

Oct. 28, 1952

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2,615,429

MANUAL DRIVE FOR HYDRAULIC SERVOMOTORS

Filed Nov. 27, 1950

5 Sheets-Sheet 1

Fig. 1

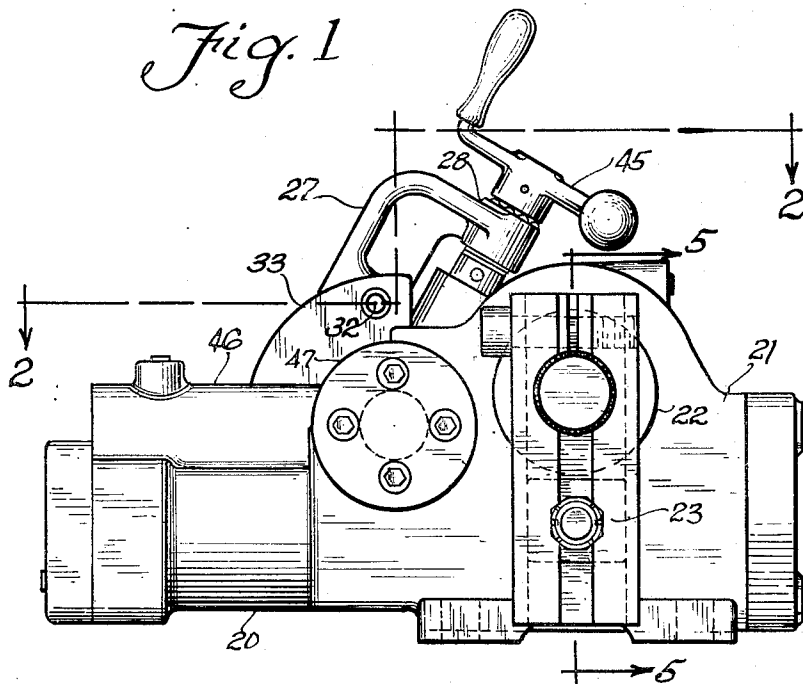
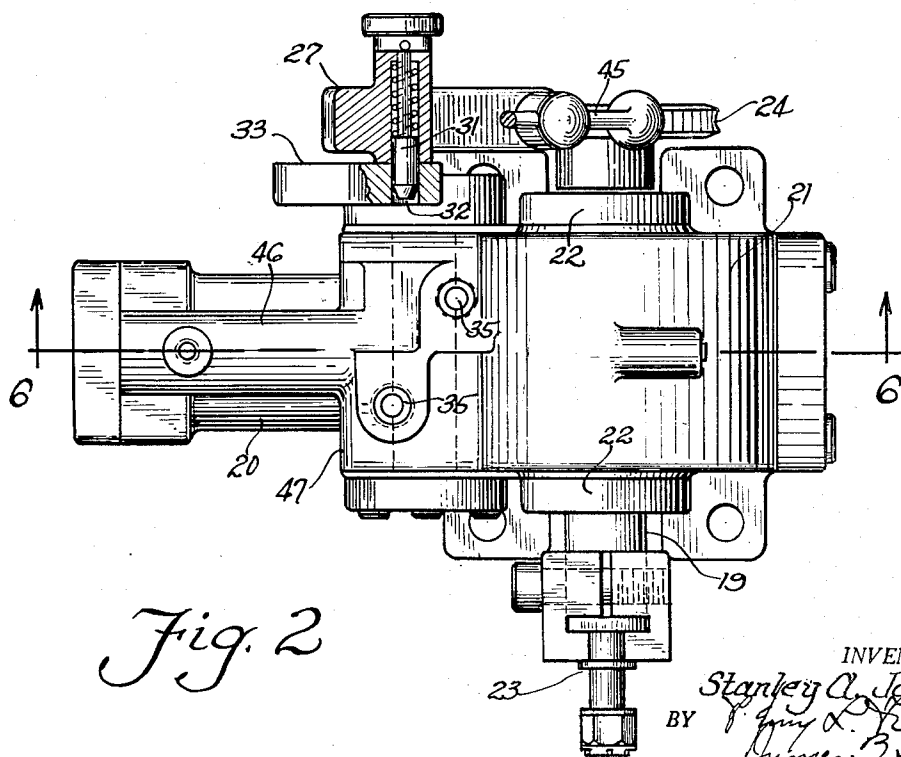


Fig. 2

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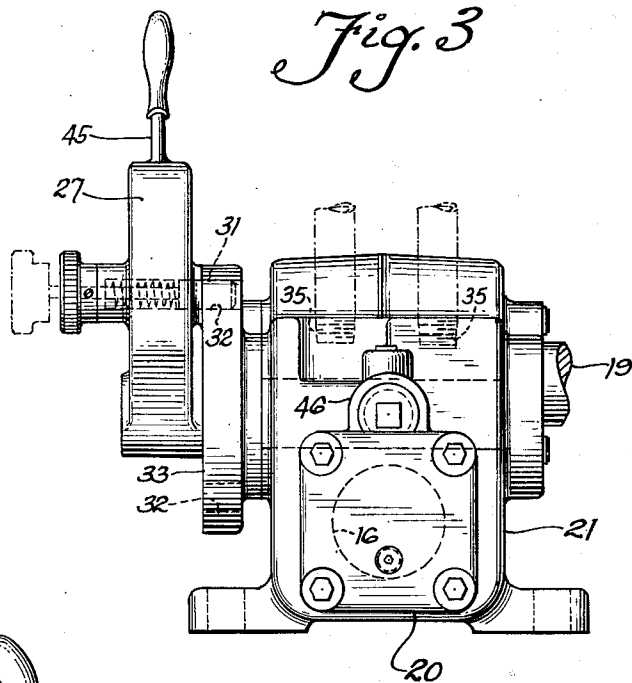
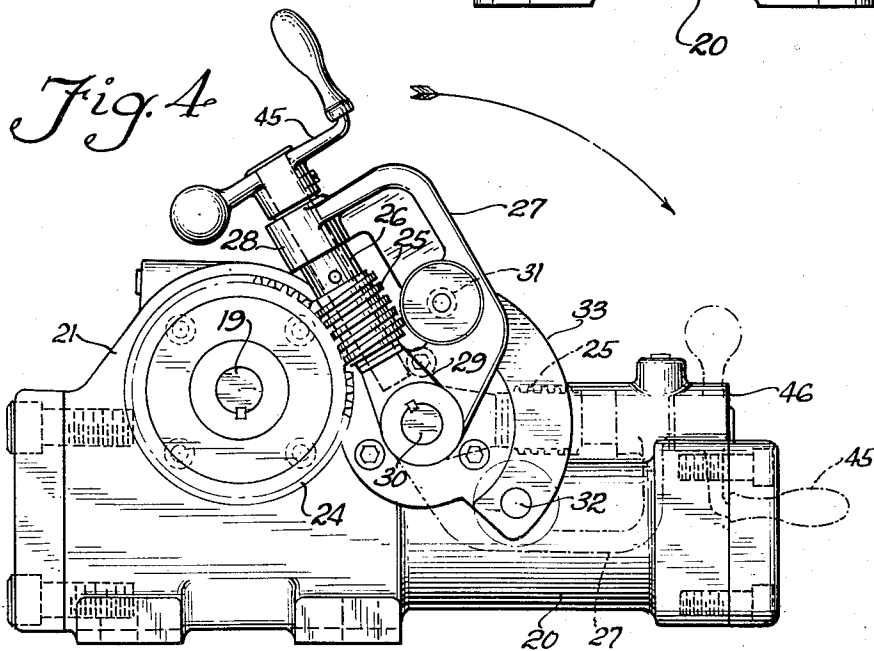
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Fig. 7

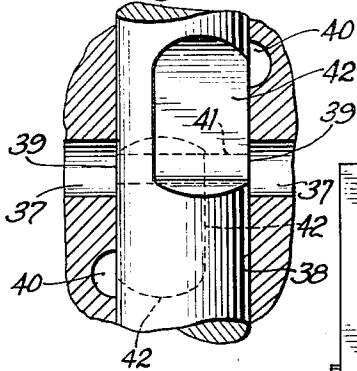


Fig. 5

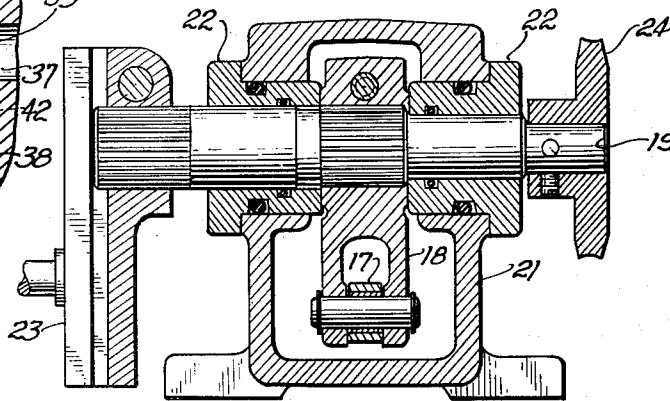


Fig. 8

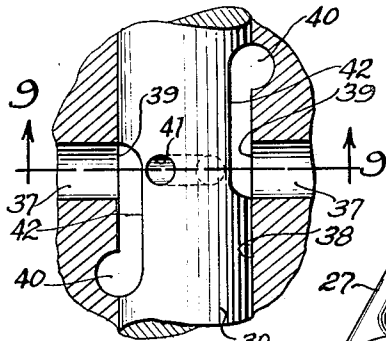
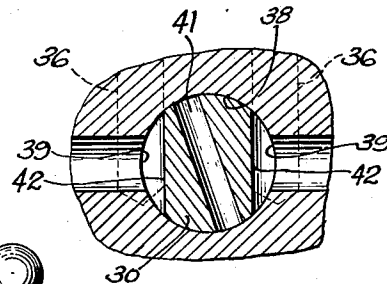


Fig. 9

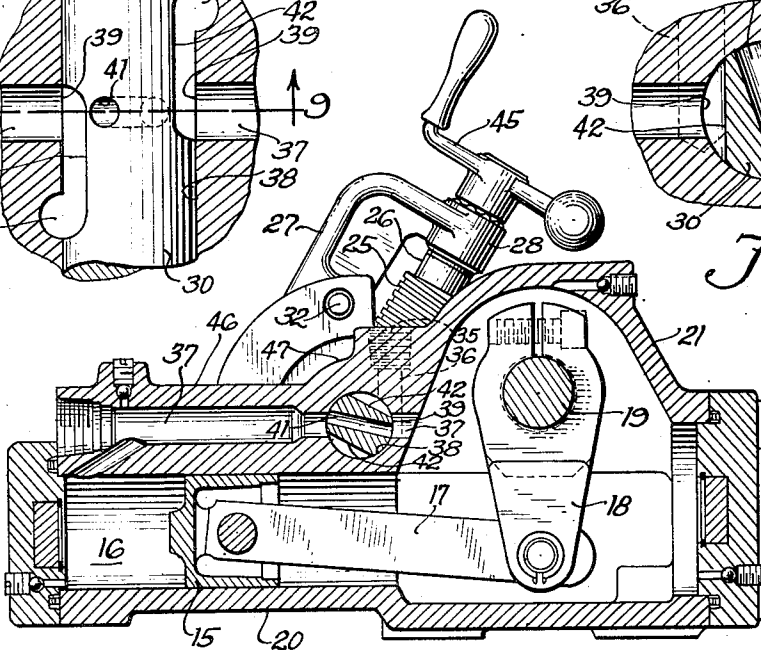


Fig. 6

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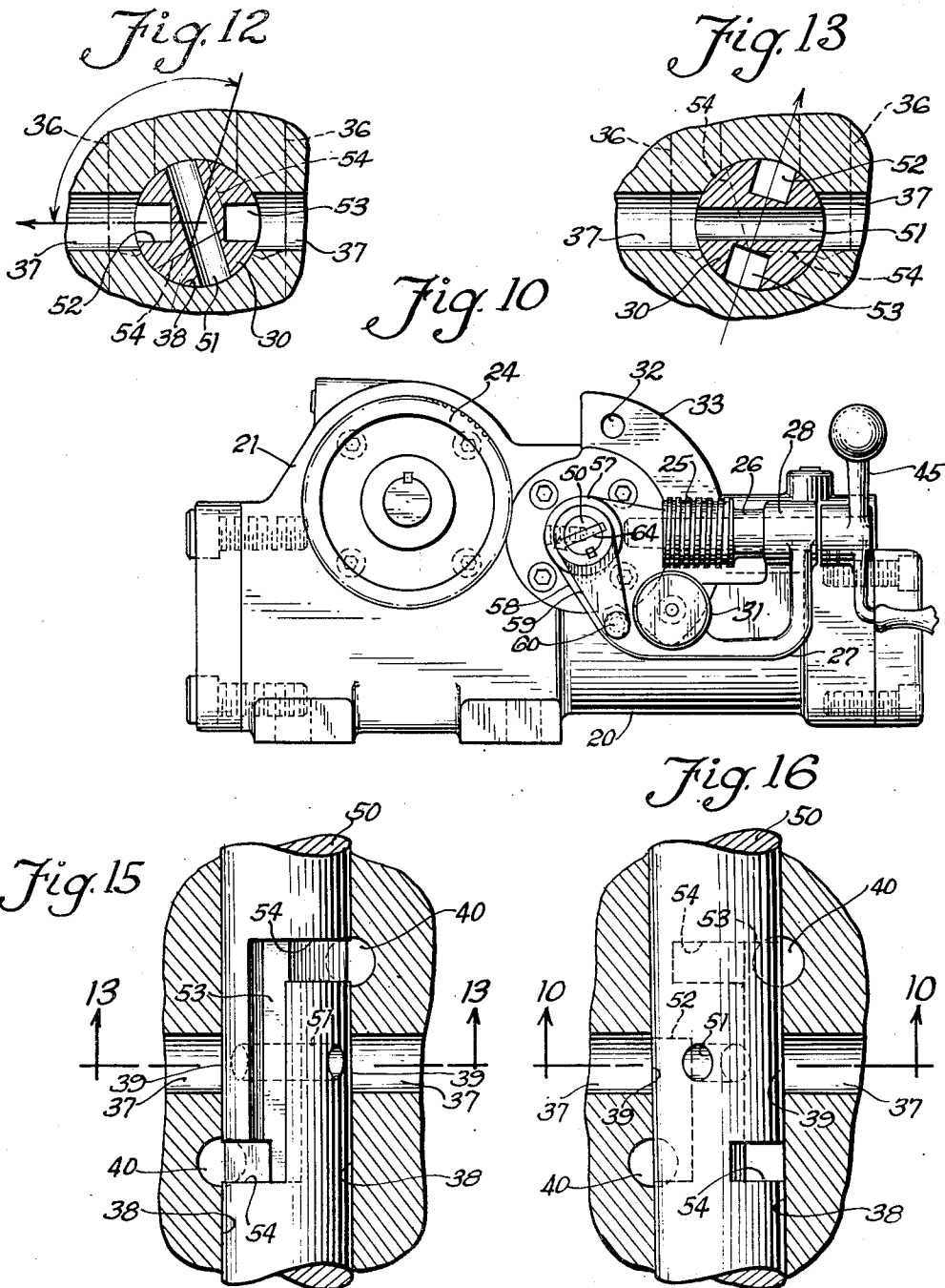
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MANUAL DRIVE FOR HYDRAULIC SERVOMOTORS

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MANUAL DRIVE FOR HYDRAULIC SERVOMOTORS

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Fig. 11

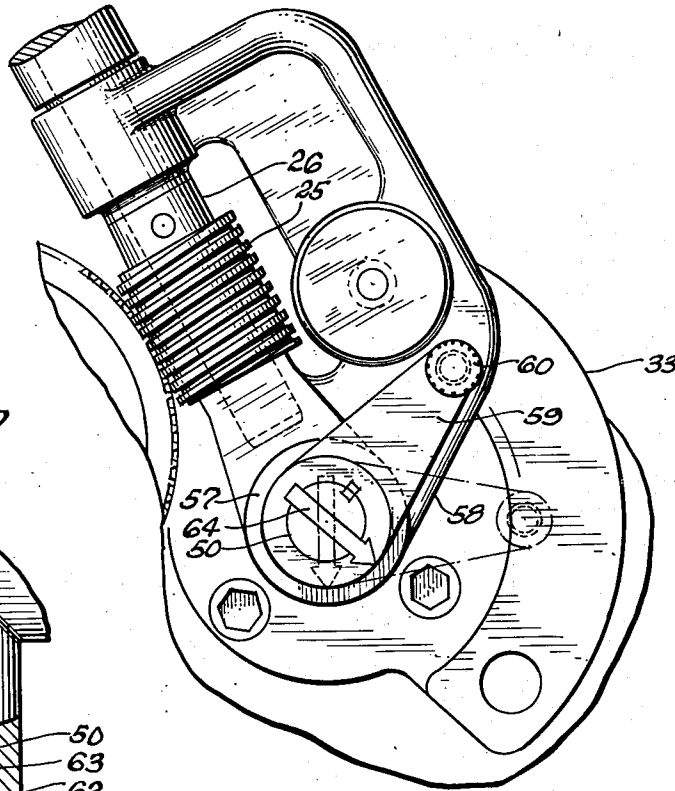


Fig. 12

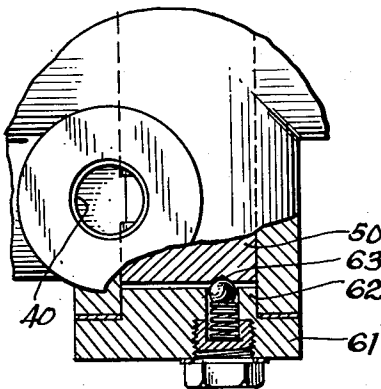
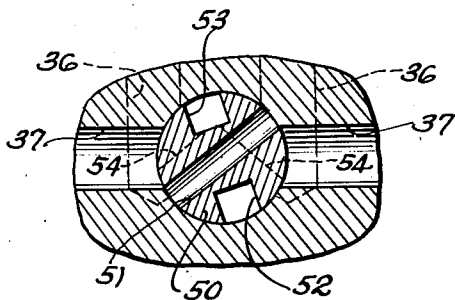


Fig. 14



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UNITED STATES PATENT OFFICE

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MANUAL DRIVE FOR HYDRAULIC
SERVOMOTORS

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2 Claims. (Cl. 121—38)

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The present invention relates to hydraulic cylinder and piston assemblies of the kind constituting the output or power unit of hydraulic systems such as power amplifiers or relays.

Such units, in addition to being operable hydraulically under control of some apparatus that acts to regulate delivery of operating fluid to the unit to move a load, in many instances are provided with auxiliary mechanical systems that permit manual movement of the load and the piston that is connected to drive it. Manual movement of a hydraulic power unit piston that is blocked from its regulator requires bleeding of the cylinder ends to prevent fluid lock, and conveniently such bleeding is accomplished by a by-pass path that may be established to interconnect the cylinder ends for manual piston movement, or blocked for normal hydraulic piston actuation. Conversion of a hydraulic power system between conditions for hydraulic and manual operation requires operation of three valves, two to block or clear communication of the cylinder ends with the hydraulic system output lines, and one to block or clear the bleeder by-pass. A mechanical drive system for a heavily loaded piston must be designed to exert a large force, and breaking means are necessary to maintain the load and piston in selected positions. Also the mechanical system almost necessarily is disconnectible from the piston system for normal hydraulic operation of the latter.

For so-called "purging" or cleaning out a hydraulic power system, sometimes it is required that provision be made to interconnect the two cylinder lines at or close to the power unit, blocking such lines from communication with the cylinder so that a closed circuit between the regulator and power unit is established through which fluid can be circulated.

A primary object of the invention is the provision in a piston and cylinder power unit for a hydraulic relay system, of a novel arrangement of a mechanical system that is manually movable for moving the piston and a load connected to it.

Another primary object is the provision of a novel arrangement for connecting and disconnecting such a mechanical system to and from the operating assembly of a piston and cylinder power unit.

Another object is the provision of a novel mechanical piston-driving system that cannot be driven by a piston with which it is interconnected.

An additional object of great importance, is the novel combination of a mechanical piston-driv-

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ing system that is connectible and disconnectible to and from the operating system of a hydraulic cylinder and piston unit, with compound two-way valve means designed to accomplish by a single valve body movement all valve actuations necessary to convert the unit between conditions for mechanical and hydraulic drive, in such operative association that the mechanism movements required to establish or disestablish the mechanical drive system respectively actuate the valve to convert the power unit between hydraulic conditions for mechanical and hydraulic piston drive.

Another object is the provision of a novel, unitary assembly of a cylinder, piston, by-pass and valve means for connecting the cylinder ends to hydraulic lines and blocking the by-pass, or blocking the cylinder ends from hydraulic lines and establishing the by-pass.

An additional object is the provision of a novel arrangement permitting establishment, for purging, of a cross connection between hydraulic system output lines and blocking such lines from their normal communication with the power unit cylinder.

In the accompanying drawings:

Fig. 1 is a side elevation of a piston and cylinder hydraulic power unit arranged in accordance with the invention.

Fig. 2 is a partial top plan and partial horizontal section, as indicated by line 2—2 of Fig. 1.

Fig. 3 is an end elevation.

Fig. 4 is an elevation of the side of the unit opposite that seen in Fig. 1.

Fig. 5 is a section on line 5—5 of Fig. 1.

Fig. 6 is a longitudinal vertical section on line 6—6 of Fig. 2.

Fig. 7 is a detail horizontal section through the valve chamber, showing the valve in condition establishing a by-pass between the cylinder ends, and blocking the cylinder ends from communication with input openings to which hydraulic control system lines are to be connected.

Fig. 8 is a view similar to Fig. 7, but showing the valve body in a condition blocking the by-pass and connecting the cylinder ends with the input openings.

Fig. 9 is a section on line 9—9 of Fig. 8.

Fig. 10 is a side elevation of a power unit having the same general arrangement as that shown in Figs. 1 to 9, but provided with a special form of valve providing for interconnection of the input openings, blocking of the by-pass and blocking communication between the cylinder ends and input openings for purging hydraulic lines connected with the input openings.

Fig. 11 is an enlarged fragmentary elevation showing an auxiliary valve operator that is used to establish the purging condition of the valve.

Figs. 12, 13, and 14 are similar fragmentary vertical median sections through the valve assembly, showing the valve body respectively in positions for normal hydraulic piston operation, mechanical piston operation, and purging of hydraulic lines connected to the unit input openings.

Figs. 15 and 16 are fragmentary horizontal sections showing the valve in purging and normal operation positions.

Fig. 17 is a fragmentary horizontal section showing a device for indexing the valve in its purging position.

Describing the drawings in detail, and first referring to Figs. 5 and 6, a hydraulic power unit comprises a piston 15 that is reciprocable in a cylinder to drive, through a piston rod 17 and crank 18, an output shaft 19. The power unit includes a housing structure that includes a barrel portion 20 enclosing cylinder 16, and a crankcase portion 21 in opposite walls of which shaft 19 is supported by bearings 22. Shaft 19 projects from crankcase 21 at both sides of the latter, and at one of its ends carries an output device, shown in Figs. 1 and 2 as a crank 23.

In accordance with the invention the second end of shaft 19 has secured to it a worm gear 24 that acts as the driven element of a mechanical piston-driving system that may be made effective and actuated to rotate shaft 19, for moving a load connected to the output crank 23. The mechanical system for rotating worm gear 24 includes a worm 25 mounted on a support shaft 26 that is pivoted to the housing structure for swinging between two positions, one of which is shown in Figs. 1, 2, and 4, and wherein the worm 25 is meshed with gear 24, while in the other position, shown in Fig. 10, and indicated in dotted lines in Fig. 4, the worm is disengaged from the gear. When the worm is meshed with gear 24, its rotation drives shaft 19, and additionally its engagement with the gear serves as a positive stop against rotation of shaft 19 by a load or by the piston.

Shaft 26 is shown as rotatable and secured to worm 25, thereby itself serving as a drive shaft as well as a support shaft for the worm. The shaft is rotatably mounted in a frame 27 that has an upper bearing part 28 and a lower bearing part 29 that is secured to a pivot shaft 30 rotatably mounted in the housing structure. Shaft 30 also functions as a valve body, as will be explained. A portion of frame 27 carries a detent plunger 31 that cooperates with suitably located holes 32 in an indexing plate 33 that is fixed to the housing structure. One hole 32 is located to maintain shaft 26 in an angular position of proper meshing engagement of worm 25 with gear 24, and, as will appear, maintain the valve body shaft 30 in an angular position for mechanical piston drive. The other hole 32 is located to latch shaft 26 in an angular position with worm 25 disengaged from gear 26, and wherein shaft 30 is angularly positioned for hydraulic piston drive.

The hydraulic system of the unit comprises a pair of external input openings 35 for connection to the two output lines of a hydraulic piston-actuating system that operates to selectively connect such lines to pressure fluid supply and exhaust. These input openings 35 form the ends of a pair of cylinder passages that have input

reaches 36 and cylinder reaches 37 that respectively communicate with opposite ends of cylinder 16 and with a transversely disposed valve bore 38, wherein shaft 30 is rotatable, forming valve output ports 39 that are diametrically opposite one another across bore 38. The supply passage input reaches enter bore 38 through ports 40 that open through opposite sides of the bore and that respectively are spaced in opposite directions from the ports 39 that enter the same sides of the bore. The rotatable shaft 30 is provided with a straight-through passage 41 located to connect ports 39 when the shaft is in the angular indexed position meshing worm 25 with gear 24, as seen in Figs. 6 and 7. Additionally, the shaft is provided with longitudinal flats 42 providing passages that interconnect the ports 39, 40 that are on the same sides of bore 38, as seen in Figs. 7 and 9, when shaft 30 is in its second indexed position. By this arrangement, when shaft 26 is latched in its position meshing worm 25 with gear 24 for mechanical piston drive, as by a handwheel 45 secured to shaft 26, the opposite ends of cylinder 16 are connected together through a by-pass comprising the two passage reaches 37 and valve body passage 41, and the passages provided by flats 42 are angularly displaced from registration with ports 39, 40, so that the cylinder reaches 37 are cut off from the input reaches 36 and from system lines connected with the input openings 35. In this condition, rotation of handwheel 45 rotates shaft 26 and the worm attached to the latter. Since worm 25 is meshed with worm gear 24, and the latter, through main shaft 19, crank 18 and link 17 is coupled to piston 15, the latter is driven in cylinder 16, which is freely permitted by passage of fluid through the by pass between the cylinder ends described immediately above. When valve body shaft 30 is in its second position, wherein body passage 41 is angularly displaced from registration with ports 39 and the passages provided by flats 42 connect corresponding pairs of ports 39, 40, shaft 26 is in an angular position wherein worm 25 is disengaged from gear 24.

It will be noted that the arrangement described above is well suited to production as a unitary assembly wherein all necessary passage lines and the valve chamber are formed as bores in a single main casting of configuration providing for passage and valve housing, as by an enlargement 46 along one side of the cylinder containing a passage reach 37 and a transverse enlargement 47 containing valve bore 38.

The power unit of Figs. 10 to 16 is the same as that described above except the valve body and its connection to shaft 26 are modified to provide a third hydraulic condition for line purging, by blocking both cylinder ends from the input passage reaches 36 and interconnecting those passage reaches at the valve. To this end the valve body shaft, designated 50, is again provided with a through passage 51 angularly positioned to interconnect ports 39 when worm 25 is meshed with gear 24. Shaft 50 also is provided with passage-forming grooves extended along opposite sides of the shaft and positioned circumferentially thereof to interconnect corresponding pairs of ports 39, 40 when the shaft is in its second indexed position. One groove, shown as 52, is only of sufficient length to extend between the pair of ports 39, 40 that it interconnects. The other groove 53 extends axially of the shaft past port 39 and to have a portion spaced circumferentially of shaft 50 from the

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part of groove 52 that registers with its associated port 40. Located to register with the two ports 40 are ways 54 that communicate with groove 53. These ways are so arranged in shaft 50 as to provide communication of both ports 40 with groove 53 in an angular position of shaft 50 that is reached by rotating the shaft a preselected angular distance beyond its second indexed position and in the same direction as its rotation from the position of meshing of worm 25 with gear 24.

Purging usually is an operation that is performed only occasionally. As seen from Fig. 10, the second indexed position of worm-support assembly preferably is alongside the cylinder barrel 20. From these considerations it is regarded as preferable to releasably connect the support shaft, designated 26 in Figs. 10 and 11, to valve shaft 50, so that the latter may be released and rotated to its third position, while support shaft 26 may remain in either of its indexed positions. Referring to Figs. 10 and 11, valve shaft 50 extends through a bearing 57 in the lower part 58 of the frame that supports shaft 26. A lever arm 59 is fixed to the end of shaft 50 and is provided with means releasably securing it to frame part 58. A screw 60 that penetrates lever arm 59 and is threaded into a tapped bore in frame part 58 is shown as a simple and effective means for coupling lever arm 59 to frame part 58 for rotating shaft 50 as the support frame is swung, removal of screw 60 releasing the lever arm from the frame to permit independent rotation of shaft 50 to its third position for purging. Preferably, an index dent is provided for indicating when shaft 50 is in its purge position. As shown, the end of shaft 50 (see Fig. 17) opposite that to which the actuating assembly is mounted, is covered by a plate 61 that has a central portion 62 projecting into the end of valve shaft bore 38 and adjacent the end surface of shaft 50. A spring biased index ball 63 bears on the end surface of shaft 50 and engages a depression properly located in the shaft end to register with ball 63 when the shaft is in its purge position. An arrow 64 also may be applied to the exposed shaft end to indicate purge position.

I claim:

1. A hydraulic piston and cylinder assembly including structure enclosing a cylinder and mounting an output shaft that is rotatable by axial movement of a piston in said cylinder, said housing structure enclosing also a cylindrical valve chamber disposed with its axis parallel to the axis of rotation of said output shaft, and a pair of passages each having an input reach opening outwardly through said structure for connection to one of a pair of supply lines, said passages having output reaches communicating with opposite ends of said cylinder, and each of said reaches entering said valve chamber through a port that is spaced from each other port, a valve body rotatable in said chamber between a first position wherein a pair of passageways provided by said body respectively interconnect the input and output reaches of the respective passages and a second position wherein a passageway provided by said body interconnects said

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output reaches and blocks them from said input reaches, a worm gear secured to said output shaft, a support arm secured to said valve body in radially projecting relation thereto, a worm mounted on said support arm and movable therewith into engagement with said worm gear by swinging of the support arm to move said valve body to its said second position and movable out of engagement with said gear when the support arm is swung to move said valve body to its first said position, and means for rotating said worm.

2. A hydraulic piston and cylinder assembly including housing structure enclosing a cylinder and mounting an output shaft rotatable by axial movement of a piston in said cylinder, said housing structure enclosing a cylindrical valve chamber disposed with its axis parallel to the axis of said output shaft and a pair of passages each having an input reach opening outwardly through said structure for connection to one of a pair of hydraulic lines, said passages having output reaches respectively communicating with opposite ends of said cylinder, and each of said reaches entering said valve chamber through a port that is spaced from each other port, a valve body rotatable in said chamber between a first position wherein a pair of passageways provided by said body respectively interconnects the input and output reaches of said passages, a second position angularly spaced in one direction of rotation from said first position and wherein a passageway provided by said body interconnects said output reaches and disconnects them from said input reaches, and a third position angularly spaced in the opposite direction of rotation from said first position and wherein a passageway provided by said body interconnects said input reaches and disconnects them from said output reaches, a worm gear secured to said output shaft, a support arm mounted on said structure for swinging about the axis of rotation of said valve body, a worm mounted on said support arm and movable therewith into and out of engagement with said worm gear by swinging of said shaft and valve body, releasable means connecting said support arm to said valve body for moving the latter to its second said position when said arm is swung to engage said worm and worm gear, and means limiting swinging movement of the support arm to move the worm away from the worm gear to limit movement of the valve body in the corresponding direction and while connected to said arm to the second said position of the valve body.

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