular latch flanges 140 and 142, respectively.

The operation of the apparatus of FIGURES 4, 5 and 6 is as follows:

Starting first with the piston rod 12 and the piston assembly 14a in the position shown in FIGURE 4, wherein the piston rod 12 is at the extreme left-hand end of its travel in the cylinder 10, it will be apparent that the heads 132 of the latching fingers 112 are positioned in engagement with the annular groove 95a formed behind the chamfered bead 136, extending around the periphery of the latch flange 140, and are locked in such engagement by the encircling lock rim 78a of the lock-ring member 58a. The lock rim 78a thus prevents radially outward escape of the heads 132 from the groove 95a. In this latter condition, the piston rod 12 is mechanically locked against axial movement in the cylinder 10, which might otherwise result from external forces applied to the piston rod tending to move or displace it axially in the cylinder.

Next, to move the piston rod 12 from the before-described locked position, fluid pressure may be introduced through port 34 to the left-hand end of the cylinder 10, and at the same time, the fluid pressure in the right-hand end of the cylinder 10 may be reduced or released through port 36, thereby producing a pressure differential across the piston between the left-hand and right-hand ends of the cylinder, tending to move the piston assembly 14 in a direction to the right in the cylinder 10, as viewed in FIGURE 4. However, before this differential pressure can result in any force being applied

to the piston rod 12 or to any of the latching fingers 112, such differential pressure first acts on the central floating piston 54, causing it to slide to the right on sleeve 53 against the compressive force of the coil spring 88 until it is stopped by abutment with the annular shoulder 64 of the spacer sleeve 52. This limited motion of the piston 54 is transmitted through the lost motion connector ring 56 to the lock-ring member 58a, resulting in equal sliding motion of the lock-ring member 58a to the right, while lock-ring 59a remains in stationary abutment with the annular end 84a of lock flange 142, thereby effecting withdrawal of the lock rim 78a from locking encirclement of the outer surfaces of the latching heads 132 of the locking fingers 112, thereby in turn freeing the heads 132 and locking fingers 112 to pivot radially outward. The fluid pressure differential thereafter applied to the piston 54, after it moves into abutment with the annular shoulder 64 of the sleeve 52, urges the piston rod and the piston rod assembly carried on the inner end thereof toward the right, as viewed in FIGURE 4, and the resultant initial right-hand motion of the piston supporting assembly including the latching flange 136, causes the chamfer on the bead 136 of the latching flange 140 to cam the heads 132 of the fingers 112 radially outward, out of latching engagement with the groove 95a formed behind the bead 136 of the latching flange 140. The latching fingers 112 are thus caused automatically to release the piston and piston rod for movement to the right from the initial position shown in FIGURE 4, and before any force can be transferred from the piston 54 to the piston rod and to the latching mechanism.

When the piston rod 12 and piston assembly 14a, in moving from the position shown in FIGURE 4 toward the right, reaches the position shown in FIGURE 6, the outer chamfered surface of the bead 138 of the locking flange 142 first encounters the beveled outer ends of the heads 144 of the locking fingers 146, camming these fingers pivotally outward in the direction indicated by the arrows 147, and thereby positioning the outer ends of the heads 144 where the annular end of the locking rim 80a is brought into endwise abutment therewith, as shown in FIGURE 6. During further right-hand movement of the piston assembly, the locking ring member 59a and rim 80a thereon are thereby held stationary while the latch flange 142 continues to move with the piston rod in a right-hand direction a distance sufficient to permit the heads 144 of the latching fingers 146 to drop into the annular groove 97a formed between the bead 138 and the adjacent annular surface of the lock ring member 59a, after which the lock ring 59a, acting under the force of the coil spring 88, is moved to a position in abutment with the annular shoulder 84a of the latch flange 142, thereby extending the latch rim 80a into a position encircling the heads 144 of the latching fingers 146, thereby locking the heads 144 in the aforesaid groove 97a and thereby restrain the piston supporting assembly and piston rod against any retrograde movement to the left in the cylinder.

When it is desired to again move the piston rod in a return direction to the left with respect to the before-described travel in the cylinder 10, the reverse of the before-described operation is performed.

From the before-described apparatus and mode of operation, it will be evident that a hydraulic actuator has been provided wherein the piston rod may be automatically and mechanically positively locked at either of its extreme or other predetermined positions within the cylinder. Consequently, if the piston rod has been moved to either of such positions within the cylinder and the source of fluid pressure supplied to the cylinder is cut off or fails, the piston will nevertheless remain positively locked mechanically in such position. Also, although the piston is mechanically positively locked at the ends of its predetermined travel within the piston, it is auto-

matically unlocked whenever fluid pressure is supplied to that end of the cylinder which will urge the piston toward the opposite end.

An important advantage of this invention is that the before-mentioned locking and unlocking operations are accomplished in accordance with this invention at times when the locking mechanism is free from forces resulting from fluid pressure introduced into either end of the actuator cylinder for its operation. Thus, the locking mechanisms of this invention are at all times free from any forces or stresses other than those which may be imposed upon them through the piston rod from external sources such as the mechanisms to which the actuator may be attached.

While as hereinbefore mentioned in connection with the description of this invention, it may be desirable to provide means to lock the piston rod at both ends of its travel in the cylinder, it will be understood that in certain applications of the actuator, such as for example where it is used simply as a lifting jack, only one locking mechanism need be employed in one end of the cylinder to positively hold the jack, piston and piston rod in extended or retracted position, as the case requires.

The foregoing is illustrative of the best mode and embodiment of the invention presently contemplated, and is not to be considered limiting. Variations may be made therein by those skilled in the art, and the invention shall include any and all such variations within the scope of the appended claims.

What is claimed is:

1. In combination: a cylinder; a piston and piston rod reciprocable axially in said cylinder, said piston being axially slidable within said cylinder and mounted on said rod with freedom for limited axial sliding movement relative thereto; means for admitting fluid pressure to an end of said cylinder to move the piston and thereby move the rod axially in said cylinder; latching means anchored in the cylinder, engageable with the rod when said rod is thus moved to a predetermined axial position in said cylinder, to hold said rod against axial movement relative to said cylinder; annular locking means coaxially mounted on said rod with freedom for limited axial sliding movement thereon relative to said piston and rod, for locking when in a first axial position relative to said rod, the latching means in such engagement with said rod; resilient means urging said locking means into said first position, and urging said piston into a predetermined axial position on said rod; and means responsive to axial sliding displacement of said piston from said predetermined position on said rod in opposition to said resilient means upon admission of fluid pressure to the other end of said cylinder, for moving the locking means into a second position relative to said rod effective to unlock said latching means from said engagement with the rod, thereby to release the piston and rod for axial movement in said cylinder by said fluid pressure.

2. In combination: a cylinder; a piston rod reciprocable axially in said cylinder and a piston mounted on said rod with freedom for axial movement between fixed limits thereon; latching means interengageable with said cylinder and said rod when said rod is moved to a certain axial position in said cylinder, to hold said rod against axial movement relative to said cylinder; locking means mounted on said rod with freedom for limited axial sliding movement thereon relative to said piston and rod, for locking when in a first axial position on said rod, the latching means in interengagement with said cylinder and rod and for unlocking such interengagement when in a second axial position on said rod; resilient means acting between said locking means and said rod, biasing said locking means to said first position; and coupling means interconnecting said piston and said locking means for moving said locking means axially, in response to axial movement of said piston in opposition to said resilient means, to a position on said rod effective to release said

interengagement, thereby to free the rod for axial movement in said cylinder.

3. In combination: a cylinder; a piston rod reciprocable axially in said cylinder, and a piston axially slidable within said cylinder and mounted on said rod with freedom for axial movement intermediate fixed limit means thereon; resilient means urging said piston to a predetermined axial position intermediate said limit means; latching means interengageable with said cylinder and said rod when said rod is moved to a predetermined axial position in said cylinder, to hold said rod against axial movement relative to said cylinder; locking means mounted on said rod adjacent said piston with freedom for limited axial sliding movement thereon relative to said piston and rod, for locking, when in a first axial position relative to said rod and said rod is in said predetermined axial position in said cylinder, the latching means in interengagement with said cylinder and rod, and for unlocking such interengagement when in a second axial position relative to said rod; and coupling means interconnecting said piston and said locking means for moving said locking means axially on said rod, in response to axial movement of said piston and in opposition to said resilient means, to a position on said rod effective to unlock said interengagement, thereby to free the rod for axial movement in said cylinder.

4. In combination: a cylinder; a piston rod reciprocable axially in said cylinder, and an annular piston axially slidable within said cylinder and mounted on said rod with freedom for axial movement intermediate fixed limit means thereon, said annular piston closing the annular space between said cylinder and said rod; resilient means urging said piston to a predetermined axial position intermediate said limit means; latching means interengageable with said cylinder and said rod when said rod is moved to a predetermined axial position in said cylinder, to hold said rod against axial movement relative to said cylinder; annular locking means mounted coaxially on said rod adjacent said piston with freedom for limited axial sliding movement thereon relative to said piston and rod, for locking, when in a first axial position relative to said rod and said rod is in said predetermined axial position in said cylinder, the latching means in interengagement with said cylinder and rod, and for unlocking such interengagement when in a second axial position relative to said rod; and coupling means interconnecting said piston and said locking means for moving said locking means axially on said rod, in response to axial movement of said piston and in opposition to said resilient means, to a position on said rod effective to unlock said interengagement, thereby to free the rod for axial movement in said cylinder.

5. In combination: a cylinder; a piston rod reciprocable axially in said cylinder, and an annular piston encircling said piston rod in axial sliding engagement with said cylinder and said rod, said annular piston having freedom for limited axial sliding movement on said rod; means for admitting fluid pressure to an end of said cylinder to move the piston on said rod to a limit of its freedom of movement thereon, and thereby move said rod axially in said cylinder; latching means anchored in the cylinder and engageable with means on said rod, when said rod is thus moved to a predetermined axial position in said cylinder, to hold said rod against axial movement relative to said cylinder; annular locking means coaxially encircling mounted on said piston rod with freedom for limited axial sliding movement thereon relative to said piston and said rod for locking when in a first axial position relative to said rod, the said latching means in such engagement with said means on the rod; resilient means urging said locking means into said first position and urging said piston into a predetermined axial position on said rod; and means responsive to axial sliding displacement of said piston on said rod in opposition to said resilient means, upon admission of fluid pressure to said end of said cylinder, for

moving the locking means into a second position relative to said rod, effective to unlock said latching means from engagement with said means on said rod, thereby to release the piston and rod for axial movement in said cylinder by said fluid pressure.

6. In combination: a cylinder; a piston rod reciprocable axially in said cylinder, and an annular piston encircling said piston rod in axial sliding engagement with said cylinder and said rod, said annular piston having freedom for limited axial sliding movement on said rod; means for admitting fluid pressure to an end of said cylinder to move the piston on said rod to a limit of its freedom of movement thereon and thereby move said rod axially in said cylinder; latching means anchored in the cylinder, and engageable with means on said rod, when said rod is thus moved to a predetermined axial position in said cylinder, to hold said rod against axial movement relative to said cylinder; annular locking means coaxially encircling mounted on said piston rod with freedom for limited axial sliding movement thereon relative to said piston and said rod for locking, when in a first axial position relative to said piston rod, the said latching means in such engagement with said means on the rod; resilient means urging said locking means into said first position and urging said piston into a predetermined axial position on said rod; and coaxial annular coupling means in slidable engagement with said cylinder interconnecting said annular locking means and said annular piston and responsive to axial sliding displacement of said piston on said rod in opposition to said resilient means, upon admission of fluid pressure to said end of said cylinder, for moving the locking means into a second position relative to said rod, effective to unlock said latching means from engagement with said means on said rod, thereby to release the piston and rod for axial movement in said cylinder by said fluid pressure.

7. In combination: a cylinder; a piston rod reciprocable axially in said cylinder, and a piston axially slidable within said cylinder and mounted on said rod with freedom for axial movement intermediate a pair of fixed limit means thereon; a pair of latching means, one or the other of which is interengageable with said cylinder and said rod when said rod is moved to one or another of two predetermined axial positions in said cylinder; a pair of axially spaced-apart locking means mounted on said rod with freedom for axial sliding movement thereon relative to said piston and said rod between said fixed limit means, one of said locking means being positioned adjacent one end of said piston and the other of said locking means being positioned adjacent the other end of said piston; resilient means acting axially between said locking means and urging said locking means axially apart relative to one another, each normally into abutment with one of said fixed limit means for locking, when in such position, one or the other of said latching means in interengagement with said cylinder and rod; telescopic lost-motion coupling means intermediate said piston and each of said locking means effective to restrain said piston to a predetermined axial position intermediate said locking means when both said locking means are in abutment with said limit means as aforesaid, and effective to move one or the other of said locking means away from abutment with one or the other of said limit means for unlocking said latching means from such interengagement, in response to axial displacement of said piston in one or the other direction from said predetermined position; and means for admitting fluid pressure to either end of said cylinder to move said piston in either direction in said cylinder and thereby move one or the other of said locking means to unlock the corresponding one of said latching means from interengagement with said cylinder and rod to free said rod for axial movement in said cylinder before forces are applied to said rod by said fluid pressure.

8. In combination: a cylinder; a piston rod reciprocable axially in said cylinder, and a piston axially slidable

within said cylinder and mounted on said rod with freedom for axial movement intermediate a pair of fixed limit means thereon; a pair of latching means, one or the other of which is interengageable with said cylinder and said rod when said rod is moved to one or another of two predetermined axial positions in said cylinder; a pair of axially spaced-apart locking means mounted on said rod with freedom for axial sliding movement thereon relative to said piston and said rod between said fixed limit means, one of said locking means being positioned adjacent one end of said piston and the other of said locking means being positioned adjacent the other end of said piston; resilient means acting axially between one of said locking means and said piston and between the other of said locking means and said piston and urging said locking means axially apart relative to one another, each normally into abutment with one of said fixed limit means for locking, when in such position, one or the other of said latching means in interengagement with said cylinder and rod; telescopic lost-motion coupling means intermediate said piston and each of said locking means effective to restrain said piston to a predetermined axial position intermediate said locking means when both said locking means are in abutment with said limit means as aforesaid, and effective to move one or the other of said locking means away from abutment with one or the other of said limit means for unlocking said latching means from such interengagement, in response to axial displacement of said piston in one or the other direction from said predetermined position; and means for admitting fluid pressure to either end of said cylinder to move said piston in either direction in said cylinder and thereby move one or the other of said locking means to unlock the corresponding one of said latching means for interengagement with said cylinder and rod to free said rod for axial movement in said cylinder before forces are applied to said rod by said fluid pressure.

9. In combination: a cylinder; a piston rod reciprocable in said cylinder, said piston rod having axially spaced-apart limit means fixed thereon within said cylinder; an annular piston axially slidable in said cylinder and mounted axially slidable on said rod intermediate said limit means; means for admitting fluid pressure to either end of said cylinder to move the piston and thereby move the rod axially in either direction in said cylinder; latching means anchored adjacent opposite end portions of said cylinder engageable with said rod when said rod is thus moved to opposite predetermined axial positions in said cylinder to hold said rod at either such position against axial movement relative to said cylinder; a first annular locking ring coaxially slidable on said rod between one of said limit means and one end of said piston; a second annular locking ring coaxially slidable on said rod between the other of said limit means and the other end of said piston; resilient means urging said locking rings axially apart and each normally into abutment with one of said stop means; coupling means interconnecting said piston independently to each of said locking rings and normally positioning said piston in a predetermined axial position on said rod intermediate said limit means when said locking rings are in abutment with said limit means, said coupling means including lost-motion means for moving the first one of said locking rings axially away from abutment with a limit means in opposition to said resilient means in response to axial displacement of said piston in one direction from said predetermined axial position, without movement of the second one of said locking rings, upon admission of fluid pressure to an end of said cylinder, and for moving the second one of said locking rings axially away from abutment with the other limit means in response to axial displacement of said piston in the other direction from said predetermined axial position, without movement of the first one of said locking rings, upon admission of fluid pressure to the other end of said cylinder, one or the other of said locking rings

being in position to lock one or the other of the latching means in such engagement with said rod when in abutment with a limit means and said rod is in one or the other of its aforesaid predetermined axial positions in said cylinder, and to unlock the latching means when moved axially away from abutment with the limit means to release the rod for axial movement in said cylinder by said fluid pressure.

10. In a hydraulic actuator having a cylinder and a piston means reciprocable axially therein, means for locking said piston means immovable at a predetermined axial position in said cylinder, comprising: a longitudinally-extending latch finger in said cylinder having an attachment end and an opposite latching head end; means pivotally attaching said attachment end of said finger to said cylinder with freedom for limited pivotal motion in a radial plane relative to the longitudinal axis of said cylinder; resilient means biasing said finger to one limit of said pivotal motion; a laterally extending head formed on the said latch head end of said finger; a latch recess means formed behind a laterally-extending projection carried by said piston means, said laterally-extending head and said projection being positioned for abutment upon axial movement of said piston means toward said latch finger in said cylinder and said latch head end and said projection being formed for lateral, camming engagement with each other upon occurrence of such abutment whereby upon continued axial movement of said piston means relative to said cylinder to a predetermined latching position therein, the said latch finger is pivotally cammed in opposition to said bias to slide over said projection and then be oppositely, pivotally moved by said bias into latching engagement within said latch recess.

11. In a hydraulic actuator having a cylinder and a piston means reciprocable axially therein, means for locking said piston means immovable at a predetermined axial position in said cylinder, comprising: a longitudinally-extending latch finger in said cylinder having an attachment end portion and an opposite latching head end; means pivotally attaching said attachment end portion of said finger to said cylinder with freedom for limited pivotal motion in a radial plane relative to the longitudinal axis of said cylinder; said attachment means including a projection attached to and extending laterally from said attachment end portion of said finger and forming a first laterally off-set shoulder facing said latch head end of said finger; a projection attached to and extending laterally from said cylinder and forming a second shoulder facing opposite to said first-mentioned shoulder, said shoulders being positioned in mutual contact whereby movement of said finger longitudinally in said cylinder in a direction toward its said latch head end is restrained; resilient means acting between said cylinder and said finger applying force longitudinally to said attachment end portion of said finger at a point off-set laterally in a direction opposite to the off-set of said first shoulder, whereby said finger is biased pivotally about a center formed at a point of mutual contact between said first and second shoulders and in a direction toward one limit of said pivotal motion; a laterally-extending head formed on the said latch head end of said finger; and a latch recess means formed behind a laterally-extending projection carried by said piston means, said laterally-extending head and said projection being positioned for abutment upon axial movement of said piston means toward said latch finger in said cylinder, said latch head and said projection being formed for lateral, camming engagement with each other upon occurrence of such abutment whereby upon continued axial movement of said piston means relative to said cylinder to a predetermined latching position therein, the said latch finger is pivotally cammed in opposition to said bias to slide over said projection and then be oppositely, pivotally moved by said bias into latching engagement within said latch recess.

12. In a hydraulic actuator having a cylinder and a

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piston means reciprocable axially therein, means for locking said piston means immovable at a predetermined axial position in said cylinder comprising: a plurality of separate, parallel, longitudinally-extending, circumferentially spaced-apart latching fingers in said cylinder, said fingers each being pivotally attached at adjacent attachment ends thereof to the cylinder, with freedom for limited pivotal motion in a radial plane with respect to the longitudinal axis of said cylinder; resilient means biasing said fingers to one limit of such pivotal motion; a laterally-extending latching head formed on each of said fingers adjacent the end thereof opposite to said attachment ends; an annular, outwardly extending flange carried on said piston means and positioned for endwise abutment with said latching heads upon axial movement of said piston means toward said latching fingers in said cylinder, said latching head and said flange being formed such that upon such abutment and continued axial movement of said piston means relative to said cylinder to a predetermined latching position therein the said latching fingers are cammed pivotally in opposition to said bias to permit the said latching heads to slide over the said flange and then pivotally move inwardly under the force of said bias to latching engagement therewith.

13. In a hydraulic actuator having a cylinder and a piston means reciprocable axially therein, means for locking said piston means immovable at a predetermined axial position in said cylinder comprising: a plurality of separate, parallel, longitudinally-extending, circumferentially spaced-apart latching fingers in said cylinder, said fingers each being pivotally attached at adjacent attachment ends thereof to the cylinder with freedom for limited, outward, pivotal motion in a radial plane with respect to the longitudinal axis of said cylinder; resilient means biasing said fingers against such outward pivotal motion; a laterally inwardly extending latching head formed on each of said fingers adjacent the end thereof opposite to said attachment ends; an annular, outwardly extending flange carried on said piston means and positioned for

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endwise abutment with said latching heads upon axial movement of said piston means toward said latching fingers in said cylinder, said latching head and said flange being formed such that upon such abutment and continued axial movement of said piston means relative to said cylinder to a predetermined latching position therein the said latching fingers are cammed pivotally outwardly in opposition to said bias to permit the said latching heads to slide over the said flange and then pivotally move inwardly under the force of said bias to latching engagement therewith.

14. In a hydraulic actuator having a cylinder and a piston means reciprocable axially therein and having locking means for locking said piston means immovable at a predetermined axial position in such cylinder, a latching finger for said locking means comprising: an elongated body having a cylinder attachment end and an opposite latching head end, said attachment end being generally hook-shaped with a laterally off-set shoulder facing the latching head end thereof, adapted to be supported against an oppositely facing supporting shoulder, and a longitudinally extending projection laterally off-set in a direction opposite to that of said shoulder; and a laterally projecting head adjacent the latch head end of said body extending laterally in the same direction relative to the axis of said body as said shoulder, whereby upon application of force longitudinally against said longitudinally extending projection with resultant reactive force against said shoulder, said latching finger will be urged to pivot, about a point of contact between said shoulder, in the direction in which said head laterally projects.

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