



HYDRAULIC JACKS

This application is a continuation in part of application Ser. No. 3903 dated 19 Jan. 1970, now abandoned.

This invention relates to hydraulic jacks, particularly but not exclusively to portable general purpose jacks.

The object of the invention is to provide a self-contained jack which can be used in any position without loss of fluid, and wherein the risk of operation being affected by air, cavitation or contamination of its hydraulic medium is minimised.

It is known to provide a jack with a fluid reservoir or chamber which is defined in part by a flexible member enabling the volume of said reservoir or chamber to vary as liquid is drawn therefrom or returned thereto in the course of operation of a ram. Materials used to make such a member are low in strength compared to other components of the jack and may easily become porous or damaged due to flexure and adverse operating conditions.

Attempts have also been made to provide a hydraulic jack incorporating a variable volume reservoir defined by a fixed wall structure of a chamber and a movable wall formed by a rigid member mounted in sliding engagement with said fixed wall structure, whereby the effective volume of the reservoir increases by movement of said member, typically a piston, in a first direction as fluid is returned to the reservoir from a ram of the jack; and the effective volume is reduced by movement of said member in the opposite direction as the fluid is withdrawn from the reservoir. Examples of such construction are described in U.S. Pats. No. 1964003 to McBride, No. 2170029 to Liddell and another, and No. 2618929 to Bidin.

It has not previously proved practicable to provide a reliable general purpose jack which will withstand the adverse conditions of extremes of heat and cold, long periods of non-use, and lack of regular maintenance to which such equipment is frequently subjected; in which the movement of a rigid member such as a piston forming part of a variable volume reservoir is effected solely by normal fluid pressure differentials created on opposite sides thereof during operation of the jack. All the above U.S. Patents disclose constructions in which springs are utilised to apply additional pressure to the member to overcome frictional resistance to movement thereof. It may have also been contemplated to use a sealed chamber whereby movement of the member in the first direction compresses air on the opposite side of said member to the reservoir, said pressure urging the member in the other direction in the manner of the springs above referred to when fluid is to be discharged from the reservoir. In either case the construction is complicated and the fluid stored in the reservoir is maintained at above atmospheric pressure giving rise to problems of leakage and seepage past check valves etc.

The object of the present invention is to provide a variable volume reservoir which avoids the above undesirable features by using a movable member which is in low friction sliding engagement with wall structure of a chamber so that it moves reliably under the sole influence of fluid pressure differentials created as the hydraulic fluid is admitted to or withdrawn from the reservoir, the member being reliably moved under the influence of atmospheric pressure alone as said fluid is withdrawn.

A preferred embodiment of the invention is now described with reference to the accompanying drawings wherein:

FIG. 1 is a composite sectional side elevation of a hydraulic jack; the part of the figure above line A — A being a section on line 1 — 1 of FIG. 2 and the part below line A — A being a section on line 1a — 1a of FIG. 2; and

FIG. 2 is a sectional plan view on line 2 — 2 of FIG. 1.

Referring to the drawings a portable self-contained hydraulic jack comprises a body 10 having a plane base 11 on which the jack stands when in an upright position as referred to in this description and as shown in the drawings. However, the jack may be operated in any position as explained hereafter:

A single acting ram comprises a first cylindrical bore 12 in the body, and a piston 13 in sliding liquid tight engagement with the wall. A piston rod 14 extends through a collar 15 and terminates externally of the body in a load supporting face 16 parallel to base 11.

A chamber 17 has a cylindrical wall formed by a second bore in body 10 parallel to cylinder 12 and opening at an upper face of the body adjacent to collar 15. A movable wall in the form of an inverted cup-shaped rigid piston 18 is in axial sliding engagement within said wall of chamber 17. The piston 18 and the wall of such part of chamber 17 as extends therebelow define a liquid reservoir 20 of variable volume.

Piston 18 is produced from lightweight aluminum alloy and is hollowed into a cup shape to reduce its weight so far as possible as well increasing the volume of oil held by reservoir 20. The second bore in body 10, defining said chamber in which piston 18 slides, is very highly finished by a roller burnishing process to give a surface finish of approximately 4 micro-inches.

A radial groove in the periphery of piston 18 accommodates a low friction elastomeric sealing ring 19 of cruciform section. One pair of limbs of said section present a pair of axially spaced sealing ribs which protrude radially from the groove and carry two hair-line sealing edges for engagement with said highly finished wall of the chamber. The other pair of limbs carry like sealing edges which engage in the groove. Preferably the ring is a "Flexible Nu-Lip Ring" supplied by Pioneer Oil Sealing and Moulding Company Limited of Barrowford, Nelson, Lancashire, England. Sealing ring 19 provides an effective fluid seal without need for high axial or radial compression forces acting on the ring, thus frictional resistance to movement of piston 18 is kept at a minimum.

The diameter of piston 18 is less than that of the bore of chamber 17 to provide a clearance of 0.010 inch to 0.015 inch. Ring 19 also serves to centre piston 18 in the bore and maintain the latter out of metal to metal contact with said bore, the parallel spaced sealing ribs stabilising the piston during sliding movement against tilting out of line with the bore.

A reciprocating pump 21 of conventional construction is located within the body 10 below reservoir 20 and is connected by ducts 22 within the body opening into the lower ends of reservoir 20 and ram cylinder 12, one-way ball valves 23 and 23a prevent back flow of liquid. The pump is actuatable manually by a lever 24 pivoted in a recess in the body 10 and provided with a socket 25 for receiving an extension handle (not shown).

A spring-loaded pressure relief valve 26 connected to duct 22 connects the lower end of bore 12 to reservoir 20 to relieve pressure in excess of a safe working limit in the ram.

A by-pass duct 27 connects the part of duct 22 which opens directly into ram cylinder 12 with the reservoir 20 through a release valve 28 of conventional type operable by rotation of a screwed valve stem 29 engaged in a threaded bore 30 opening to one end of body 10 adjacent to lever 24.

The upper end of the reservoir bore 17 is closed by a cover plate 31 attached to the body by screws 32 but permitting venting to the atmosphere of the part of the chamber which lies above piston 18. Preferably the venting is through an oil impregnated wire mat filter 33 positioned between cover plate 31 and the upper face of body 10.

In use the jack hydraulic system including reservoir 20 is filled with hydraulic liquid by means of a removable screw plug opening into passage 22. The liquid used is oil having a high fat content to give good lubricating characteristics both statically and dynamically, for example Castrol "Magna DX" oil. The volume of liquid is such that with ram piston 13 in its lowest position; i.e. with piston rod 14 fully withdrawn into the body, the reservoir piston 18 is in its highest position adjacent to cover plate 31 so that substantially the whole of the bore 17 constitutes the reservoir 20 which is entirely filled with liquid.

When the jack is to be operated release valve 28 is closed and pump 21 activated to draw liquid from the reservoir and force it into ram cylinder 12 to move load supporting face 16 upwards. As liquid is drawn from reservoir 20 piston 18 is moved downwards by the atmospheric pressure on the upper surface thereof, filtered air being drawn into the upper part of second bore 17 through the filter 33. When release valve 28 is opened to return liquid to the reservoir, piston 18 is moved upwards by the returning liquid so that the capacity of reservoir 20 increases to accommodate said liquid. At the same time air in the upper part of bore 17 is expelled through filter 33.

The above described construction of reservoir piston 18 ensures positive movement thereof under very low pressure differentials. The low friction and low inertia characteristics of the construction described above ensures movement of the piston under pressure differentials of as little as 2 inches Hg, equivalent to approximately 1 lb per sq. in. As normal atmospheric pressure is 14.7 lbs. per sq. in. movement of the piston is assured as the liquid is withdrawn from the reservoir and there is no risk of the piston sticking or hanging up and preventing transfer of liquid rendering the jack inoperable.

The above described construction ensures that, provided the jack is correctly filled with fluid, no cavitation of liquid can take place and no air is drawn into direct contact with the liquid to cause possible contamination and malfunctioning of the jack. Moreover, the

jack can be operated in any position, e.g. even in an inverted position with base 11 uppermost, without loss of liquid or fear of air locks as piston 18 ensures that reservoir 20 is always completely filled with the required volume of liquid only. The said construction ensures reliable operation within a wide range of operating conditions, for example in a temperature range from -40°C to $+70^{\circ}\text{C}$. I claim:

1. A hydraulic jack comprising a body housing a ram, a chamber vented to atmosphere at one end but otherwise closed at that end, ducting within the body interconnecting the other end of the chamber with the ram, pump and valve means in said ducting selectively operable to effect transfer of hydraulic liquid between the ram and the chamber, and a free light weight relatively rigid piston in fluid tight sliding engagement within the chamber forming a movable wall between the two ends of the chamber so defining a variable volume reservoir for containing the hydraulic fluid within the chamber, said piston being so constructed and arranged within the chamber as to have such minimal low friction sliding engagement with the chamber as to be freely and positively movable under the sole influence of fluid pressure differentials created on opposite sides thereof in the chamber by admission or withdrawal of the liquid during operation of the jack.

2. A jack according to claim 1, wherein the chamber is a bore in the body having a high internal surface finish.

3. A jack according to claim 2, wherein said bore is roller burnished to a surface finish of substantially four micro-inches.

4. A jack according to claim 1, wherein the piston is formed from aluminum alloy and is cup-shaped.

5. A jack according to claim 2, wherein the piston includes a radial peripheral groove, and a sealing ring is located in the groove in fluid sealing engagement with the chamber wall.

6. A jack according to claim 5, wherein the ring is formed from elastomeric material and is cruciform in cross section to present a pair of axially spaced sealing ribs protruding radially from the groove to engage said wall.

7. A jack according to claim 6, wherein said sealing ribs each carry a hair-line sealing edge for low friction sliding sealing engagement with said wall.

8. A jack according to claim 6, wherein there is one sealing ring only and the diameter of the piston is less than the internal diameter of the chamber, whereby the ribs of the ring serve to locate and stabilise the piston centrally of the chamber to avoid direct contact thereof with the chamber wall.

9. A jack according to claim 1, wherein the chamber is vented to atmosphere only through a filter.

10. A jack according to claim 1, wherein the ram is located in the body externally of the chamber.

* * * * *