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 [21] Appl. No. **813,012**
 [22] Filed **Apr. 3, 1969**
 [45] Patented **Oct. 5, 1971**
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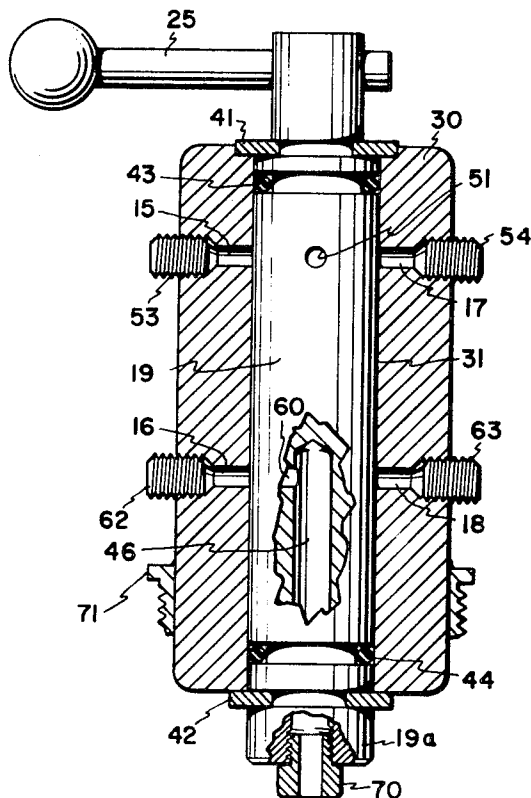
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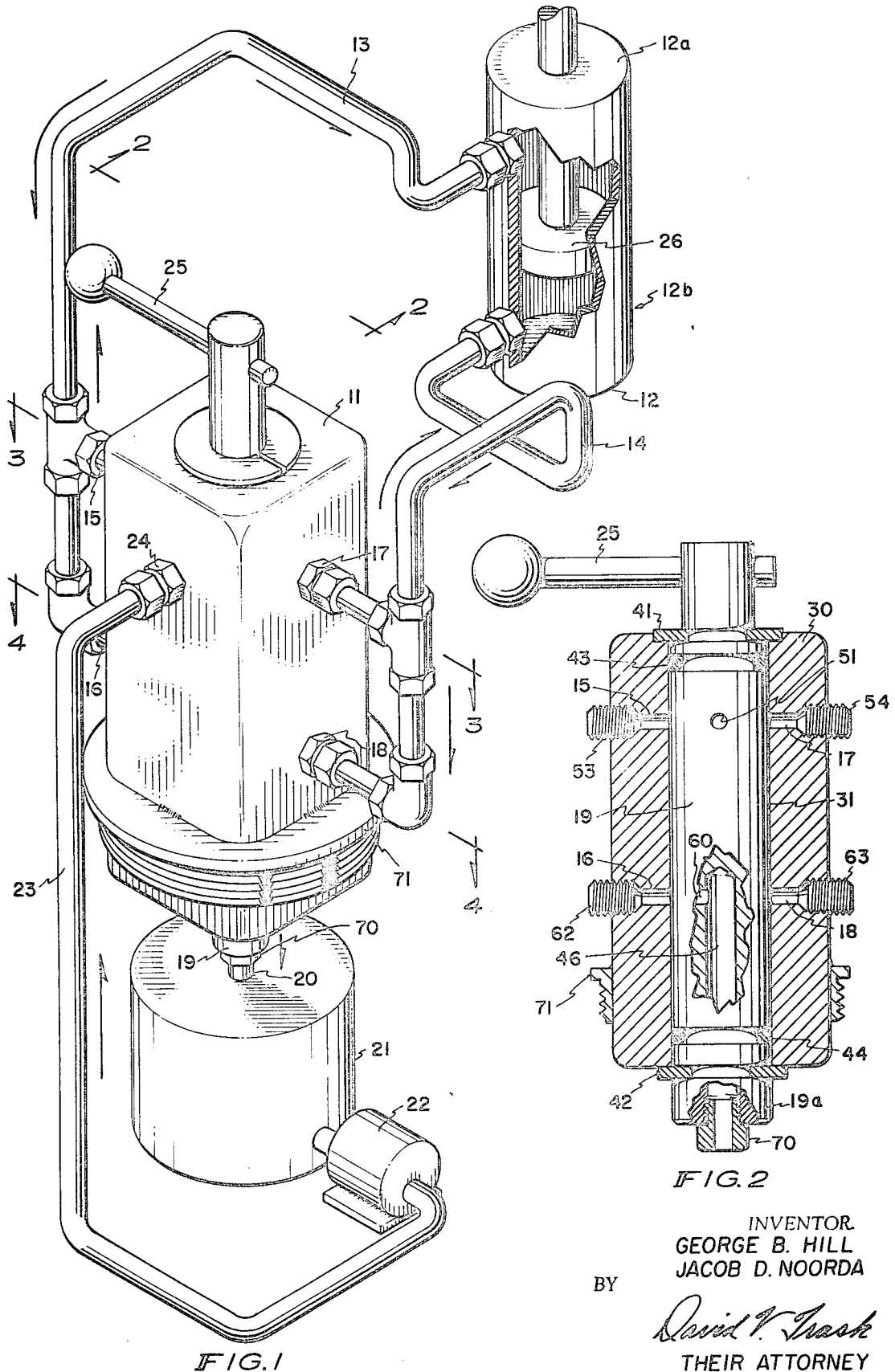
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[54] **FOUR-WAY HYDRAULIC VALVE**
7 Claims, 6 Drawing Figs.

[52] U.S. Cl. 137/625.23
 [51] Int. Cl. F16k 11/02
 [50] Field of Search 137/625.17,
 625.18, 625.19, 625.21, 625.22, 625.23, 625.24

ABSTRACT: A valve for use in hydraulic systems is constructed with a body member and a stem member having corresponding lateral bores which may be brought into alignment or blocked in selected relationship by rotating the stem between two established positions to reverse the direction of flow in a pair of hydraulic lines. The stem is provided with a longitudinal exhaust bore thereby eliminating the need for milled grooves on the valve stem.





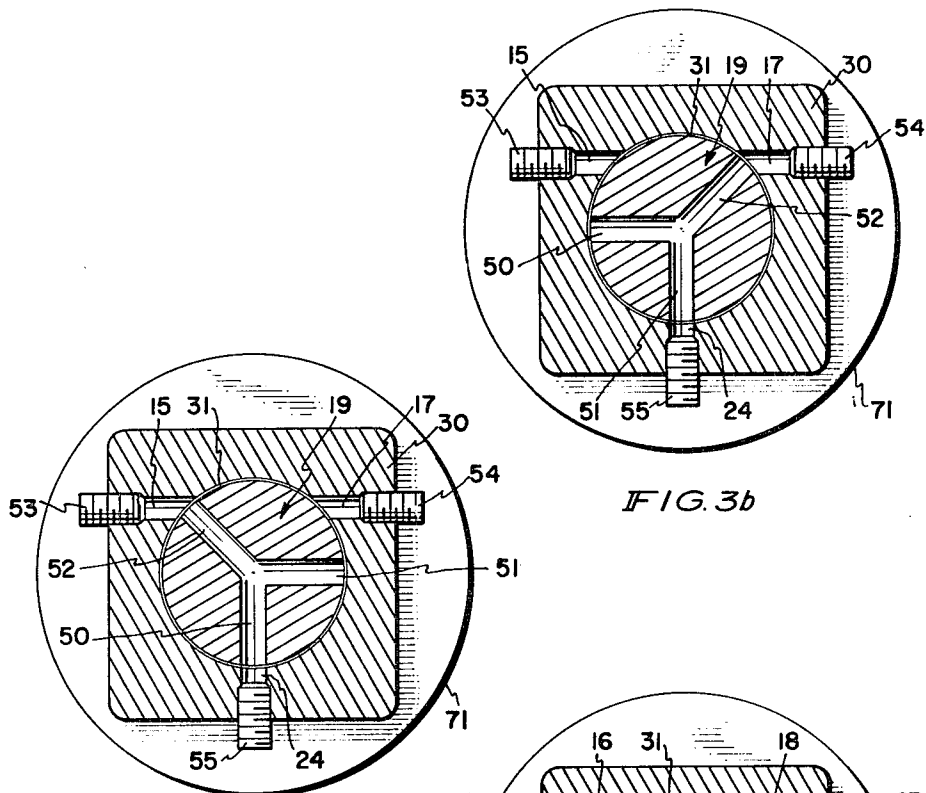


FIG. 3a

FIG. 3b

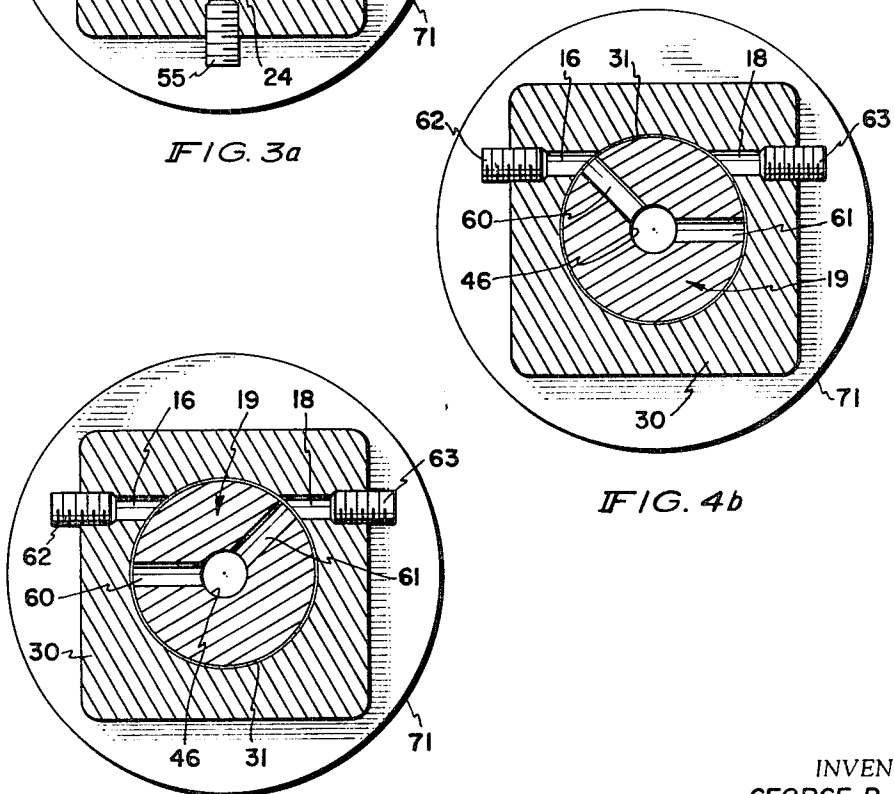


FIG. 4a

FIG. 4b

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FOUR-WAY HYDRAULIC VALVE

BACKGROUND OF THE INVENTION

1. Field

This invention relates to valves, notably hydraulic control valves, and provides a novel, four-way, hydraulic valve.

2. State of the Art

Hydraulic systems, including four-way valves, are well known. The four-way valves in such systems function to reverse the direction of flow of hydraulic fluid in a pair of hydraulic lines communicating with a hydraulic cylinder on opposite sides of a piston mounted therein. Such valves tend to be rather intricate, requiring a milled valve stem. A valve stem without external grooves would be simpler and less expensive to machine and would permit the assembly of a less intricate valve structure.

SUMMARY OF THE INVENTION

The present invention provides an improved, four-way, hydraulic valve comprising a body member adapted to receive a valve stem member with an internal, longitudinal, discharge bore at one end. The body member and valve stem have corresponding sets of lateral bores which may be aligned, according to the rotational position of the valve stem, to provide various flow paths through the valve. The body member conveniently includes an inlet port and a plurality of supply ports which can communicate with the inlet port only through the valve stem. In a first position of the valve stem, fluid introduced to the valve through the inlet port is passed to exit the valve through a first supply port; fluid is returned to the valve through a first exhaust port and is passed by the valve stem through the aforementioned, longitudinal discharge bore. In a second position of the valve stem, fluid introduced through the inlet port is passed to exit the valve through a second supply port; fluid is returned to the valve through a second exhaust port and is passed through the longitudinal discharge bore. The valve stem may have additional positions if more elaborate flow control is required, but two positions are all that is required for conventional, four-way control. Any supply ports or discharge ports not required for fluid transport when the valve stem is in one of its selected control positions are automatically closed or blocked off by the valve stem.

The valve stem is conveniently inserted in a longitudinal, cylindrical bore within the body member of the valve and the annular space between the stem and body member may be packed in conventional fashion at regions embracing the lateral bores with known types of valve packing. By eliminating all milled grooves on the outside surface of the valve stem, the structure of the valve stem required for the exhaust of hydraulic fluid from an associated hydraulic cylinder is very much simplified. The longitudinal exhaust bore also makes it possible to regulate flow by the emplacement of various sizes of orifice plugs in the bore.

DESCRIPTION OF THE DRAWINGS

In the drawings, which illustrate what is presently regarded as the best mode for carrying out the invention:

FIG. 1 is a schematic pictorial illustration showing the invention as a component of a typical hydraulic system.

FIG. 2, a partial view in section, partially broken away, taken along the line 2—2 of FIG. 1.

FIG. 3a, a partial view in section taken along the line 3—3 of FIG. 1, corresponding to a first valve stem position;

FIG. 3b, a similar view corresponding to a second valve stem position;

FIG. 4a, a partial view in section taken along the line 4—4 of FIG. 1, corresponding to the valve stem position of FIG. 3a; and

FIG. 4b, a similar view, corresponding to the valve stem position of FIG. 3b.

DESCRIPTION OF THE ILLUSTRATED EMBODIMENT

A four-way valve 11 of this invention is illustrated by FIG. 1 in its normal, installed configuration connected to opposite ends, 12a and 12b, of a hydraulic cylinder 12, by hydraulic lines 13 and 14, respectively. The hydraulic line 13 is connected to a supply port 15 and an exhaust port 16 (see FIG. 2) of the valve while the hydraulic line 14 is connected to a supply port 17 and an exhaust port 18 (see FIG. 2) of the valve. Discharge from the valve is through valve stem 19 and a suitable fluid conductor 20 to a reservoir 21. Hydraulic fluid is delivered from the reservoir 21 through a pump 22 and a line 23 to an inlet port 24.

The valve stem 19 is rotated by a handle 25 between first and second positions. In the first position, fluid introduced to the valve through inlet port 24 passes out supply port 15, through line 13 to one end 12a of the hydraulic cylinder 12 to drive the piston 26 toward the opposite end 12b of the cylinder, thereby exhausting fluid through the line 14. The exhausted fluid passes through exhaust port 18 and discharges through the valve stem 19. When the valve is turned to its second position, hydraulic fluid introduced to the valve through inlet port 24 is directed out supply port 17 through hydraulic line 14 into the end 12b of the cylinder 12 to drive the piston 26 toward the opposite end 12a of the cylinder, thereby exhausting hydraulic fluid through line 13 into exhaust port 16 for discharge through the valve stem 19.

Preferred structural details of the claimed valve assembly are illustrated by FIGS. 2 through 4. As illustrated, the valve comprises a body member 30 with a longitudinal cylindrical bore 31 therethrough. The three delivery ports 15, 17, and 24, respectively, referred to in connection with FIG. 1, extend transversely from spaced locations at the outside surface of the body member 30 to openly communicate with the longitudinal bore 31 as shown by FIG. 3. The two exhaust ports, 16 and 18, respectively, extend transversely from spaced locations at the outside surface of the body member into communication with the longitudinal bore 31 as shown by FIG. 4.

As illustrated, all of the delivery ports are approximately lateral bores lying in a common plane, while the exhaust ports are approximately lateral bores lying in a second plane approximately parallel the plane defined by the delivery ports. Substantial deviation from this arrangement is permissible, provided the exhaust ports communicate with the longitudinal bore on a common side of the plane defined by the intersections of the delivery ports with the cylindrical bore 31.

The valve stem 19 is installed in the body member 30 in conventional fashion, as illustrated by FIG. 2, with conventional stop washers 41 and 42 and packing rings 43 and 44. The packing rings are desirably located as shown such that the communication of all delivery and exhaust ports with the cylindrical bore 31 are embraced between sealed annular regions. Rotational force is applied to the stem as needed by the handle 25.

A longitudinal discharge bore 46 extends from the end 19a of the valve stem 19 opposite the handle 25 into the valve stem for a portion of its length. The stem is further provided with lateral fluid-passing means, such as the illustrated lateral stem bores, 50, 51, and 52, FIG. 3, and 60 and 61, FIG. 4, arranged to be brought into alignment with the ports in the body member as illustrated by FIGS. 3 and 4. FIG. 3a and FIG. 4a illustrate the orientation of the lateral stem bores in a first position of the valve stem while FIGS. 3b and 4b illustrate the orientation of the lateral bores in a second position of the valve stem as in FIG. 2.

As illustrated, the two control positions of the valve stem are separated by approximately 90 degrees so that the valve stem is rotated about one-quarter turn to reverse the direction of flow of hydraulic fluid. The locations and directions of the lateral bores in the body member and valve member may be altered appreciably from the illustrated embodiment, it being necessary only that the appropriate bores of the stem are brought into alignment with the appropriate bores of the body

member when the stem member is in one of its control positions.

Referring to FIG. 3, the portion of the valve stem 19 adjacent the delivery ports 15, 17, and 24 of the body member 30 is provided with three, approximately lateral, transverse bores 50, 51 and 52, respectively, which communicate with each other internal the valve stem and extend to the surface of the valve stem as shown. The longitudinal stem bore 46 terminates out of communication with these bores. Each of the delivery ports 15, 16, and 24, is provided with an appropriate nipple 53, 54, and 55, respectively, for the attachment of hydraulic fluid lines. The delivery port 24 serves as the inlet port for hydraulic fluid, both when the valve stem is in its first position as illustrated by FIG. 3a and when it is in its second position as illustrated by FIG. 3b.

In the first position of the valve stem (FIG. 3a), hydraulic fluid is delivered by a hydraulic line (23, FIG. 1) through nipple 55 and supply port 24 into the stem bore 50. It then flows out stem bore 52 through delivery supply port 15 and nipple 53 to a hydraulic line 13 (FIG. 1) for delivery to one end 12a of a hydraulic cylinder 12. In its second position (FIG. 3b), hydraulic fluid introduced through the hydraulic line 23 is delivered through nipple 55 and port 24 as before, but enters the lateral stem bore 51. It thus flows out via lateral stem bore 52 through delivery port 17 and nipple 54 to hydraulic line 14 (FIG. 1) for delivery to the opposite end 12b of the hydraulic cylinder 12. In its first position, the valve stem blocks the delivery port 17 while in its second position it blocks the delivery port 15.

As illustrated by FIG. 4, the region of the valve stem adjacent the exhaust ports 16 and 18 of the body member 30 is provided with two, approximately lateral, transverse bores 60 and 61 which communicate with the longitudinal discharge bore 46 in the valve stem 19 and extend to the surface of the valve stem to communicate such that the stem bore 61 communicates with the exhaust port 18 when the valve stem is in its first position (FIG. 4a) and the stem bore 60 communicates with the exhaust port 16 when the valve stem is in its second position (FIG. 4b). The exhaust ports 16 and 18 are provided with appropriate nipples 62 and 63, respectively, for attachment to hydraulic lines 13 and 14, respectively, (FIG. 1).

With the valve stem in its first position, whereby hydraulic fluid is delivered to the end 12a of the cylinder 12 as previously explained, hydraulic fluid is exhausted from the cylinder through hydraulic line 14 into exhaust port 18 via nipple 63 for discharge through the stem bore 61 and discharge bore 46. In this position, the valve stem blocks exhaust port 16. When the valve stem is in its second position, to introduce fluid to the opposite end 12b of the cylinder 12, hydraulic fluid is exhausted from the cylinder through hydraulic line 13 into exhaust port 16 through nipple 62 for discharge through the stem bore 60 and discharge bore 46. In this position, the valve stem blocks port 18.

If desired, orifice means 70 of selected orifice size may be provided in the end 19a of the valve stem to fix the effective diameter of the discharge bore 46. Preferably, the orifice means is interchangeable to permit emplacement of selected orifice sizes in the bore. A hydraulic line may be connected to the discharge bore 46, but it is often preferred that the valve be mounted to a reservoir by a suitable threaded connection 71. Because of its compact construction, the four-way valve of this invention is particularly suitable for incorporation in compact units of conventional type including a mechanical pump, oil sump, and control valve.

Reference herein to details of the illustrated embodiment is not intended to limit the scope of the claims which themselves recite those features regarded as essential to the invention. Many modifications to the illustrated valve will be suggested by this disclosure to those skilled in the art.

We claim:

1. A valve comprising:

a body member with:

a longitudinal, bore therethrough,

a set of three, transverse delivery ports extending from spaced locations at the outside surface of the body member into communication with said longitudinal bore, and

a set of two, transverse exhaust ports, extending from spaced locations at the outside surface of the body member into communication with said longitudinal bore on a common side of the plane defined by the intersections of the delivery ports with the longitudinal bore;

a stem member rotatably mounted within said longitudinal bore with:

first transverse fluid-passing means arranged to openly connect two while blocking the third of said three delivery ports when the stem is in a first position and to openly connect the third said port with one while blocking the other of the remaining two of the three said delivery ports when the stem is in a second position,

a longitudinal discharge bore from one end of said stem terminating out of communication with said first transverse fluid-passing means,

second transverse fluid-passing means arranged to openly connect the first said exhaust port to said discharge bore while blocking the second said exhaust port when the stem in said first position and to connect the second said exhaust port to the discharge bore while blocking the first said exhaust port when the stem is in said second position, and

means at the end of the stem opposite said discharge bore for rotating the stem within the longitudinal cylindrical bore in said body member; and

means for sealing the annular space between the stem and body at regions embracing said delivery and exhaust ports.

2. A valve according to claim 1 wherein the three transverse delivery ports are arranged with respect to the first fluid-passing means in said stem such that one of said delivery ports functions as the inlet port for said valve for both said positions of the valve stem.

3. A valve according to claim 2 wherein the delivery ports and fluid-passing means are approximately lateral bores.

4. A valve according to claim 1 including interchangeable orifice means for emplacement in said longitudinal discharge bore.

5. A valve according to claim 1 wherein the longitudinal bore through the body member is approximately cylindrical.

6. A valve according to claim 1 wherein the means for sealing the annular space between the stem and body comprises packing means.

7. A valve according to claim 1 wherein the longitudinal bore through the body member and the stem member mounted within said longitudinal bore are substantially cylindrical, the means for sealing the annular space between the stem and body comprises packing means, and the delivery ports and fluid-passing means are approximately lateral bores.