SINGLE-ACTING PISTON PUMP AND VALVE UNIT

Homer J. Shafer and Benjamin A. Metzger, Mansfield, Ohio, assignors to Shafer Valve Company, Mansfield, Ohio, a corporation of Ohio

Filed Apr. 24, 1956, Ser. No. 580,267

2 Claims. (Cl. 137—624)

The invention relates generally to fluid systems for operating hydraulic motors having piston and cylinder means, and more particularly to a hand piston pump having a control valve for controlling the flow between the pump and a hydraulic motor.

The improved pump and valve unit is particularly adapted for use as a stand-by device for manually operating a hydraulic operator for a valve in a pipe line when the usual source of power for the operator has failed or is not available for any reason. Prior constructions employing a hand wheel for manual operation are slow and difficult to operate for large pipe line valves, and the changeover from power to manual operation usually requires manipulation of several control valves in different locations.

The hand pump of the improved unit is single-acting because the greatest amount of manual power is obtained on the downstroke, and a novel single control valve is part of the same unit so that the pump operator can quickly and easily change the direction of flow to and from the pump. The control valve must be capable of repeated operations in which the direction of flow is changed or reversed, without leakage between the valve ports and the ports leading to and from the pump, and without marring the valve surfaces. A disk or plate type valve is preferable to insure maintaining a positive seal between the various connections.

Another feature to be met is that during a certain part of the manual operation cycle more power with less volume may be required. For example, in opening a large gate valve more power is required to crack the gate open, after which less power with more volume is desirable to accelerate the remainder of the opening cycle, and during the closing cycle the power requirements are reversed.

It is an object of the present invention to provide an improved manual pump and valve unit which obtains maximum efficiency, is easily adjustable to different power requirements, and adjustably controls the direction of flow of fluid to and from the pump.

Another object is to provide an improved pump and valve unit for manually operating a hydraulic motor, said valve unit having a rotatable disk valve and novel port connections selectively making liquid-tight sealing connections with opposite sides of the disk leading to the pump and motor, without scratching or marring the disk.

These objects, and others which will appear from the following specification, are attained by the construction comprising the present invention, a preferred embodiment of which is shown by way of example in the accompanying drawings and described in detail herein. Various modifications and changes in details of construction are comprehended within the scope of the appended claims.

The improved pump and valve unit has a handle lever at one end for applying power on the downstroke to a pump having concentric pistons, with latch means for selectively operating the inner piston alone or in combination with the outer piston, a rotatable disk valve at the other end for controlling fluid flow to and from the pump, and nylon bushings in the connecting ports on opposite sides of the valve disk slidably engaging the valve disk to make liquid-tight sealing connections with the ports in the valve disk.

Referring to the drawings:

Fig. 1 is a longitudinal sectional view of the improved pump and valve unit, with parts in elevation, showing the two pistons interlocked for operating together and taken on line 1—1 of Fig. 3.

Fig. 2 is a fragmentary sectional view similar to Fig. 1, taken on line 2—2 of Fig. 4, showing the inner piston released from the outer piston for operating alone, and partly raised.

Fig. 3 is a bottom plan view of the pistons in interlocked position, taken on line 3—3 of Fig. 1.

Fig. 4 is a bottom plan view of the pistons in separated position, taken on line 4—4 of Fig. 2.

Fig. 5 is a bottom plan view of the unit taken on line 5—5 of Fig. 1, showing the valve control handle in neutral position.

Fig. 6 is a similar view, showing the valve control handle in an operating position.

Fig. 7 is a fragmentary sectional view as on line 7—7 of Fig. 5, showing the nylon bushings slidably abutting opposite sides of the valve disk.

Fig. 8 is a plan sectional view on line 8—8 of Fig. 1.

Fig. 9 is a fragmentary vertical sectional view taken at right angles to Fig. 1, as on line 9—9 of Fig. 13, with the valve disk in neutral position.

Fig. 10 is a similar view, with the valve disk rotated to an operating position, as on line 10—10 of Fig. 14.

Fig. 11 is a sectional view on line 11—11 of Fig. 14.

Fig. 12 is a plan sectional view on line 12—12 of Fig. 9.

Fig. 13 is a plan sectional view on line 13—13 of Fig. 9.

Fig. 14 is a similar view with the valve disk rotated to the operating position, as on line 14—14 of Fig. 10.

Fig. 15 is a plan sectional view on line 15—15 of Fig. 9.

Fig. 16 is a similar view with the valve disk rotated to the operating position, as on line 16—16 of Fig. 10.

Fig. 17 is a plan sectional view on line 17—17 of Fig. 9.

Fig. 18 is a bottom plan sectional view on line 18—18 of Fig. 9.

Fig. 19 is a bottom plan sectional view on line 19—19 of Fig. 9.

The housing of the unit is preferably made in three sections held in abutting relation by means of four bolts passing through the corner portions of the sections. The upper section 11 constitutes the pump cylinder, the lower section 12 comprises the housing for the control valve disk, and the intermediate section 13 houses the check valves for the pump suction and discharge and the connections thereto. As shown in Figs. 3 and 4, the bottom flange portion 14 of the pump housing is substantially square in cross section, as is the intermediate section 13 and the lower section 12 (Figs. 4 and 5).

When used for operating a hydraulic operator for a pipe line valve, the unit is mounted in an upright position on the operator, and for this purpose transverse mounting bolts 15 may be tapped into the flange 14 and an upper flange 16 on the pump cylinder.
the stroke of the handle, by screwing the upper part 28' into the lower part 28 and providing a locknut 31 on the upper part.

Around the outer piston 19 in the upper end of the housing 20 are three longitudinally spaced rings; the inner ring 33 being an O-ring to provide a seal, and the upper and lower rings 34 being wiper rings preferably L-shaped in cross section and made of oil-resistant material such as neoprene. Around the lower end of piston 19 is a felt wiper ring 35. Similarly, the inner piston 18 is encircled by three radially spaced circular grooves in the upper end of the outer piston 19, the middle ring 33 being an O-ring and the upper and lower rings 34 being wiper rings, and the piston has a felt wiper ring 35' around its lower end.

The upper wiper ring 34' is positioned under a metal cap ring 36 secured on the upper end of piston sleeve 19 by screws 37. A handle lever 38 extends laterally from cap ring 36, as shown in Fig. 8, for rotating the piston 19 through 90° to interlock its lower end with the housing 11 and at the same time release it from piston 18 to allow piston 18 to be operated alone.

Normally, the pistons 18 and 19 are operated in unison to pump a maximum volume of fluid, and the normal position is shown in Figs. 1 and 3. The bottom end of piston sleeve 19 has diametrically opposite L-shaped projections 40 which are adapted, in the position of Figs. 2 and 16, to engage circumferential flanges 41 on a ring 42 secured in the bottom end of the pump cylinder and which register with slots 43 in flanges 41 in the position of Figs. 1 and 3. Thus, in the normal position the piston sleeve 19 is free to slide axially in the pump cylinder and in the position of Figs. 2 and 4 it is interlocked therewith.

On their inner surfaces the projections 40 have semicircular recessed ribs 44 which, in the position of Figs. 1 and 3, engage and interlock with diametrically opposite flanges 45 forming the bottom of an inverted T-shaped projection on the bottom of piston 18. When the piston 19 is rotated 90° to the position of Figs. 2 and 4, the projections 40 and the flanges 41 move axially in the opposite direction, by engagement with one of the ribs 44.

Accordingly, if it is desired during any part of the operation cycle to produce more pressure with the pump at the sacrifice of less volume, the operator need only complete a downstroke of the pump handle 24 and then rotate the lever 38 90° in a clockwise direction, as viewed in Fig. 8, which locks or latches the outer piston 19 to the housing and releases the inner piston 18 to operate alone as in Fig. 2.

During each downstroke of the pump fluid is forced through port 48 in housing section 13, unseating ball check 49 and closing ball check 50. Fluid passing around ball check 49 passes through port 51 to the valve disk 52 which is suitably ported to conduct the fluid to an exhaust connection 72 on the exterior of the housing. On the upstroke of the pump fluid is sucked from the valve disk and port 53, unseating ball check 50 and closing ball check 49, and thence into the pump cylinder. Suction connections 54 and 54' (Figs. 5 and 6) supply the valve disk compartment with fluid. If desired, the ball checks 49 and 50 can be made of nylon which has sufficient resiliency to improve the seal of the ball on its seat.

The pump pistons are single-acting so that the pressure is delivered on the downstroke of the pump handle during which the greatest manual force is exerted. This simplifies the fluid connections to and from the pump.

The particular porting arrangement in valve disk 52 forms no part of the present invention, because such arrangement may be varied to suit particular requirements. For example, the valve disk may have two positions for controlling flow to and from the pump through separate suction and exhaust connections, and an intermediate neutral position in which flow to and from the pump is shut off. Such an intermediate position is shown in Figs. 1, 9 and 13.

The means for rotating the valve disk 52 to a selected position preferably includes a hand lever 56 having a clevis pivoted on a cross pin 57 in the lower projecting end of the shaft 58 on the upper end of which the valve disk 52 is non-rotatively mounted. Downward swinging movement of lever 56 is resisted by a nut 59, on the bottom end of a spring-pressed plunger 60, the upper end of which enters a socket 61 when the valve disk 52 is in neutral position. The plunger 60 extends through an arcuate slot 62 in the lever 56 and a washer 63 above the nut 59 is slidable laterally on a ledge surrounding the slot. Thus, the lever can be rotated in either direction from neutral position to selected positions determined by the ends of the slot. One such position is shown in Fig. 6. When the washer 63 is at either end of the slot 62, the upper end of plunger 60 is in a circular hole or socket (not shown) in the valve disk circumferentially spaced from socket 61, to maintain the disk in selected position.

Means for maintaining the hand lever 56 in any selected position is provided. An arcuate slot 62 in the lever 56 extends into a slotted plate 65 secured on the bottom of the housing when the valve is in the neutral position of Figs. 1 and 5. In order to swing the lever 56 in either direction it is necessary to press downwardly on lever 56 sufficiently to withdraw the lug 64 from plate 65 and to continue to hold the lever 56 down while swinging it laterally. After lever 56 is swung to a position such as shown in Fig. 6 and released, the lug 64 will be positioned between plate 65 and one of the bosses 66 on the bottom of housing section 12, and thus prevent lateral swinging of the lever 56 without first pressing it downwardly against the action of the spring plunger 60.

As shown in Figs. 1 and 7, the connecting ports on opposite sides of the valve disk 52 have nylon bushings slidably abutting the surfaces of the disk. The bushings 68 preferably have annular flanges 69 on their inner ends abutting the disk surface, and are backed up by springs 70 urging them against the disk. The bushings have a loose or sloppy fit in the ports in which they are positioned, and small O-rings 71 are located around the bushings behind the annular flanges 69 and form seals between the bushings and the ports.

The nylon bushings have a certain amount of resiliency and their loose fit in the ports allows the flanges 69 to conform to slight irregularities on the surfaces of the valve disk, when urged against the disk by the springs. Moreover, the nylon has the property of picking up and absorbing tiny particles of grit on the metal surface of the valve disk, which grit would otherwise mar the metal surface, and ultimately affect the seal between the valve disk and connecting ports. After a prolonged period of use, the nylon bushings may be easily replaced without requiring refacing or replacement of the valve disk.

As shown in Fig. 7, the valve disk is abutted on opposite surfaces by the nylon bushings, so that the disk always rotates slidably between the annular flanges of the nylon bushings, thus preventing metal-to-metal contact with the surfaces of the valve disk.

The construction and operation of the valve disk 52 is illustrated in Figs. 9 to 19. Referring first to Figs. 9 and 13, assume that connection 54 is connected to the normal operating fluid under pressure, and connection 72 is connected to the pressure side of a hydraulic motor for operating it in one direction, while connection 72' is connected to the exhaust side of the motor and connection 54' is connected to the exhaust line. Fluid under pressure
enters connection 54 and passes through the port 73 in housing 12, the port 74 in the valve disk, and thence through port 75 in housing section 13 to pressure connection 72. Fluid exhausting from the motor passes part of the disk, and in this position of the disk port 82 is connected to port 75 in housing section 13. Thus the fluid expelled by the pump on the downstroke is delivered to connection 72 and thence to the pressure side of the motor.

Fluid exhausting from the motor passes through exhaust connection 72' and port 75' in the housing section 13, through port 83' in the disk and port 73' to the exhaust line connection 54'. (See Fig. 10.)

When the lever 56 is shifted to the opposite position from that in Figs. 14 and 16, to reverse the flow through the motor for hand pump operation, the unnumbered ports in the valve disk function in a similar manner to the corresponding numbered ports to control the flow.

The improved pump and valve unit is compact and easy to assemble and disassemble, and provides easily accessible means for adjusting the power delivered by the pump and for controlling the direction of fluid flow to and from the pump.

What is claimed is:

1. A valve unit for controlling the flow to a piston pump connected to the pressure side of a hydraulic motor and from the other side of the motor to exhaust, comprising a housing having pump connections at one end and motor connections at the other end, a disk valve axially rotatable in said housing between the pump connections and the motor connections, said disk having ports opening on opposite faces for registering with said pump and motor connections, means for axially rotating said disk to selectively control fluid flow between the pump and motor connections, and nylon bushings fitted loosely in the connections to opposite sides of said disk, said nylon bushings each having an outturned annular flange overlying its connection and slidably abutting the disk, and an O-ring surrounding the bushing behind the flange.

2. A valve unit for controlling the flow to a piston pump connected to the pressure side of a hydraulic motor and from the other side of the motor to exhaust, comprising a housing having a valve compartment intermediate its ends, one end of said housing having pump conduits leading longitudinally into one end of said compartment and the other end of said housing having motor conduits leading longitudinally into the opposite end of said compartment, a disk valve axially rotatable in said compartment and having ports on opposite sides for registering with said pump and motor conduits, means for axially rotating said disk valve to selectively control fluid flow between said pump and motor conduits, nylon bushings fitted loosely in said pump and motor conduits and having outturned annular flanges overlying said conduits and slidably abutting said disk valve to space the disk valve from the ends of said compartment, an O-ring surrounding each bushing behind said flange, and a spring urging each flange into abutment with said disk valve.

References Cited in the file of this patent

UNITED STATES PATENTS

2,083,854 McGee ........................ June 15, 1937
2,165,096 Frechette ........................ July 4, 1939
2,564,445 Parsons ........................ Aug. 14, 1951
2,706,532 Ringo et al. .................... Apr. 19, 1955