Aug. 16, 1949. A. E. KREMILLER 2,479,169

HYDRAULIC ACTUATOR AND LOCK UNIT

Filed Feb. 19, 1946

3 Sheets-Sheet 1

Fig. 1.

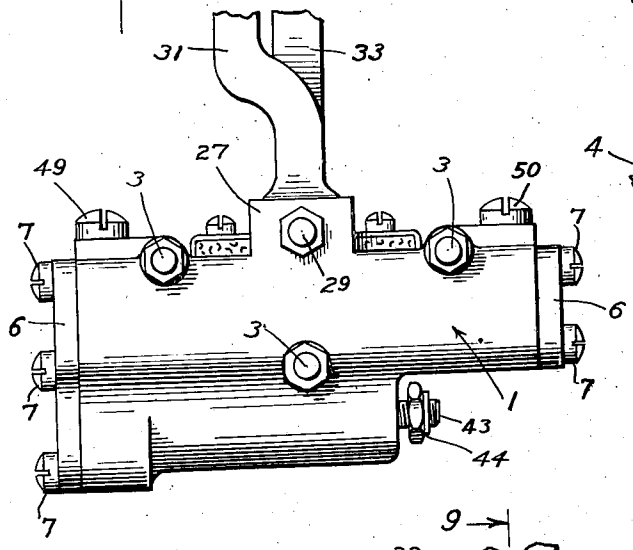


Fig. 2.

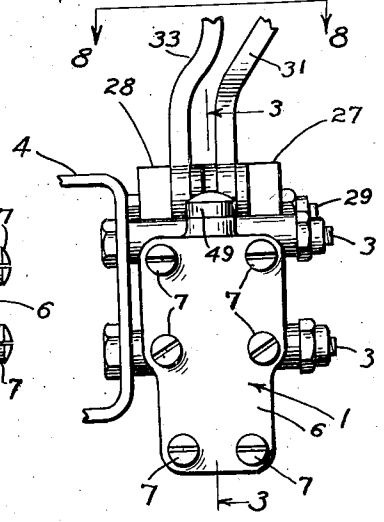
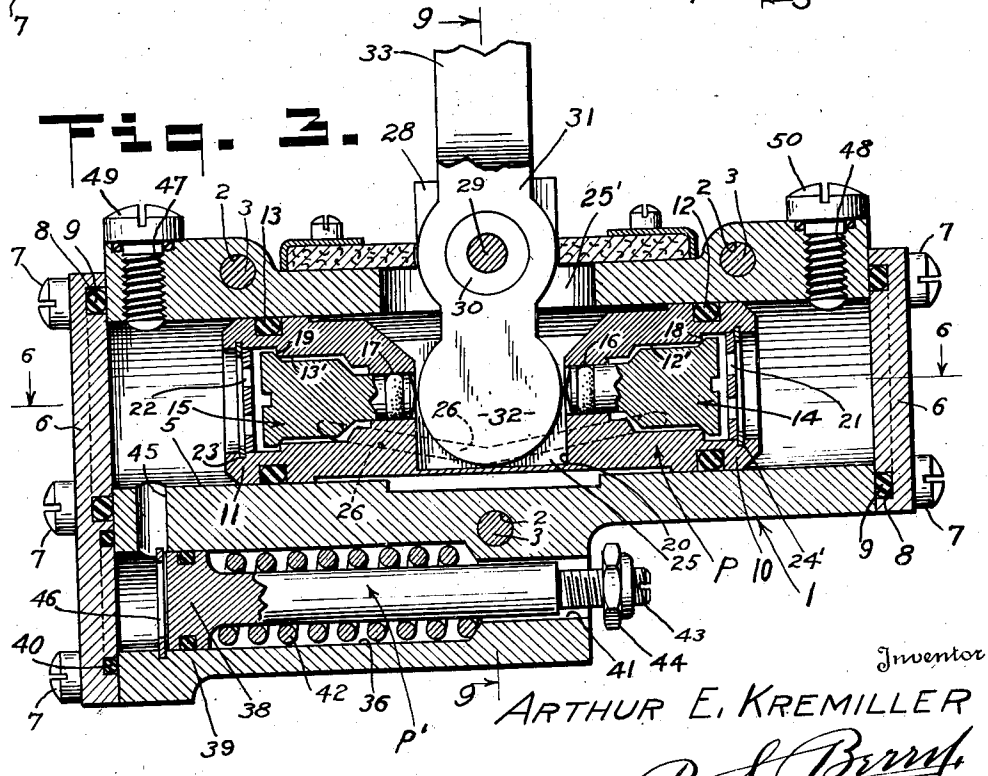


Fig. 3.



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Fig. 4.

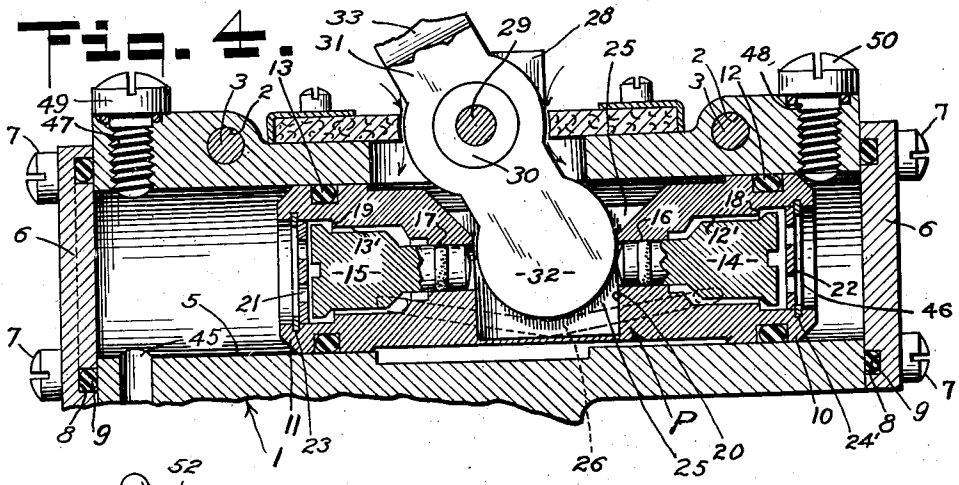


Fig. 5.

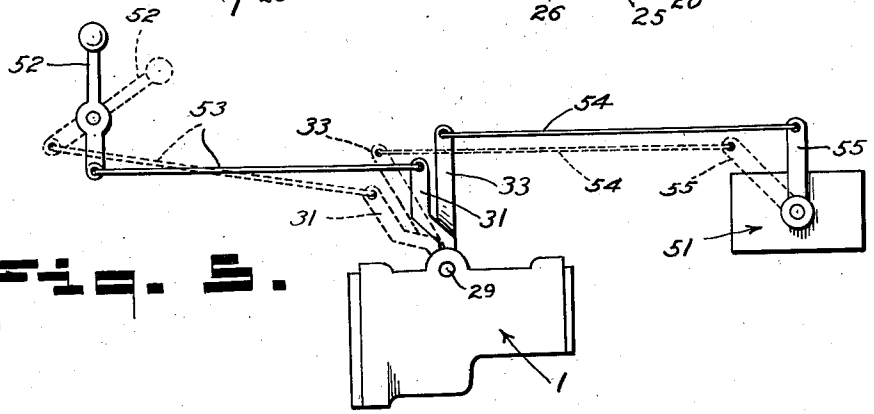
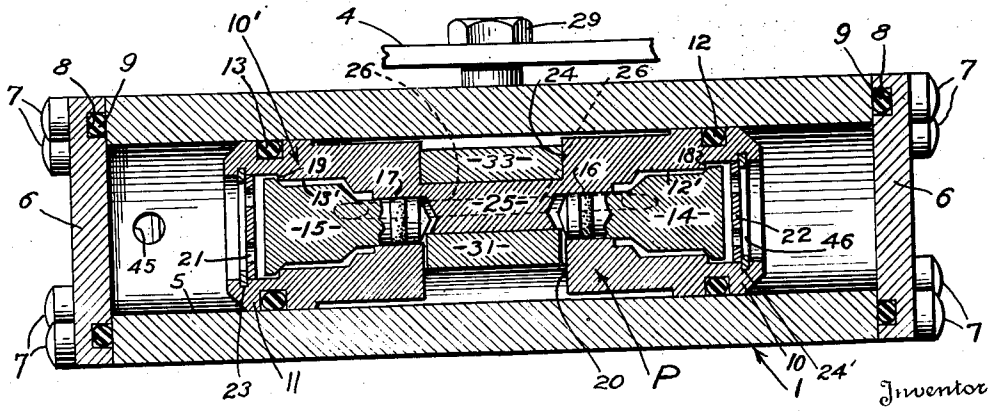


Fig. 6.



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Fig. 7.

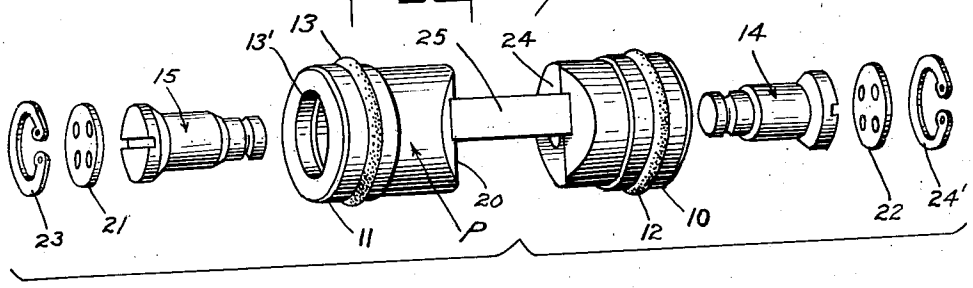


Fig. 8.

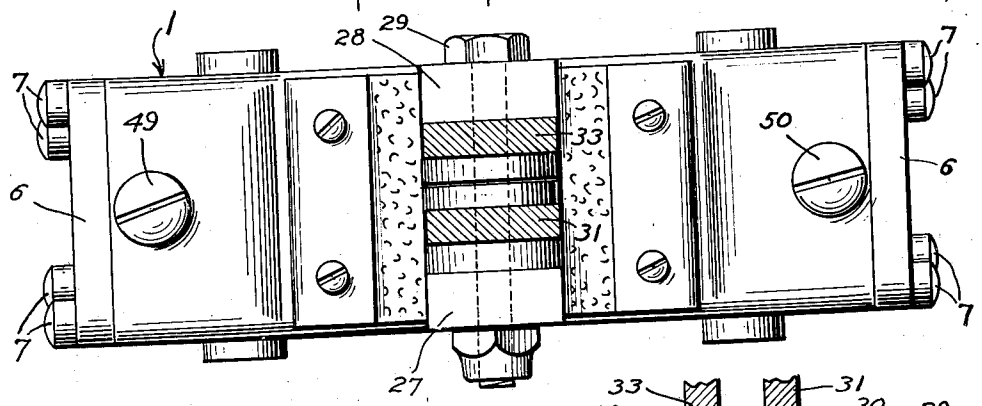


Fig. 9.

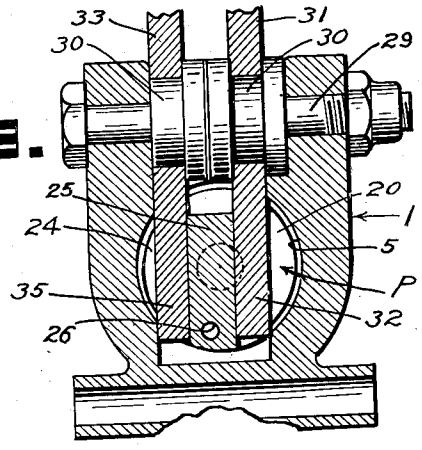
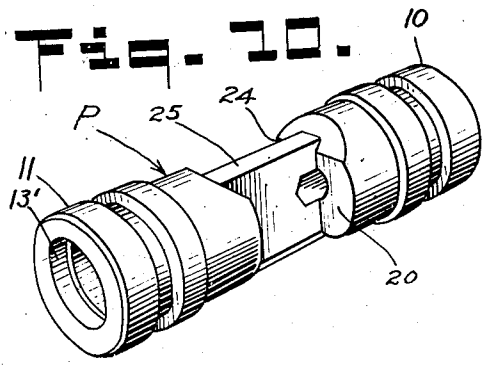


Fig. 10.



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UNITED STATES PATENT OFFICE

2,479,169

HYDRAULIC ACTUATOR AND LOCK UNIT

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Application February 19, 1946, Serial No. 648,688

5 Claims. (Cl. 192—8)

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This invention has for an object the provision of a self contained hydraulic lock unit which may be installed as a link in any train of reciprocable mechanism for operating a control element, to operate as a ratchet throughout infinitely small increments of movement in either direction thereby affording a nicety of control of said element and assuring the holding thereof in any position to which it is moved.

An object of the invention is to provide a hydraulic lock mechanism which will prevent the transmission of any external forces imposed on the driven end of a reciprocable mechanism from being transmitted to the driving end so that the driven end and element operated thereby will be hydraulically locked in any position to which it is moved by said reciprocable mechanism.

Still another object of the invention is to provide a device of the above character which includes a novel means for maintaining the fluid contained therein at a substantially uniform initial pressure regardless of thermal changes and minor leakage.

A still further object of the invention is to provide a device of the above character in which any depletion of the volume of fluid is indicated externally of the device.

Still another object of the invention is to provide a device of the above character in which means is provided for rendering the pressure creating means inoperative during the filling or refilling operation.

In the following specification there is disclosed by way of example a manner in which the above and such other desirable objects as may subsequently appear may be realized in practice, reference being had to the accompanying drawings in which:

Fig. 1 is a side elevation of one form of hydraulic lock valve embodying the present invention;

Fig. 2 is an end elevation of the device shown in Fig. 1;

Fig. 3 is a sectional view taken substantially on the line 3—3 of Fig. 2;

Fig. 4 is a fragmentary sectional view corresponding to Fig. 3 showing the device in one extreme position;

Fig. 5 is a schematic view of the device shown in Fig. 1, incorporated in a control mechanism;

Fig. 6 is a sectional view taken on the line 6—6 of Fig. 3;

Fig. 7 is an exploded view of the piston and valve assembly;

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Fig. 8 is a sectional view of the device taken on the line 8—8 of Fig. 2;

Fig. 9 is a cross sectional view taken on the line 9—9 of Fig. 3;

Fig. 10 is a perspective view of the assembled piston valve unit.

As shown in the accompanying drawings, one embodiment of this invention includes a body member 1 having a series of transverse holes 2 for the reception of bolts 3 by which it may be mounted to any suitable support, such as a bracket 4. The body member constitutes a cylinder provided with a longitudinally extending bore 5 the ends of which are closed by end-plates 6 secured thereto with screws 7. Preferably the plates 6 are provided with grooves 8 in which are mounted suitable pressure-responsive sealing rings 9 to prevent the escape of fluid.

Mounted for reciprocation in the bore 5 is a double-headed piston member P having opposed-like piston heads 10 and 11 provided with pressure-responsive sealing rings 12 and 13, respectively. These piston heads are provided with axial bores 12' and 13' adapted to receive reciprocable poppet valve members 14 and 15 the stems of which are provided with sealing rings 16 and 17. The bores within the piston, near the outer ends of the heads are enlarged to provide valve seats 18 and 19 against which the valve members seat. While, as shown, there are no spring elements to maintain the valves 14 and 15 in normally seated position, such springs may be used without departure from the invention.

Intermediate its ends the piston member P is provided with recess 20 which is of such depth that it intersects the bores 12' and 13' and is of such width that the outer ends of the stems of the valves 14 and 15 when the latter are seated will project somewhat beyond the side walls of the recess or in other words the inner end of the piston heads 10 and 11. The valves 14 and 15 are retained in their respective bores by perforated cover plates 21 and 22 which are held in place by snap rings 23 and 24' engageable with suitable grooves in the ends of the pistons 11 and 10, respectively.

The piston P is also provided with a recess 24 which is diametrically opposite the recess 20, but which is of less depth than recess 20 so that it does not intersect the bores containing the valves 14 and 15. The recesses 20 and 24 define a web 25 connecting the piston heads 10 and 11. Extending through the web member 25 is a port 26 for connecting the valve bores 10 and 11.

The recesses 20 and 24 are open to the atmos-

phere through an opening 25' in the body member 1, said opening being in direct communication with that portion of the bore 5 which is between the piston heads 10 and 11.

The body member 1 intermediate its ends is provided with a pair of upstanding lugs 27 and 28 which are bored to receive a bolt 29. Pivotally mounted on the bolt 29 with interposition of a ball bearing member 30 is a driving lever 31 having a rounded lower end 32 extending through the opening 25' in the body 1 for operating the valves 14 and 15 as well as moving the piston responsive to rocking of the lever 31. It should be noted that the recess 20 is somewhat wider than the rounded end 32 so that a small amount of play or relative movement between the end 32 and the piston P will take place under operating conditions such as will be hereinafter fully described.

Moreover, it should be noted with reference to Figs. 6, 7 and 10 that the valve-receiving bore 12' and 13' in the piston heads 10 and 11 extend partly into the web 25 so that only small segments of the inner ends of the stems of the valves 14 and 15 are exposed in the recess 20 for contact with the rounded end 32 of the driving lever 31. Therefore only small portions of the opposite curved surfaces of the end 32 are disposed to contact the valve stems whereas the major portions of said curved surfaces are disposed to abut the end walls of the recess 20, that is, the inner ends of the heads 10 and 11. The clearance between the curved surfaces of the rounded end 32 and the inner end faces of the heads 10 and 11 as well as between the inner ends of the stems of valves 14 and 15 and the opposite surfaces of the end 32, is such that the piston unit P may shift relative to said end 32 or vice versa sufficient to center the piston unit with respect to said end and therefore allow the valves 14 and 15 to be seated to hydraulically lock the piston P and associated elements against movement responsive to forces applied to the mechanism other than through intentional manipulation of the driving lever 31, all as will be hereinafter fully described.

A driving lever 33 similar to lever 31 is pivoted on the bolt 29 and has a lower end 35 which extends into the recess 24 and is shaped to completely fill that recess so that no play will take place in the direction of movement of the lever 33 and piston P. From the foregoing it will be appreciated that as the piston P reciprocates in the bore 5 responsive to movement of the driving lever 31 the lever 33 will be moved correspondingly about the bolt 29 as a fulcrum.

The body member 1 is provided with a second cylinder portion in the bore 36 on which is mounted a spring-pressed piston P' including a piston head 38 which latter carried a pressure-responsive sealing ring 39. The bore 36 is closed at one end by one of the plates 6 which is provided with a second sealing ring 40. At its other end the bore 36 is formed with a reduced diameter portion 41 through which the piston P' extends. A compression spring 42 surrounds the piston P' with one end bearing against the piston head 38. The piston P' extends through the portion 41 and is provided with a reduced diameter threaded portion 43 carrying a lock nut 44. The body member 1 adjacent the end of the bore 36 adjacent the cover plate 6 is provided with a port 45 which affords communication of one end of the bore 5 with the bore 36. The bore 36 is provided with a groove which accommodates a snap ring 46 for limiting the movement of the piston head under the influence of the spring 42 to a position short of closing the port 45.

Filler holes 47 and 48 normally closed by means of screw plugs 49 and 50 are provided at the ends of the body 1 for filling the two cylinder bores 5 and 36. The main purpose of the piston P' and associated elements is to provide a means for maintaining the fluid in the device under constant pressure and assure the proper seating of valves 14 and 15. When the device is to be filled or refilled the nut 44 is screwed up on the threaded portion 43 drawing the piston back against the pressure of the spring 42. The cylinder cavities are then filled through the filler holes 47 and 48, the plugs 49 and 50 replaced, and the nut 44 is backed off, allowing the piston to exert the pressure of the spring 42 against the fluid.

Any changes in the volume of the fluid by reason of thermal changes or by reason of minor leakage will be compensated for by the action of the spring pressed piston P' so that an initial pressure on the fluid and the proper volume of fluid within the bore 5 are maintained. When the piston P' is disposed at a point which indicates that the head 38 is either in contact with or close to the stop ring 46, the piston head may be withdrawn by the stop nut 44 and additional fluid added through the filler holes 47 and 48, as above described. Thus the piston P' indicates by its position the amount of fluid in the device.

Referring now to Fig. 5 there is shown diagrammatically a typical installation of the device and a train of mechanism for operating a carburetor, or the like, designated by the numeral 51 by forces derived from remotely located operating lever 52. A rod 53 connects the lever 52 with the drive lever 31 and a rod 54 connects the driven lever 33 with an operating arm 55 on the device 51 to be operated.

It will be noted that when the operating lever 52 is turned about its fulcrum in a clockwise direction, the drive lever 31 connected thereto through the rod 53, will be turned upon the pivot bolt 29 in a counter-clockwise direction with resultant movement of the piston P to the right, as viewed in Fig. 7. The first movement of the end 32 of the lever 31 will unseat the valve 14 and permit the flow of fluid through the openings in the plate 22, past the valve seat 18, through the port 26, into bore 13' where it will unseat the valve 15 and pass to the opposite end of the cylinder. Incident to the opening of the valve 14, the end 32 through contact with the head 10 will move the piston P to the right. This movement of the piston will effect a simultaneous movement of the lever 33 equal in extent to the movement imparted to the piston by the movement of the lever 31 whereby the rod 54 will move the operating arm 55 and control device 51. Movement of the operating lever 52 in the opposite direction will cause the piston P to move to the left and also move the driven lever 33 and the operating arm 55 of the device 51 to the right.

Upon cessation of movement of the operating lever 52, the piston P is stopped and as the inner ends of the stems of the valves 14 and 15 are exposed to atmospheric pressure through the recess 20 and the opening 25' in the body 1, while the valves themselves are exposed to the fluid pressure created in both ends of the bore 5 by the spring loaded piston P', both valves will be instantly seated. In thus seating, the valve stem of the valve which is in contact with the end 32 of lever 31, will push against said end so that the piston is bodily shifted slightly, sufficiently

to center itself with respect to said end whereby said lever will not interfere with the pressure seating of said valves. This action is made possible by the slight clearance between the inner ends of the piston heads 10 and 11 and the curved end 32 opposed to said inner ends. When the valves 14 and 15 are seated following a given operation of the operating lever 52 and consequent response of the piston P and driven elements which operate the controlled device 51, the piston P is hydraulically locked and therefore the entire mechanism becomes locked against movement responsive to any externally applied force, that is, any force other than transmitted through intentional operation of the operating lever 52. In this manner it is assured that the control arm 55 of the device 51 operated through the mechanism hereof will be maintained in any position into which it has been moved and may be moved out of said position only responsive to operation of the operating lever 52 and the driving lever 31.

It is now apparent that should a force other than derived from movement of the operating lever 52 be applied so as to tend to move the driven lever 33 and the control arm 55 it will be ineffective to move such parts due to the fact that the piston P is hydraulically locked and no play is permitted by the operative connection of said driven lever 33 and said piston, thereby assuring that the control arm 55 of the device 51 will be positively held in the selected position into which it is moved.

With the means of this invention it is possible to accurately control and operate a device or control element with provision for positively locking said device or element in any position within the range of its movement in either direction, there being a positive locking action provided with much smaller increments of movement than possible with mechanical-ratchet or similar mechanical means.

While I have shown and described a specific embodiment of my invention I do not limit myself to the exact details of construction set forth, and the invention embraces such changes, modifications and equivalents of the parts and their formation and arrangement as come within the purview of the appended claims.

I claim:

1. In a hydraulic actuator and lock unit, a cylinder adapted to contain a hydraulic fluid, a piston reciprocable in said cylinder and having a fluid passage affording the transfer of fluid from one end of the cylinder to the other whereby the piston may be reciprocated, a drive lever fulcrumed on said cylinder with one end disposed to directly contact the piston for reciprocating it, a driven lever fulcrumed on said cylinder with one end disposed for contact with the piston for movement responsive to the movement of said piston, means for maintaining the fluid in said cylinder under pressure, and valve means for controlling the flow through said passage constructed and arranged to be unseated and open said passage responsive to the initial operation of said drive lever and to be seated by the pressure of the fluid in said cylinder so as to close said passage and hydraulically lock said piston against movement, upon cessation of operation of said drive lever.

2. In a hydraulic actuator and lock unit, a closed cylinder adapted to contain a hydraulic fluid, a piston reciprocable in said cylinder, means for maintaining the fluid in said cylinder under pressure, a by-pass passage in said piston affording the transfer of fluid from one end of the cylinder to the other whereby the piston may be reciprocated, a drive lever fulcrumed on said cylinder with one end disposed for contact with said piston for reciprocating it, a driven lever having one end disposed to contact said piston and moving responsive to movement of said piston, and valve means controlling said passage constructed and arranged to be unseated and open said passage responsive to operation of said drive lever, and to be seated by the pressure of the fluid in said cylinder and close said passage incident to the cessation of operation of said drive lever.

3. In a hydraulic actuator and lock unit, a closed cylinder containing a hydraulic fluid, a piston reciprocable in said cylinder, means for maintaining the liquid in said cylinder under pressure, a by-pass passage in said piston affording the transfer of fluid from one end of the cylinder to the other whereby the piston may be reciprocated, a drive lever having one end disposed in the cylinder and in lost motion connection with said piston and operable for reciprocating said piston, a driven lever fulcrumed on the cylinder with one end directly connected to the piston and operating responsive to movement of said piston, and valve means for controlling said passage being normally seated by the pressure of the fluid in said cylinder and constructed and arranged to be unseated responsive to initial movement of said drive lever and responsive to flow through said passage responsive to initial movement of said piston, and being seated by the pressure in said cylinder so as to close said passage and hydraulically lock said piston against movement incident to cessation of operation of said drive lever.

4. In a hydraulic actuator and lock unit, a closed cylinder adapted to contain a hydraulic fluid, a piston reciprocable in said cylinder, means for maintaining the liquid in said cylinder under pressure, a by-pass passage in said piston affording the transfer of fluid from one end of the cylinder to the other whereby the piston may be reciprocated, a drive lever for reciprocating said piston, said piston having a recess between its ends into which one end of said drive lever is extended so that it will contact opposite walls of the recess and move the piston upon the rocking of said lever about its fulcrum, a driven lever mechanically connected with and operating responsive to movement of said piston, a pair of valves for controlling said passage having stems arranged to protrude into said recess when said valves are seated, there being an opening in said cylinder through which said levers extend and which affords communication of said recess with the atmosphere whereby said stems are exposed to atmospheric pressure, said valves being exposed to and seated by the pressure of the fluid in said cylinder, said end of said drive lever and said recess and said stems being constructed and arranged so that upon initial movement of said lever one of said valves will be unseated and open said passage to flow of fluid against the other valve to thereby unseat the other so that fluid will be transferred through said passage from one of the ends of the cylinder to the other on movement of said piston, said valves being seated by the pressure of the fluid in said cylinder and closing said passage and hydraulically locking the piston against movement incident to cessation of driving movement of said drive lever.

5. In a hydraulic actuator and lock unit, a cylinder closed at its ends and having an opening between its ends affording communication of the

interior of the cylinder with the atmosphere, a piston unit reciprocable in said cylinder and having recesses in opposite sides between its ends, which recesses are in registration with said opening in all positions of said piston unit, said piston unit having coaxial bores extending from opposite ends thereof with their inner ends opening into one of said recesses, valve seats in said bores, valve members arranged to seat on said seats in a direction toward said one recess, stems on said valve members sealing the inner ends of said bores and having a slight protrusion into said one recess when the valve members are seated, a driving lever pivoted on said cylinder with one end extending through said opening and into said one recess for unseating said valve members and moving said piston unit, said end of said lever having a width such that the piston unit and said end are subject to limited relative movement with said end disposed to contact one or the other of said stems and open one or the other of the valve members depending on the direction of movement of said lever and thereafter to move said piston unit as the movement of the lever continues, said cylinder being adapted to contain a liquid between its end and the ends of said piston unit to hydraulically hold the piston against

movement when the valve members are closed, said piston unit having therein a connecting passage between said coaxial bores affording the passage of the liquid from the bore in which the valve is opened by said end of said lever into the other bore so as to open the valve in said other bore, a driven lever pivoted on said cylinder with one end disposed in the other recess so that the driven lever will be rocked responsive to movement of said piston, and means for creating an initial pressure of the liquid in said cylinder such that when movement of the driving lever is stopped the valve members will be seated due to the ends of the stems being exposed to atmospheric pressure in said one recess while the valve members are exposed to the pressure of the liquid in said cylinder.

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