

[54] HYDRAULIC MANIFOLD SYSTEM

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[51] Int. Cl. F17d 1/00

[58] Field of Search 137/608, 454.5;
251/360, 363, 316; 285/175; 287/60

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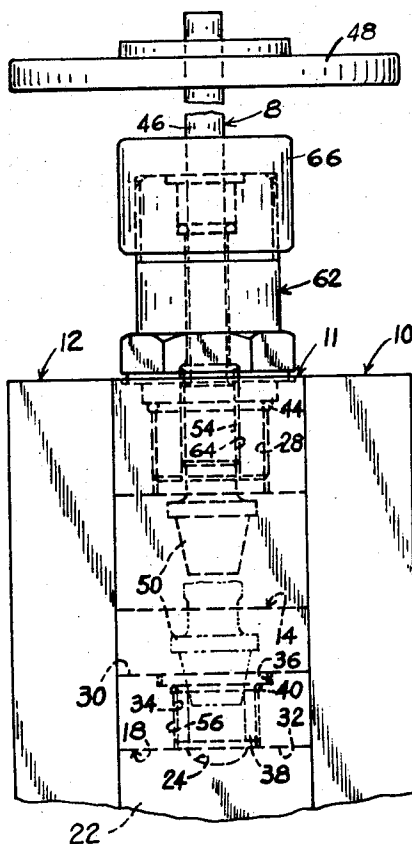
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[57] ABSTRACT

Improvement in a hydraulic manifold system having a hydraulic manifold having a hydraulic circuit therein providing hydraulic service external to said manifold, said circuit including a pair of manifold passages, a set of interconnecting passages intersecting each said manifold passage, a set of valves in each said manifold passage operative therein, respectively, at the intersections with the respective interconnecting passages, said improvement comprising said hydraulic manifold having means for mounting a plurality of hydraulic units thereon, two service ports for each said hydraulic unit, said service ports arranged in two sets intersecting, respectively, the two sets of interconnecting passages so as to provide both upstream hydraulic service to and downstream service from said hydraulic units wherein one of said manifold passages and the respective set of service ports therefor pass upstream flow of hydraulic liquid to said hydraulic units while the other manifold passage and the respective set of service ports therefor pass downstream flow of hydraulic liquid from said hydraulic units, whereby either or both of the upstream and downstream flows to any of said hydraulic units can be controlled without interfering with the respective flows to or from the other hydraulic units.

6 Claims, 5 Drawing Figures



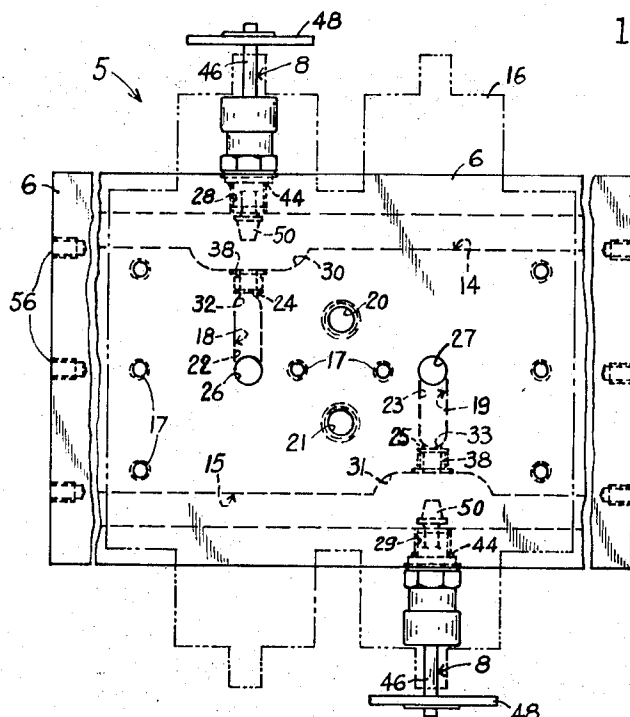


Fig. 2

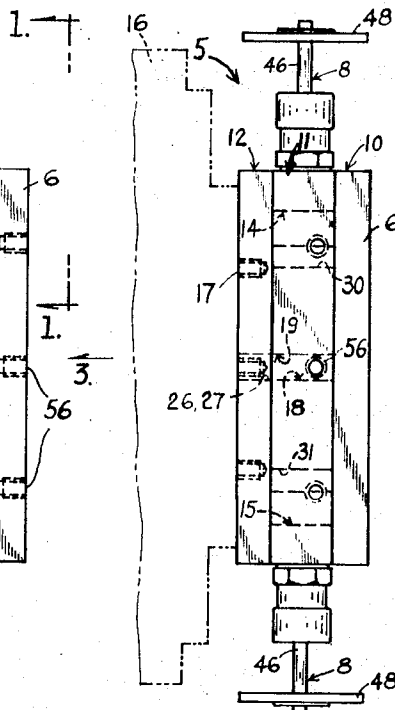


Fig. 3

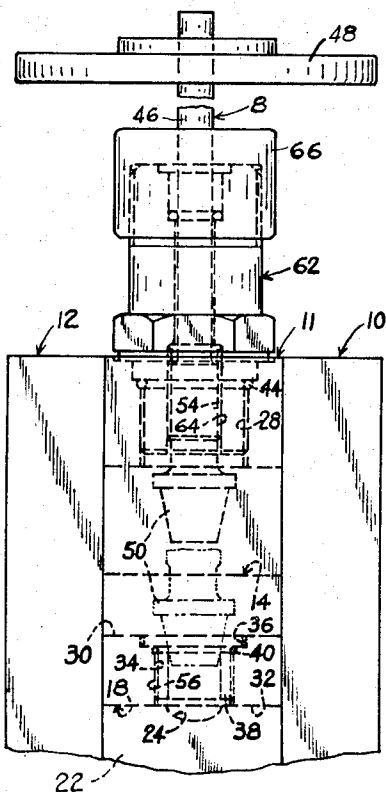


Fig. 1

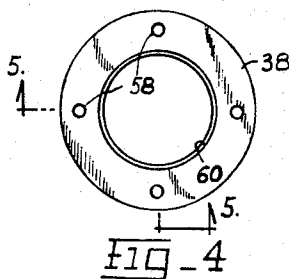


Fig. 4

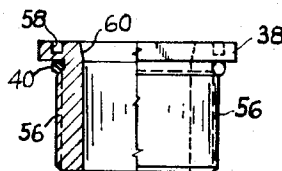


Fig. 5

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HYDRAULIC MANIFOLD SYSTEM

My invention relates to hydraulic manifolds.

The principal object of my invention is the provision of a hydraulic manifold system which incorporates therein flow control valve means having a novel construction providing a number of advantages including minimal pressure drop thereacross.

The foregoing object of my invention and the advantages thereof will become apparent during the course of the following description, taken in conjunction with the accompanying drawings, in which:

FIG. 1 is an enlarged side elevational view of a portion of the structure of FIG. 2 taken along the line 1—1 thereof;

FIGS. 2 and 3 are, respectively, top plan and side elevational views of a hydraulic manifold system embodying my invention; and

FIGS. 4 and 5 are, respectively, top plan and front elevational views of valve seat means employed in said system.

Referring to the drawings in greater detail, 5 generally designates said hydraulic manifold system which comprises, in combination, a hydraulic manifold 6 having therein an oil-directing hydraulic circuit and a pair of flow control valve means 8 controlling the flow of oil in said hydraulic circuit. Said hydraulic manifold 6, in the instance, is a brazed hydraulic manifold consisting of at least two metal layers and, in the instance, three metal layers 10 - 12 brazed together face to face. Said hydraulic circuit, in the instance, comprises manifold pressure and return oil passage means 14 and 15, respectively. Said pressure oil passage means 14 communicates upstream with inlet port means (not shown) for said hydraulic manifold 6 into which is forced pressure oil from a hydraulic pump (not shown) and which feeds with such pressure oil one or more multi-way directional valves 16 mounted via mounting apertures 17 upon the top face of the hydraulic manifold 6. Said return oil passage means 15 communicates downstream with outlet port means (not shown) for said manifold 6 and accepts return oil from the directional valves 16 and feeds such return oil to said outlet port means. Said hydraulic circuit also comprises for each directional valve 16 inlet and outlet oil passage means 18 and 19, respectively, communicating with oil passage means 14 and 15, respectively, and a pair of oil passages 20 and 21. Said inlet and outlet oil passage means 18 and 19 comprise, respectively, oil passages 22, 24, 26 and 23, 25, 27. In constructing said hydraulic manifold system 5, a part of said hydraulic circuit is formed in said hydraulic manifold 6 prior to brazing and a part thereof is formed subsequent to brazing. Oil passage means 14 and 15 including the transversely widened portions 30 and 31 thereof, respectively, in the locations of the flow control valves and oil passages 22 and 23 are cut in the metal layer 11 prior to brazing of the hydraulic manifold 6. Said oil passage means 14, 15 and oil passages 22, 23 are drilled at the ends thereof vertically through the metal layer 11 prior to such cutting, as shown and indicated at 32 and 33, respectively, for the oil passages 22 and 23, respectively. The oil passage means 14 and 15 and the oil passages 22 and 23 are straight walled oil passageways from being cut rather than drilled. The oil passage means 20 and 21 are drilled subsequent to brazing vertically clear through said hydraulic manifold between the top and bottom faces thereof and are pipe

tapped at the bottom ends thereof for connecting to hydraulic fittings and tubing leading to a hydraulic work device (not shown) remote from the hydraulic manifold and controlled by the respective directional valve 16. The oil passages 24 and 25 are drilled in the metal layer 11 subsequent to brazing inwardly from the rear and front faces, respectively, of the hydraulic manifold 6 until they intersect the cut inlet and outlet oil passage means 18 and 19, respectively. The oil passages 26 and 27 are drilled subsequent to brazing vertically inwardly from the top face of the hydraulic manifold 6 through the metal layer 12 until they intersect the cut inlet and outlet oil passage means 18 and 19, respectively. Passage means 28 and 29 which are not oil passages are drilled in the metal layer 11 subsequent to brazing inwardly from the rear and front faces, respectively, of said hydraulic manifold 6 until they intersect the cut oil passage means 14 and 15, respectively, and are tapped with straight female threads to threadably engage straight male threads on the valve body 62 of each flow control valve 8. Said male threads are provided on the lower end of each valve body 62, the upper end of which threadably engages a packing nut 66. Passages 20, 21, 24, 25, 26, 27, 28 and 29 are cylindrical walled passageways from being drilled. The oil passages 24 and 25, respectively, are doubly counter bored, as shown at 34 and 36 for the oil passage 24 to accommodate valve seat means 38. The counter bores 113 are each tapped with straight lefthand female threads to threadably engage straight lefthand male threads 56 on each valve seat means 38 for purpose which will appear. Each valve seat means 38 is provided with liquid tight seal means in the form of an O-ring 40 disposed around the outside cylindrical wall thereof behind the front flange thereof and ahead of the threads 56 thereon and with special wrench-engaging means 58 for tightening and loosening the respective valve seat means 38 in its respective threaded counter bore 34. Each flow control valve 8 has a valve stem 46 and is similarly provided with liquid-tight seal means in the form of an O-ring 44 disposed around the outside cylindrical wall of the lower portion of the valve body 62 ahead of the straight male threads thereon. The passage means 28 and 29, respectively, are tapped with straight righthand female threads to threadably engage said straight male threads on the lower end of each valve body 62. Said lower portion of the valve body 62 is provided with straight righthand female threads 54 which threadably engage straight righthand male threads 64 on said valve stem 46 by which the latter is moveable axially in respect to the valve body 62 upon manual rotation of a handwheel 48 fast on the rear end of said valve stem 46. the front end of said valve stem 46 carries fast thereon a tapered valve element 50 which operates transversely of the respective oil passage means 14 and 15 for seating against a tapered annular valve seat 60 formed on the upper portion of the I.D. of each valve seat means 38.

In mounting each directional valve 16 upon the top face of the hydraulic manifold 6 the inlet and outlet ports of the directional valve 16 are in communication, respectively, with the oil passages 26 and 27 and the control ports thereof are in communication with the oil passages 20 and 21. The pair of flow control valves 8 provided for each directional valve 16 close off oil flow from the oil passage means 14 and 15, respectively, into the inlet and outlet oil passage means 18 and 19,

respectively, for the respective valve 16 when the latter is taken out of service for any reason, as for example, to demount the same from the hydraulic manifold 6 for repair or replacement purposes. No oil will be lost from the system nor will the operation of the other directional valves be affected while the respective directional valve 16 is demounted.

In assembly of said hydraulic system 5, after the hydraulic manifold 6 is constructed, as described, the pair of valve seat means 38 for each directional valve 16 is inserted into and through the threaded passage means 28 and 29, and the oil passage means 14 and 15, respectively, and each valve seat means 38 is tightened and water-tight sealed in its respective threaded bore 34 by rotating it counter-clockwise in accordance with the lefthand threads thereon by means of a special wrench for handling each said valve seat means 38 which has a plurality of projections thereon for engaging the plurality of depressions 58 which are inwardly formed in the front face of the front flange of said valve seat means 8. After tightening and water-tight sealing each valve seat means 38 in the respective threaded bore 34 sealed in its respective threaded passage means 28 or 29 and the valve stem 46 operated and tested so that its respective plug element 50 properly engages the valve seat 60 on the respective valve seat means 38.

In operation of said hydraulic manifold system 5, on the power stroke of the work device for each directional valve 16, hydraulic oil is pumped from a hydraulic reservoir into the inlet port means for the hydraulic manifold 6 and thence into the oil passage means 14. If desired, the hydraulic pressure oil entering the oil passage means 14 may be filtered by oil filter means which includes a filter cavity built in the interior of the manifold 6 or in a separate housing mounted on the top face of said hydraulic manifold 6 in accordance with my copending continuation -in-part patent application Ser. No. 44,231 filed June 8, 1970, now U.S. Pat. No. 3,667,603. The hydraulic pressure oil delivered to the oil passage means 14 on the upstream side of the respective directional valve 16 divides and one part thereof enters the inlet oil passage means 18 for the latter when the respective flow control valve means 8 is open and the other part thereof continues to flow downstream from the respective directional valve 16 in the oil passage means 14 to feed in like manner the next subsequent directional valve 16 with hydraulic pressure oil. When the respective flow control valve means 8 is closed, all of the hydraulic pressure oil continues downstream in the oil passage means 14 to feed the next subsequent directional valve 16 with hydraulic pressure oil. The hydraulic pressure oil which enters the inlet oil passage means 18 for each directional valve 16 enters the latter through the inlet port means thereof and exits therefrom via one of the control ports thereof and also exits from the hydraulic manifold 6 through one of the passages 20 or 21 to one side of the respective work device. The return oil from the work device enters the hydraulic manifold 6 through the other of the passages 20 and 21 and enters the directional valve 16 through the other of the control ports thereof and then exits from the directional valve 16 through the outlet port thereof and enters the outlet oil passage means 19 and the enters the return oil passage means 15. Return oil from the next subsequent directional valve 16 likewise enters the return oil passage means 15 from its respective outlet oil passage means 19 and all of such return oil leaves

the hydraulic manifold 6 through said return oil passage means 19 and through the hydraulic manifold outlet port means and finally returns to the hydraulic reservoir for the hydraulic pump. The enlargements 30 and 31 in the pressure and return oil passage means 14 and 15, respectively, together with the large cross-section of each of the latter in respect to the respective plug element 50 is such that with the latter open there is virtually no pressure drop across the respective flow control valve 8 and with the latter closed there is a minimal pressure drop across the respective flow control valve 8 due to the unobstructed flow paths above and below the respective plug element 50. In respect to the flow of hydraulic liquid in the perpendicular passage means, i.e. in the inlet and outlet passage means 18 and 19, respectively, there is a certain amount of pressure drop across the respective valve seat means 38 but this is minimized by virtue of the minimum length of the oil passages 24 and 25 which have the same I. D. as the respective valve seat means 38 and of the enlargements on the inlet and outlet sides thereof, i.e. the enlargements 30 and 31, respectively, and the enlargements of the inlet and outlet passage means 18 and 19, respectively. The provision of threads of opposite hand for moving the valve stem 16 and for anchoring the valve seat means 38 of each flow control valve 8 obviates any tendency for the valve seat means 38 to loosen from continued opening of said flow control valve 8 when the friction is greater than during closing from the plug element 50 and the valve seat 60 being drier.

It will thus be seen that there has been provided by my invention a hydraulic manifold system in which the object hereinabove set forth together with many thoroughly practical advantages has been successfully achieved. My hydraulic manifold system provides a very compact and useful combination of elements by which the flow of hydraulic liquid through one section of a hydraulic manifold can be throttled or shut-off by a flow control valve with a minimal pressure drop thereacross so that the flow of hydraulic liquid in the other sections is not thereby adversely affected and by which said one section can be taken out of service without affecting the operation of said other sections of the same hydraulic manifold.

What I claim is:

1. Improvement in a hydraulic manifold system having a hydraulic manifold having a hydraulic circuit therein providing hydraulic service external to said manifold, said circuit including a pair of manifold passages, a set of interconnecting passages intersecting each said manifold passage, a set of valves in each said manifold passage operative therein, respectively, at the intersections with the respective interconnecting passages, said improvement comprising said hydraulic manifold itself consisting of no pipes and having means for mounting a plurality of hydraulic units thereon, said manifold having two service ports therein for each said hydraulic unit, said service ports arranged in two sets intersecting, respectively, the two sets of interconnecting passages, so as to provide both upstream hydraulic service to and downstream service from said hydraulic units wherein one of said manifold passages and the respective set of service ports therefor pass upstream flow of hydraulic liquid to said hydraulic units while the other manifold passage and the respective set of service ports therefor pass downstream flow of hydraulic liquid from said hydraulic units, whereby either or both of the

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upstream and downstream flows to any of said hydraulic units can be controlled without interfering with the respective flows to or from the other hydraulic units.

2. Improvement in a hydraulic manifold system as claimed in claim 1, said hydraulic manifold a brazed hydraulic manifold consisting of at least two plates brazed together face to face, each said manifold passage and each said interconnecting passage cut in at least one of said plates prior to brazing of said hydraulic manifold.

3. Improvement in a hydraulic manifold system as claimed in claim 1, each said valve having a valve seat threadably fastened in said hydraulic manifold and a valve stem moveable in respect to said valve seat, said valve stem moveable by threads of opposite hand to those fastening said valve seat so that during opening of said valve frictional forces have a tendency to tighten said valve seat in place in said hydraulic manifold.

4. Improvement in a hydraulic manifold system as claimed in claim 1, each said valve having a valve seat

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fastened in the respective interconnecting passage and a valve stem moveable across the respective manifold passage, each said manifold passage having an enlargement in cross-section therein at the respective intersection where the respective valve stem moves thereacross, the cross-section of said enlargement being greater than that of said manifold passage both upstream and downstream in respect to said enlargement.

5. Improvement in a hydraulic manifold system as claimed in claim 4, each said interconnecting passage having a cross-section larger than that of the respective valve seat.

6. Improvement in a hydraulic manifold system as claimed in claim 5, said hydraulic manifold a brazed hydraulic manifold consisting of at least two plates brazed together face to face, each said manifold passage including the enlargement therein and each said interconnecting passage cut in at least one of said plates prior to brazing of said hydraulic manifold.

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